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PHOTOSYNTHESIS AND RESPIRATION RATES
IN THE MONTICELLO EXPERIMENTAL STREAMS:
1976/77 Diel Field Data and Computed Results

by

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16. ABSTRACT Two-station diel dissolved oxygen measurements collected during 1976 and 1977 at the Monticello Ecological Research Station (Monticello, MN) have been analyzed by a graphical-analytical method and by a computer model, Dissolved Oxygen Routing Model (DORM), to determine daily community respiration and photosynthesis. A third set of values was generated by using the DORM model to simulate the graphical method. The complete DORM included surface oxygen exchange, longitudinal dispersion, a higher order curve extrapolation between upstream dissolved oxygen measurements and the dependence of respiratory rate on water temperature and dissolved oxygen measurements and the dependence of respiratory rate on water temperature and dissolved oxygen concentration, but neither the graphical nor the simulated graphical models included these factors. The complete DORM gave consistently higher rates of respiration and photosynthesis than either the graphical-analytical method or the computer simulation.		
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SECTION 2

RESULTS AND CONCLUSIONS

Two methods of diel D.O. curve analysis were used to determine total daily community respiration (R) and photosynthesis (P) rates in the MERS field channels. The first is a graphical-analytical method described by Mattke and Stefan (1980). The second uses a computer model DORM (Dissolved Oxygen Routing Model) which solves the unsteady advective, dispersive, D.O. transport equation for P & R values as discussed by Gulliver, Mattke, and Stefan (1980). DORM may also be used to simulate the graphical method by assuming zero surface oxygen exchange, zero dispersion, and no temperature or D.O. dependence of respiration.

Tables 1a and 1b give the best estimates of total daily rates of photosynthesis and total daily rates of respiration obtained by either of the two methods. To arrive at the values in Table 1a, adjustments of partial daily rates to total daily rates had to be made. The procedure is described in Section 4.

For three surveys (8-23-77, 4-25-77, and 4-26-77) respiration and photosynthesis rates were calculated by three different methods: (a) the graphical-analytical method, (b) the numerical routing method DORM, and (c) a numerical simulation of the graphical-analytical method with DORM. The results are given in Table 7.

The complete routing (DORM) gave consistently higher rates of R and P than the graphical method. This is due to the omission of reaeration (surface oxygen exchange) in the graphical method. Based on Table 7 values, the effect of reaeration on P and R is channel position dependent, at least in spring and late summer. In the winter, reaeration effects may be the same throughout the channel because of low respiration rates.

Total daily rates of respiration and total daily rates of photosynthesis obtained by the graphical method were consistently smaller than

TABLE 1a. BEST ESTIMATES OF TOTAL DAILY RATES OF PHOTOSYNTHESIS
($\text{g m}^{-2} \text{ day}^{-1}$)

Date	Channel Nos.			
Station Nos.	1	4	5	8
7-28-76				
6 → 10	12.83	18.89	16.52	10.12
14 → 18	9.41	14.54	13.78	10.81
7-29-76				
6 → 10	20.23	16.81	18.21	10.09
14 → 18	11.70	16.63	13.07	13.19
8-5-76				
6 → 10	7.46	7.84	9.06	17.01
14 → 18	11.64	3.48	7.04	13.43
10-27-76				
2 → 10			3.20	4.81
10 → 18			3.86	6.36
10-28-76				
2 → 10			3.11	4.55
10 → 18			4.21	6.35
1-26-77				
2 → 10				8.46
10 → 18				6.48
1-27-77				
2 → 10				8.26
10 → 18				7.23
4-25-77				
2 → 10			5.77*	11.88*
10 → 18			7.48*	12.09*
4-26-77				
2 → 10			5.97*	12.79*
10 → 18			9.14*	13.20*
7-19-77				
2 → 10	18.76		19.81	11.79
10 → 18	11.06		15.07	17.94
7-20-77				
2 → 10	12.45		13.10	6.25
10 → 18	7.39		12.22	11.41
8-23-77				
2 → 10			10.96*	9.73*
10 → 18			10.37*	13.13*

*P-values determined by numerical routing with DORM (see Table 7).
All others are obtained by the graphical method and adjusted.

TABLE 1b. BEST ESTIMATES OF TOTAL DAILY RATES OF RESPIRATION
($\text{g m}^{-2} \text{ day}^{-1}$)

Date				
Station Nos.	1	4	5	8
7-28-76				
6 → 10	19.45	17.99	19.45	17.54
10 → 14	15.47	19.03	20.58	18.88
8-5-76				
6 → 10	24.56	9.21	9.21	22.22
10 → 14	22.13	11.29	8.36	10.67
10-27-76				
2 → 10			3.47	10.88
10 → 18			4.21	8.30
1-26-77				
2 → 10			1.13	4.13
10 → 18			--	4.09
4-25-77				
2 → 10			8.21*	16.50*
10 → 18			9.98*	12.75*
4-26-77				
2 → 10			8.65*	17.28*
10 → 18			10.81*	13.75*
7-19-77				
2 → 10	17.99		20.97	17.43
10 → 18	12.24		19.86	18.96
8-23-77				
2 → 10			10.54*	14.36*
10 → 18			10.08*	14.35*

*R-values determined by numerical routing with DORM. All other obtained by the graphical method.

NOTE: Unstarred values were derived from Table 3 values as follows:

$$R(\text{g m}^{-2} \text{ day}^{-1}) = \frac{R(\text{g m}^{-3} \text{ hr}^{-1}) * (24 \text{ hrs/day}) * h(\text{m})}{(\text{reaeration adjustment})}$$

where $R(\text{g m}^{-3} \text{ hr}^{-1})$ = respiration rate, obtained by graphical method and given in Table 3

$h(\text{m})$ = hydraulic mean depth given in Appendix C

reaeration adjustment (accounts for omission of reaeration in graphical method)

= 0.87 for upper channel reaches

= 0.76 for lower channel reaches

those obtained by the DORM. The average fractions were 87 per cent and 89 per cent, respectively, for the upper channel reach (Stations 2-10) and 76 per cent and 81 per cent, respectively, for the lower channel reach (10-18). The results of the graphical method (Tables 3 and 6) were divided by these fractions to obtain the value in Tables 1a and 1b.

A sensitivity analysis was conducted to determine how rates of photosynthesis and respiration change in response to changes in residence time. This was of particular interest because information on channel cross sections was very incomplete. It was found that P and R rates go up as residence time goes up, and vice versa (Table 8). The relationship is nonlinear; for a +20 per cent change in residence time, R changed from +1.7 per cent to 11.0 per cent; for a -20 per cent change in residence time, R changed between -2.3 per cent to -9.6 per cent. The associated rate changes for photosynthesis (P) are +2.9 per cent to +13.6 per cent and -2.6 per cent to -12.7 per cent. For an unknown reason, this result is different from that found by Gulliver et al. (1980). Gulliver et al. (1980) found consistently a change of 17 to 18 per cent in total daily R and total daily P when residence times were changed by 20 per cent.

SECTION 3

RECOMMENDATIONS

It is recommended that in future studies using diel dissolved oxygen routing, particular care be taken to measure channel cross sections and flow rates or hydraulic residence time directly by tracer routing.

Application of a constant correction coefficient to the results of the graphical method implies that reaeration effects are of the same magnitude in spring, summer and fall. It is believed that this is not an unreasonable assumption, which has been verified at least for spring and late summer data. Application of the numerical method DORM would eliminate the assumption.

SECTION 4

APPLICATION OF A GRAPHICAL-ANALYTICAL PROCEDURE FOR STREAM PRODUCTIVITY ANALYSIS

GENERAL PROCEDURE

During 1976 and 1977 two-station diel D.O. measurements were taken by D. Rastetter of the Monticello Ecological Research Station staff. The data were made available to the authors for analysis. The data are reproduced in Appendix A.

To estimate the rates of community photosynthesis P ($\text{g m}^{-2} \text{ day}^{-1}$) and the rates of community respiration R from the D.O. measurements a graphical-analytical routing method which is described by Mattke and Stefan (1980) was used. The method includes the following steps:

After calculating the hydraulic residence time in a channel reach, the upstream station diel oxygen curve with the residence time added to the D.O. measurement time is plotted on the same graph with the downstream station diel oxygen curve. The difference in D.O. during night hours divided by the residence time yields an hourly nighttime respiration rate. All nighttime respiration rates are averaged and used as an estimate of the respiration rate that occurred during daylight hours. The photosynthetic rate is graphically determined by measuring the D.O. difference each hour during daylight. Each value is divided by the residence time to give an hourly rate; adding the average respiration rates gives an hourly photosynthetic rate ($\text{g m}^{-3} \text{ hr}^{-1}$). The photosynthetic rates in $\text{g m}^{-3} \text{ hr}^{-1}$ were multiplied by the hydraulic mean depth to produce photosynthetic rates per unit surface area in $\text{g m}^{-2} \text{ hr}^{-1}$. Addition of all hourly photosynthetic rates ($\text{g m}^{-2} \text{ hr}^{-1}$) yielded an accumulated rate for the period of record.

Tables and graphs used in the actual computations are reproduced in Appendix B.

Residence Times

Residence times computed from 1976 and 1977 morphological channel data and temperature front data are summarized in Table 2. Residence

TABLE 2. CHANNEL SEGMENTS AND RESIDENCE TIMES FOR 1976-77 DIEL
D.O. CURVE ANALYSIS

Survey Period Hours & Date	Channel Nos.						
	1	3	4	5	6	7	8
0515 7/28/76	6+10 ¹	*	6+10 ¹	6+10 ¹	*	*	6+10 ¹
to 2115 7/29/76	2.22 ²		2.16 ²	2.16 ²			2.16 ²
	14+18		14+18	14+18			14+18
	2.22		2.16	2.16			2.16
1300 8/5/76	6+10	*	6+10	6+10	*	*	6+10
to 0920 8/6/76	1.37		1.37	1.32			1.37
	14+18		14+18	14+18			14+18
	1.37		1.37	1.32			1.37
0640 10/27/76	*	*	*	2+10	*	*	2+10
to 1800 10/28/76				2.06			2.0 ³
				10+18			10+18
				2.00			2.0 ³
0600 1/26/77	*	*	*	2+10	*	*	2+10
to 1730 1/27/77				2.06			2.0 ³
				10+18			10+18
				2.00			2.0 ³
0400 4/25/77	*	*	*	2+10	*	*	2+10
to 1620 4/26/77				2.06			2.0 ³
				10+18			10+18
				2.00			2.0 ³
0500 7/19/77	2+10	**	*	2+10	*	**	2+10
to 1700 7/20/77	2.04			2.06			2.0 ³
	10+18			10+18			10+18
	1.78			2.00			2.0 ³
0500 8/23/77	*	**	*	2+10	*	**	2+10
to 0500 8/24/77				2.06			2.00 ³
				10+18			10+18
				2.00			2.00 ³

* No D.O. data taken.

** D.O. data taken, but channel segment residence time was too large for diel D.O. curve analysis.

¹ Channel Reach, Station numbers.

² Hydraulic Residence Time (hrs).

³ Hydraulic Residence Times determined by temperature fronts.

times for 7-28 and 7-29-76, 8-5-76, and 10-27 and 10-28-76 were computed between stations 6 and 10 and stations 14 and 18. However, residence times for 10-27 and 10-28-76, 1-26 and 1-27-77, 4-25 and 4-26-77, 7-19 and 7-20-77, and 8-23-77 were computed between stations 2 and 10 and stations 10 and 18 to obtain longer residence times for the diel curve analysis. On 7-19 and 7-20-77 and 8-23-77 a low flow rate in channel 3 resulted in unreasonably high residence times for the analysis.

Determination of hydraulic mean residence times presented difficulty because morphological channel data were incomplete. Channel cross section data were obtained on 8-4 and 8-5-77 in channels 5 and 8, on 4-6-77 in channel 1, and on 10-4 and 10-18-76 for channel 1. The average cross-sectional areas and flow rates were used to compute the residence time for each reach. The 8-4 and 8-5-77 calculated residence times were 2.06 hours and 2.00 hours in channel 5 and 1.65 hours and 1.64 hours in channel 8 for the upper and lower reach, respectively. These residence times were initially applied to the 7-19 and 7-20-77 and 8-23-77 D.O. survey dates.

No morphological data in channels 5 and 8 were taken in the spring and winter of 1977 and fall of 1976. However, areal cross sections and surface widths were determined for channel 1 on 4-6-77. These channel characteristics were used for channels 5 and 8 on 4-25-77 and gave a better estimate than the July or August channel data because of the increased water elevations due to macrophyte growth.

The 10-4 and 10-18-76 channel 1 morphometric survey was used to compute the residence times for the 7-28 and 7-29-76 and 8-5-76 D.O. measurements. Channel riffles were measured on 10-4-76 and channel pool sections on 10-18-76 and compiled to obtain a complete channel survey. The channel 1 data were applied to channels 4, 5, and 8 for residence time computations and are listed on Table 2.

The residence times calculated from the 8-4 and 8-5-77 and 4-6-77 morphological channel data were compared with residence times obtained by routing temperature discontinuities. Power failures produced temperature fronts in channel 8 before and after the 8-23-77 D.O. survey (see Figs. 1 and 2). Because channel 5 was not heated, there were no temperature fronts which could be used to estimate residence times. In this case the residence times computed from the 8-4 and 8-5-77 cross section surveys were assumed

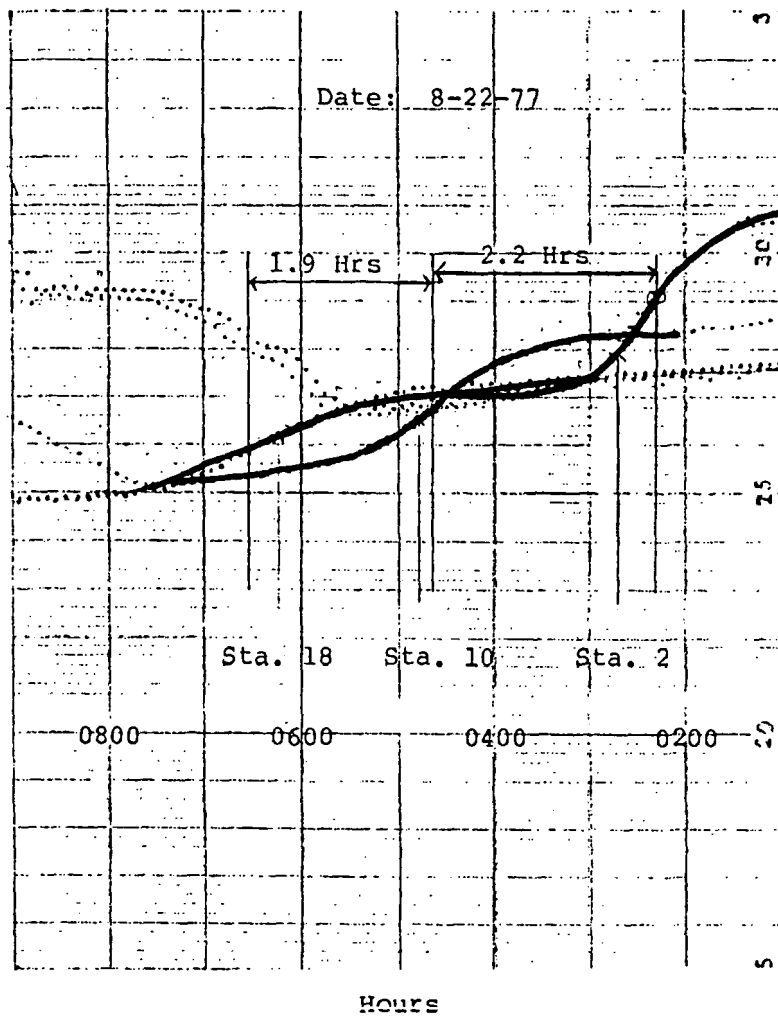


Fig. 1. Residence time determination from a temperature front on 8-22-77 between Stations 2 and 10 and Stations 10 and 18 in Channel 8.

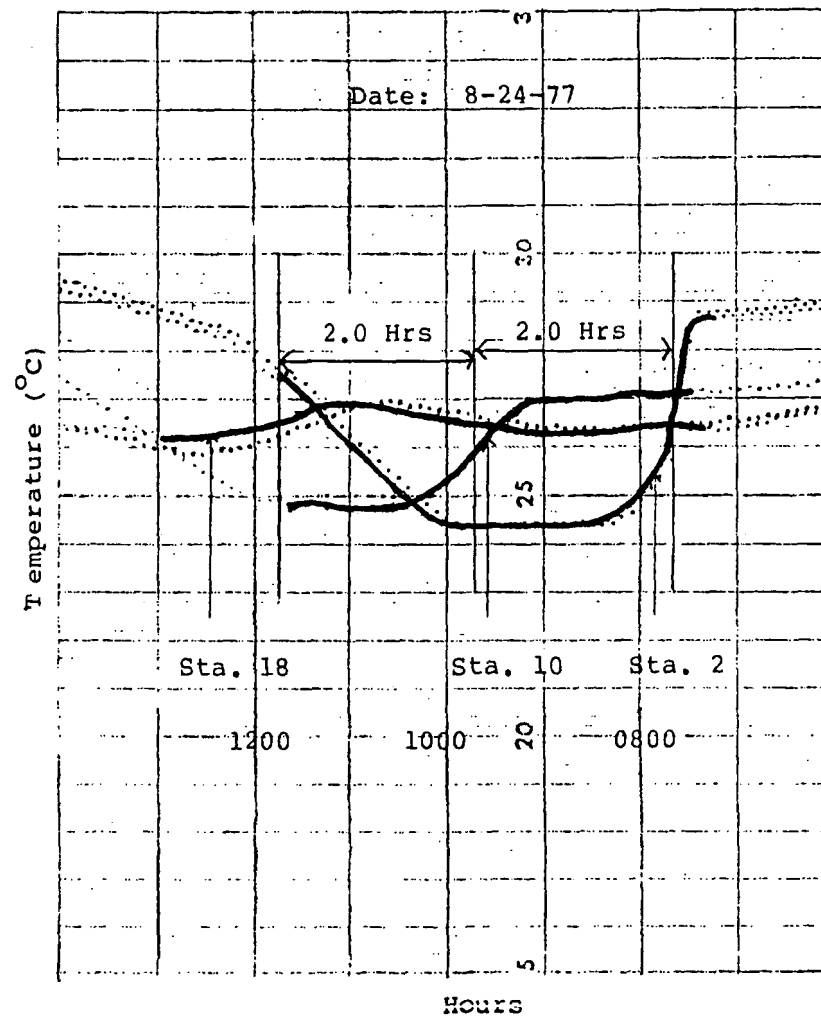


Fig. 2. Residence time determination from a temperature front on 8-24-77 between Stations 2 and 10 and Stations 10 and 18 in Channel 8.

correct for channel 5 because they were the same as the temperature front residence times in channel 8.

The application of channel 1 cross sections to channels 5 and 8 was tested by comparing a 4-19-77 channel 8 temperature front to the 4-6-77 channel 1 cross sections. The upper reach residence time determined by the temperature front, shown in Fig. 3, agreed with that determined from channel 1 morphological data which was 2 hours. The downstream channel 8 temperature front does not give as precise residence time resolution but is at least 2 hours. The lower reach channel 1 data residence time was 1.64 hours, which is at least 18 per cent lower than the temperature front residence time. It was assumed that the lower reach travel time was the same as the upper reach travel time of 2 hours, which was used in the graphical analysis for 4-25 and 4-26-77, 1-26 and 1-27-77, and 10-27 and 10-28-77. Table 2 summarizes and lists the best estimates of channel residence times determined by morphological or temperature front data.

Only the starting time and the end time of each D.O. sampling interval in the MERS channels had been recorded. It was therefore necessary to estimate the actual time at which a D.O. sample was taken from a particular station. Knowledge of the sampling sequence in which stations along the channels were sampled permitted estimates of actual D.O. measurement times. Knowing the length of a survey and the number of stations sampled, it was determined that it took approximately 3 minutes to collect each D.O. sample and to travel to the next station. Therefore, 3 minutes were added to the sampling time of each station in the order sampled. The D.O. measurements along with the estimated time are shown in Appendix A.

Rates of Community Respiration & Photosynthesis

Respiration Rates

Several difficulties were encountered in the determination of community respiration and photosynthesis rates as explained and discussed in the paragraphs that follow.

The July 28 and 29, 1976, respiration rates were difficult to evaluate because of the lack of D.O. data during the night. As shown on the graphs for 7-28 and 7-29-76 in Appendix B, linear interpolation between late evening and early morning D.O. reading resulted in unreasonably high respiration rates. In view of this problem, the oxygen curves were

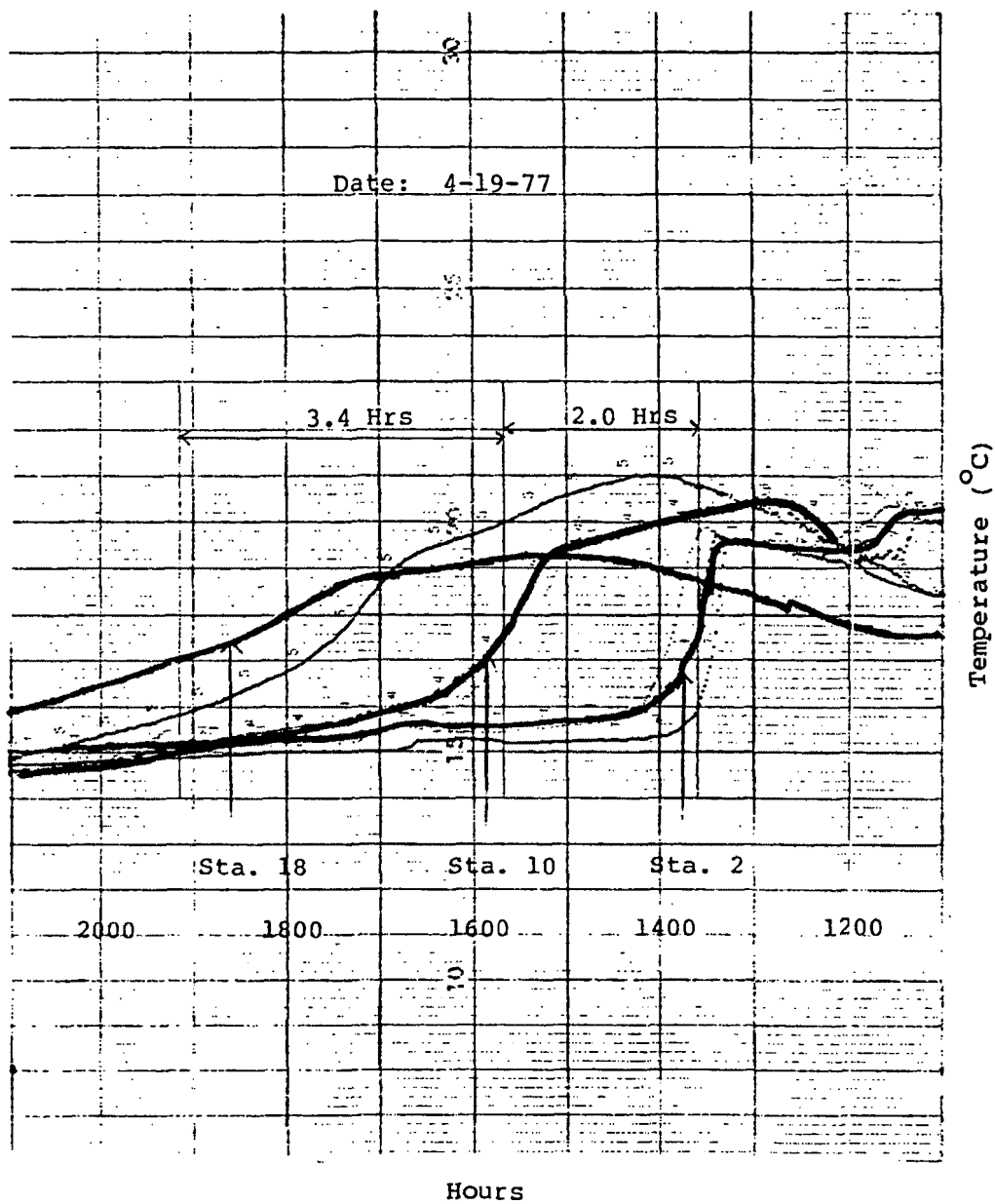


Fig. 3. Residence time determination from a temperature front on 4-19-77 between stations 2 and 10 and Stations 10 and 18 in Channel 8.

evaluated only to the point where the actual D.O. readings ended. When the computed residence time was obviously incorrect or when no D.O. measurements had been taken during the night, the respiration rate for the reach upstream or downstream was used. This problem only occurred on 7-28-76 in channels 4 and 5 between stations 6 and 10 as indicated in Table 3.

At low D.O. concentrations respiration may be reduced. When D.O. concentration fell below 3 mg/l during the night, a respiration rate limitation was anticipated. This data was therefore not used in determining an average respiration rate. Date restrictions for this method of analysis are footnoted in Table 3.

Photosynthetic Rates

When morphological channel residence time underestimated temperature front residence time (channel 8), the surveyed cross-sectional areas were adjusted in proportion to the difference in residence times. It was assumed that the surface width remained the same in spite of the areal increase because of the steep channel slopes. The hydraulic mean depth for each reach was determined using the newly computed cross sections divided by the known surface width. This hydraulic mean depth was multiplied by the volumetric photosynthetic rate ($\text{g m}^{-3} \text{ hr}^{-1}$) to yield a photosynthetic rate ($\text{g m}^{-2} \text{ hr}^{-1}$) per unit surface area. The daily community photosynthetic rates derived from the given D.O. data are presented in Table 4. Difficulties encountered during the analysis are identified.

A problem arose from incomplete D.O. measurements, not covering all of the daylight hours. The computed daily photosynthetic rates were therefore partial rates and had to be multiplied by a coefficient to obtain total daily photosynthetic rates. The coefficient was derived (Table 5) by determining the fraction of total hourly photosynthetic rates that the missing daylight hours represented. This was accomplished by determining fractions of total daily photosynthesis from complete data sets obtained on other survey days. The complete data sets were chosen on the basis of similarity of light intensity and length of day. The fractioning process is designed to account for changes in light intensity over a day, and to account for differences in total daily radiation between the dates which are being compared. Three days (from which the coefficients were derived) were chosen

TABLE 3. HOURLY RESPIRATION RATES FROM
GRAPHICAL-ANALYTICAL PROCEDURE

(g m⁻³ hr⁻¹)

Date	Channel Nos.			
Station Nos.	1	4	5	8
7-28-76				
6 → 10	1.33 a	1.23 b, e	1.33 b, e	1.20 a
14 → 18	1.00 a	1.23	1.33 a	1.22 a
8-5-76				
6 → 10	1.68	0.63	0.63	1.52 c
14 → 18	1.43 c	0.73 c	0.54 c	0.69 c
10-27-76				
2 → 10			0.37	1.16
10 → 18			0.37	0.73
1-26-77				
2 → 10			0.12 d	0.44
10 → 18			d	0.36
4-25-77				
2 → 10			0.84	1.72
10 → 18			0.84	0.92
7-19-77				
2 → 10	1.63		2.00	1.58
10 → 18	1.02		1.70	1.58 c
8-23-77				
2 → 10			1.06	1.39
10 → 18			0.86	1.59 c

a - Used only ΔD.O. after sunset + lag time to determine respiration value.

b - Lag seems to be incorrect and no D.O. data readings during the evening. Used computed downstream respiration value.

c - D.O. values below 3 mg/l were not used in calculating respiration.

d - ΔD.O. too small to make meaningful analysis.

e - Lag time appears to be incorrect (started 2300 Hr in calculating R-value)

TABLE 4. PARTIAL DAILY RATES OF COMMUNITY PHOTOSYNTHESIS
FROM GRAPHICAL-ANALYTICAL PROCEDURE
(g m⁻² day⁻¹)

Date	Channel Nos.			
Station Nos.	1	4	5	8
7-28-76				
6 → 10	11.13 a ₂	16.38 a ₂ , d	14.33 a ₂ , d	8.49 a ₃
14 → 18	6.79 a ₄	11.48 a ₂	10.88 a ₂	8.54 a ₂
7-29-76				
6 → 10	18.01	14.96 d	16.21 a	8.75 a ₂
14 → 18	9.48 c, d	13.47	10.32 a ₂	9.51 a ₄
8-5-76				
6 → 10	2.90 a ₉	3.05 a ₉	3.52 a ₉	6.61 a ₉
14 → 18	4.11 a ₉	1.23 a ₉	2.49 a ₉	4.75 a ₉
10-27-76				
2 → 10			2.85	4.28
10 → 18			3.10 a ₁	5.15
10-28-76				
2 → 10			2.25 b ₂	4.05
10 → 18			3.41	5.14
1-26-77				
2 → 10			0.01 e	7.53
10 → 18			-- e	5.25
1-27-77				
2 → 10			-- e	7.35
10 → 18			-- e	5.86
4-25-77				
2 → 10			4.55	10.09
10 → 18			5.21	8.18
4-26-77				
2 → 10			4.03 b ₃	8.90 b ₃
10 → 18			5.38 b ₃	7.82 b ₃
7-19-77				
2 → 10	16.57 a ₁		17.49	10.41 a ₁
10 → 18	8.89 a ₁		12.11	14.16 a ₂
7-20-77				
2 → 10	8.92 b ₃		7.77 b ₅	4.48 b ₃
10 → 18	4.82 b ₃		7.97 b ₃	7.44 b ₃
8-23-77				
2 → 10			9.59 a ₁	8.17 a ₁
10 → 18			7.42 a ₁	11.06 a ₁

a_N - Missing hours from sunrise where N indicates number of hours missing, i.e. a₄ implies first 4 consecutive hours after sunrise.

b_N - Missing hours before sunset where N indicates number of hours missing, i.e. b₂ implies last 2 hours before sunset are missing.

c - Negative photosynthetic rate value occurred before sunset so this value was not included in accumulated photosynthetic rate.

d - Residence time seems incorrect.

e - ΔD.O. too small to make meaningful analysis.

NOTE: Hydraulic mean depths are given in appendix C.

TABLE 5. COEFFICIENTS TO ADJUST PARTIAL DAILY RATES OF PHOTOSYNTHESIS
TO TOTAL DAILY RATES OF PHOTOSYNTHESIS

Date Coeff. Was Derived For:	Date Coeff. Was Derived From:	Hours Missing After Sunrise					Hours Missing Before Sunset		
		1 Hr	2 Hr	3 Hr	4 Hr	9 Hr	2 Hr	3 Hr	5 Hr
<u>Coefficients</u>									
7/28-29/76 7/19-20/77 8/ 5/76	7/31/79	1.008	1.026	1.061	1.123	2.290		1.242	1.501
10-27-76	10-8-78	1.010					1.233		
4-26-77	4-25-77							1.120	
8-23-77	8-1-79	1.022							

Example: The 4-26-77 coefficient was derived from the 4-25-77 survey as shown in Appendix D.

from Mattke and Stefan (1980) while the fourth day in April was selected prior to the day with missing data as shown in Table 5. Table 6 presents the corrected total daily photosynthetic rates. (For example, the adjusted photosynthetic rate for channel 8 on 8/23/77 for Stations 2 to 10 is $8.17 \times 1.022 = 8.35$.)

TABLE 6. TOTAL DAILY RATES OF COMMUNITY PHOTOSYNTHESIS
FROM GRAPHICAL-ANALYTICAL PROCEDURE WITHOUT
REAERATION ADJUSTMENT
($\text{g m}^{-2} \text{ day}^{-1}$)

Date	Channel Nos.			
Station Nos.	1	4	5	8
7-28-76				
6 → 10	11.42 a_2	16.81 a_2, d	14.70 a_2, d	9.01 a_3
14 → 18	7.62 a_4	11.78 a_2	11.16 a_2	8.76 a_2
7-29-76				
6 → 10	18.01	14.96 d	16.21 d	8.98 a_2
14 → 18	9.48 c, d	13.47	10.59 a_2	10.68 a_4
8-5-76				
6 → 10	6.64 a_9	6.98 a_9	8.06 a_9	15.14 a_9
14 → 18	9.43 a_9	2.82 a_9	5.70 a_9	10.88 a_9
10-27-76				
2 → 10			2.85	4.28
10 → 18			3.13 a_1	5.15
10-28-76				
2 → 10			2.77 b_2	4.05
10 → 18			3.41	5.14
1-26-77				
2 → 10			-- e	7.53
10 → 18			-- e	5.25
1-27-77				
2 → 10			-- e	7.35
10 → 18			-- e	5.86
4-25-77				
2 → 10			4.55	10.09
10 → 18			5.21	8.18
4-26-78				
2 → 10			4.50 b_3	9.97 b_3
10 → 18			6.03 b_3	8.76 b_3
7-19-77				
2 → 10	16.70 a_1		17.63	10.49 a_1
10 → 18	8.96 a_1		12.21	14.53 a_1
7-20-77				
2 → 10	11.08 b_3		11.66 b_5	5.56 b_3
10 → 18	5.99 b_3		9.90 b_3	9.24 b_3
8-23-77				
2 → 10			9.80 a_1	8.35 a_1
10 → 18			7.58 a_1	11.30 a_1

a_N - Missing hours from sunrise where N indicates number of hours missing, i.e. a_4 implies first 4 consecutive hours after sunrise.

b_N - Missing hours before sunset where N indicates number of hours missing, i.e., b_2 implies last 2 hours before sunset are missing.

c - Negative photosynthetic rate value occurred before sunset, so this value was not included in accumulated photosynthetic rate.

d - Residence time seems incorrect.

e - $\Delta D.O.$ too small to make meaningful analysis

NOTE: Hydraulic mean depths are given in Appendix C.

SECTION 5

APPLICATION OF THE NUMERICAL DISSOLVED OXYGEN ROUTING METHOD (DORM) FOR STREAM PRODUCTIVITY ANALYSIS

A numerical Dissolved Oxygen Routing Model (DORM) was developed by Gulliver, Mattke, and Stefan (1980) to determine total stream community photosynthesis and respiration rates through successive routing of two-station diel D.O. measurements. The model includes surface oxygen exchange, longitudinal dispersion, a higher order curve extrapolation between upstream D.O. measurements, and dependence of respiratory rate on water temperature and D.O. concentration.

The graphical-analytical procedure can also be simulated by DORM numerically. This is accomplished by making the same assumptions as in the graphical method; namely, no surface oxygen exchange (reaeration) or longitudinal dispersion occurs, respiration is independent of temperature and D.O. concentration, and a linear interpolation between D.O. measurements is used. DORM used in this manner will be referred to as "graphical DORM" as opposed to the "complete DORM."

Two D.O. survey dates were selected (8-23-77 and 4-25-77) for complete DORM and graphical DORM analysis. These dates were used to investigate the seasonal effect of surface exchange on photosynthesis and respiration rates. All input parameters needed for DORM were readily available except for appropriate channel cross sections. As previously discussed, when morphological channel characteristics underestimated temperature front residence times, the cross sections were increased in proportion to the difference in their residence times.

Table 7 compares results from the complete DORM, the graphical DORM, and the true graphical procedure for daily community respiration and photosynthetic rates. As before, incomplete D.O. measurements taken during the day resulted in partial photosynthetic rates. These values

TABLE 7. TOTAL AND PARTIAL DAILY COMMUNITY RESPIRATION AND PHOTOSYNTHESIS RATES FOR COMPLETE DORM, GRAPHICAL DORM, AND THE GRAPHICAL-ANALYTICAL METHOD (UNADJUSTED FOR MISSING DAYLIGHT HOURS)

Date	Channel	Segment	Respiration $\text{g m}^{-2} \text{ day}^{-1}$			Photosynthesis $\text{g m}^{-2} \text{ day}^{-1}$			¶ Graphical DORM R-Value Is of Complete DORM	§ Graphical DORM P-Value Is of Complete DORM
			Complete DORM	Graphical DORM	Graphical	Complete DORM	Graphical DORM	Graphical		
8-23-77	5	2 10	10.54	8.78	9.36 a_1	10.72	9.41	9.59 a_1	83	88
8-23-77	5	10 18	10.08	7.55	7.25 a_1	10.15	8.03	7.42 a_1	75	79
8-23-77	8	2 10	14.36	13.27	12.79 a_1	9.52	8.55	8.17 a_1	92	90
8-23-77	8	10 18	14.35	11.63	13.90 a_1	12.85	10.81	11.06 a_1	81	84
4-25-77	5	2 10	8.21	7.45	6.85	5.77	5.14	4.55	91	89
4-25-77	5	10 18	9.98	8.04	7.26	7.48	5.95	5.21	81	80
4-25-77	8	2 10	16.50	14.59	14.04	11.88	10.61	10.09	88	89
4-25-77	8	10 18	12.75	9.44	7.95	12.09	9.68	8.18	74	80
4-26-77	5	2 10	8.65	7.45	6.85 b_3	5.33	4.71	4.03 b_3	86	88
4-26-77	5	10 18	10.81	8.04	7.26 b_3	8.16	6.77	5.38 b_3	74	83
4-26-77	8	2 10	17.28	14.59	14.04 b_3	11.42	10.17	8.90 b_3	84	89
4-26-77	8	10 18	13.75	9.44	7.95 b_3	11.79	9.55	7.82 b_3	69	81

a_1 indicates 1 hour of D.O. measurements were missing before sunrise.
 b_3 indicates 3 hours of D.O. measurements were missing before sunset.

were multiplied by the coefficients in Table 5 to obtain the total daily photosynthetic rates listed in Table 8.

When comparing the graphical DORM and complete DORM, assuming a small temperature change between the upstream and downstream reaches, the D.O. saturation concentrations can be considered approximately the same. The lower the measured D.O. falls below the D.O. saturation concentration, the greater the oxygen influx from surface exchange. As a control volume travels downstream, respiration occurs, which lowers the D.O. concentration in that control volume. Thus, surface exchange should increase downstream. The higher surface exchange becomes, the higher the respiration rate must become to account for this increased oxygen input into the system. The graphical methods with and without DORM will underestimate P and R downstream due to the increased extent of surface oxygen exchange.

TABLE 8. TOTAL DAILY RATES OF PHOTOSYNTHESIS FROM DORM
($\text{g m}^{-2} \text{ day}^{-1}$)

Date	Channel Nos.			
Station Nos.	1	4	5	8
4-25-77				
2 → 10			5.77	11.88
10 → 18			7.48	12.09
4-26-77				
2 → 10			5.97*	12.79*
10 → 18			9.14	13.20
8-23-77				
2 → 10			10.96*	9.73*
10 → 18			10.37*	13.13*
*Photosynthetic rates adjusted from complete DORM for missing daylight hours.				

SECTION 6

RESIDENCE TIME SENSITIVITY ANALYSIS

Gulliver et al. (1980) found total daily community photosynthesis and respiration rates very sensitive to the hydraulic residence time. Thus, a sensitivity analysis was conducted with DORM to investigate the influence of residence time on respiration and photosynthetic rates.

The residence time was increased and decreased by 20 per cent by increasing and decreasing the cross-sectional area by 20 per cent. The channel surface width was not altered in order to provide a constant surface area for surface exchange. A 20 per cent error margin for residence time was used for a variety of reasons. As discussed previously, residence time computed from channel cross sections was 18 per cent lower than found by temperature fronts. Also, a 3 to 5 per cent error is possible in the actual flow rate measurements at MERS. Also variation in water depth due to macrophyte growth is observed at a constant flow rate.

The results of the residence time sensitivity analysis are shown in Table 9.

TABLE 9. RESIDENCE TIME SENSITIVITY ANALYSIS

Date	Channel	Segment		Respiration $\text{g m}^{-2} \text{ day}^{-1}$			Photosynthesis $\text{g m}^{-2} \text{ day}^{-1}$			% Difference			
				Complete DORM	20% Increase	20% Decrease	Complete DORM	20% Increase	20% Decrease	Respiration		Photosynthesis	
										Increase	Decrease	Increase	Decrease
8-23-77	5	2	10	10.54	11.18	9.94	10.71	11.50	10.03	6.1	-5.7	7.4	-6.3
8-23-77	5	10	18	10.08	11.19	9.11	10.15	11.53	8.86	11.0	-9.6	13.6	-12.7
8-23-77	8	2	10	14.36	14.86	13.93	9.53	10.03	9.08	3.5	-3.0	5.4	-4.6
8-23-77	8	10	18	14.35	15.03	13.72	12.85	13.62	12.11	4.7	-4.4	6.0	-5.8
4-25-77	5	2	10	8.21	8.49	7.89	5.78	6.01	5.43	3.4	-3.9	4.0	-6.0
4-25-77	5	10	18	9.98	10.50	9.50	7.48	8.06	6.94	5.2	-4.8	7.8	-7.2
4-25-77	8	2	10	16.50	16.79	16.12	11.88	12.22	11.57	1.8	-2.3	2.9	-2.6
4-25-77	8	10	18	12.75	13.57	12.01	12.09	12.95	11.29	6.4	-5.8	7.1	-6.6
4-26-77	5	2	10	8.66	8.95	8.32	5.33	5.65	5.01	3.3	-3.9	6.0	-6.0
4-26-77	5	10	18	10.81	11.37	10.27	8.16	8.85	7.52	5.2	-5.00	8.5	-7.8
4-26-77	8	2	10	17.28	17.58	16.88	11.42	11.81	11.02	1.7	-2.3	3.4	-3.5
4-26-77	8	10	18	13.75	14.64	12.95	11.79	12.82	10.82	6.5	-5.8	8.7	-8.2

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APPENDIX A

SUMMARY OF DIEL DISSOLVED OXYGEN DATA

PROVIDED BY MERS

Format: 12F5.2, F5.2, 19
Data, Station #, Channel #, Date

The first two lines give the values of the measured D.O. (g/m^3) and the following two lines give the time (hrs) (after 0:00 hr of the first day) corresponding to each D.O. measurement.

Data														Sta-	Chan-	Date
														tion	nel	
D.O. (g/m ³)	4.60	4.70	5.25	5.70	6.40	6.85	7.20	7.20	6.60	4.35	5.00	4.10		2.0	8	7-28-76
D.O. (g/m ³)	6.50	6.15	7.50	7.35	7.30	6.60	0	0	0	0	0	0		2.0	8	7-28-76
Time (hr)	5.18	7.18	9.18	11.18	13.18	15.18	17.18	19.18	21.18	29.18	31.18	33.18		2.0	8	7-28-76
Time (hr)	35.18	37.18	39.18	41.18	43.18	45.18	0	0	0	0	0	0		2.0	8	7-28-76
	2.50	3.05	4.20	5.70	6.00	6.75	7.35	6.60	4.60	2.70	3.10	2.95		4.0	8	7-28-76
	2.75	3.25	5.05	6.75	7.90	7.80	7.55	6.90	4.80	0	0	0		4.0	8	7-28-76
	5.21	7.21	9.21	11.21	13.21	15.21	17.21	19.21	21.21	23.48	25.48	27.48		4.0	8	7-28-76
	29.21	31.21	33.21	35.21	37.21	39.21	41.21	43.21	45.21	0	0	0		4.0	8	7-28-76
	1.65	2.50	4.55	6.35	7.50	8.30	8.80	7.25	4.15	1.80	2.60	5.60		6.0	8	7-28-76
	7.95	9.80	10.10	9.25	6.25	4.35	0	0	0	0	0	0		6.0	8	7-28-76
	5.24	7.24	9.24	11.24	13.24	15.24	17.24	19.24	21.24	23.42	25.42	27.42		6.0	8	7-28-76
	35.24	37.24	39.24	41.24	43.24	45.24	0	0	0	0	0	0		6.0	8	7-28-76
	.20	.35	2.70	5.10	7.10	7.75	8.95	8.10	4.55	1.55	.30	.40		10.0	8	7-28-76
	.50	2.40	5.65	9.70	10.60	10.30	6.90	4.80	0	0	0	0		10.0	8	7-28-76
	5.27	7.27	9.27	11.27	13.27	15.27	17.27	19.27	21.27	23.45	25.45	27.45		10.0	8	7-28-76
	31.27	33.27	35.27	37.27	39.27	41.27	43.27	45.27	0	0	0	0		10.0	8	7-28-76
	.05	.65	4.30	7.00	10.20	11.50	11.15	8.80	5.30	.10	3.65	8.15		14.0	8	7-28-76
	12.15	12.60	11.25	8.60	5.55	0	0	0	0	0	0	0		14.0	8	7-28-76
	5.30	7.30	9.30	11.30	13.30	15.30	17.30	19.30	21.30	23.39	25.39	27.39		14.0	8	7-28-76
	37.39	39.39	41.39	43.39	45.39	0	0	0	0	0	0	0		14.0	8	7-28-76
	.30	2.50	5.05	8.20	10.60	11.40	10.05	6.25	2.60	.20	.15	2.35		18.0	8	7-28-76
	6.30	10.90	12.60	12.35	9.90	6.60	0	0	0	0	0	0		18.0	8	7-28-76
	7.33	9.33	11.33	13.33	15.33	17.33	19.33	21.33	23.42	25.42	27.33	33.33		18.0	8	7-28-76
	35.33	37.33	39.33	41.33	43.33	45.33	0	0	0	0	0	0		18.0	8	7-28-76
	4.90	4.90	6.20	6.40	7.20	7.55	8.00	7.55	6.20	4.75	5.60	7.85		2.0	5	7-28-76
	8.05	8.70	7.95	5.20	0	0	0	0	0	0	0	0		2.0	5	7-28-76
	5.51	7.51	9.51	11.51	13.51	15.51	17.51	19.51	21.51	23.51	25.51	27.51		2.0	5	7-28-76
	37.51	39.51	41.51	43.51	45.51	0	0	0	0	0	0	0		2.0	5	7-28-76
	3.40	4.30	5.40	6.40	7.85	8.60	8.75	7.50	5.25	4.40	3.95	3.80		4.0	5	7-28-76
	3.40	4.60	8.45	9.80	9.35	7.10	5.40	0	0	0	0	0		4.0	5	7-28-76
	5.48	7.48	9.48	11.48	13.48	15.48	17.48	19.48	21.48	23.27	25.27	27.27		4.0	5	7-28-76
	29.48	31.48	33.48	35.48	37.48	39.48	41.48	43.48	45.48	0	0	0		4.0	5	7-28-76
	2.85	4.00	5.80	7.40	8.85	10.00	10.15	8.25	5.10	2.90	4.10	9.40		6.0	5	7-28-76
	10.15	11.40	10.20	7.65	5.35	0	0	0	0	0	0	0		6.0	5	7-28-76
	5.45	7.45	9.45	11.45	13.45	15.45	17.45	19.45	21.45	23.45	25.45	27.45		6.0	5	7-28-76
	37.45	39.45	41.45	43.45	45.45	45	0	0	0	0	0	0		6.0	5	7-28-76

1.90	2.70	5.40	6.80	9.20	11.30	11.90	10.80	7.25	5.25	2.75	2.40	10.0	5	7-28-76	
2.15	2.80	8.20	11.40	13.20	12.65	10.20	7.15	0	0	0	0	10.0	5	7-28-76	
5.42	7.42	9.42	11.42	13.42	15.42	17.42	19.42	21.42	23.33	25.33	27.33	10.0	5	7-28-76	
29.42	31.42	35.42	37.42	39.42	41.42	43.42	45.42	47	0	0	0	0	10.0	5	7-28-76
1.55	2.00	4.70	7.40	10.50	12.40	13.00	12.00	8.85	1.55	1.75	8.30	14.0	5	7-28-76	
13.00	14.55	13.60	12.25	9.00	0	0	0	0	0	0	0	0	14.0	5	7-28-76
5.39	7.39	9.39	11.39	13.39	15.39	17.39	19.39	21.39	29.39	31.39	35.39	14.0	5	7-28-76	
37.39	39.39	41.39	43.39	45.39	47	0	0	0	0	0	0	0	14.0	5	7-28-76
1.05	1.15	3.30	5.60	8.90	11.55	12.85	11.95	9.45	6.25	3.40	1.90	18.0	5	7-28-76	
.90	1.05	6.00	9.95	13.25	14.20	13.25	10.60	0	0	0	0	18.0	5	7-28-76	
5.36	7.36	9.36	11.36	13.36	15.36	17.36	19.36	21.36	23.36	25.36	27.36	18.0	5	7-28-76	
29.36	31.36	33.36	35.36	37.36	39.36	41.36	43.36	45.36	47	0	0	0	18.0	5	7-28-76
5.05	5.45	6.20	7.20	7.85	8.75	9.05	8.45	7.15	5.40	5.60	6.90	2.0	4	7-28-76	
7.80	8.75	9.10	9.20	8.45	7.20	0	0	0	0	0	0	2.0	4	7-28-76	
5.18	7.18	9.18	11.18	13.18	15.18	17.18	19.18	21.18	29.18	31.18	33.18	18	2.0	4	7-28-76
35.18	37.18	39.18	41.18	43.18	45.18	47	0	0	0	0	0	0	2.0	4	7-28-76
3.95	4.45	5.75	7.25	8.15	8.95	9.35	8.75	6.45	5.25	4.85	4.20	4.0	4	7-28-76	
4.25	4.65	6.60	8.20	9.15	10.00	9.45	8.45	6.55	0	0	0	4.0	4	7-28-76	
5.21	7.21	9.21	11.21	13.21	15.21	17.21	19.21	21.21	23.21	24.25	24.27	24	4.0	4	7-28-76
29.21	31.21	33.21	35.21	37.21	39.21	41.21	43.21	45.21	47	0	0	0	4.0	4	7-28-76
3.35	3.50	5.65	7.35	8.55	9.95	10.55	9.35	6.40	3.45	3.90	6.25	6.0	4	7-28-76	
8.55	10.80	11.25	11.00	9.25	6.60	0	0	0	0	0	0	6.0	4	7-28-76	
5.24	7.24	9.24	11.24	13.24	15.24	17.24	19.24	21.24	29.24	31.24	33.24	24	6.0	4	7-28-76
35.24	37.24	39.24	41.24	43.24	45.24	47	0	0	0	0	0	0	6.0	4	7-28-76
2.20	2.60	5.05	7.10	9.30	10.95	12.00	11.10	7.75	4.85	3.05	4.60	10.0	4	7-28-76	
2.30	2.50	5.30	8.75	11.60	13.05	13.35	11.15	8.20	0	0	0	10.0	4	7-28-76	
5.27	7.25	9.27	11.27	13.27	15.27	17.27	19.27	21.27	23.27	30.25	30.27	30	10.0	4	7-28-76
29.27	31.27	33.27	35.27	37.27	39.27	41.27	43.27	45.27	47	0	0	0	10.0	4	7-28-76
1.35	1.60	3.85	5.85	8.40	10.30	11.85	11.60	9.45	1.40	1.65	3.95	14.0	4	7-28-76	
7.25	10.70	12.20	12.40	14.25	10.00	0	0	0	0	0	0	14.0	4	7-28-76	
5.30	7.30	9.30	11.30	13.30	15.30	17.30	19.30	21.30	29.30	31.30	33.30	30	14.0	4	7-28-76
35.30	37.30	39.30	41.30	43.30	45.30	47	0	0	0	0	0	0	14.0	4	7-28-76
1.10	1.20	3.30	5.30	7.95	10.10	11.50	11.20	9.25	7.15	4.40	2.55	18.0	4	7-28-76	
1.30	1.25	3.60	7.55	10.05	12.15	13.40	12.50	6.0	0	0	0	18.0	4	7-28-76	
5.33	7.33	9.33	11.33	13.33	15.33	17.33	19.33	21.33	23.33	36.25	36.27	36	18.0	4	7-28-76
29.33	31.33	33.33	35.33	37.33	39.33	41.33	43.33	45.33	47	0	0	0	18.0	4	7-28-76

4.80	5.20	6.20	6.60	7.10	7.85	8.00	9.55	6.25	4.80	4.90	6.10	2.0	1	7-28-76
7.05	7.75	8.00	8.20	7.55	7.00	0	0	0	0	0	0	2.0	1	7-28-76
5.51	7.51	9.51	11.51	13.51	15.51	17.51	19.51	21.51	29.51	31.51	33.51	2.0	1	7-28-76
35.51	37.51	39.51	41.51	43.51	45.51	0	0	0	0	0	0	2.0	1	7-28-76
2.40	3.30	4.35	5.25	5.90	6.50	6.50	5.60	4.55	4.95	3.45	3.20	4.0	1	7-28-76
2.90	3.30	4.85	6.15	6.70	7.05	6.85	5.85	5.00	0	0	0	4.0	1	7-28-76
5.48	7.48	9.48	11.48	13.48	15.48	17.48	19.48	21.48	23.21	25.21	27.21	4.0	1	7-28-76
29.48	31.48	33.48	35.48	37.48	39.48	41.48	43.48	45.48	0	0	0	4.0	1	7-28-76
1.45	1.80	3.00	3.60	4.55	5.20	5.40	4.80	3.20	1.85	2.00	3.30	6.0	1	7-28-76
4.60	5.85	6.00	5.95	5.25	4.00	0	0	0	0	0	0	6.0	1	7-28-76
5.45	7.45	9.45	11.45	13.45	15.45	17.45	19.45	21.45	29.45	31.45	33.45	6.0	1	7-28-76
35.45	37.45	39.45	41.45	43.45	45.45	0	0	0	0	0	0	6.0	1	7-28-76
1.35	2.90	4.95	6.30	6.60	6.45	3.80	1.15	.60	.15	.65	.05	10.0	1	7-28-76
3.60	6.40	8.95	8.90	7.40	1.95	0	0	0	0	0	0	10.0	1	7-28-76
7.42	9.42	11.42	13.42	15.42	17.42	19.42	21.42	23.18	25.18	27.18	29.42	10.0	1	7-28-76
33.42	35.42	37.42	39.42	41.42	43.42	0	0	0	0	0	0	10.0	1	7-28-76
.75	4.50	6.40	8.65	9.95	9.65	7.00	1.75	.45	4.80	9.30	12.10	14.0	1	7-28-76
12.20	10.05	6.60	2.85	0	0	0	0	0	0	0	0	14.0	1	7-28-76
7.35	9.39	11.39	13.39	15.39	17.39	19.39	21.39	23.39	25.39	27.39	29.39	14.0	1	7-28-76
39.39	41.39	43.39	45.39	0	0	0	0	0	0	0	0	14.0	1	7-28-76
.35	2.35	5.35	8.75	9.70	9.35	7.60	3.40	.60	.30	3.55	8.00	18.0	1	7-28-76
11.50	11.55	10.55	7.45	4.05	0	0	0	0	0	0	0	18.0	1	7-28-76
7.36	9.36	11.36	13.36	15.36	17.36	19.36	21.36	23.15	25.15	27.15	29.36	18.0	1	7-28-76
37.36	39.36	41.36	43.36	45.36	0	0	0	0	0	0	0	18.0	1	7-28-76
8.45	9.25	9.60	9.90	8.60	7.85	7.10	6.90	6.80	6.80	7.60	0	2.0	1	8- 5-76
13.00	15.00	17.00	19.00	21.00	23.00	25.00	27.00	29.00	31.00	33.00	0	2.0	1	8- 5-76
9.60	10.40	10.50	9.95	7.85	5.90	5.55	5.40	5.50	7.55	0	0	6.0	1	8- 5-76
13.03	15.03	17.03	19.03	21.03	23.03	25.03	27.03	29.03	31.03	33.03	0	6.0	1	8- 5-76
8.80	10.25	9.40	8.65	6.10	4.80	3.95	3.70	2.75	3.60	6.40	0	10.0	1	8- 5-76
13.06	15.06	17.06	19.06	21.06	23.06	25.06	27.06	29.06	31.06	33.06	0	10.0	1	8- 5-76
10.15	11.45	10.95	9.65	7.05	3.25	2.60	2.30	2.70	6.05	0	0	14.0	1	8- 5-76
13.09	15.09	17.09	19.09	21.09	23.09	25.09	27.09	29.09	31.09	33.09	0	14.0	1	8- 5-76
10.30	11.90	11.60	10.00	6.55	4.20	1.85	1.65	1.45	3.80	0	0	18.0	1	8- 5-76
13.12	15.12	17.12	19.12	21.12	23.12	25.12	27.12	29.12	31.12	33.12	0	18.0	1	8- 5-76

7.90 8.80 9.20 9.20 8.25 7.45 7.05 6.55 6.60 6.50 7.15	0	2.0	8	8-	5-76
13.0015.0017.0019.0021.0023.0025.0027.0029.0031.0033.00	0	2.0	8	8-	5-76
9.55 9.80 9.95 8.95 7.20 5.85 5.25 4.60 4.65 4.85 7.10	0	6.0	8	8-	5-76
13.0315.0317.0319.0321.0323.0325.0327.0329.0331.0333.03	0	6.0	8	8-	5-76
10.6011.6010.95 9.30 6.80 4.55 3.60 2.70 3.20 1.80 3.45	0	10.0	8	8-	5-76
13.0615.0617.0619.0621.0623.0625.0627.0629.0631.0633.06	0	10.0	8	8-	5-76
11.8513.0012.3010.65 7.30 4.85 3.70 2.40 2.10 2.20 5.45	0	14.0	8	8-	5-76
13.0915.0917.0919.0921.0923.0925.0927.0929.0931.0933.09	0	14.0	8	8-	5-76
13.2014.9513.8011.90 8.50 5.35 3.50 2.15 1.25 1.65 4.60	0	18.0	8	8-	5-76
13.1215.1217.1219.1221.1223.1225.1227.1229.1231.1233.12	0	18.0	8	8-	5-76
9.30 9.65 9.70 9.20 7.95 7.25 6.60 6.40 6.45 6.80 8.00	0	2.0	4	8-	5-76
13.2715.2717.2719.2721.2723.2725.2727.2729.2731.2733.27	0	2.0	4	8-	5-76
10.5010.8010.20 9.65 7.20 5.10 5.05 4.95 5.20 7.70	0	6.0	4	8-	5-76
13.2415.2417.2419.2421.2425.2427.2429.2431.2433.24	0	6.0	4	8-	5-76
10.8511.8511.4510.40 7.90 4.60 4.25 4.05 4.20 6.60	0	10.0	4	8-	5-76
13.2115.2117.2119.2121.2125.2127.2129.2131.2133.21	0	10.0	4	8-	5-76
11.9513.4013.0511.50 8.35 4.20 3.55 3.20 3.10 5.80	0	14.0	4	8-	5-76
13.1815.1817.1819.1821.1825.1827.1829.1831.1833.18	0	14.0	4	8-	5-76
10.7013.0013.6512.40 9.45 6.95 4.30 3.20 2.65 2.65 4.80	0	18.0	4	8-	5-76
13.1515.1517.1519.1521.1523.1525.1527.1529.1531.1533.15	0	18.0	4	8-	5-76
9.05 9.05 9.05 8.55 6.65 6.45 6.40 6.00 6.15 6.20 7.90	0	2.0	5	8-	5-76
13.2715.2717.2719.2721.2723.2725.2727.2729.2731.2733.27	0	2.0	5	8-	5-76
10.6010.6510.05 9.00 6.35 5.20 5.15 4.70 4.75 5.15 7.90	0	6.0	5	8-	5-76
13.2415.2417.2419.2421.2423.2425.2427.2429.2431.2433.24	0	6.0	5	8-	5-76
11.2512.0011.6010.10 7.25 5.30 4.50 3.75 3.70 4.15 6.80	0	10.0	5	8-	5-76
13.2115.2117.2119.2121.2123.2125.2127.2129.2131.2133.21	0	10.0	5	8-	5-76
11.8513.2013.3011.45 8.55 5.80 4.30 3.40 3.05 3.40 5.90	0	14.0	5	8-	5-76
13.1815.1817.1819.1821.1823.1825.1827.1829.1831.1833.18	0	14.0	5	8-	5-76
11.7013.5514.0512.65 9.30 6.85 4.60 3.35 2.70 2.90 5.00	0	18.0	5	8-	5-76
13.1515.1517.1519.1521.1523.1525.1527.1529.1531.1533.15	0	18.0	5	8-	5-76

13.	0013.	1014.	2015.	3016.	1016.	7016.	4015.	3014.	9014.	3013.	6513.	30	2.0	5	10-27-76	
13.	0013.	0014.	4015.	1016.	0016.	6016.	10	0	0	0	0	0	2.0	5	10-27-76	
6.	43	8.	5010.	3312.	1014.	1116.	0818.	0820.	0822.	1024.	0826.	0328.	03	2.0	5	10-27-76
30.	0332.	0334.	0336.	0338.	0340.	0342.	03	0	0	0	0	0	2.0	5	10-27-76	
12.	6013.	0014.	3015.	7016.	9517.	2016.	2015.	1014.	7014.	1013.	5512.	95	6.0	5	10-27-76	
12.	6012.	8014.	4015.	6016.	7016.	9016.	30	0	0	0	0	0	6.0	5	10-27-76	
6.	58	8.	6410.	3712.	1514.	1616.	1218.	1320.	1322.	1424.	1226.	0828.	08	6.0	5	10-27-76
30.	0832.	0834.	0836.	0838.	0840.	0842.	08	0	0	0	0	0	6.0	5	10-27-76	
12.	1012.	6014.	3015.	8517.	3017.	6016.	7015.	3014.	4513.	9513.	3012.	65	10.0	5	10-27-76	
12.	4012.	5014.	2015.	7017.	20	0	0	0	0	0	0	0	10.0	5	10-27-76	
6.	72	8.	7910.	4212.	1914.	2016.	1718.	1720.	1722.	1924.	1726.	1228.	12	10.0	5	10-27-76
30.	1232.	1234.	1236.	1240.	12	0	0	0	0	0	0	0	10.0	5	10-27-76	
12.	0012.	4014.	2015.	9017.	6018.	0017.	1015.	3014.	4013.	8013.	4012.	70	14.0	5	10-27-76	
12.	2012.	3013.	8015.	8017.	3517.	70	0	0	0	0	0	0	14.0	5	10-27-76	
6.	87	8.	9410.	4612.	2414.	2516.	2218.	2220.	2222.	2424.	2226.	1728.	17	14.0	5	10-27-76
30.	1732.	1634.	1636.	1638.	1640.	16	0	0	0	0	0	0	14.0	5	10-27-76	
12.	0012.	2013.	9015.	9017.	7518.	5017.	2015.	3014.	3513.	8013.	2012.	70	18.0	5	10-27-76	
12.	1012.	1013.	7015.	7017.	5018.	2016.	60	0	0	0	0	0	18.0	5	10-27-76	
7.	01	9.	0810.	5112.	2814.	2916.	2618.	2620.	2622.	2824.	2626.	2128.	21	18.0	5	10-27-76
30.	2132.	2134.	2136.	2138.	2140.	2142.	21	0	0	0	0	0	18.0	5	10-27-76	
11.	8011.	9012.	6013.	6014.	2014.	8014.	3013.	9013.	0512.	8012.	1511.	80	2.0	8	10-27-76	
11.	6011.	5012.	3013.	3013.	8014.	1013.	80	0	0	0	0	0	2.0	8	10-27-76	
6.	33	8.	1810.	0312.	0314.	2316.	0818.	0820.	0322.	0324.	1326.	0728.	03	2.0	8	10-27-76
30.	0532.	1334.	0336.	0338.	1340.	0342.	03	0	0	0	0	0	2.0	8	10-27-76	
11.	0011.	1012.	4013.	8514.	4014.	5013.	5012.	7012.	2011.	8511.	2510.	80	6.0	8	10-27-76	
10.	5011.	3012.	1013.	4014.	0014.	2013.	00	0	0	0	0	0	6.0	8	10-27-76	
6.	38	8.	2310.	0712.	0714.	2816.	1218.	1320.	0822.	0824.	1726.	1228.	08	6.0	8	10-27-76
30.	1032.	1834.	0836.	0838.	1840.	0842.	08	0	0	0	0	0	6.0	8	10-27-76	
10.	0010.	1011.	9014.	0014.	9014.	7013.	3011.	8011.	2510.	8510.	50	9.90	10.0	8	10-27-76	
9.	60	9.	5011.	3013.	4514.	3014.	3012.	50	0	0	0	0	10.0	8	10-27-76	
6.	42	8.	2710.	1212.	1214.	3216.	1718.	1720.	1222.	1224.	2226.	1628.	12	10.0	8	10-27-76
30.	1432.	2234.	1236.	1238.	2240.	1242.	12	0	0	0	0	0	10.0	8	10-27-76	
12.	0012.	4014.	2015.	9017.	6018.	0017.	1015.	3014.	4013.	8013.	4012.	70	14.0	5	10-27-76	
12.	2012.	3013.	8015.	8017.	3517.	70	0	0	0	0	0	0	14.0	5	10-27-76	
6.	87	8.	9410.	4612.	2414.	2516.	2218.	2220.	2222.	2424.	2226.	1728.	17	14.0	5	10-27-76
30.	1732.	1634.	1636.	1638.	1640.	16	0	0	0	0	0	0	14.0	5	10-27-76	

12.00	12.20	13.90	15.90	17.75	18.50	17.20	15.30	14.35	13.80	13.20	12.70	18.0	5	10-27-76
12.10	12.10	13.70	15.70	17.50	18.20	16.60	0	0	0	0	0	18.0	5	10-27-76
7.01	9.08	10.51	12.28	14.29	16.26	18.26	20.26	22.28	24.26	26.21	28.21	18.0	5	10-27-76
30.21	32.21	34.21	36.21	38.21	40.21	42.21	0	0	0	0	0	18.0	5	10-27-76
11.80	11.90	12.60	13.60	14.20	14.80	14.30	13.90	13.05	12.80	12.15	11.80	2.0	8	10-27-76
11.60	11.50	12.30	13.30	13.80	14.10	13.80	0	0	0	0	0	2.0	8	10-27-76
6.33	8.18	10.03	12.03	14.23	16.08	18.08	20.03	22.03	24.13	26.07	28.03	2.0	8	10-27-76
30.05	32.13	34.03	36.03	38.13	40.03	42.03	0	0	0	0	0	2.0	8	10-27-76
11.00	11.10	12.40	13.85	14.40	14.50	13.50	12.70	12.20	11.85	11.25	10.80	6.0	8	10-27-76
10.50	11.30	12.10	13.40	14.00	14.20	13.00	0	0	0	0	0	6.0	8	10-27-76
6.38	8.23	10.07	12.07	14.28	16.12	18.13	20.08	22.08	24.17	26.12	28.08	6.0	8	10-27-76
30.10	32.18	34.08	36.08	38.18	40.08	42.08	0	0	0	0	0	6.0	8	10-27-76
10.00	10.10	11.90	14.00	14.90	14.70	13.30	11.80	11.25	10.85	10.50	9.90	10.0	8	10-27-76
9.60	9.50	11.30	13.45	14.30	14.30	12.50	0	0	0	0	0	10.0	8	10-27-76
6.42	8.27	10.12	12.12	14.32	16.17	18.17	20.12	22.22	24.22	26.16	28.12	10.0	8	10-27-76
30.14	32.22	34.12	36.12	38.22	40.12	42.12	0	0	0	0	0	10.0	8	10-27-76
9.50	9.70	11.80	14.50	15.90	15.60	13.20	11.40	10.50	10.30	9.90	9.45	14.0	8	10-27-76
9.00	9.10	11.20	14.00	15.10	14.90	12.70	0	0	0	0	0	14.0	8	10-27-76
6.47	8.31	10.16	12.16	14.37	16.22	18.22	20.17	22.22	24.26	26.21	28.17	14.0	8	10-27-76
30.19	32.27	34.16	36.16	38.27	40.16	42.16	0	0	0	0	0	14.0	8	10-27-76
9.00	9.30	11.70	14.75	15.50	15.30	13.80	11.30	10.30	9.75	9.45	9.10	18.0	8	10-27-76
8.60	8.50	11.10	14.15	15.90	15.40	12.90	0	0	0	0	0	18.0	8	10-27-76
6.51	8.36	10.21	12.21	14.41	16.26	18.26	20.21	22.24	24.31	26.25	28.21	18.0	8	10-27-76
30.23	32.31	34.21	36.21	38.31	40.21	42.21	0	0	0	0	0	18.0	8	10-27-76
9.70	9.60	9.60	9.70	9.80	9.80	9.90	9.90	9.85	9.80	9.75	9.70	2.0	5	1-26-77
9.80	9.90	10.20	9.85	9.80	9.80	9.80	0	0	0	0	0	2.0	5	1-26-77
6.03	8.03	10.03	12.03	14.03	16.03	18.03	20.03	22.03	24.03	26.03	28.03	2.0	5	1-26-77
30.03	32.03	34.03	36.03	38.03	40.03	42.03	0	0	0	0	0	2.0	5	1-26-77
9.65	9.30	9.40	9.60	9.70	9.70	9.80	9.90	9.75	9.75	9.60	9.70	6.0	5	1-26-77
9.70	9.80	9.70	9.80	9.70	9.70	0	0	0	0	0	0	6.0	5	1-26-77
6.08	8.07	10.07	12.07	14.07	16.08	18.08	20.08	22.08	24.08	26.08	28.08	6.0	5	1-26-77
30.08	32.08	34.08	36.08	38.08	40.08	0	0	0	0	0	0	6.0	5	1-26-77
10.50	9.05	9.20	9.30	9.50	9.55	9.60	9.65	9.65	9.60	9.35	9.60	10.0	5	1-26-77
9.60	9.70	9.50	9.80	9.70	9.70	9.70	0	0	0	0	0	10.0	5	1-26-77
6.12	8.12	10.12	12.12	14.12	16.12	18.12	20.12	22.12	24.12	26.12	28.12	10.0	5	1-26-77
30.12	32.12	34.12	36.12	38.12	40.12	42.12	0	0	0	0	0	10.0	5	1-26-77
10.90	9.65	9.30	9.20	9.40	9.30	9.80	9.45	9.35	9.60	9.50	9.60	14.0	5	1-26-77
9.60	9.60	9.50	9.60	9.60	9.75	0	0	0	0	0	0	14.0	5	1-26-77
6.17	8.16	10.16	12.16	14.16	16.16	17.18	17.20	17.22	17.24	17.26	17.28	17.0	5	1-26-77
30.17	32.16	34.16	36.16	38.16	40.16	0	0	0	0	0	0	14.0	5	1-26-77

9.40	9.05	8.90	9.00	9.20	9.20	9.30	9.35	9.35	9.40	9.35	9.40	18.0	5	1-26-77
9.40	9.60	9.40	9.45	9.60	9.60	9.60	0	0	0	0	0	18.0	5	1-26-77
6.21	8.2110	2112	2114	2116	2118	2120	2122	2124	2126	2128	21	18.0	5	1-26-77
30.2132	2134	2136	2138	2140	2141	51	0	0	0	0	0	18.0	5	1-26-77
7.90	7.30	7.90	7.90	8.30	7.65	7.25	8.00	7.70	6.80	6.85	7.20	2.0	8	1-26-77
7.00	7.50	7.50	8.30	8.10	8.20	8.30	0	0	0	0	0	2.0	8	1-26-77
6.33	8.0310	0312	0314	0316	0318	0320	0322	0324	0326	0328	03	2.0	8	1-26-77
30.0332	0334	0336	0338	0340	0341	33	0	0	0	0	0	2.0	8	1-26-77
7.20	7.50	9.4011	1011	15	9.50	7.00	6.55	6.85	6.95	6.90	6.90	6.0	8	1-26-77
6.90	7.20	9.0011	0010	80	9.30	0	0	0	0	0	0	6.0	8	1-26-77
6.38	8.0710	0712	0714	0716	0818	0820	0822	0824	0826	0828	08	6.0	8	1-26-77
30.0832	0834	0836	0838	0840	08	0	0	0	0	0	0	6.0	8	1-26-77
6.80	7.2010	1013	3014	2012	40	7.25	6.60	6.50	6.30	6.25	6.30	10.0	8	1-26-77
6.30	6.5010	2513	1013	8011	50	9.30	0	0	0	0	0	10.0	8	1-26-77
6.42	8.1210	1212	1214	1216	1218	1220	1222	1224	1226	1228	12	10.0	8	1-26-77
30.1232	1234	1236	1238	1240	1241	42	0	0	0	0	0	10.0	8	1-26-77
6.80	7.4010	6014	7015	7514	10	8.25	6.75	6.25	6.20	5.95	5.90	14.0	8	1-26-77
5.90	6.3010	2014	3015	9013	50	0	0	0	0	0	0	14.0	8	1-26-77
6.47	8.1610	1612	1614	1616	1718	1720	1722	1724	1726	1728	17	14.0	8	1-26-77
30.1732	1634	1636	1638	1640	16	0	0	0	0	0	0	14.0	8	1-26-77
7.20	7.9010	7014	8016	0015	50	9.85	7.40	6.50	5.20	4.95	5.70	18.0	8	1-26-77
5.70	6.00	9.6014	7016	8015	2012	10	0	0	0	0	0	18.0	8	1-26-77
6.51	8.2110	2112	2114	2116	2118	2120	2122	2124	2126	2128	21	18.0	8	1-26-77
30.2132	2134	2136	2138	2140	2141	51	0	0	0	0	0	18.0	8	1-26-77
9.25	9.10	9.5010	1010	8511	3011	5011	2010	5010	15	9.90	9.65	2.0	5	4-25-77
9.30	9.00	9.5010	2010	6010	9011	00	0	0	0	0	0	2.0	5	4-25-77
4.03	6.03	8.0310	0312	0314	0316	0318	0320	0322	0324	0326	03	2.0	5	4-25-77
28.0330	0332	0334	0336	0338	0340	03	0	0	0	0	0	2.0	5	4-25-77
8.40	8.40	9.2010	1510	9011	3011	4010	85	9.60	9.30	9.00	8.80	6.0	5	4-25-77
8.50	8.40	9.2010	1010	7011	0011	10	0	0	0	0	0	6.0	5	4-25-77
4.08	6.08	8.0710	0712	0714	0716	0818	0820	0822	0824	0826	08	6.0	5	4-25-77
28.0830	0832	0834	0836	0838	0840	08	0	0	0	0	0	6.0	5	4-25-77
7.90	8.00	9.3010	4011	4011	9011	8010	90	9.10	8.70	8.30	8.30	10.0	5	4-25-77
7.90	7.70	9.2010	6011	3011	7011	55	0	0	0	0	0	10.0	5	4-25-77
4.12	6.12	8.1210	1212	1214	1216	1218	1220	1222	1224	1226	12	10.0	5	4-25-77
28.1230	1232	1234	1236	1238	1240	12	0	0	0	0	0	10.0	5	4-25-77

7.40	7.40	9.10	10.70	11.95	12.50	12.25	10.90	8.80	8.00	7.70	7.60	14.0	5	4-25-77
7.40	7.30	9.00	10.90	11.90	12.30	12.10	0	0	0	0	0	14.0	5	4-25-77
4.17	6.17	8.16	10.16	12.16	14.16	16.17	18.17	20.17	22.17	24.17	26.17	14.0	5	4-25-77
28.17	30.17	32.16	34.16	36.16	38.16	40.16	0	0	0	0	0	14.0	5	4-25-77
6.60	6.80	8.50	10.70	12.05	12.70	12.35	10.80	8.40	7.20	6.90	6.70	18.0	5	4-25-77
6.60	6.50	8.40	10.80	12.20	12.90	14.45	0	0	0	0	0	18.0	5	4-25-77
4.21	6.21	8.21	10.21	12.21	14.21	16.21	18.21	20.21	22.21	24.21	26.21	18.0	5	4-25-77
28.21	30.21	32.21	34.21	36.21	38.21	40.21	0	0	0	0	0	18.0	5	4-25-77
8.10	7.70	8.20	8.70	9.20	9.85	9.95	9.50	9.10	8.75	8.40	7.70	2.0	8	4-25-77
7.90	7.75	7.90	8.70	9.10	9.25	9.25	0	0	0	0	0	2.0	8	4-25-77
4.03	6.03	8.03	10.03	12.03	14.03	16.03	18.03	20.03	22.03	24.03	26.03	2.0	8	4-25-77
28.03	30.03	32.03	34.03	36.03	38.03	40.03	0	0	0	0	0	2.0	8	4-25-77
5.80	6.00	8.20	9.60	10.60	10.65	10.25	9.05	6.90	6.40	6.10	6.10	6.0	8	4-25-77
5.80	5.60	7.60	10.10	10.60	10.75	9.95	0	0	0	0	0	6.0	8	4-25-77
4.08	6.08	8.07	10.07	12.07	14.07	16.08	18.08	20.08	22.08	24.08	26.08	6.0	8	4-25-77
28.08	30.08	32.08	34.08	36.08	38.08	40.08	0	0	0	0	0	6.0	8	4-25-77
5.05	4.80	7.90	10.40	11.80	12.05	11.30	9.05	6.20	5.45	5.10	4.95	10.0	8	4-25-77
4.70	4.40	7.90	10.60	11.80	12.00	11.20	0	0	0	0	0	10.0	8	4-25-77
4.12	6.12	8.12	10.12	12.12	14.12	16.12	18.12	20.12	22.12	24.12	26.12	10.0	8	4-25-77
28.12	30.12	32.12	34.12	36.12	38.12	40.12	0	0	0	0	0	10.0	8	4-25-77
4.00	4.10	7.40	11.20	13.50	12.40	9.80	6.10	4.40	4.00	3.80	14.0	8	4-25-77	
3.60	3.90	7.10	11.00	13.30	12.10	0	0	0	0	0	14.0	8	4-25-77	
4.17	6.17	8.16	10.16	12.16	14.16	16.17	18.17	20.17	22.17	24.17	26.17	14.0	8	4-25-77
28.17	30.17	32.16	34.16	36.16	38.16	40.16	0	0	0	0	0	14.0	8	4-25-77
3.55	3.90	7.50	11.60	14.00	14.10	13.00	10.00	5.90	3.80	3.40	3.30	18.0	8	4-25-77
3.10	3.70	7.40	11.80	14.00	14.20	12.90	0	0	0	0	0	18.0	8	4-25-77
4.21	6.21	8.21	10.21	12.21	14.21	16.21	18.21	20.21	22.21	24.21	26.21	18.0	8	4-25-77
28.21	30.21	32.21	34.21	36.21	38.21	40.21	0	0	0	0	0	18.0	8	4-25-77
5.75	6.30	6.65	7.10	8.40	8.40	8.20	7.80	7.40	6.70	6.25	6.05	2.0	1	7-19-77
4.90	5.40	5.30	5.40	6.00	6.60	7.70	0	0	0	0	0	2.0	1	7-19-77
5.38	7.38	9.38	11.38	13.38	15.38	17.38	19.38	21.38	23.38	25.38	27.38	2.0	1	7-19-77
30.08	31.38	33.38	35.38	37.38	39.38	41.38	0	0	0	0	0	2.0	1	7-19-77
3.00	4.60	8.30	11.10	13.60	14.05	11.15	7.90	4.55	3.50	3.30	2.90	10.0	1	7-19-77
3.30	3.20	3.10	4.20	7.20	10.65	0	0	0	0	0	0	10.0	1	7-19-77
5.34	7.34	9.34	11.34	13.34	15.34	17.34	19.34	21.34	23.34	25.34	27.34	10.0	1	7-19-77
30.04	31.34	33.34	35.34	37.34	39.34	41.34	0	0	0	0	0	10.0	1	7-19-77

1.80	2.70	6.90	12.00	11.40	15.75	14.85	9.50	5.35	2.40	1.85	1.70	18.0	1	7-19-77
2.10	2.10	2.20	2.80	5.75	10.15	10.65	0	0	0	0	0	18.0	1	7-19-77
5.30	7.30	9.30	11.30	13.30	15.30	17.30	19.30	21.30	23.30	25.30	27.30	18.0	1	7-19-77
30.00	31.30	33.30	35.30	37.30	39.30	41.30	0	0	0	0	0	18.0	1	7-19-77
1.60	3.40	5.90	7.40	8.30	8.20	8.40	8.25	6.85	5.80	5.10	4.60	2.0	3	7-19-77
4.30	3.80	3.70	4.70	5.40	6.25	6.90	0	0	0	0	0	2.0	3	7-19-77
5.32	7.32	9.32	11.32	13.32	15.32	17.32	19.32	21.32	23.32	25.32	27.32	2.0	3	7-19-77
30.02	31.32	33.32	35.32	37.32	39.32	41.32	0	0	0	0	0	2.0	3	7-19-77
3.70	3.70	5.60	7.70	9.50	10.95	10.60	8.90	7.00	5.35	3.50	2.70	10.0	3	7-19-77
1.60	3.40	5.90	7.40	8.30	8.20	8.40	8.25	6.85	5.80	5.10	4.60	2.0	3	7-19-77
4.30	3.80	3.70	4.70	5.40	6.25	6.90	0	0	0	0	0	2.0	3	7-19-77
5.32	7.32	9.32	11.32	13.32	15.32	17.32	19.32	21.32	23.32	25.32	27.32	2.0	3	7-19-77
30.02	31.32	33.32	35.32	37.32	39.32	41.32	0	0	0	0	0	2.0	3	7-19-77
3.70	3.70	5.60	7.70	9.50	10.95	10.60	8.90	7.00	5.35	3.50	2.70	10.0	3	7-19-77
1.60	1.30	1.00	2.05	4.90	6.25	0	0	0	0	0	0	10.0	3	7-19-77
7.28	9.28	11.28	13.28	15.28	17.28	19.28	21.28	23.28	25.28	27.28	29.28	10.0	3	7-19-77
31.28	33.28	35.28	37.28	39.28	41.28	38	0	0	0	0	0	10.0	3	7-19-77
3.90	2.70	1.20	7.00	7.20	8.90	7.60	10.90	8.80	4.50	2.85	2.70	18.0	3	7-19-77
2.10	1.40	1.50	1.70	2.30	4.20	4.90	0	0	0	0	0	18.0	3	7-19-77
5.24	7.24	9.24	11.24	13.24	15.24	17.24	19.24	21.24	23.24	25.24	27.24	18.0	3	7-19-77
29.54	31.24	33.24	35.24	37.24	39.24	41.24	24	0	0	0	0	18.0	3	7-19-77
6.00	6.00	7.60	8.50	9.10	8.90	8.50	7.20	7.10	5.90	5.40	4.50	2.0	5	7-19-77
5.50	4.60	4.70	5.80	5.90	6.50	0	0	0	0	0	0	2.0	5	7-19-77
5.03	9.03	11.03	13.03	15.03	17.03	19.03	21.03	23.03	25.03	27.03	29.03	2.0	5	7-19-77
31.03	33.03	35.03	37.03	39.03	41.03	03	0	0	0	0	0	2.0	5	7-19-77
4.05	4.60	7.50	10.30	11.80	12.40	11.10	8.80	5.00	4.20	3.05	3.60	6.0	5	7-19-77
3.70	3.50	3.50	4.10	5.55	8.55	8.50	0	0	0	0	0	6.0	5	7-19-77
5.09	7.09	9.09	11.09	13.09	15.09	17.09	19.09	21.09	23.09	25.09	27.09	6.0	5	7-19-77
29.39	31.09	33.09	35.09	37.09	39.09	41.09	09	0	0	0	0	6.0	5	7-19-77
2.80	3.50	7.40	11.55	13.30	14.15	12.70	9.25	4.80	3.05	2.70	2.50	10.0	5	7-19-77
2.70	2.30	2.50	3.10	4.75	8.60	9.70	0	0	0	0	0	10.0	5	7-19-77
5.12	7.12	9.12	11.12	13.12	15.12	17.12	19.12	21.12	23.12	25.12	27.12	10.0	5	7-19-77
29.42	31.12	33.12	35.12	37.12	39.12	41.12	12	0	0	0	0	10.0	5	7-19-77
1.85	2.50	6.80	12.95	14.90	15.60	13.70	10.10	4.40	2.30	1.70	1.50	14.0	5	7-19-77
1.30	1.40	1.70	2.20	4.60	8.55	10.65	0	0	0	0	0	14.0	5	7-19-77
5.15	7.15	9.15	11.15	13.15	15.15	17.15	19.15	21.15	23.15	25.15	27.15	14.0	5	7-19-77
29.45	31.15	33.15	35.15	37.15	39.15	41.15	15	0	0	0	0	14.0	5	7-19-77

1.15	2.00	6.00	12.15	15.50	15.75	14.10	10.30	5.30	2.00	1.10	.90	18.0	5	7-19-77
1.10	1.00	1.10	1.70	4.00	8.50	10.90	0	0	0	0	0	18.0	5	7-19-77
5.21	7.21	9.21	11.21	13.21	15.21	17.21	19.21	21.21	23.21	25.21	27.21	18.0	5	7-19-77
29.51	31.21	33.21	35.21	37.21	39.21	41.21	21	0	0	0	0	18.0	5	7-19-77
6.85	7.25	8.80	9.50	9.25	9.05	9.95	8.80	7.20	6.80	6.70	6.60	4.0	7	7-19-77
6.90	6.90	6.90	7.50	8.70	9.20	9.10	0	0	0	0	0	4.0	7	7-19-77
5.09	7.09	9.09	11.09	13.09	15.09	17.09	19.09	21.09	23.09	25.09	27.09	4.0	7	7-19-77
29.39	31.09	33.09	35.09	37.09	39.09	41.09	09	0	0	0	0	4.0	7	7-19-77
6.65	6.30	8.80	11.80	12.80	13.45	11.90	10.80	8.80	8.10	7.50	7.10	18.0	7	7-19-77
5.70	4.90	3.90	3.40	6.00	9.20	10.00	0	0	0	0	0	18.0	7	7-19-77
5.27	7.27	9.27	11.27	13.27	15.27	17.27	19.27	21.27	23.27	25.27	27.27	18.0	7	7-19-77
29.57	31.27	33.27	35.27	37.27	39.27	41.27	27	0	0	0	0	18.0	7	7-19-77
5.65	5.60	5.90	6.55	3.95	7.65	9.65	7.45	6.80	6.25	5.80	5.40	2.0	8	7-19-77
5.10	5.20	5.30	5.30	5.80	6.60	7.15	0	0	0	0	0	2.0	8	7-19-77
5.03	7.03	9.03	11.03	13.03	15.03	17.03	19.03	21.03	23.03	25.03	27.03	2.0	8	7-19-77
29.33	31.03	33.03	35.03	37.03	39.03	41.03	03	0	0	0	0	2.0	8	7-19-77
4.30	4.80	5.90	7.00	7.55	8.65	7.65	7.00	5.50	5.10	4.60	4.20	6.0	8	7-19-77
4.40	4.00	4.10	4.30	5.30	6.30	6.60	0	0	0	0	0	6.0	8	7-19-77
5.12	7.12	9.12	11.12	13.12	15.12	17.12	19.12	21.12	23.12	25.12	27.12	6.0	8	7-19-77
29.42	31.12	33.12	35.12	37.12	39.12	41.12	12	0	0	0	0	6.0	8	7-19-77
2.70	3.20	5.40	8.05	7.25	9.55	8.85	6.30	3.80	3.25	3.30	2.80	10.0	8	7-19-77
2.90	2.70	2.70	3.20	4.40	6.80	6.70	0	0	0	0	0	10.0	8	7-19-77
5.15	7.15	9.15	11.15	13.15	15.15	17.15	19.15	21.15	23.15	25.15	27.15	10.0	8	7-19-77
29.45	31.15	33.15	35.15	37.15	39.15	41.15	15	0	0	0	0	10.0	8	7-19-77
1.80	2.30	5.40	9.25	6.95	11.45	10.05	6.50	3.80	2.10	1.75	1.70	14.0	8	7-19-77
1.90	1.70	1.70	2.20	3.95	7.10	7.20	0	0	0	0	0	14.0	8	7-19-77
5.18	7.18	9.18	11.18	13.18	15.18	17.18	19.18	21.18	23.18	25.18	27.18	14.0	8	7-19-77
29.48	31.18	33.18	35.18	37.18	39.18	41.18	18	0	0	0	0	14.0	8	7-19-77
1.10	1.70	5.40	10.55	13.80	12.70	10.90	6.90	3.10	1.30	1.05	1.00	18.0	8	7-19-77
1.40	1.10	1.10	1.70	5.60	7.20	7.70	0	0	0	0	0	18.0	8	7-19-77
5.24	7.24	9.24	11.24	13.24	15.24	17.24	19.24	21.24	23.24	25.24	27.24	18.0	8	7-19-77
29.54	31.24	33.24	35.24	37.24	39.24	41.24	24	0	0	0	0	18.0	8	7-19-77

5.20	5.30	7.35	8.45	8.80	11.20	10.90	9.80	8.70	7.40	6.10	6.10	2.0	3	8-23-77
5.50	0	0	0	0	0	0	0	0	0	0	0	2.0	3	8-23-77
5.32	7.32	9.32	11.32	13.32	15.32	17.32	19.32	21.32	23.32	25.32	27.32	2.0	3	8-23-77
29.32	0	0	0	0	0	0	0	0	0	0	0	2.0	3	8-23-77
5.75	4.65	4.70	5.25	7.90	10.90	13.50	14.50	12.30	11.80	9.60	8.20	10.0	3	8-23-77
6.10	0	0	0	0	0	0	0	0	0	0	0	10.0	3	8-23-77
5.28	7.28	9.28	11.28	13.28	15.28	17.28	19.28	21.28	23.28	25.28	27.28	10.0	3	8-23-77
29.28	0	0	0	0	0	0	0	0	0	0	0	10.0	3	8-23-77
4.80	3.95	4.40	6.40	9.60	10.70	12.70	14.00	13.40	11.30	7.10	5.20	18.0	3	8-23-77
0	0	0	0	0	0	0	0	0	0	0	0	18.0	3	8-23-77
5.24	7.24	9.24	11.24	13.24	15.24	17.24	19.24	21.24	23.24	25.24	27.24	18.0	3	8-23-77
0	0	0	0	0	0	0	0	0	0	0	0	18.0	3	8-23-77
5.45	7.10	7.50	8.55	11.00	9.90	11.30	10.20	7.70	7.60	7.10	6.90	2.0	5	8-23-77
5.90	0	0	0	0	0	0	0	0	0	0	0	2.0	5	8-23-77
5.03	7.03	9.03	11.03	13.03	15.03	17.03	19.03	21.03	23.03	25.03	27.03	2.0	5	8-23-77
29.03	0	0	0	0	0	0	0	0	0	0	0	2.0	5	8-23-77
5.20	5.35	7.70	9.50	12.30	13.50	13.10	10.20	7.90	7.05	6.35	6.10	6.0	5	8-23-77
5.50	0	0	0	0	0	0	0	0	0	0	0	6.0	5	8-23-77
5.09	7.09	9.09	11.09	13.09	15.09	17.09	19.09	21.09	23.09	25.09	27.09	6.0	5	8-23-77
29.09	0	0	0	0	0	0	0	0	0	0	0	6.0	5	8-23-77
3.10	4.00	6.35	9.30	13.50	15.00	14.20	10.90	7.40	6.20	5.40	5.10	10.0	5	8-23-77
4.90	0	0	0	0	0	0	0	0	0	0	0	10.0	5	8-23-77
5.12	7.12	9.12	11.12	13.12	15.12	17.12	19.12	21.12	23.12	25.12	27.12	10.0	5	8-23-77
29.12	0	0	0	0	0	0	0	0	0	0	0	10.0	5	8-23-77
3.40	3.40	5.50	9.25	13.40	15.70	15.60	12.40	7.50	5.80	5.20	4.50	14.0	5	8-23-77
4.20	0	0	0	0	0	0	0	0	0	0	0	14.0	5	8-23-77
5.15	7.15	9.15	11.15	13.15	15.15	17.15	19.15	21.15	23.15	25.15	27.15	14.0	5	8-23-77
29.15	0	0	0	0	0	0	0	0	0	0	0	14.0	5	8-23-77
2.75	2.75	4.75	8.70	13.40	15.80	16.10	13.10	7.90	5.50	4.80	3.90	18.0	5	8-23-77
3.60	0	0	0	0	0	0	0	0	0	0	0	18.0	5	8-23-77
5.21	7.21	9.21	11.21	13.21	15.21	17.21	19.21	21.21	23.21	25.21	27.21	18.0	5	8-23-77
29.21	0	0	0	0	0	0	0	0	0	0	0	18.0	5	8-23-77
7.00	7.00	8.05	8.85	9.20	9.00	8.80	7.10	6.80	6.70	6.90	6.80	4.0	7	8-23-77
5.09	7.09	9.09	11.09	13.09	15.09	17.09	19.09	21.09	23.09	25.09	27.09	4.0	7	8-23-77

7.20	7.00	8.00	9.25	12.40	13.00	13.00	11.80	10.60	9.60	8.55	8.40	18.0	7	8-23-77	
7.90	0	0	0	0	0	0	0	0	0	0	0	18.0	7	8-23-77	
5.27	7.27	9.27	11.27	13.27	15.27	17.27	19.27	21.27	23.27	25.27	27.27	18.0	7	8-23-77	
29.27	0	0	0	0	0	0	0	0	0	0	0	18.0	7	8-23-77	
6.90	6.75	7.10	8.00	8.80	9.70	9.90	9.50	8.70	7.70	7.30	7.00	2.0	8	8-23-77	
6.90	0	0	0	0	0	0	0	0	0	0	0	2.0	8	8-23-77	
5.03	7.03	9.03	11.03	13.03	15.03	17.03	19.03	21.03	23.03	25.03	27.03	2.0	8	8-23-77	
29.03	0	0	0	0	0	0	0	0	0	0	0	2.0	8	8-23-77	
5.70	5.35	7.00	8.00	9.90	10.40	10.40	9.00	6.80	6.60	6.10	5.80	6.0	8	8-23-77	
5.12	7.12	9.12	11.12	13.12	15.12	17.12	19.12	21.23	22.25	12.27	12.29	12	6.0	8	8-23-77
4.75	4.90	6.50	7.45	10.20	10.80	10.70	8.40	6.30	5.20	4.90	4.70	10.0	8	8-23-77	
4.60	0	0	0	0	0	0	0	0	0	0	0	10.0	8	8-23-77	
5.15	7.15	9.15	11.15	13.15	15.15	17.15	19.15	21.15	23.15	25.15	27.15	10.0	8	8-23-77	
29.15	0	0	0	0	0	0	0	0	0	0	0	10.0	8	8-23-77	
3.70	3.80	5.70	8.00	11.30	11.80	11.00	8.20	5.40	4.10	3.70	3.50	14.0	8	8-23-77	
3.40	0	0	0	0	0	0	0	0	0	0	0	14.0	8	8-23-77	
5.18	7.18	9.18	11.18	13.18	15.18	17.18	19.18	21.18	23.18	25.18	27.18	14.0	8	8-23-77	
29.18	0	0	0	0	0	0	0	0	0	0	0	14.0	8	8-23-77	
3.10	3.25	5.95	8.65	13.20	13.40	12.00	8.70	4.50	3.30	3.00	2.60	18.0	8	8-23-77	
2.50	0	0	0	0	0	0	0	0	0	0	0	18.0	8	8-23-77	
5.24	7.21	9.24	11.24	13.24	15.24	17.24	19.24	21.24	23.24	25.24	27.24	18.0	8	8-23-77	
29.24	0	0	0	0	0	0	0	0	0	0	0	18.0	8	8-23-77	
10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.10	10.30	10.40	10.60	10.70	2.5	10-	8-78	
10.75	10.50	10.30	10.25	10.10	0	0	0	0	0	0	0	2.5	10-	8-78	
2.12	3.12	4.12	5.12	6.12	8.00	9.00	10.00	11.00	12.00	13.00	14.00	2.5	10-	8-78	
15.00	17.00	18.00	19.00	21.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	2.5	10-	8-78	
9.70	9.70	9.70	9.70	9.70	9.75	9.85	10.00	10.05	10.25	10.50	10.70	6.5	10-	8-78	
10.80	10.60	10.55	10.55	10.30	10.00	9.85	0	0	0	0	0	6.5	10-	8-78	
2.19	3.19	4.19	5.19	6.19	8.02	9.02	10.02	11.02	12.02	13.02	14.02	6.5	10-	8-78	
15.02	16.02	17.02	18.02	19.02	20.12	21.02	22.02	24.02	24.02	24.02	24.02	6.5	10-	8-78	
9.60	9.60	9.60	9.60	9.60	9.60	9.70	9.85	9.95	10.10	10.40	10.65	8.5	10-	8-78	
10.70	10.55	10.60	10.55	10.30	10.10	9.95	0	0	0	0	0	8.5	10-	8-78	
2.39	3.39	4.39	5.39	6.39	8.04	9.04	10.04	11.04	12.04	13.04	14.04	8.5	10-	8-78	
15.04	16.04	17.04	18.04	19.04	20.14	21.04	22.04	24.04	24.04	24.04	24.04	8.5	10-	8-78	
9.00	9.00	9.00	9.00	9.00	9.10	9.35	9.70	10.05	10.30	10.55	10.70	15.5	10-	8-78	
10.85	10.80	10.45	10.10	9.80	9.60	0	0	0	0	0	0	15.5	10-	8-78	
2.26	3.26	4.26	5.26	6.26	8.08	9.08	10.08	11.08	12.08	13.08	14.08	15.5	10-	8-78	
15.08	17.08	18.08	19.08	20.18	21.08	22.08	24.08	24.08	24.08	24.08	24.08	15.5	10-	8-78	

8.80	8.80	8.80	8.80	8.80	8.90	8.90	9.00	9.25	9.60	9.35	9.30	2.5	9-29-78
9.30	9.20	9.15	9.10	9.10	-0	-0	-0	-0	-0	-0	-0	2.5	9-29-78
2.57	3.57	4.57	5.57	6.57	8.10	9.00	10.00	11.00	13.00	15.25	16.00	2.5	9-29-78
17.00	18.00	19.00	20.00	21.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	2.5	9-29-78
8.50	8.50	8.50	8.50	8.50	8.55	8.60	8.90	9.15	9.45	9.45	9.40	6.5	9-29-78
9.20	9.05	8.80	8.80	0	0	0	0	0	0	0	0	6.5	9-29-78
2.50	3.50	4.50	5.50	6.50	8.12	9.02	11.02	12.06	13.02	15.27	16.02	6.5	9-29-78
18.02	19.02	20.02	21.02	22.04	0024	0024	0024	0024	0024	0024	0024	6.5	9-29-78
8.15	8.15	8.15	8.15	8.15	8.15	8.40	8.45	8.60	8.75	9.05	9.30	8.5	9-29-78
9.50	9.40	9.10	9.00	8.80	8.60	0	0	0	0	0	0	8.5	9-29-78
2.48	3.48	4.48	5.48	6.48	8.14	9.04	10.04	11.04	12.08	13.04	15.29	8.5	9-29-78
16.04	17.04	18.04	19.04	20.04	21.04	24.00	24.00	24.00	24.00	24.00	24.00	8.5	9-29-78
7.85	7.85	7.85	7.85	7.85	8.10	8.35	8.50	8.75	9.05	9.25	9.60	11.5	9-29-78
9.60	9.40	9.20	9.10	8.85	8.70	0	0	0	0	0	0	11.5	9-29-78
2.45	3.45	4.45	5.45	6.45	8.16	9.06	10.06	11.06	12.10	13.06	15.31	11.5	9-29-78
16.06	17.06	18.06	19.06	20.06	21.06	24.00	24.00	24.00	24.00	24.00	24.00	11.5	9-29-78
7.50	7.50	7.50	7.50	7.50	7.75	8.10	8.60	8.90	9.40	9.50	9.50	15.5	9-29-78
9.45	9.25	9.00	8.70	8.35	8.15	0	0	0	0	0	0	15.5	9-29-78
2.40	3.40	4.40	5.40	6.40	8.18	9.08	10.08	11.08	12.12	13.08	15.33	15.5	9-29-78
16.08	17.08	18.08	19.08	20.08	21.08	24.00	24.00	24.00	24.00	24.00	24.00	15.5	9-29-78
7.30	7.30	7.30	7.30	7.30	7.60	8.00	8.50	9.00	9.45	9.80	9.70	17.5	9-29-78
9.65	9.30	8.95	8.60	8.25	8.00	-0	-0	-0	-0	-0	-0	17.5	9-29-78
2.37	3.37	4.37	5.37	6.37	8.21	9.11	10.11	12.11	13.16	15.10	15.35	17.5	9-29-78
16.10	17.09	18.09	19.10	20.10	21.10	24.00	24.00	24.00	24.00	24.00	24.00	17.5	9-29-78
8.15	8.15	8.15	8.15	8.15	8.20	8.20	8.25	8.50	8.60	8.75	8.80	6.5	9-20-78
9.05	9.05	9.00	8.90	8.70	8.60	8.40	-0	-0	-0	-0	-0	6.5	9-20-78
1.56	2.56	3.56	4.56	5.56	7.05	8.02	9.02	10.02	11.02	12.02	13.02	6.5	9-20-78
14.02	15.09	17.02	18.02	19.02	20.54	24.00	24.00	24.00	24.00	24.00	24.00	6.5	9-20-78
8.00	8.00	8.00	8.00	8.00	8.00	8.10	8.20	8.40	8.55	8.75	8.85	8.5	9-20-78
9.10	9.15	9.10	9.00	8.70	8.55	8.25	-0	-0	-0	-0	-0	8.5	9-20-78
1.58	2.58	3.58	4.58	5.58	8.04	9.03	10.03	11.03	12.03	13.03	14.04	8.5	9-20-78
15.11	16.04	17.04	18.04	19.04	20.52	24.00	24.00	24.00	24.00	24.00	24.00	8.5	9-20-78
7.60	7.60	7.60	7.60	7.60	7.65	7.70	7.85	8.05	8.15	8.45	8.65	11.5	9-20-78
8.95	9.10	9.10	9.00	8.85	8.50	8.25	7.95	-0	-0	-0	-0	11.5	9-20-78
2.02	3.02	4.02	5.02	6.02	7.07	8.06	9.04	10.04	11.05	12.04	13.04	11.5	9-20-78
14.06	15.13	16.06	17.06	18.06	19.06	20.08	21.00	24.00	24.00	24.00	24.00	11.5	9-20-78

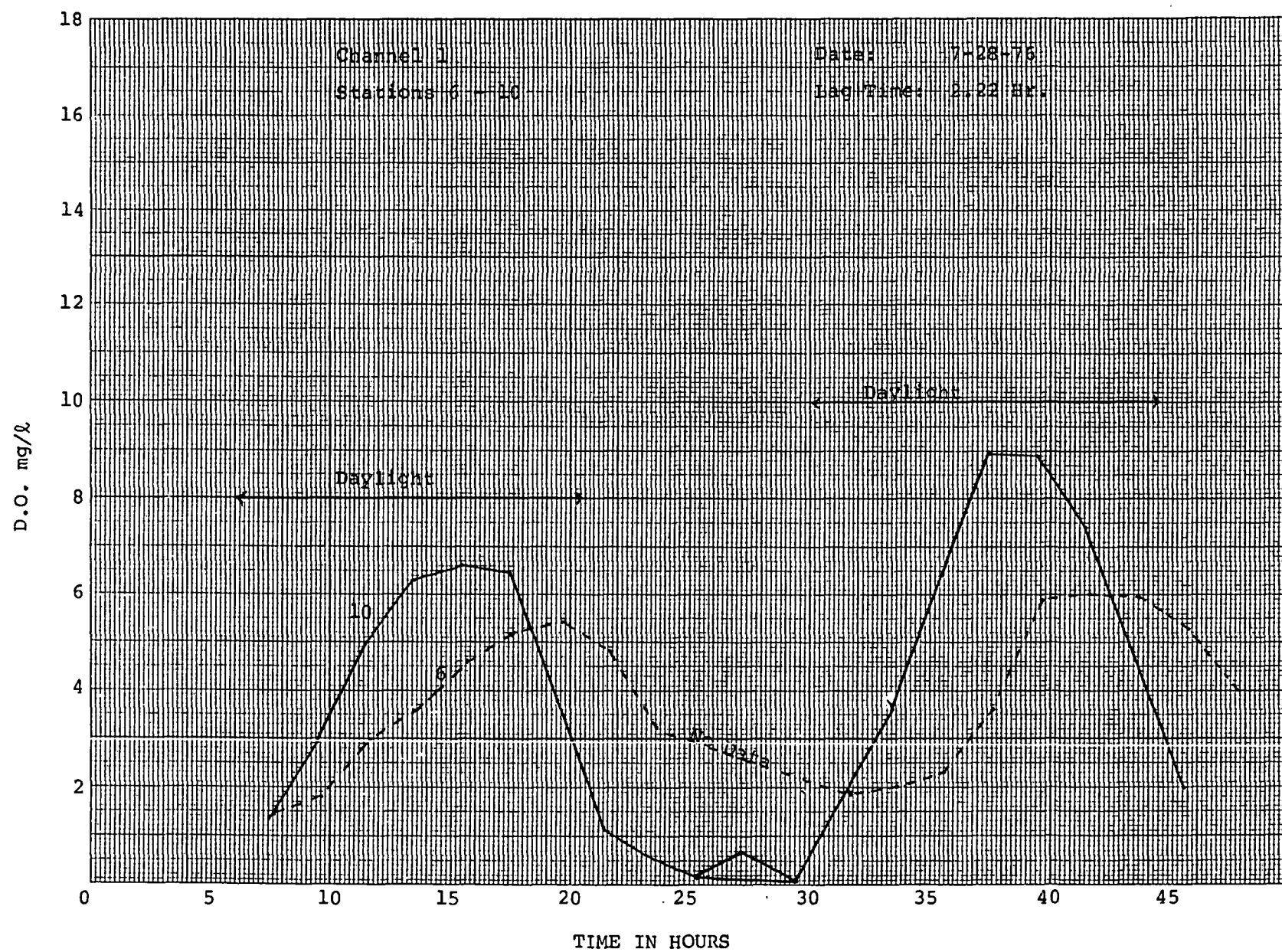
7.05	7.05	7.05	7.05	7.05	7.10	7.20	7.40	7.75	8.00	8.30	8.65	15.5	9-20-78
8.95	9.20	9.25	9.15	8.90	8.45	8.00	7.75	-0	-0	-0	-0	15.5	9-20-78
2.10	3.10	4.10	5.10	6.10	7.08	8.08	9.05	10.05	11.06	12.05	13.05	15.5	9-20-78
14.08	15.15	16.08	17.08	18.08	19.08	20.12	21.03	24.00	24.00	24.00	24.00	15.5	9-20-78
6.80	6.80	6.80	6.80	6.80	6.85	7.00	7.20	7.50	7.90	8.30	8.65	17.5	9-20-78
9.10	9.15	9.30	9.20	8.95	8.50	8.00	7.65	-0	-0	-0	-0	17.5	9-20-78
2.14	3.14	4.14	5.14	6.14	7.09	8.10	9.07	10.07	11.09	12.07	13.08	17.5	9-20-78
14.10	15.19	16.11	17.11	18.11	19.11	20.16	21.05	24.00	24.00	24.00	24.00	17.5	9-20-78
7.50	7.50	7.50	7.50	7.50	7.55	7.60	7.60	7.75	7.80	7.80	7.70	-2.5	9-13-78
7.70	7.05	6.35	0	0	0	0	0	0	0	0	0	-2.5	9-13-78
2.59	3.59	4.59	5.59	6.59	8.00	9.00	10.00	11.00	12.05	13.00	16.02	-2.5	9-13-78
19.00	21.00	22.02	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	-2.5	9-13-78
7.05	7.05	7.05	7.05	7.05	7.20	7.20	7.25	7.30	7.40	7.45	7.50	6.5	9-13-78
7.00	6.80	7.60	7.20	6.65	7.30	6.35	6.55	5.90	0	0	0	6.5	9-13-78
2.04	3.04	4.04	5.04	6.04	7.00	8.02	9.02	10.01	11.02	12.07	13.02	6.5	9-13-78
14.02	15.02	16.03	17.01	18.07	19.02	20.04	21.04	22.05	24.00	24.00	24.00	6.5	9-13-78
6.85	6.85	6.85	6.85	6.85	6.95	6.95	7.00	7.00	7.10	7.30	7.30	8.5	9-13-78
7.45	7.45	6.60	6.25	0	0	0	0	0	0	0	0	8.5	9-13-78
2.07	3.07	4.07	5.07	6.07	7.02	8.04	9.04	10.03	11.04	12.09	13.04	8.5	9-13-78
16.03	19.04	21.06	22.08	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	8.5	9-13-78
6.35	6.35	6.35	6.35	6.35	6.50	6.50	6.60	6.70	6.85	7.10	7.15	11.5	9-13-78
7.25	6.90	6.80	6.30	6.10	6.05	0	0	0	0	0	0	11.5	9-13-78
2.11	3.11	4.11	5.11	6.11	7.04	8.06	9.06	10.04	11.06	12.11	13.06	11.5	9-13-78
16.07	18.11	19.07	20.10	21.09	22.11	24.00	24.00	24.00	24.00	24.00	24.00	11.5	9-13-78
5.75	5.75	5.75	5.75	5.75	5.95	6.00	6.00	6.15	6.30	6.60	6.75	15.5	9-13-78
7.00	6.55	6.55	6.05	0	0	0	0	0	0	0	0	15.5	9-13-78
2.17	3.17	4.17	5.17	6.17	7.05	8.08	9.08	10.06	11.08	12.13	13.08	15.5	9-13-78
16.09	18.13	19.09	21.11	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	15.5	9-13-78
5.40	5.40	5.40	5.40	5.40	5.65	5.70	5.90	6.20	6.50	6.65	6.90	17.5	9-13-78
6.70	6.45	6.25	6.20	0	0	0	0	0	0	0	0	17.5	9-13-78
2.19	3.19	4.19	5.19	6.19	7.06	8.10	10.07	11.10	12.15	13.10	16.10	17.5	9-13-78
17.08	18.15	19.12	21.15	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	17.5	9-13-78
6.40	6.40	6.40	6.40	6.40	6.70	6.70	6.80	6.85	6.95	7.05	7.10	2.5	9-11-78
7.10	7.10	7.15	7.10	7.00	6.90	0	0	0	0	0	0	2.5	9-11-78
2.39	3.39	4.39	5.39	6.39	7.00	8.00	9.00	10.00	12.00	13.00	14.00	2.5	9-11-78
15.05	16.05	17.03	18.05	19.02	21.05	24.00	24.00	24.00	24.00	24.00	24.00	2.5	9-11-78

6.10	6.10	6.10	6.10	6.10	6.20	6.30	6.50	6.65	6.80	6.95	6.95	6.5	9-11-78
7.00	7.15	7.10	6.95	6.90	6.70	6.60	0	0	0	0	0	6.5	9-11-78
2.31	3.31	4.31	5.31	6.31	7.02	9.02	10.02	11.02	12.02	13.02	14.02	6.5	9-11-78
15.07	16.07	17.05	18.08	19.04	20.07	21.07	24.00	24.00	24.00	24.00	24.00	6.5	9-11-78
5.85	5.85	5.85	5.85	5.85	5.90	5.95	6.00	6.20	6.50	6.70	6.80	8.5	9-11-78
6.95	7.15	7.25	7.20	7.00	6.80	6.55	6.50	0	0	0	0	8.5	9-11-78
2.23	3.23	4.23	5.23	6.23	7.04	8.04	9.04	10.04	11.04	12.04	13.04	8.5	9-11-78
14.04	15.09	16.09	17.07	18.11	19.06	20.09	21.09	24.00	24.00	24.00	24.00	8.5	9-11-78
5.30	5.30	5.30	5.30	5.30	5.40	5.50	5.90	6.65	6.70	6.75	7.25	11.5	9-11-78
7.30	7.30	7.20	6.85	6.45	5.95	5.60	0	0	0	0	0	11.5	9-11-78
2.17	3.17	4.17	5.17	6.17	7.06	8.06	9.06	11.06	12.06	13.06	14.06	11.5	9-11-78
15.11	16.11	17.09	18.14	19.08	20.11	21.11	24.00	24.00	24.00	24.00	24.00	11.5	9-11-78
4.55	4.55	4.55	4.55	4.55	4.55	4.85	5.40	6.00	6.55	6.90	6.90	15.5	9-11-78
7.55	7.80	7.80	7.50	6.85	6.40	5.65	5.15	0	0	0	0	15.5	9-11-78
2.14	3.14	4.14	5.14	6.14	7.08	8.08	9.08	10.08	11.08	12.08	13.08	15.5	9-11-78
14.08	15.13	16.13	17.11	18.17	19.10	20.13	21.14	24.00	24.00	24.00	24.00	15.5	9-11-78
4.05	4.05	4.05	4.05	4.05	4.15	4.40	5.15	6.00	6.40	7.00	6.95	17.5	9-11-78
7.55	7.80	7.80	7.60	7.00	6.40	5.45	4.85	0	0	0	0	17.5	9-11-78
2.11	3.11	4.11	5.11	6.11	7.10	8.10	9.10	10.10	11.10	12.10	13.10	17.5	9-11-78
14.10	15.15	16.15	17.15	18.19	19.12	20.15	21.18	24.00	24.00	24.00	24.00	17.5	9-11-78
7.05	7.05	7.05	7.05	7.05	7.20	7.30	7.40	7.55	7.50	7.50	7.50	2.5	9- 5-78
7.40	7.00	6.75	6.30	-0	-0	-0	-0	-0	-0	-0	-0	2.5	9- 5-78
2.02	3.02	4.02	5.02	6.02	7.17	8.02	10.02	12.02	13.02	14.02	15.02	2.5	9- 5-78
17.09	18.06	19.02	20.08	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	2.5	9- 5-78
5.70	5.70	5.70	5.70	5.70	5.80	6.30	6.40	6.60	7.00	7.20	7.25	10.5	9- 5-78
7.15	7.00	6.75	6.30	-0	-0	-0	-0	-0	-0	-0	-0	10.5	9- 5-78
2.04	3.04	4.04	5.04	6.04	7.19	10.04	11.04	12.04	13.04	14.04	16.04	10.5	9- 5-78
17.11	18.08	19.04	20.12	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	10.5	9- 5-78
4.80	4.80	4.80	4.80	4.80	4.90	5.25	5.65	6.40	6.55	7.20	7.30	15.5	9- 5-78
7.60	7.60	7.70	7.45	6.90	6.45	5.50	0	0	0	0	0	15.5	9- 5-78
2.06	3.06	4.06	5.06	6.06	7.21	8.06	9.06	10.06	11.06	12.06	13.06	15.5	9- 5-78
14.06	15.06	16.06	17.14	18.09	19.07	20.16	24.00	24.00	24.00	24.00	24.00	15.5	9- 5-78
4.20	4.20	4.20	4.20	4.20	4.30	4.60	5.25	6.10	6.90	7.35	7.90	19.5	9- 5-78
8.05	8.20	7.85	7.30	6.50	5.70	0	0	0	0	0	0	19.5	9- 5-78
2.08	3.08	4.08	5.08	6.08	7.23	8.08	9.08	10.08	11.08	12.08	13.08	19.5	9- 5-78
14.08	16.08	17.16	18.11	19.09	20.18	24.00	24.00	24.00	24.00	24.00	24.00	19.5	9- 5-78

APPENDIX B

TABULAR AND GRAPHICAL ANALYSIS OF TWO-STATION DIEL DISSOLVED OXYGEN DATA

(Procedure described in University of Minnesota St.
Anthony Falls Hydraulic Laboratory Project Report
No. 198, June, 1981 and External Memorandum M-169,
Dec. 1980.)



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

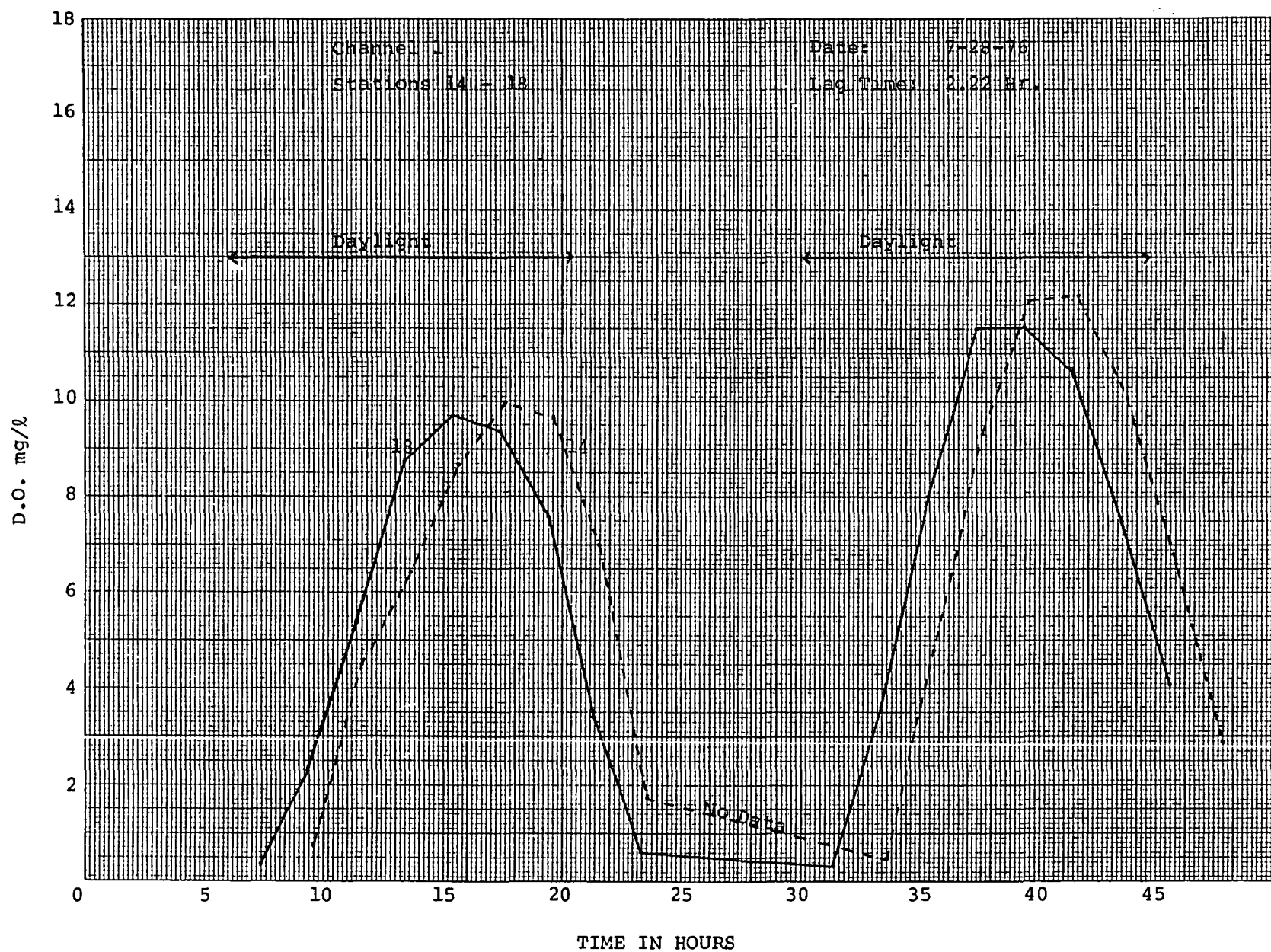
LOCATION OF REACH: Station 6 to 10 in Channel 1

Date: 7-28-76

Travel Time: 2.22 Hrs

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000	**					1. Error in Station 10
0100						D.O. data.
0200						2. Only one hour was
0300						used to compute
0400						respiration rate,
0500						due to lack of D.O.
0600						data.
0700						
0800	1.33	0.12	0.05	1.38	0.73	
0900		0.40	0.18	1.51	0.80	
1000		0.66	0.30	1.63	0.86	
1100		0.86	0.39	1.72	0.91	
1200		1.01	0.46	1.78	0.94	
1300		1.17	0.53	1.86	0.99	
1400		1.19	0.54	1.87	0.99	
1500		1.04	0.47	1.80	0.95	
1600		0.85	0.38	1.71	0.91	
1700		0.68	0.31	1.64	0.87	
1800		0.21	0.10	1.42	0.75	
1900		-0.43	-0.19	1.14	0.60	
2000		-0.90	-0.40	0.92	0.49	
2100	1.33	-1.51	-0.68	0.65	0.34	
2200		-3.56				
2300	1.33					
2400						$\Sigma P = 11.13 \text{ g m}^{-2} \text{ day}^{-1}$
2500						$\bar{R} = 1.33 \text{ g m}^{-3} \text{ hr}^{-1}$
2600						
2700						
2800						
2900						
3000	1.33	0.59	0.27	1.60	0.85	
3100		1.06	0.48	1.81	0.96	
3200		1.49	0.67	2.00	1.06	
3300		1.85	0.83	2.16	1.14	
3400		2.32	1.04	2.37	1.26	
3500		2.89	1.30	2.63	1.39	
3600		3.34	1.50	2.83	1.50	
3700		3.62	1.63	2.96	1.57	
3800		3.51	1.58	2.91	1.54	
3900		2.98	1.34	2.67	1.42	
4000		2.44	1.10	2.43	1.29	
4100		2.07	0.93	2.26	1.20	
4200		1.56	0.70	2.03	1.08	
4300		0.96	0.43	1.76	0.93	
4400	1.33	0.48	0.22	1.55	0.82	
4500	D.O. Data Ended					
4600						
4700						$\Sigma P = 18.01 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

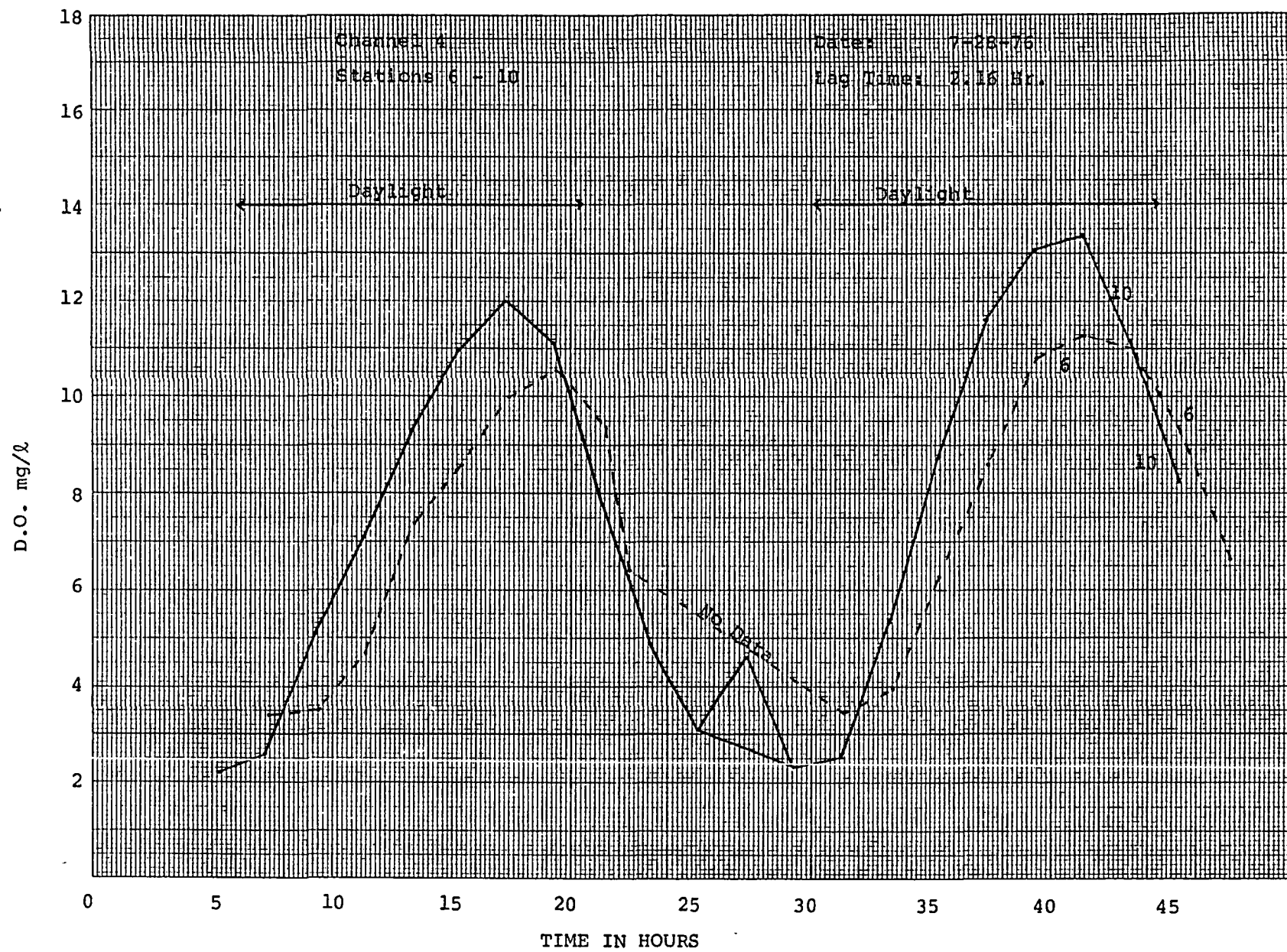
LOCATION OF REACH: Station 14 to 18 in Channel 1

Date: 7-28-76

Travel Time: 2.22 Hrs

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						** Only one hour was used to compute respiration rate due to lack of D.O. data.
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000	1.00	1.80	0.81	1.81	0.89	
1100		1.42	0.64	1.64	0.80	
1200		1.54	0.69	1.69	0.83	
1300		2.29	1.03	2.03	0.99	
1400		2.20	0.99	1.99	0.98	
1500		1.56	0.70	1.70	0.83	
1600		0.72	0.32	1.32	0.65	
1700		-0.13	-0.06	0.94	0.46	
1800		-1.05	-0.47	0.53	0.26	
1900		-1.75	-0.79	0.21	0.10	
2000	1.00	-2.80	-1.26			$\Sigma P = 6.79\ g\ m^{-2}\ day^{-1}$ $\bar{R} = 1.00\ g\ m^{-3}\ hr^{-1}$
2100						
2200						
2300	1.00					
2400						
2500						
2600						
2700						
2800						
2900						
3000	1.00	-0.57	-0.26	0.74	0.36	
3100		-0.48	0.22	0.78	0.38	
3200		0.62	0.28	1.28	0.63	
3300		3.41	1.54	2.54	1.24	
3400		3.69	1.66	2.66	1.30	
3500		3.72	1.68	2.68	1.31	
3600		3.47	1.56	2.56	1.25	
3700		2.91	1.31	2.31	1.13	
3800		1.43	0.64	1.64	0.80	
3900		0.32	0.14	1.14	0.56	
4000		-0.87	-0.39	0.61	0.30	
4100		-1.42	-0.64	0.36	0.18	
4200		-2.05	-0.92	0.08	0.04	
4300	1.00	-2.71	-1.22			$\Sigma P = 9.48\ g\ m^{-2}\ day^{-1}$
4400						
4500						
4600						
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

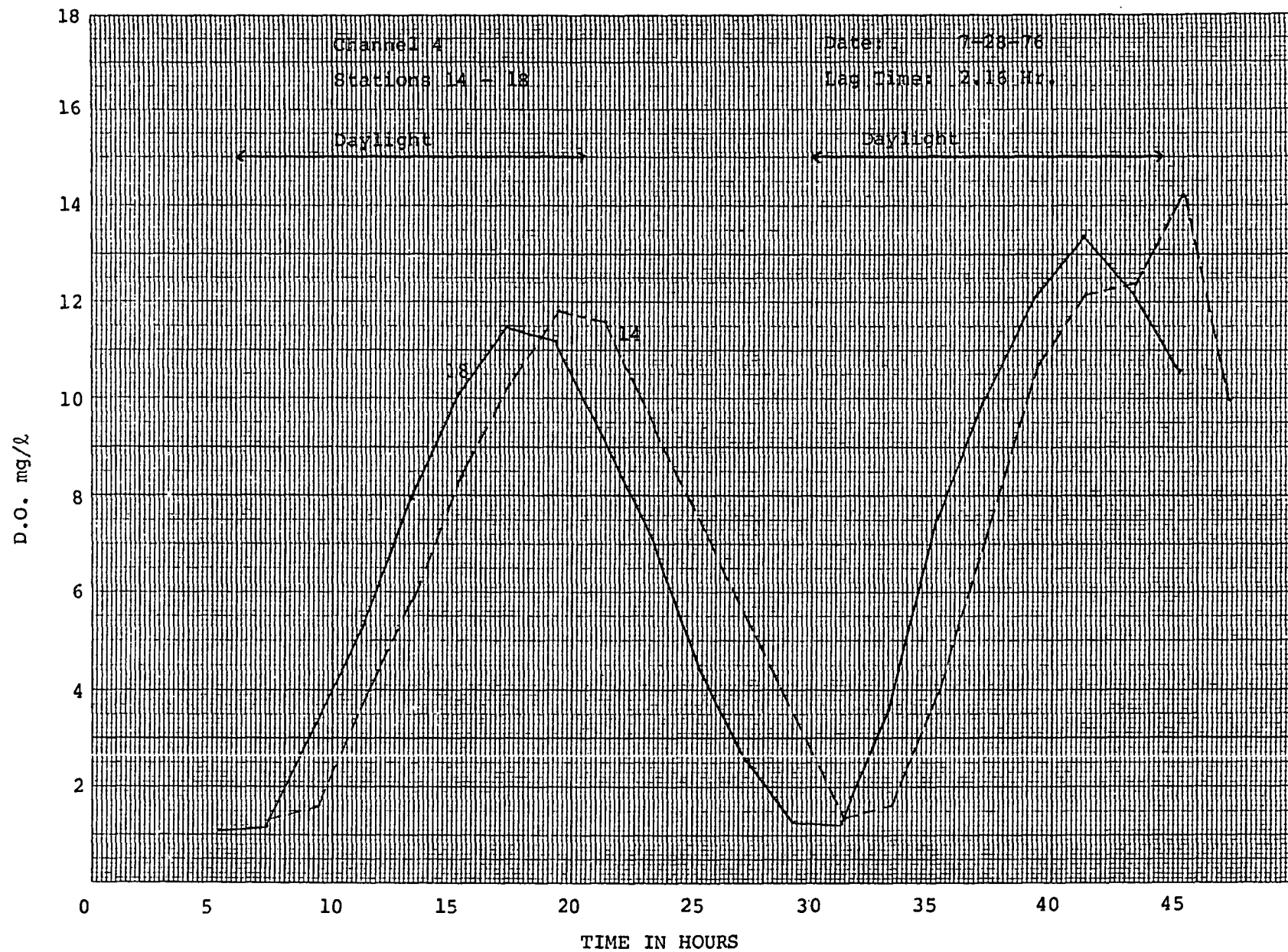
LOCATION OF REACH: Station 6 to 10 in Channel 4

Date: 7-28-76

Travel Time: 2.16

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	ΔD_2O g m^{-3}	ΔD_2O $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						1. Error in Station 10 27.33 hr D.O. measure- ment.
0100						
0200						
0300						2. Residence time is not correct so R-value is difficult to determine.
0400						
0500						3. Will use R-value computed between stations 14 to 18 in channel 4.
0600						
0700						
0800	1.23	0.09	0.04	1.27	0.33	
0900		1.19	0.55	1.78	0.47	
1000		1.91	0.88	2.11	0.55	
1100		2.35	1.09	2.32	0.60	
1200		2.32	1.07	2.30	0.60	
1300		2.10	0.97	2.20	0.58	
1400		2.13	0.99	2.22	0.58	
1500		2.34	1.08	2.31	0.60	
1600		2.29	1.06	2.29	0.60	
1700		2.10	0.97	2.20	0.58	
1800		1.56	0.72	1.95	0.51	
1900		0.83	0.38	1.61	0.42	
2000	1.23	-0.23	-0.11	1.12	0.29	
2100		-1.36	-0.63	0.60	0.16	
2200						
2300						
2400						$\Sigma P = 16.38 \text{ g m}^{-2} \text{ day}^{-1}$
2500						$\bar{R} = 1.23 \text{ g m}^{-3} \text{ hr}^{-1}$
2600						
2700						
2800						
2900						
3000	1.23	-1.51	-0.70	0.53	0.28	
3100		-1.11	-0.51	0.72	0.38	
3200		-0.10	-0.05	1.18	0.63	
3300		1.05	0.49	1.72	0.91	
3400		1.88	0.87	2.10	1.11	
3500		2.41	1.12	2.35	1.25	
3600		2.68	1.24	2.47	1.31	
3700		2.97	1.38	2.60	1.38	
3800		2.86	1.32	2.55	1.35	
3900		2.47	1.14	2.37	1.26	
4000		2.22	1.03	2.26	1.20	
4100		2.12	0.98	2.21	1.17	
4200		1.42	0.66	1.89	1.00	
4300		0.44	0.20	1.43	0.76	
4400	1.23	-0.35	0.16	1.07	0.57	
4500		-1.01	0.47	0.76	0.40	
4600						
4700						$\Sigma P = 14.96 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

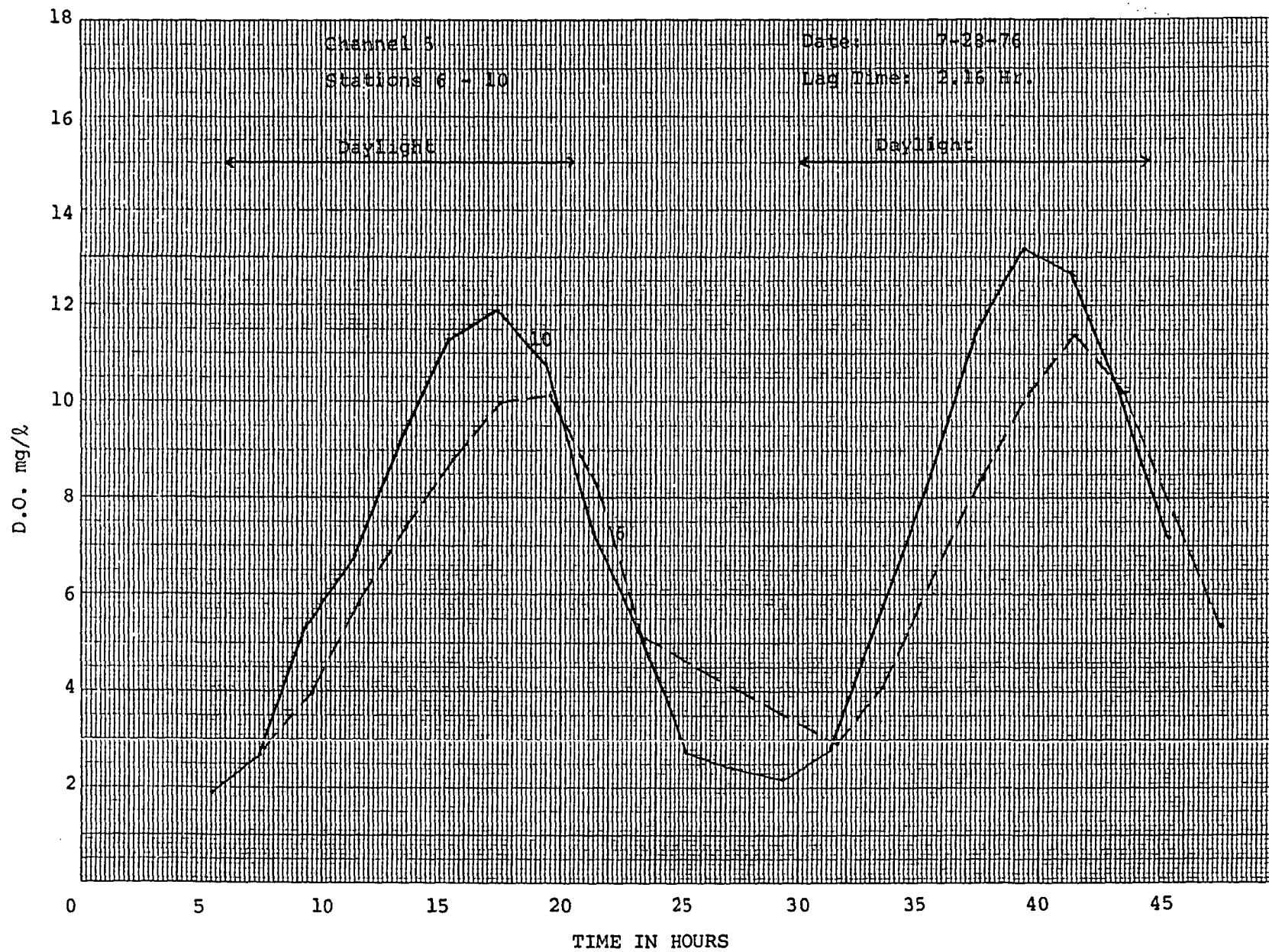
LOCATION OF REACH: Station 14 to 18 in Channel 4

Date: 7-28-76

Travel Time: 2.16 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800	1.23	0.53	0.24	1.48	0.73	
0900		1.42	0.66	1.89	0.93	
1000		1.77	0.82	2.05	1.00	
1100		1.63	0.76	1.98	0.97	
1200		1.80	0.83	2.06	1.01	
1300		2.09	0.97	2.20	1.08	
1400		2.09	0.97	2.20	1.08	
1500		1.88	0.87	2.10	1.03	
1600		1.68	0.78	2.01	0.98	
1700		1.39	0.64	1.87	0.92	
1800		0.72	0.33	1.56	0.76	
1900		-0.24	-0.11	1.12	0.55	
2000		-1.23	-0.57	0.66	0.32	
2100	1.23	-2.11	-0.98	0.25	0.12	
2200						
2300	1.10					
2400	1.19					$\Sigma P = 11.48 \text{ g m}^{-2} \text{ day}^{-1}$
2500	1.35					$\bar{R} = 1.23 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	1.41					
2700	1.35					
2800	1.25					
2900	1.06					
3000	1.23	-1.55	-0.72	0.51	0.25	
3100		-0.57	-0.26	0.97	0.48	
3200		0.56	0.26	1.49	0.73	
3300		1.52	0.70	1.93	0.95	
3400		2.64	1.22	2.45	1.20	
3500		3.52	1.63	2.86	1.40	
3600		3.49	1.62	2.85	1.40	
3700		3.10	1.44	2.66	1.30	
3800		2.47	1.14	2.37	1.16	
3900		1.94	0.90	2.13	1.04	
4000		1.45	0.67	1.90	0.93	
4100		1.31	0.61	1.84	0.90	
4200		0.79	0.37	1.59	0.78	
4300		0.08	0.04	1.27	0.62	
4400		-1.18	-0.55	0.68	0.33	
4500	1.23			-0.14		
4600						
4700						$\Sigma P = 13.47 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

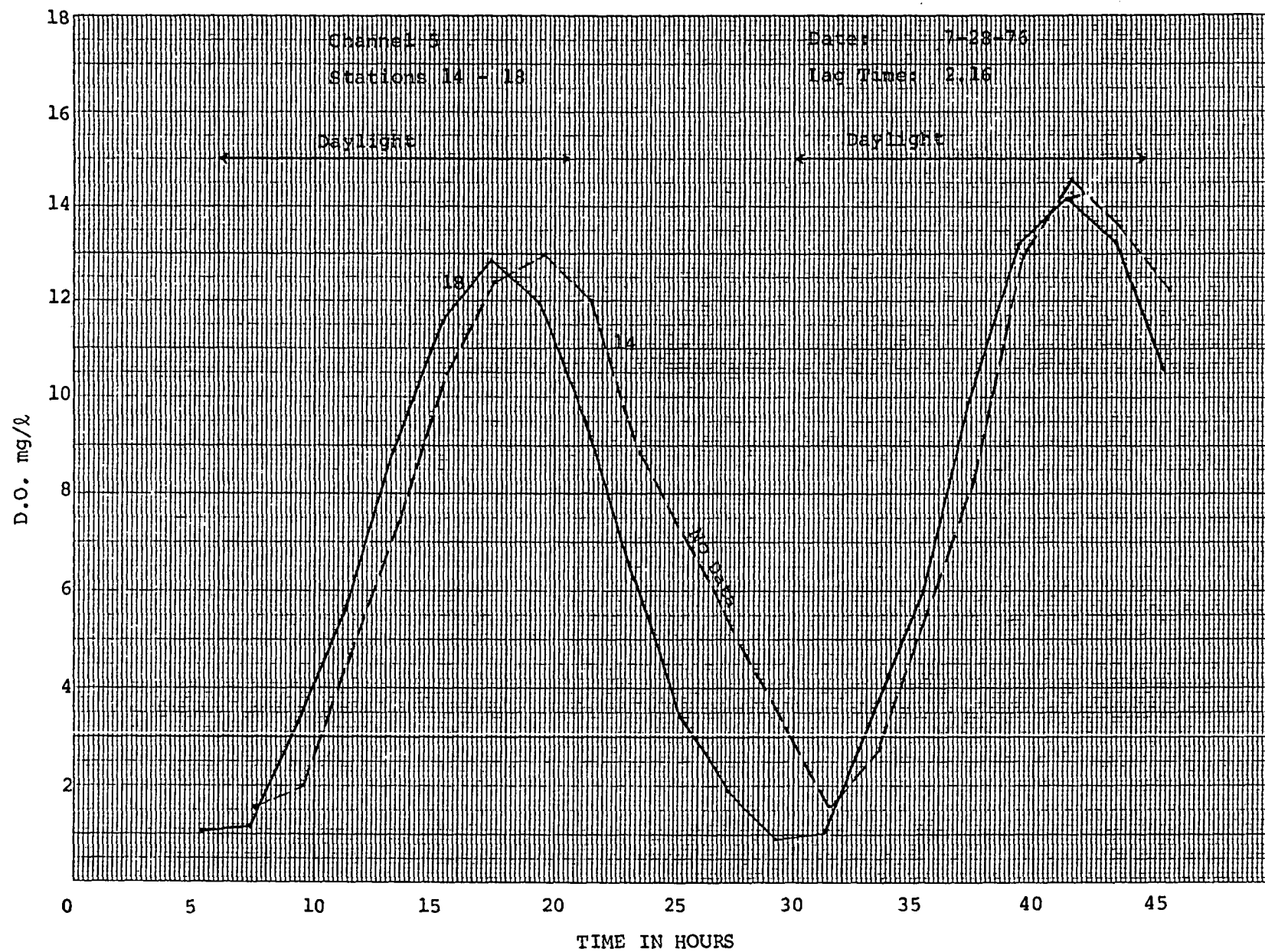
LOCATION OF REACH: Station 6 to 10 in Channel 5

Date: 7-28-76

Travel Time: 2.16 Hrs

Time at Downstream Station (hrs)	R g m ⁻³ hr ⁻¹	ΔD.O. g m ⁻³	ΔD.O. g m ⁻³ hr ⁻¹	P g m ⁻³ hr ⁻¹	P g m ⁻² hr ⁻¹	Comments
0000	**					1. Residence time is not correct so R-value is difficult to determine. 2. Will use R-value computed between stations 14 to 18 in channel 5.
0100						
0200						
0300						
0400						
0500						
0600	↑ <					

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

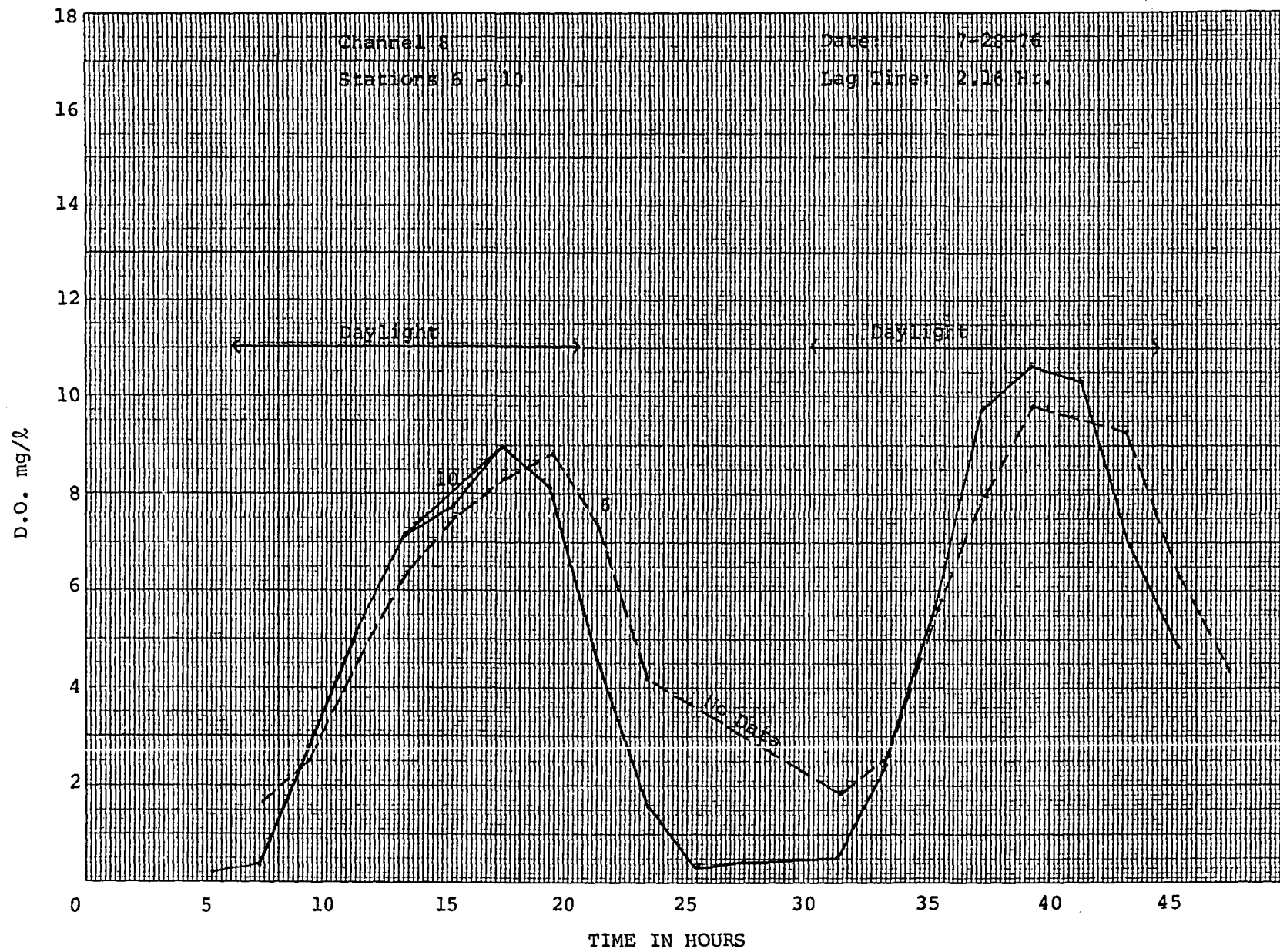
LOCATION OF REACH: Station 14 to 18 in Channel 5

Date: 7-28-76

Travel Time: 2.16 Hrs

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						** Only one hour was used to complete respiration rate due to lack of D.O. data
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800	1.33	0.18	0.08	1.41	0.69	
0900		1.04	0.48	1.81	0.89	
1000		1.47	0.68	2.01	0.98	
1100		1.25	0.60	1.91	0.94	
1200		1.45	0.67	2.00	0.98	
1300		1.75	0.81	2.14	1.05	
1400		1.74	0.81	2.14	1.05	
1500		1.49	0.69	2.02	0.99	
1600		1.09	0.50	1.83	0.90	
1700		0.78	0.36	1.69	0.83	
1800		0.05	0.02	1.35	0.66	
1900		-0.62	-0.29	1.04	0.51	
2000		-1.59	-0.74	0.59	0.29	
2100	1.33	-2.34	-1.08	0.25	0.12	
2200						
2300	1.33					
2400						$\Sigma P = 10.88\ g\ m^{-2}\ day^{-1}$
2500						$\bar{R} = 1.33\ g\ m^{-3}\ hr^{-1}$
2600						
2700						
2800						
2900						
3000	1.33					
3100						
3200		0	0.00	1.33	0.65	
3300		0.63	0.29	1.62	0.79	
3400		0.96	0.44	1.77	0.87	
3500		1.70	0.79	2.12	1.04	
3600		1.09	0.50	1.83	0.90	
3700		1.70	0.79	2.12	1.04	
3800		1.72	0.80	2.13	1.04	
3900		1.53	0.71	2.04	1.00	
4000		0.23	0.11	1.44	0.71	
4100		-0.05	-0.02	1.31	0.64	
4200		-0.50	-0.23	1.10	0.54	
4300		-0.42	-0.19	1.14	0.56	
4400	1.33	-0.82	-0.38	0.95	0.47	
4500		-2.54	-1.18	0.15	0.07	
4600						
4700						$\Sigma P = 10.32\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

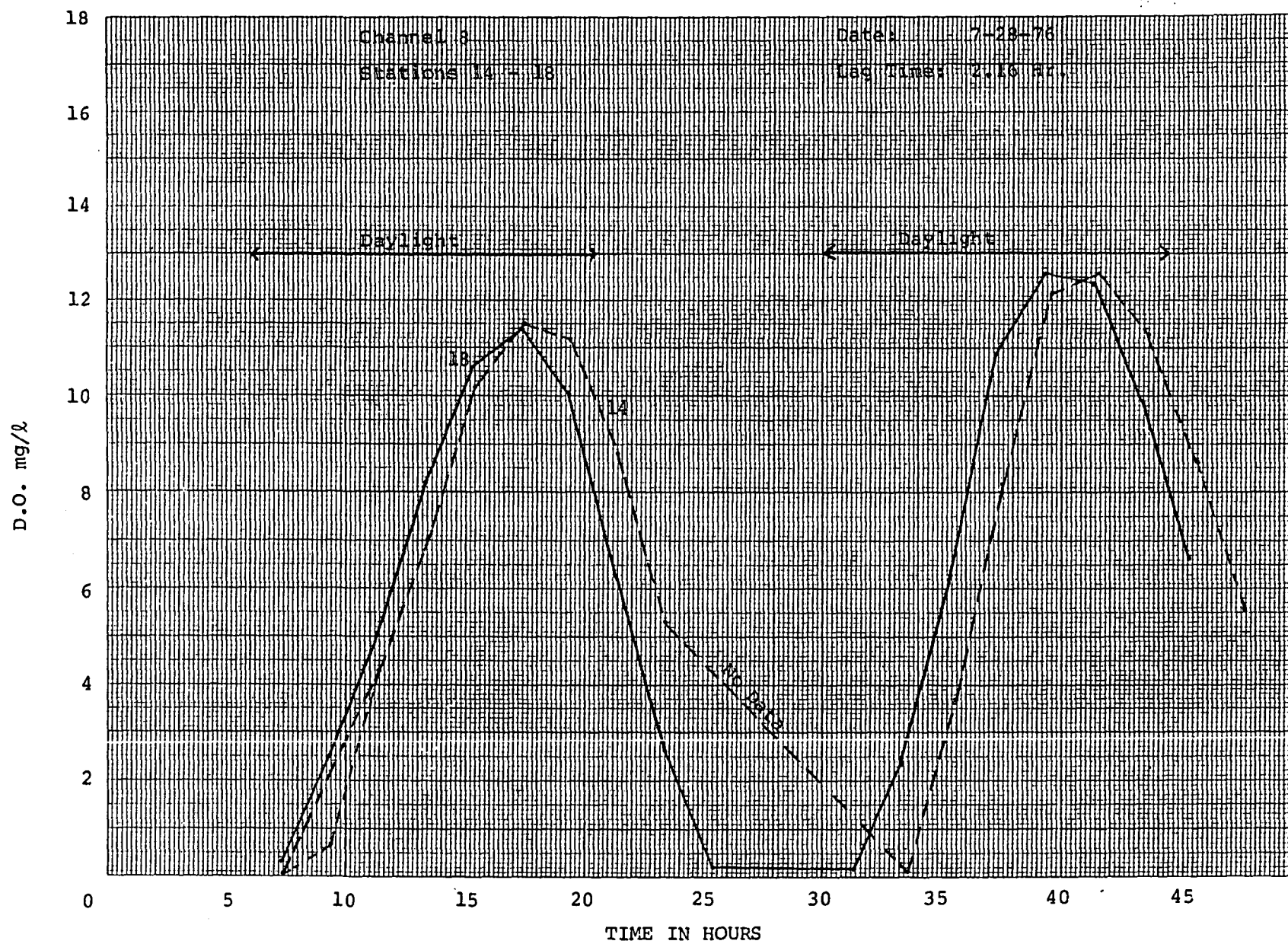
LOCATION OF REACH: Station 6 to 10 in Channel 8

Date: 7-28-76

Travel Time: 2.16 Hrs

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000	1.20					1. D.O. measurement error seems to exist at Station 10 for 15.30 Hrs. 2. Only one hour was used to compute respiration rate, due to lack of D.O. data.
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900		0	0.00	1.20	0.64	
1000		0.40	0.18	1.39	0.74	
1100		0.55	0.26	1.45	0.77	
1200		0.67	0.31	1.51	0.80	
1300		0.77	0.36	1.56	0.83	
1400		0.76	0.35	1.55	0.82	
1500		0.61	0.28	1.48	0.78	
1600		0.61	0.28	1.48	0.78	
1700		0.68	0.32	1.51	0.80	
1800		0.23	0.11	1.31	0.69	
1900		-0.47	-0.22	0.98	0.52	
2000		-1.44	-0.67	0.53	0.28	
2100	1.20	-2.42	-1.12	0.08	0.04	
2200						
2300	1.20					
2400						$\Sigma P = 8.49\ g\ m^{-2}\ day^{-1}$
2500						$\bar{R} = 1.20\ g\ m^{-3}\ hr^{-1}$
2600						
2700						
2800						
2900						
3000	1.20					
3100						
3200		-0.89	-0.41	0.79	0.42	
3300		-0.31	-0.14	1.06	0.56	
3400		0.10	0.05	1.25	0.66	
3500		0.20	0.09	1.29	0.68	
3600		0.75	0.35	1.55	0.82	
3700		1.56	0.72	1.92	1.02	
3800		1.54	0.71	1.91	1.01	
3900		1.06	0.49	1.69	0.90	
4000		0.81	0.38	1.58	0.84	
4100		0.77	0.36	1.56	0.83	
4200		-0.20	-0.09	1.11	0.59	
4300		-1.78	-0.82	0.38	0.20	
4400		-1.86	-0.86	0.34	0.18	
4500	1.20	-2.43	-1.12	0.08	0.04	
4600						$\Sigma P = 8.75\ g\ m^{-2}\ day^{-1}$
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

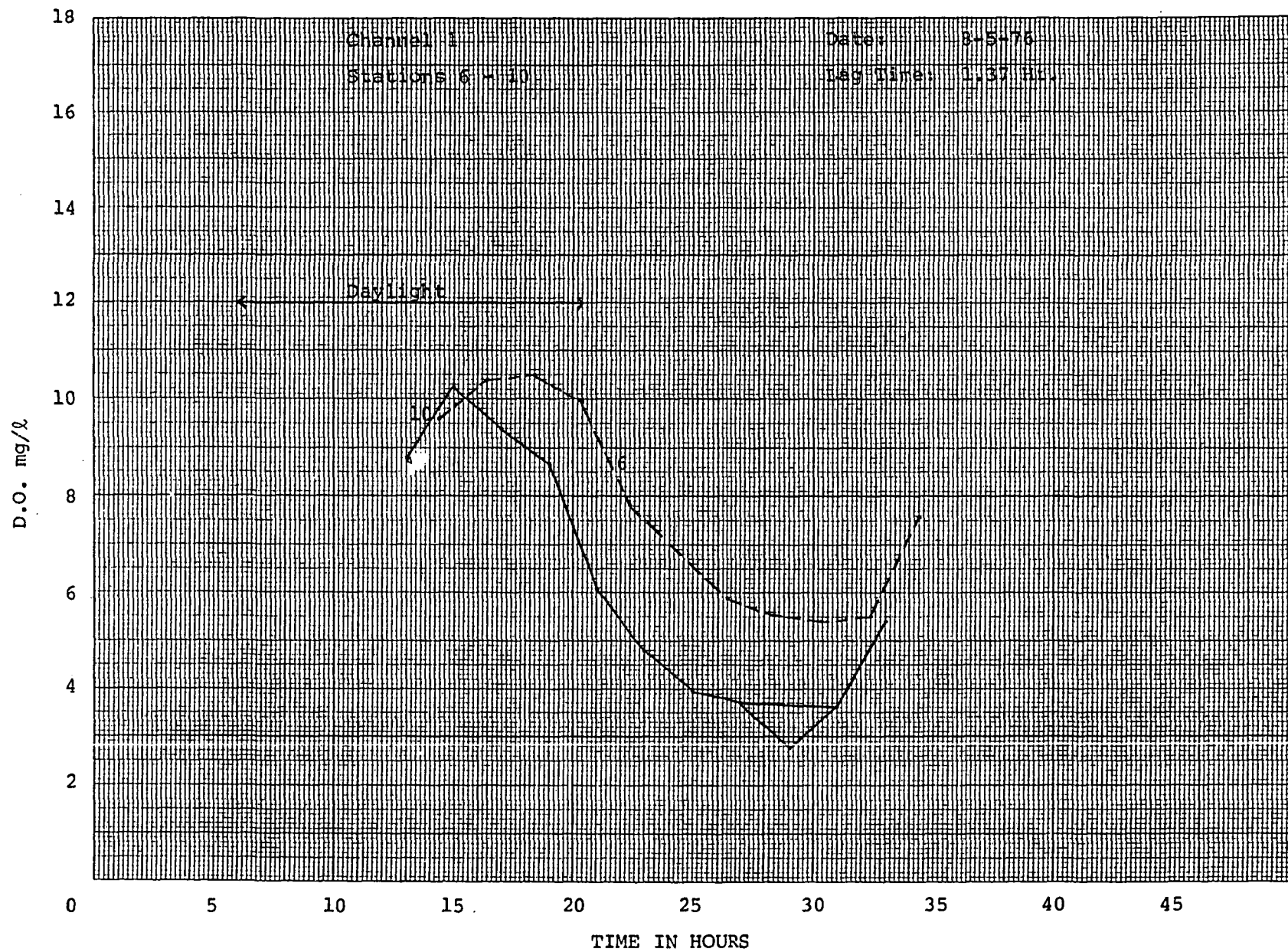
LOCATION OF REACH: Station 14 to 18 in Channel 8

Date: 7-28-76

Travel Time: 2.16 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta D.O.$ g m^{-3}	$\Delta D.O.$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000	**					
0100	Only one hour used to compute the respiration rate due to lack of D.O. data.					
0200						
0300						
0400						
0500						
0600						
0700						
0800	1.22	0.32	0.15	1.37	0.67	$\Sigma P = 8.54 \text{ g m}^{-2} \text{ day}^{-1}$ $\bar{R} = 1.22 \text{ g m}^{-3} \text{ hr}^{-1}$
0900		0.34	0.16	1.38	0.68	
1000		0.45	0.21	1.43	0.70	
1100		0.69	0.32	1.54	0.75	
1200		1.00	0.46	1.68	0.82	
1300		1.25	0.58	1.80	0.88	
1400		1.08	0.50	1.72	0.84	
1500		0.68	0.32	1.53	0.75	
1600		0.30	0.14	1.36	0.67	
1700		0.05	0.02	1.24	0.61	
1800		-0.42	-0.19	1.03	0.50	
1900		-0.95	-0.44	0.78	0.38	
2000		-1.65	-0.76	0.46	0.23	
2100	1.22	-2.35	-1.09	0.13	0.06	
2200						
2300	1.22					
2400						$\Sigma P = 9.51 \text{ g m}^{-2} \text{ day}^{-1}$
2500						
2600						
2700						
2800						
2900						
3000						
3100						
3200						
3300						
3400	1.22	2.83	1.31	2.53	1.24	
3500		2.96	1.37	2.59	1.27	
3600		3.17	1.47	2.69	1.32	
3700		3.32	1.54	2.76	1.35	
3800		2.54	1.18	2.40	1.18	
3900		1.33	0.62	1.84	0.90	
4000		0.26	0.12	1.34	0.66	
4100		-0.08	-0.04	1.18	0.58	
4200		-0.71	-0.33	0.89	0.44	
4300		-1.29	-0.60	0.62	0.30	
4400		-1.81	-0.84	0.38	0.19	
4500	1.22	-2.24	-1.04	0.16	0.08	
4600						
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 6 to 10 in Channel 1

Date: 8-5-76

Travel Time: 1.37 Hr.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						Possible error in D.O. reading Station 10 - 2900 Hr.
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500	1.68	0.44	0.32	2.00	1.06	
1600		-0.39	-0.28	1.40	0.74	
1700		-0.99	-0.72	0.96	0.51	
1800		-1.43	-1.04	0.64	0.34	
1900		-1.64	-1.20	0.48	0.25	
2000	1.68	-2.60	-1.90			
2100						
2200	2.04					
2300	1.27					
2400	2.13					
2500	1.90					
2600	1.65					
2700	1.53					
2800	1.48					
2900	1.42					
3000						
3100						
3200						
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						

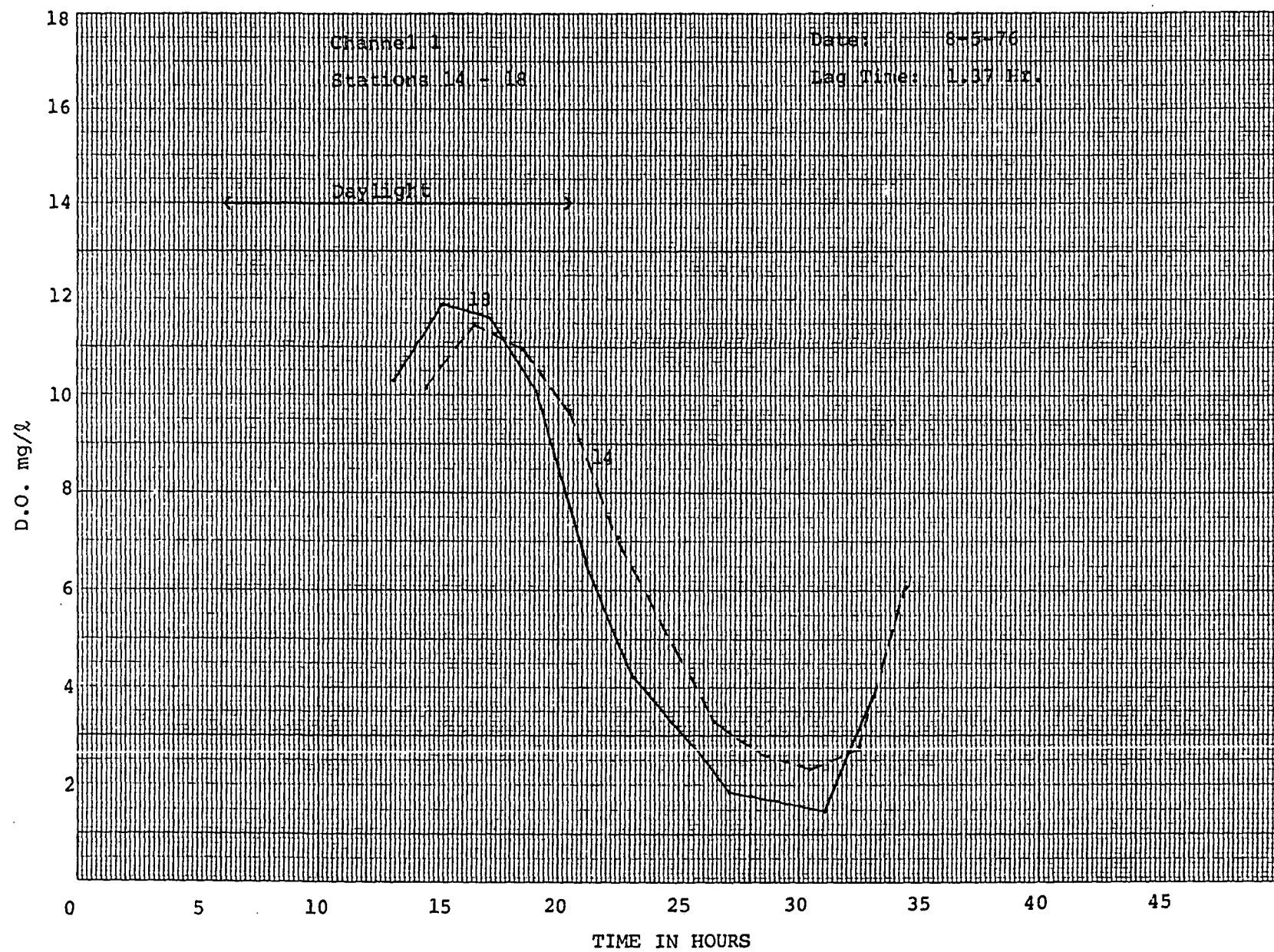
<

$$\Sigma P = 2.90 \text{ g m}^{-2} (5 \text{ Hrs})^{-1}$$

$$\bar{R} = 1.68 \text{ g m}^{-3} \text{ hr}^{-1}$$

$$\Sigma P = \text{g m}^{-2} \text{ day}^{-1}$$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

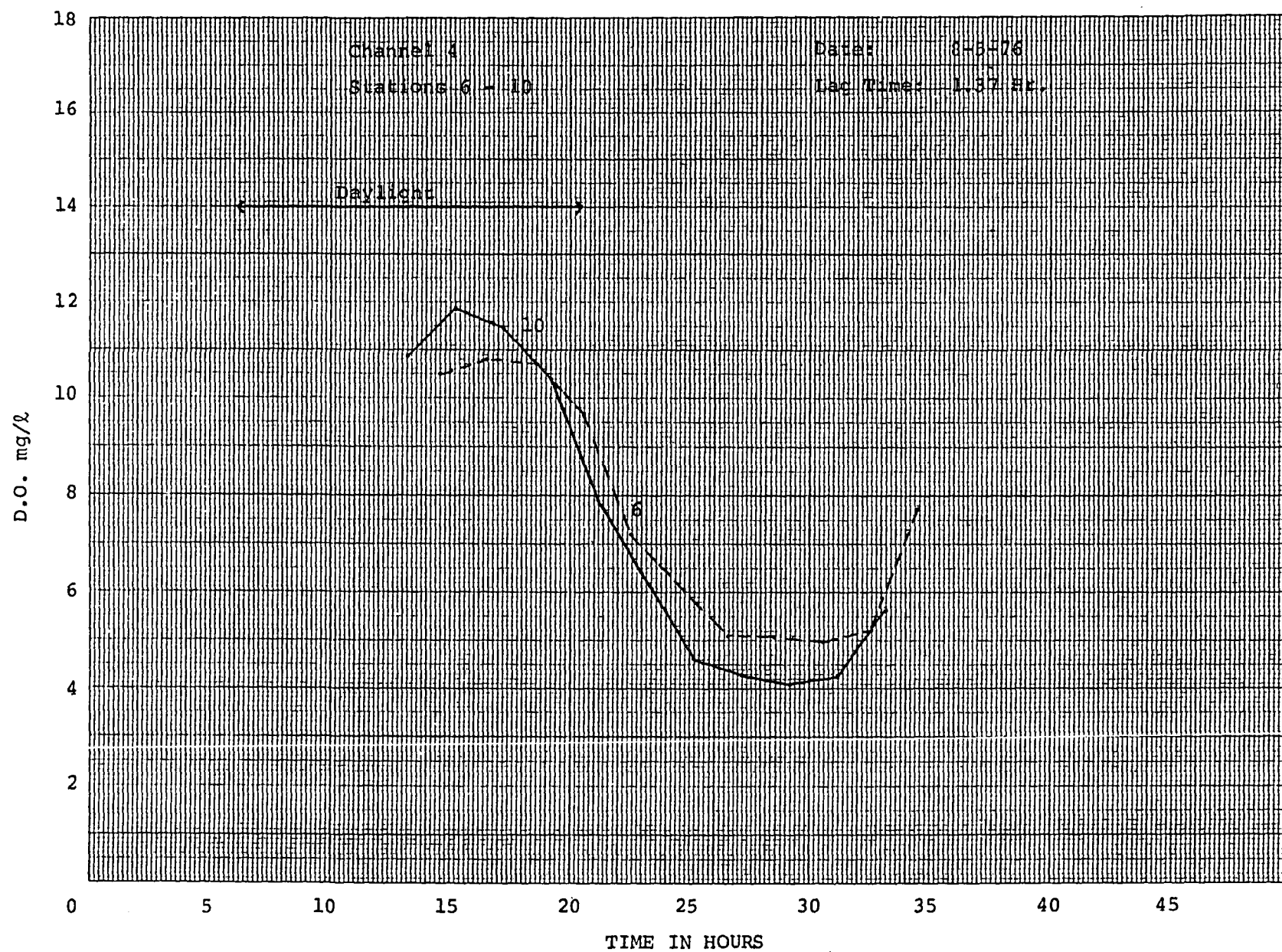
LOCATION OF REACH: Station 14 to 18 in Channel 1

Date: 8-5-76

Travel Time: 1.37 Hr.

Time at Downstream Station (hrs)	R_3 $g\ m^{-3}\ hr^{-1}$	$\Delta D_3 O_2$ $g\ m^{-3}$	$\Delta D_3 O_2$ $g\ m^{-3}\ hr^{-1}$	P_3 $g\ m^{-3}\ hr^{-1}$	P_2 $g\ m^{-2}\ hr^{-1}$	Comments
0000	**					D.O. values below 3 mg/l not used in calculation of respiration
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500	1.43	1.20	0.88	2.31	1.13	$\Sigma P = 4.11\ g\ m^{-2}\ (6\ Hrs)^{-1}$ $R = 1.43\ g\ m^{-3}\ hr^{-1}$
1600		0.62	0.45	1.88	0.92	
1700		0.18	0.13	1.56	0.76	
1800		-0.26	-0.19	1.24	0.61	
1900		-0.49	-0.36	1.07	0.52	
2000		-1.48	-1.08	0.35	0.17	
2100	1.43	-2.18	-1.59	-0.16		
2200	1.58					
2300	1.64					
2400	1.38					
2500	1.12					
2600						$\Sigma P = \quad g\ m^{-2}\ day^{-1}$
2700						
2800						
2900						
3000						
3100						
3200						
3300						
3400						
3500						
3600						$\Sigma P = \quad g\ m^{-2}\ day^{-1}$
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						$\Sigma P = \quad g\ m^{-2}\ day^{-1}$
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

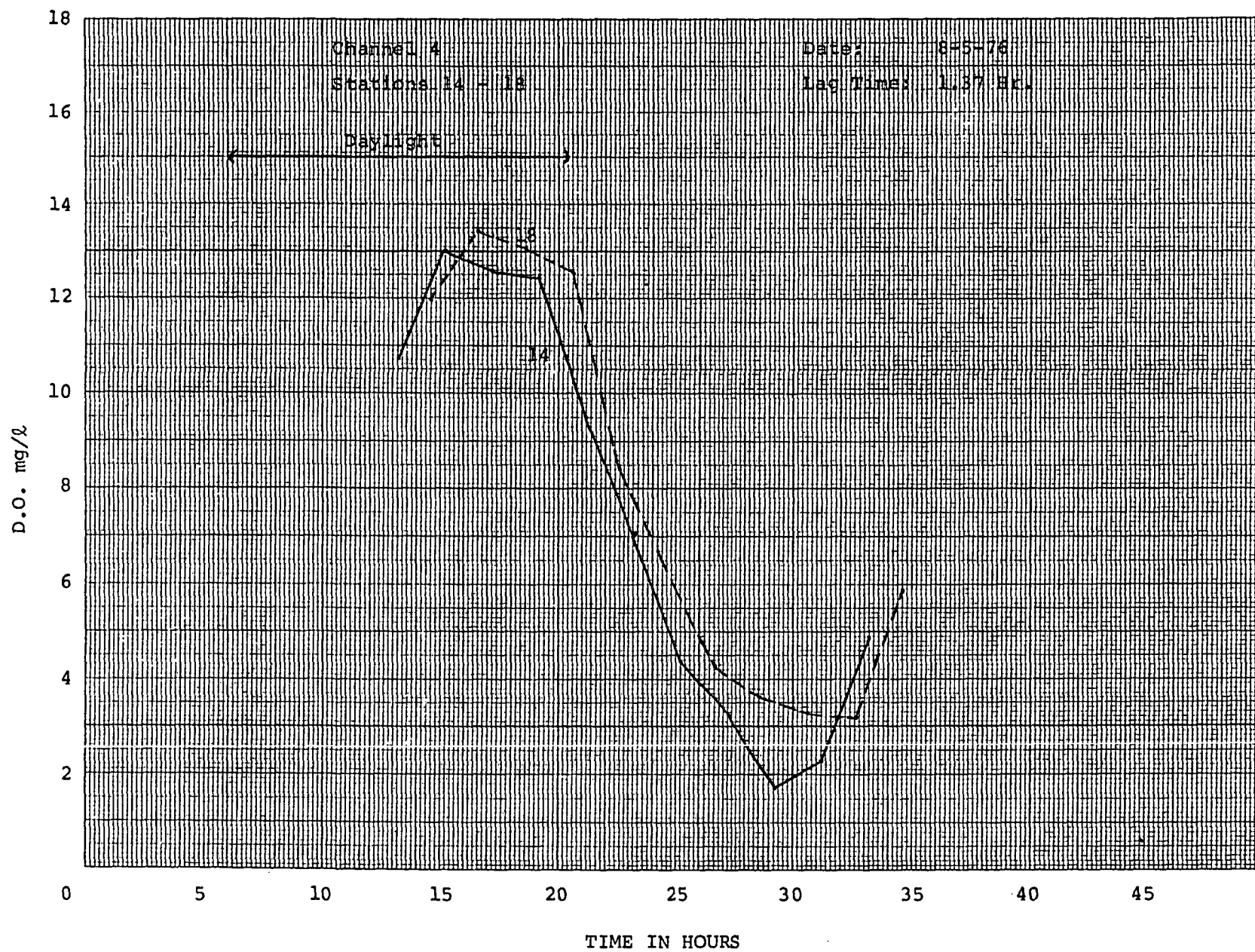
LOCATION OF REACH: Station 6 to 10 in Channel 4

Date: 8-5-76

Travel Time: 1.37 Hr.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500	0.63	1.20	0.88	1.51	0.80	
1600		1.01	0.74	1.37	0.73	
1700		0.72	0.53	1.16	0.61	
1800		0.33	0.24	0.87	0.46	
1900		0.00	0.00	0.63	0.33	
2000		-0.55	-0.40	0.23	0.12	
2100	0.63	-0.99	-0.72	-0.09		
2200						
2300	0.39					
2400	0.61					$\Sigma P = 3.05\ g\ m^{-2}\ (6\ Hrs)^{-1}$
2500	0.84					
2600	0.66					$R = 0.63\ g\ m^{-3}\ hr^{-1}$
2700	0.58					
2800	0.58					
2900	0.68					
3000						
3100						
3200						
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = \quad g\ m^{-2}\ day^{-1}$

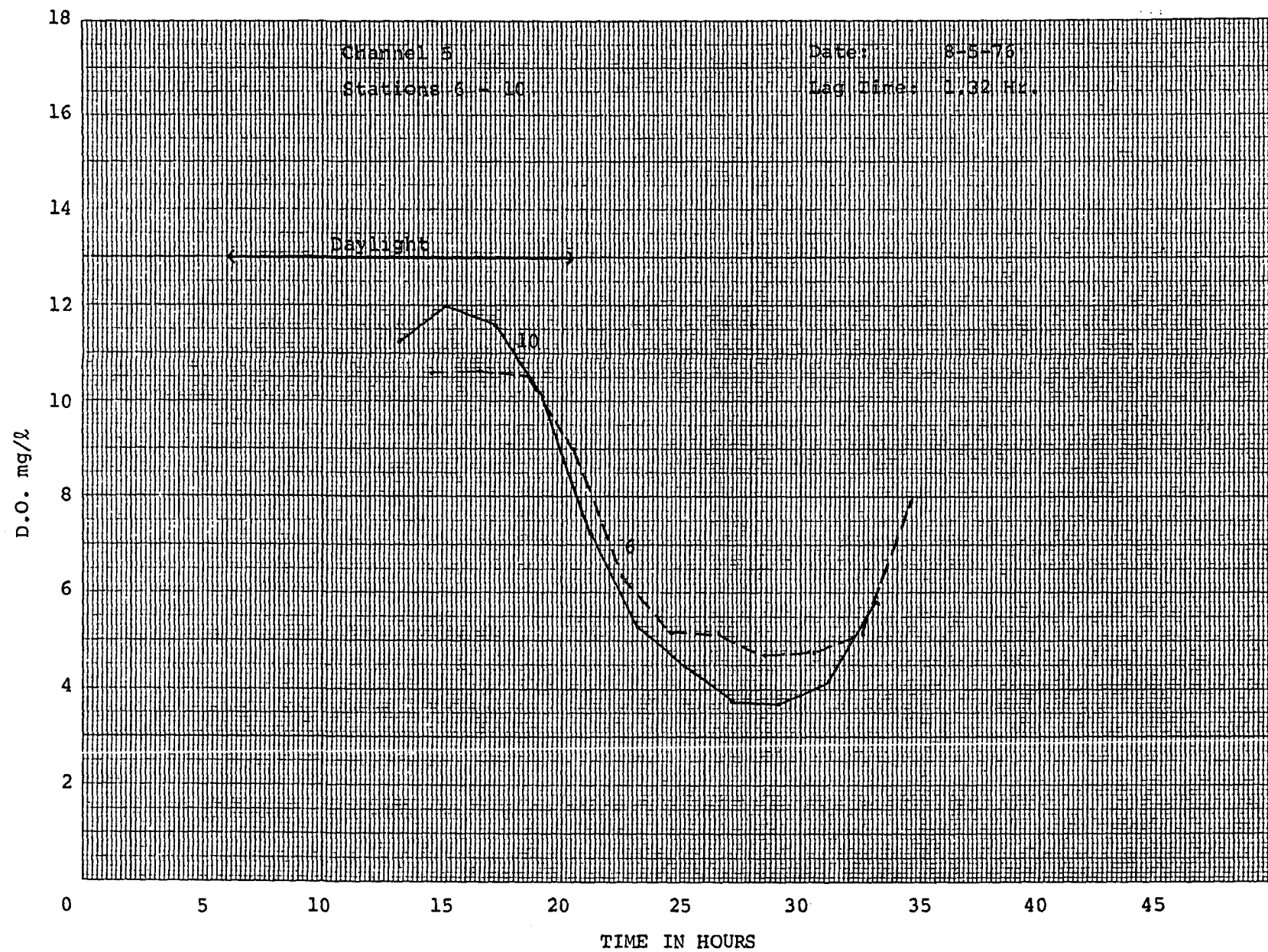
**Daylight savings time.



LOCATION OF REACH: Station 14 to 18 in Channel 4

Travel Time: 1.37 Hr

****Daylight savings time.**



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 6 to 10 in Channel 5

Date: 8-5-76

Travel Time: 1.32

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
--	---	---	--	---	---	----------

0000 **

0100

0200

0300

0400

0500

0600

0700

0800

0900

1000

1100

1200

1300

1400

1500 0.63 1.32 1.00 1.63 0.86

1600 1.34 1.02 1.65 0.87

1700 1.06 0.80 1.43 0.76

1800 0.47 0.36 0.99 0.52

1900 0.05 0.04 0.67 0.36

2000 -0.45 -0.34 0.29 0.15

2100 0.63 -0.83 -0.63 0.00

2200 0.45

2300 0.45

2400 0.41

2500 0.46

2600 0.73

2700 0.92

2800 0.83

2900 0.76

3000

3100

3200

3300

3400

3500

3600

3700

3800

3900

4000

4100

4200

4300

4400

4500

4600

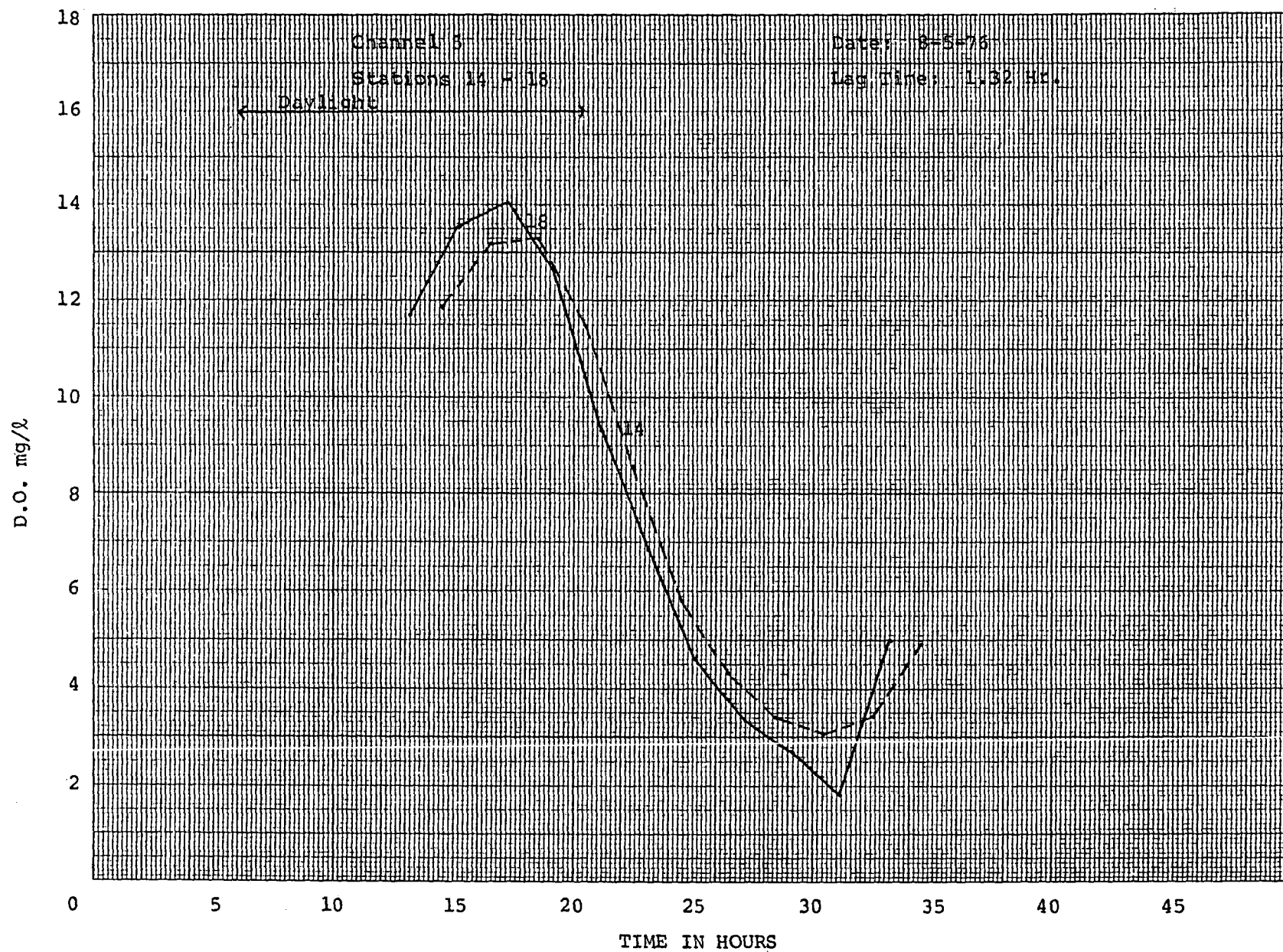
4700

$$\Sigma P = 3.52 \text{ g m}^{-2} (6 \text{ Hrs})^{-1}$$

$$\bar{R} = 0.63 \text{ g m}^{-3} \text{ hr}^{-1}$$

$$\Sigma P = \text{g m}^{-2} \text{ day}^{-1}$$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

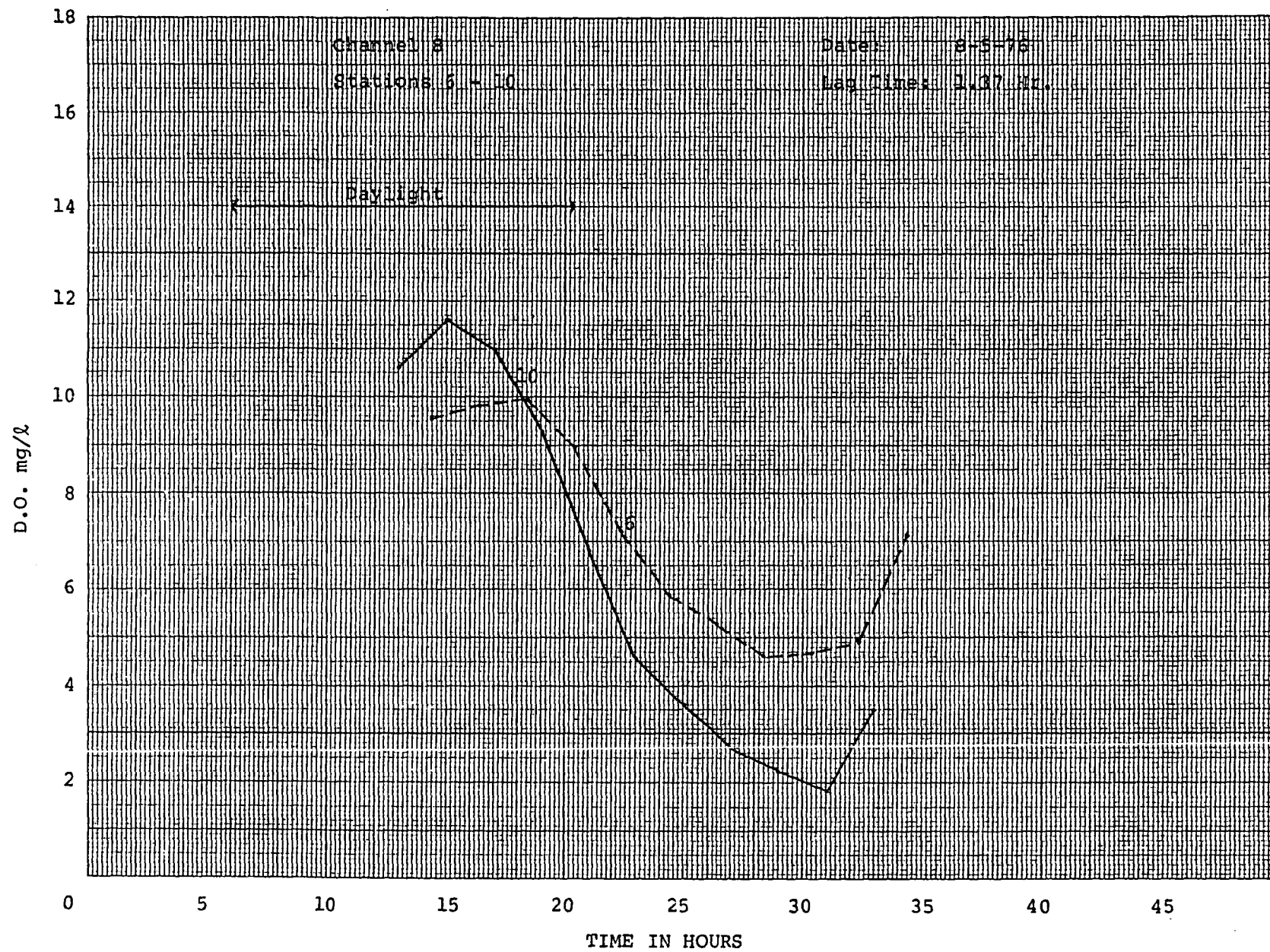
LOCATION OF REACH: Station 14 to 18 in Channel 5

Date: 8-5-76

Travel Time: 1.32

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						D.O. values below 3 mg/l were not used in calcula- tion of respiration value.
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500	0.54	1.26	0.95	1.49	0.73	
1600		0.90	0.68	1.22	0.60	
1700		0.80	0.61	1.15	0.56	
1800		0.24	0.18	0.72	0.35	
1900		-0.08	-0.06	0.48	0.24	
2000		-0.68	-0.52	0.02	0.01	
2100	0.54	-1.22				
2200	0.80					$\Sigma P = 2.49 \text{ g m}^{-2} (6 \text{ Hrs})^{-1}$ $\bar{R} = 0.54 \text{ g m}^{-3} \text{ hr}^{-1}$
2300	0.64					
2400	0.49					
2500	0.55					
2600	0.47					
2700	0.42					
2800	0.42					
2900						
3000						
3100						
3200						$\Sigma P = \quad \text{g m}^{-2} \text{ day}^{-1}$
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

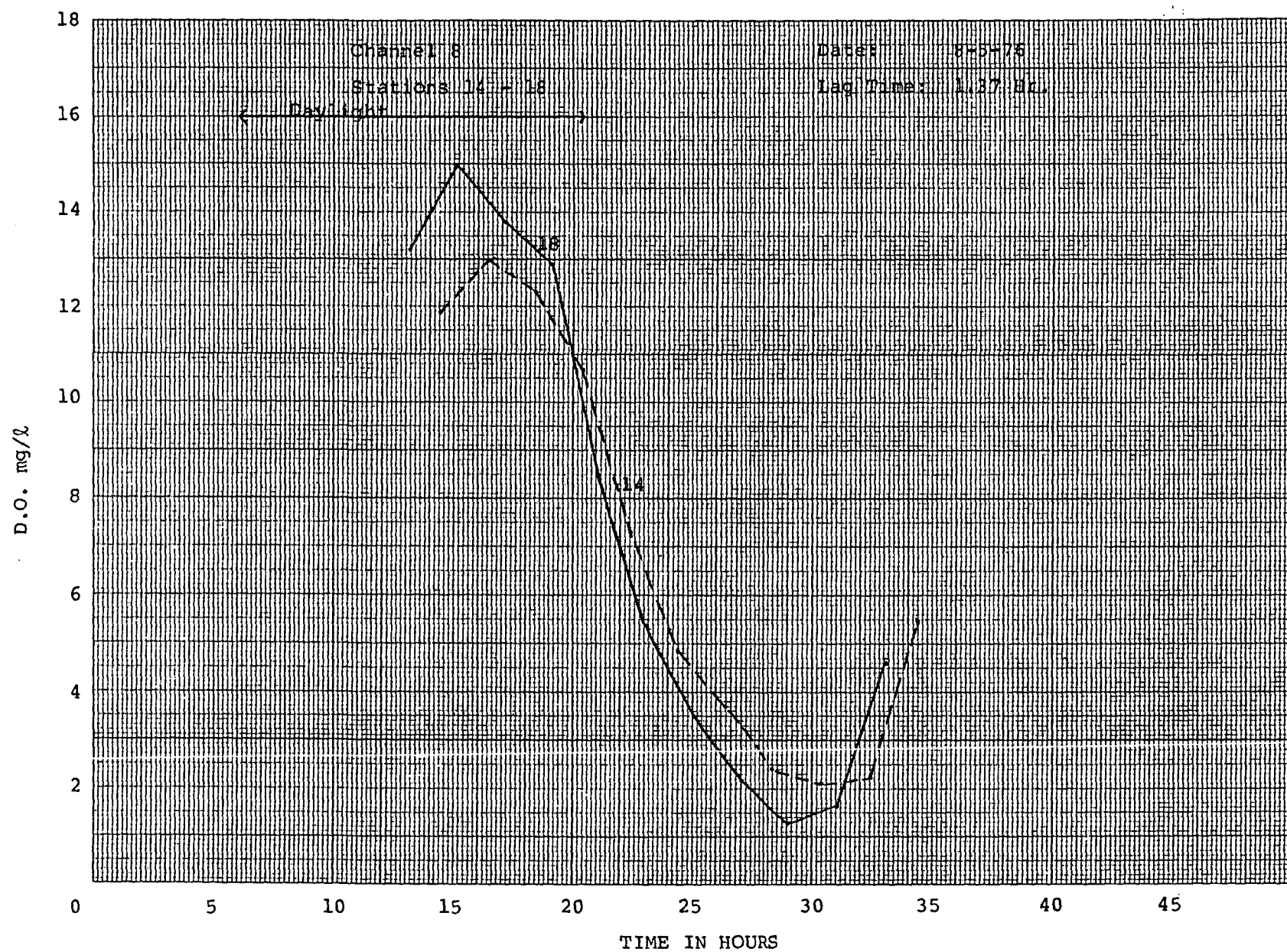
LOCATION OF REACH: Station 6 to 10 in Channel 8

Date: 8-5-76

Travel Time: 1.37 Hrs

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{ hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{ hr}^{-1}$	P $\text{g m}^{-3} \text{ hr}^{-1}$	P $\text{g m}^{-2} \text{ hr}^{-1}$	Comments
0000						D.O. values below 3 mg/l were not used in calculat. of respiration
0100						
0200						
0300						
0400						
0500						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

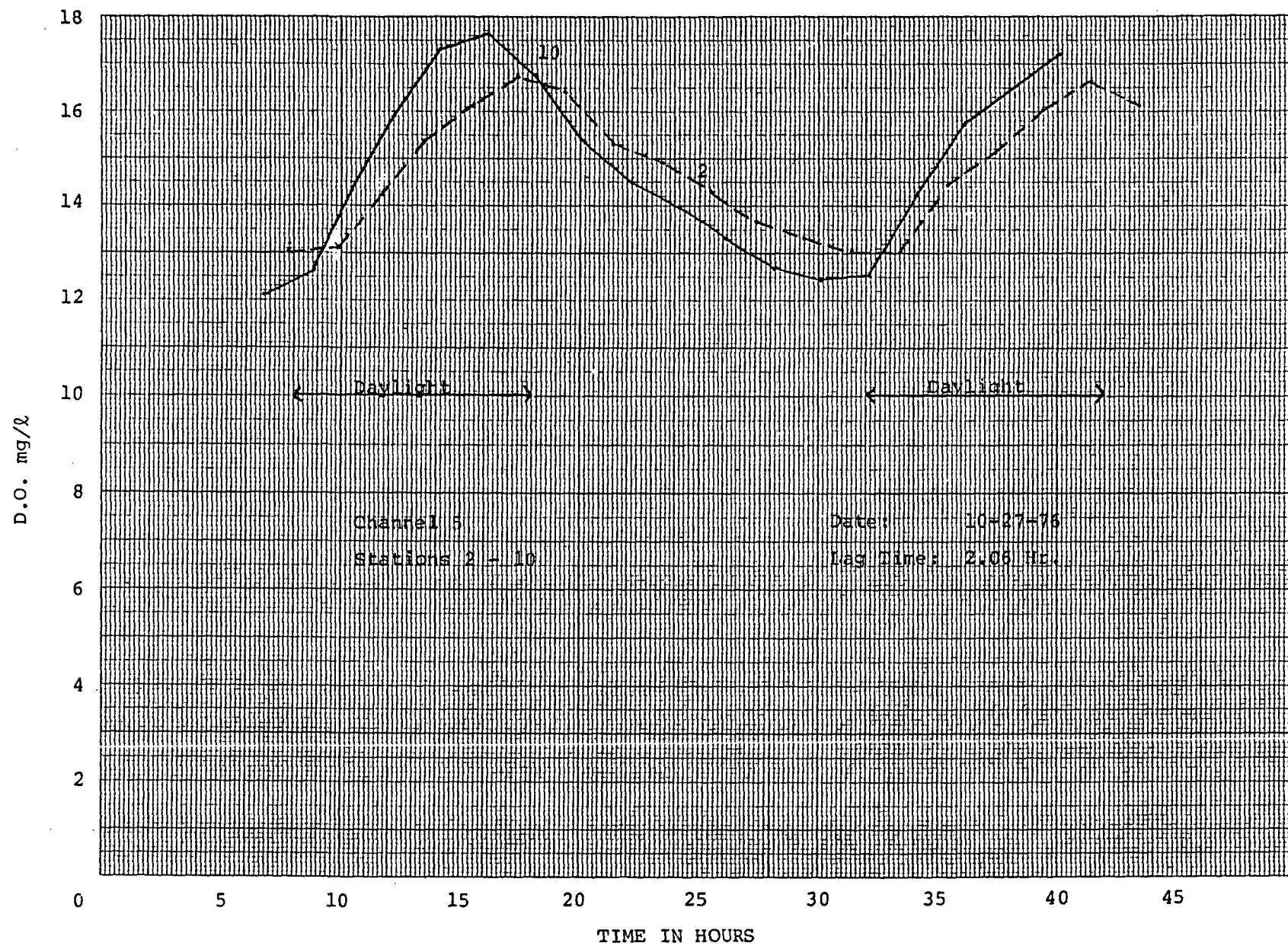
LOCATION OF REACH: Station 14 to 18 in Channel 8

Date: 8-5-76

Travel Time: 1.37 Hrs

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						D.O. values below 3 mg/l were not used in calculation of respiration
0100						
0200						
0300						
0400						
0500						<

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

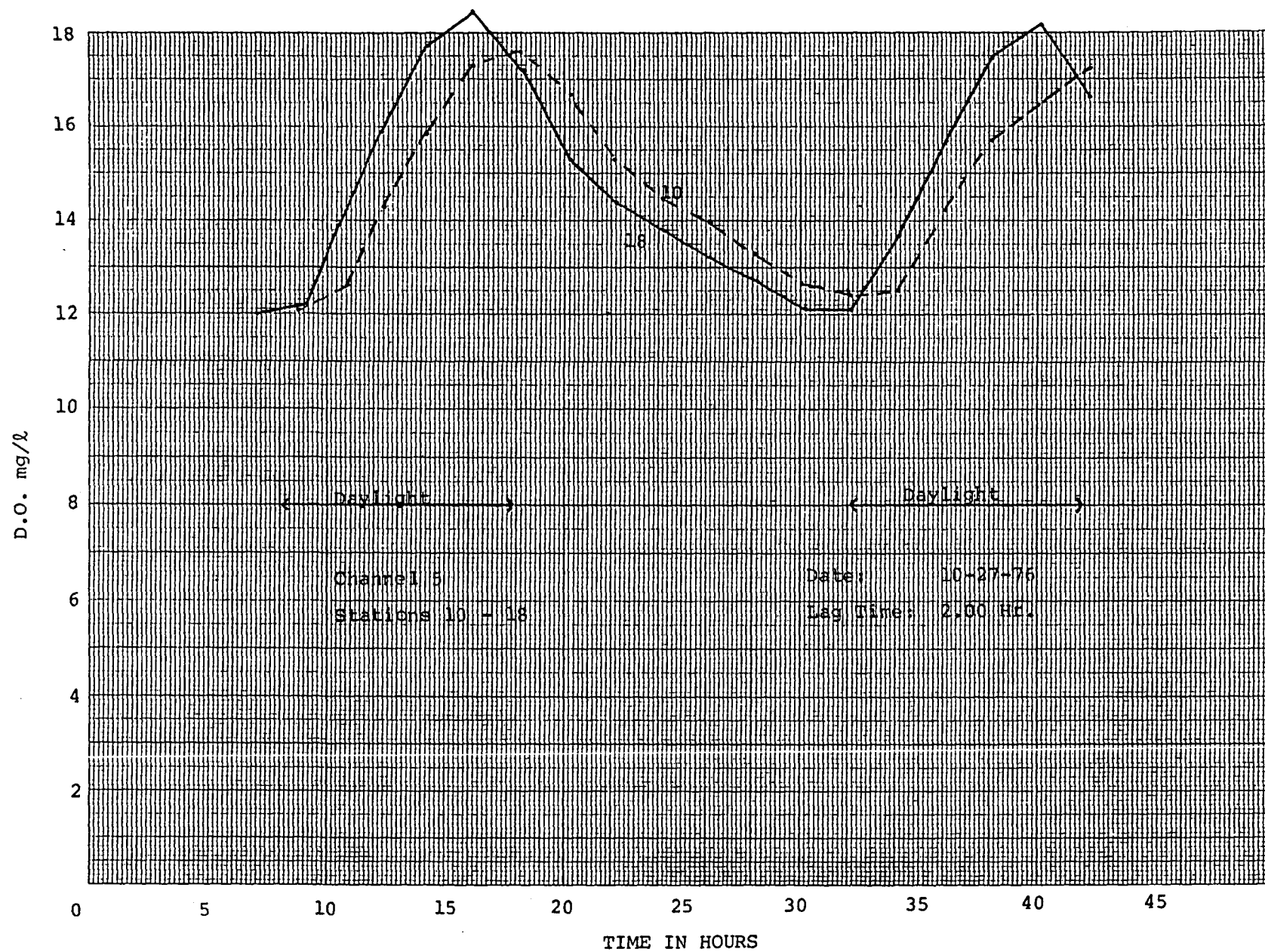
LOCATION OF REACH: Station 2 to 10 in Channel 5

Date: 10-27-76

Travel Time: 2.06 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D}_2\text{O}$ g m^{-3}	$\Delta \text{D}_2\text{O}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800	0.37	-0.62	-0.30	0.07	0.02	
0900		-0.25	-0.12	0.25	0.08	
1000		0.71	0.34	0.71	0.24	
1100		1.05	0.51	0.88	0.30	
1200		1.31	0.64	1.01	0.34	
1300		1.46	0.71	1.08	0.37	
1400		1.65	0.80	1.17	0.40	
1500		1.51	0.73	1.10	0.37	
1600		1.32	0.64	1.01	0.34	
1700		0.69	0.33	0.70	0.24	
1800	0.37	0.17	0.08	0.45	0.15	
1900						
2000						
2100	0.27					
2200	0.31					
2300	0.36					
2400	0.36					$\Sigma P = 2.85 \text{ g m}^{-2} \text{ day}^{-1}$
2500	0.52					$\bar{R} = 0.37 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	0.38					
2700	0.40					
2800	0.41					
2900	0.41					
3000	0.38					
3100	0.30					
3200	0.37	-0.51	-0.25	0.12	0.04	
3300		0.24	0.12	0.49	0.17	
3400		0.70	0.34	0.71	0.24	
3500		0.74	0.36	0.73	0.34	
3600		1.00	0.49	0.86	0.29	
3700		1.07	0.52	0.89	0.30	
3800		1.07	0.52	0.89	0.30	
3900		0.97	0.47	0.84	0.29	
4000	0.37	0.94	0.46	0.83	0.28	
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 2.25 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

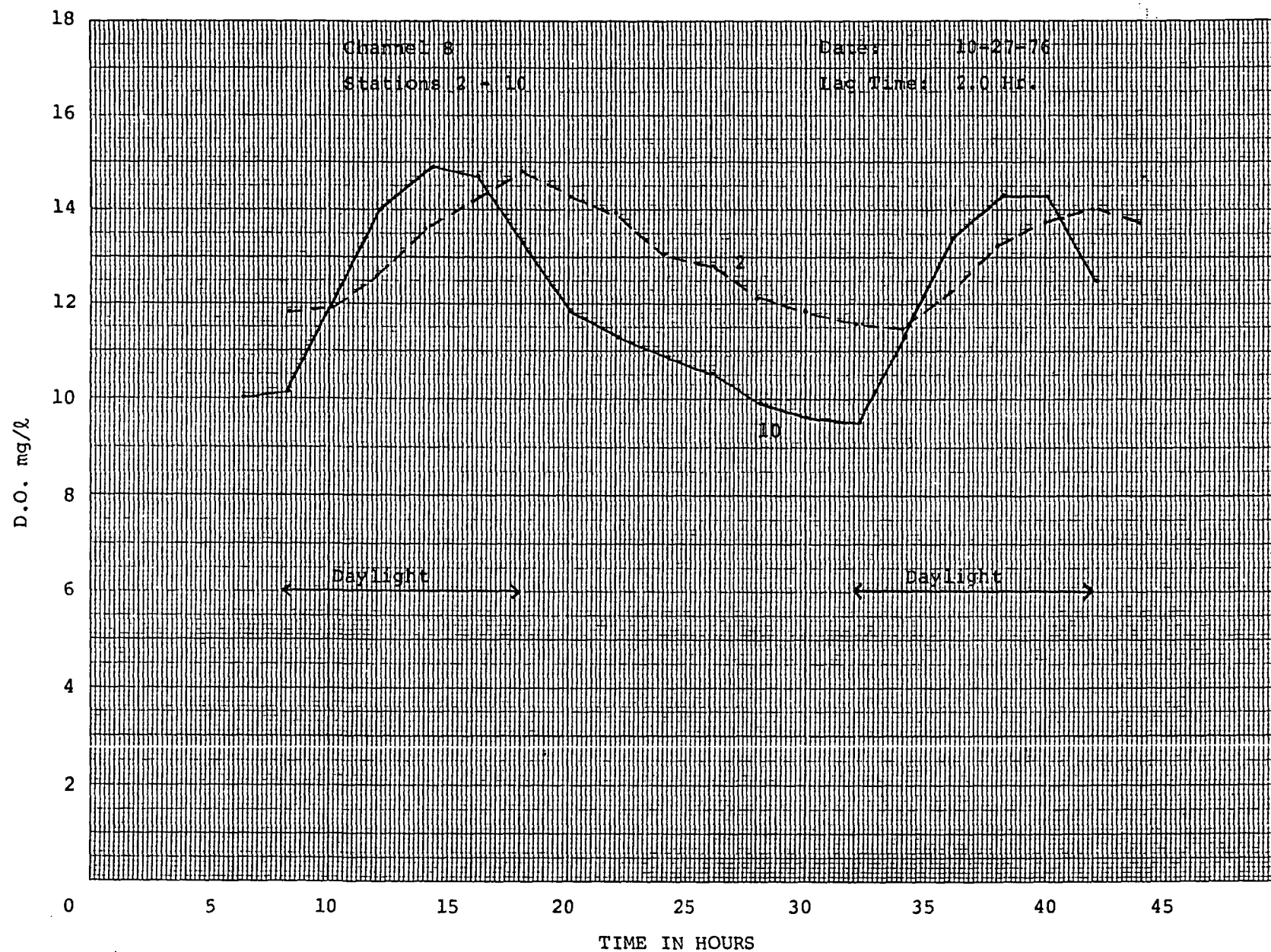
LOCATION OF REACH: Station 10 to 18 in Channel 5

Date: 10-27-76

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R_3 $g\ m^{-3}\ hr^{-1}$	$\Delta D_3 O_2$ $g\ m^{-3}$	$\Delta D_3 O_2$ $g\ m^{-3}\ hr^{-1}$	P_3 $g\ m^{-3}\ hr^{-1}$	P_2 $g\ m^{-2}\ hr^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900	0.37	0.05	0.03	0.40	0.14	
1000		0.88	0.44	0.81	0.29	
1100		1.64	0.82	1.19	0.43	
1200		1.67	0.84	1.21	0.44	
1300		0.83	0.42	0.79	0.28	
1400		1.79	0.90	1.27	0.46	
1500		1.50	0.75	1.12	0.40	
1600		1.20	0.60	0.97	0.35	
1700	0.37	0.39	0.20	0.57	0.21	
1800		-0.21	-0.11	0.27	0.10	
1900						
2000	0.63					
2100	0.59					
2200	0.47					
2300	0.39					
2400	0.33					$\Sigma P = 3.10\ g\ m^{-2}\ day^{-1}$
2500	0.33					$\bar{R} = 0.37\ g\ m^{-3}\ hr^{-1}$
2600	0.37					
2700	0.33					
2800	0.28					
2900	0.26					
3000	0.25					
3100	0.22					
3200	0.37	-0.31	-0.16	0.22	0.08	
3300		0.29	0.15	0.52	0.19	
3400		1.01	0.51	0.88	0.32	
3500		1.21	0.61	0.98	0.35	
3600		1.35	0.68	1.05	0.38	
3700		1.54	0.77	1.14	0.41	
3800		1.68	0.84	1.21	0.44	
3900		1.72	0.86	1.23	0.44	
4000		1.70	0.85	1.22	0.44	
4100	0.37	0.80	0.40	0.77	0.28	
4200		-0.33	-0.17	0.21	0.08	
4300						
4400						
4500						
4600						
4700						$\Sigma P = 3.41\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



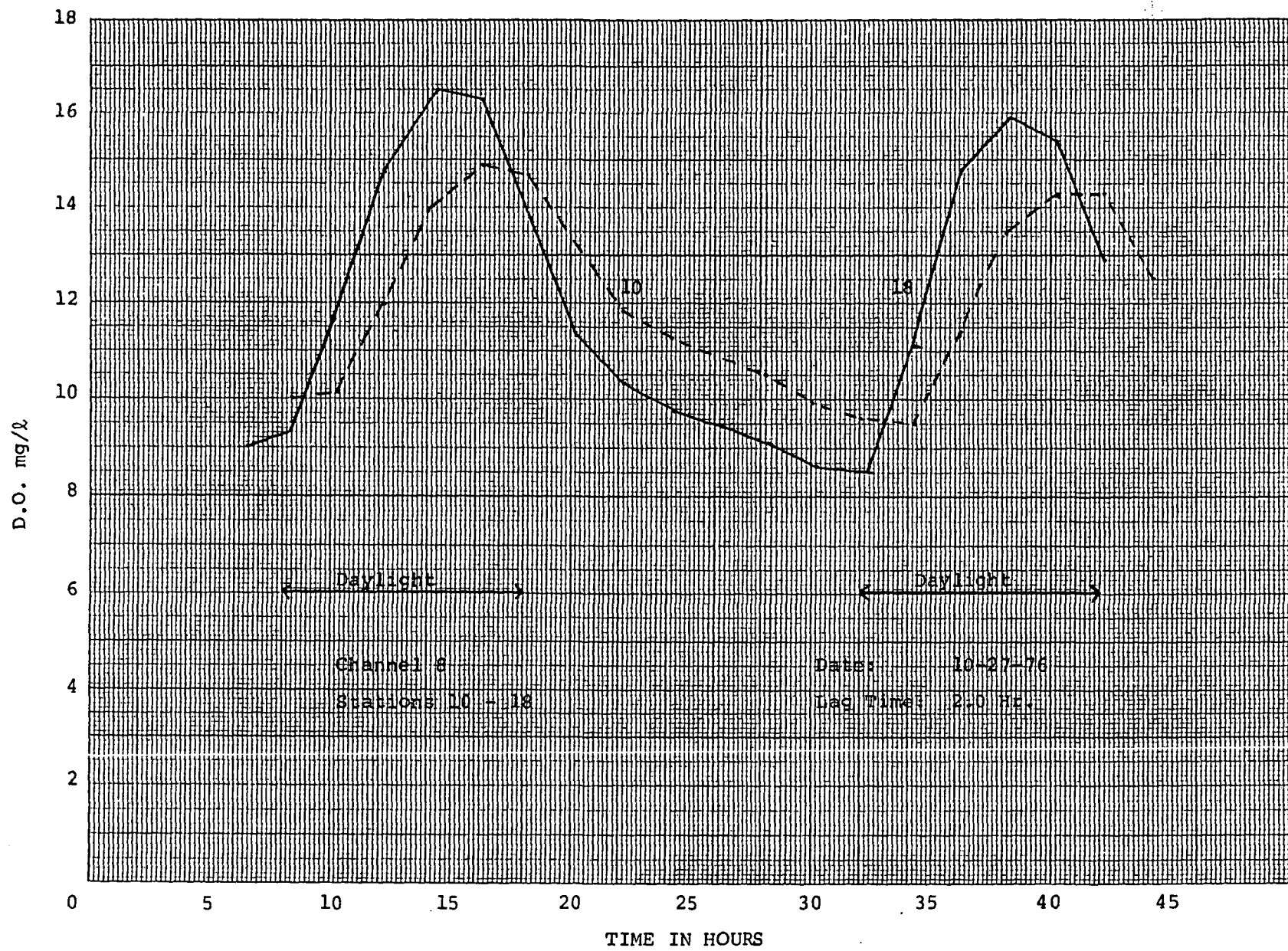
HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL
LOCATION OF REACH: Station 2 to 10 in Channel 8

Date: 10-27-76

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900	1.16	-1.01	-0.50	0.66	0.22	
1000		-0.11	-0.06	1.10	0.37	
1100		0.61	0.31	1.46	0.50	
1200		1.25	0.63	1.79	0.61	
1300		1.30	0.65	1.81	0.62	
1400		1.15	0.58	1.74	0.59	
1500		0.93	0.47	1.63	0.55	
1600		0.55	0.28	1.44	0.49	
1700	1.16	-0.38	-0.19	0.97	0.33	
1800						
1900						
2000	1.20					
2100	1.27					
2200	1.32					
2300	1.20					
2400	1.08					$\Sigma P = 4.28 \text{ g m}^{-2} \text{ day}^{-1}$
2500	1.12					$\bar{R} = 1.16 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	1.14					
2700	1.14					
2800	1.12					
2900	1.11					
3000	1.10					
3100	1.16					
3200	1.16	-2.10	-1.05	0.11	0.04	
3300		-1.30	-0.65	0.51	0.17	
3400		-0.35	-0.18	0.99	0.34	
3500		0.35	0.18	1.34	0.46	
3600		1.12	0.56	1.72	0.58	
3700		1.03	0.52	1.68	0.57	
3800		0.92	0.46	1.62	0.55	
3900		0.77	0.39	1.55	0.53	
4000		0.52	0.26	1.42	0.48	
4100	1.16	-0.40	-0.20	0.96	0.33	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 4.05 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

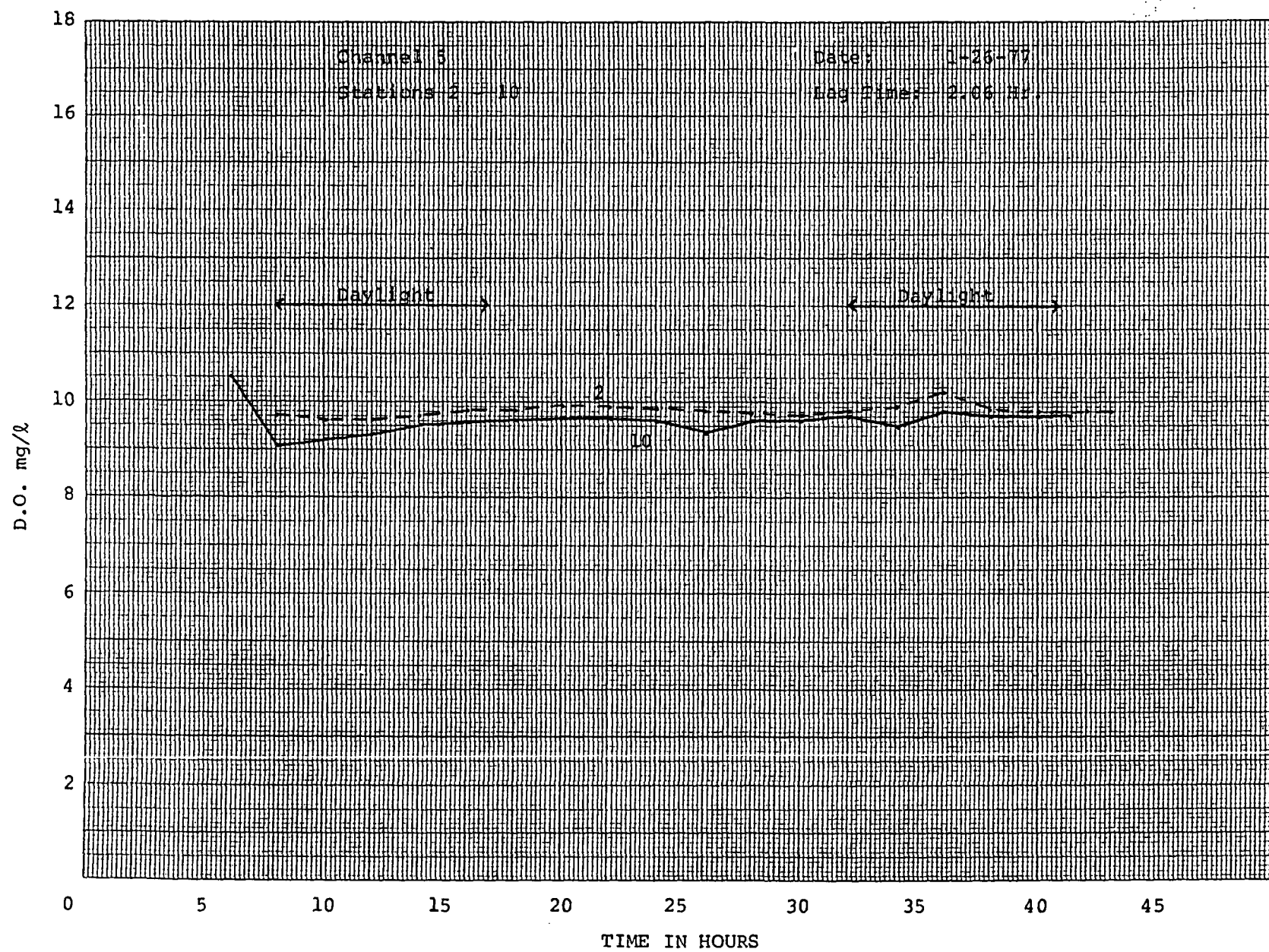
LOCATION OF REACH: Station 10 to 18 in Channel 8

Date: 10-27-76

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R_3 $g\ m^{-3}\ hr^{-1}$	$\Delta D_3 O_2$ $g\ m^{-3}$	$\Delta D_3 O_2$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900	0.73	0.14	0.07	0.80	0.29	
1000		1.35	0.68	1.40	0.50	
1100		2.15	1.08	1.80	0.65	
1200		2.67	1.34	2.06	0.74	
1300		2.67	1.34	2.06	0.74	
1400		2.35	1.18	1.90	0.68	
1500		2.10	1.05	1.78	0.64	
1600		1.60	0.80	1.53	0.55	
1700	0.73	0.56	0.28	1.01	0.36	
1800						
1900						
2000	0.86					
2100	0.86					
2200	0.77					
2300	0.77					
2400	0.74					$\Sigma P = 5.15\ g\ m^{-2}\ day^{-1}$
2500	0.73					$\bar{R} = 0.73\ g\ m^{-3}\ hr^{-1}$
2600	0.70					
2700	0.70					
2800	0.69					
2900	0.67					
3000	0.65					
3100	0.61					
3200	0.73	-1.10	-0.55	0.18	0.06	
3300		-0.16	-0.08	0.65	0.23	
3400		1.25	0.63	1.36	0.49	
3500		2.30	1.15	1.88	0.68	
3600		3.13	1.57	2.30	0.83	
3700		2.90	1.45	2.18	0.78	
3800		2.40	1.20	1.93	0.69	
3900		1.93	0.97	1.69	0.61	
4000		1.26	0.63	1.36	0.49	
4100	0.73	0.10	0.05	0.78	0.28	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 5.14\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 2 to 10 in Channel 5

Date: 1-26-77

Travel Time: 2.06 Hrs.

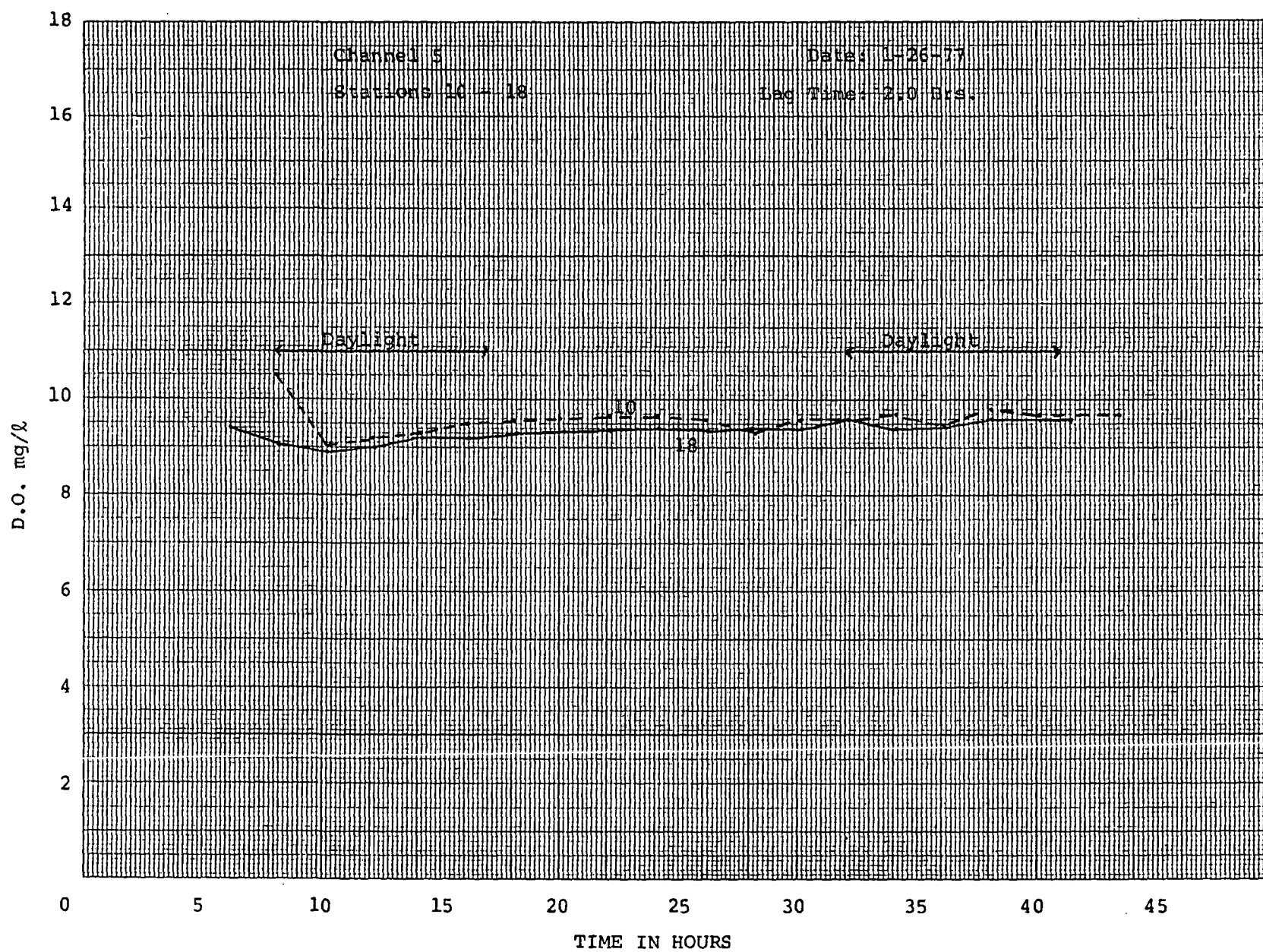
Time at Downstream Station (hrs)	R g m ⁻³ hr ⁻¹	ΔD.O. g m ⁻³	ΔD.O. g m ⁻³ hr ⁻¹	P g m ⁻³ hr ⁻¹	P g m ⁻² hr ⁻¹	Comments	
0000						1. ΔD.O. to close to determine accurate ph synthetic values. 2. Same situation for 1-26-77; channel 5; Station 10 → 18.	
0100							
0200							
0300							
0400							
0500							
0600							
0700							
0800	↑ 0.12 ↓	0.12	-0.55	-0.27			
0900			-0.66	-0.32			
1000			-0.42	-0.20			
1100			-0.37	-0.18			
1200			-0.32	-0.16	-0.04		
1300			-0.28	-0.14			
1400			-0.21	-0.10	0.02	0.01	
1500			-0.24	-0.12	-0.00	0.00	
1600	0.12	-0.24	-0.12	-0.00	0.00		
1700		-0.24	-0.12	0.00	0.00		
1800							
1900							
2000							
2100							
2200	0.12						
2300	0.14						
2400	0.13					ΣP = 0.01 g m ⁻² day ⁻¹	
2500	0.16					R̄ = 0.12 g m ⁻³ hr ⁻¹	
2600	0.21						
2700	0.16						
2800	0.09						
2900	0.06						
3000	0.04						
3100	0.05						
3200	↑ 0.12 ↓	0.12	-0.11	-0.05	0.07	0.03	
3300			-0.24	-0.12	0.00	0.00	
3400			-0.39	0.19	-0.07	-0.04	
3500							
3600							
3700							
3800							
3900							
4000							
4100							
4200							
4300							
4400							
4500							
4600							
4700						ΣP = g m ⁻² day ⁻¹	

$$\Sigma P = 0.01 \text{ g m}^{-2} \text{ day}^{-1}$$

$$\bar{R} = 0.12 \text{ g m}^{-3} \text{ hr}^{-1}$$

$$\Sigma P = \text{g m}^{-2} \text{ day}^{-1}$$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 10 to 18 in Channel 5

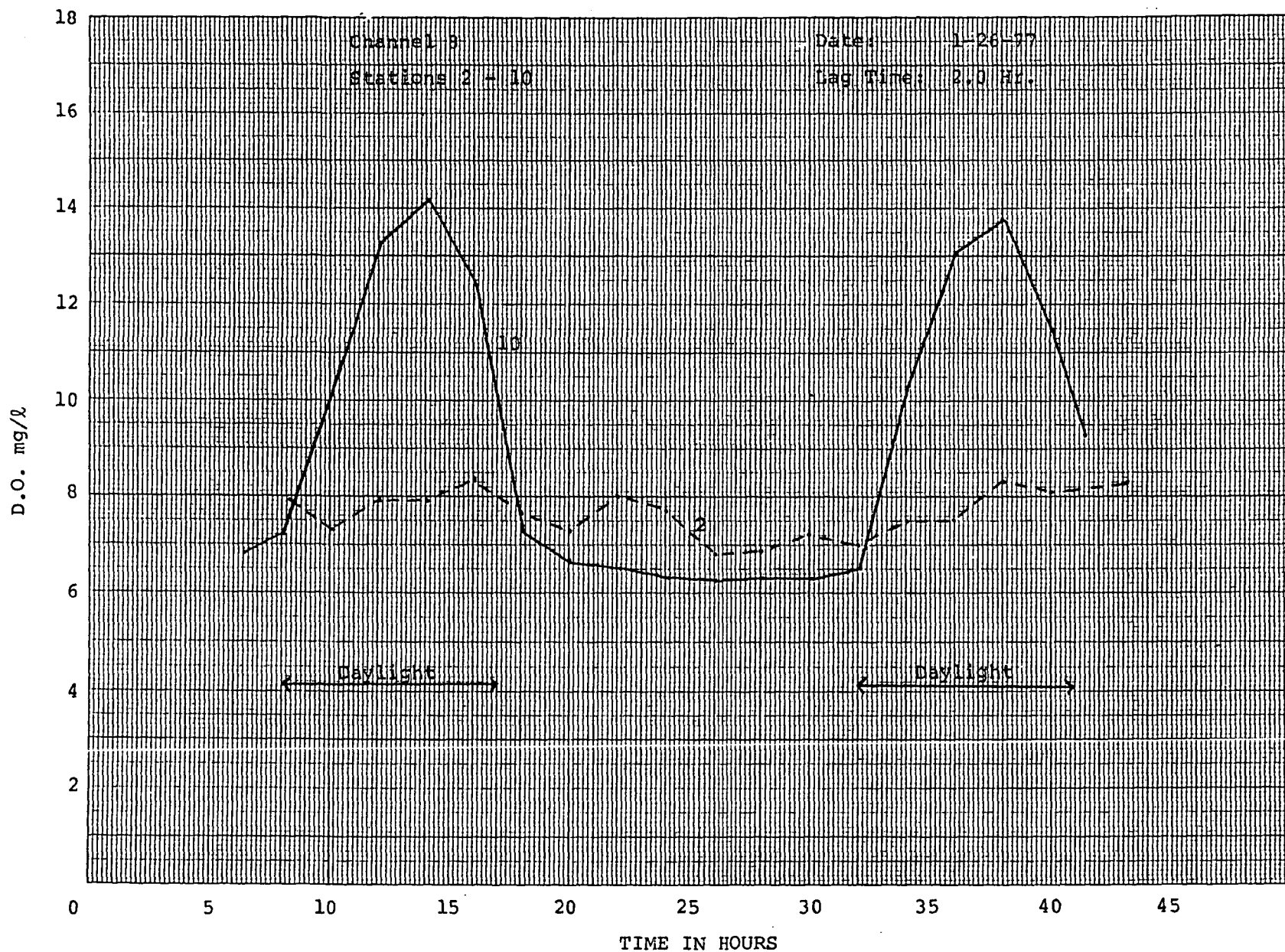
Date: 1/26/77

Travel Time: 2.0 Hrs.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}\ *$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500						
1600						
1700						
1800						
1900						
2000						
2100						
2200						
2300						
2400						
2500						
2600						
2700						
2800						
2900						
3000						
3100						
3200						
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						

Graphical difference between upstream and downstream diel oxygen curves are insignificant to conduct meaningful analysis.

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

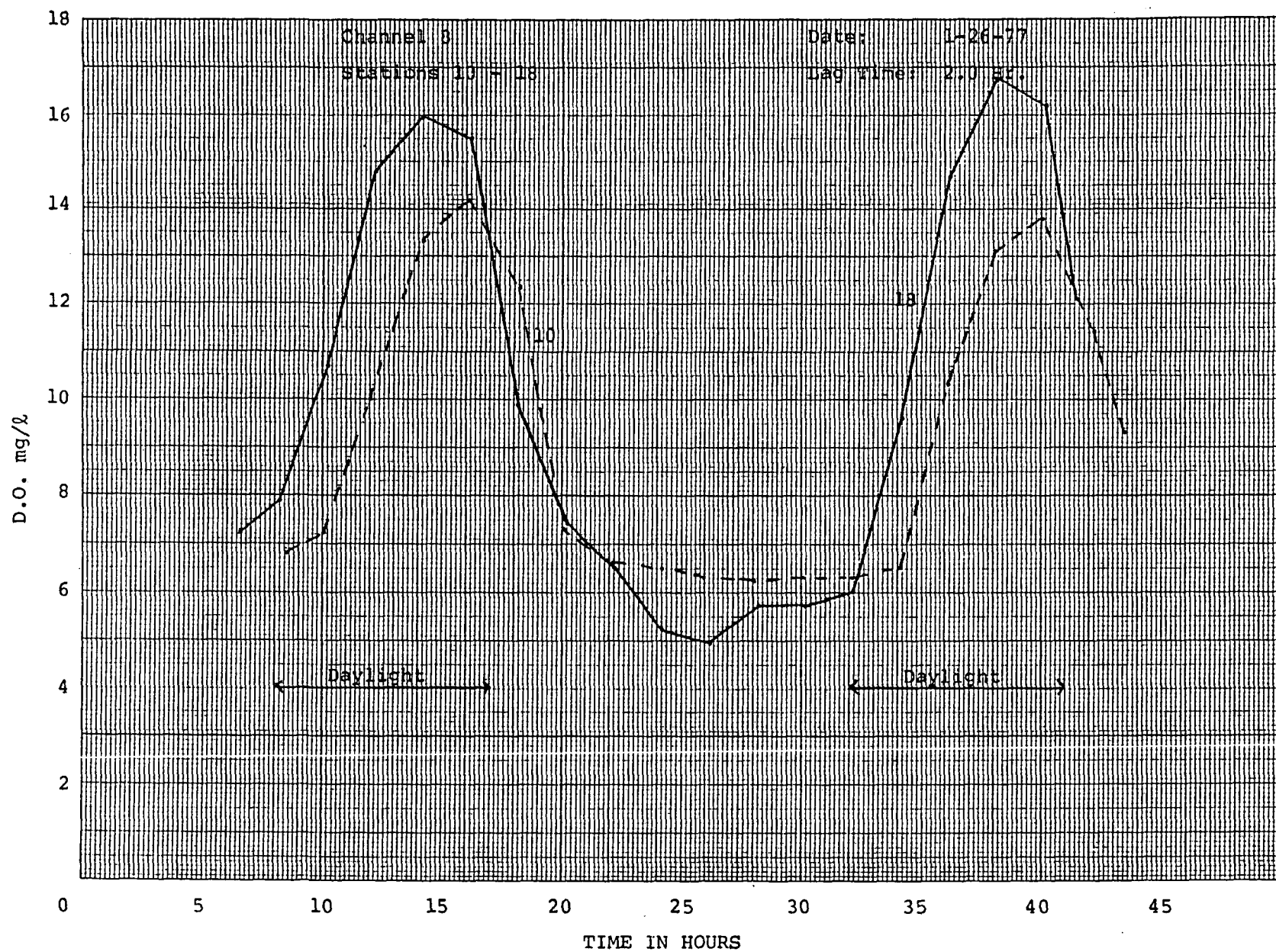
LOCATION OF REACH: Stations 2 to 10 in Channel 8

Date: 1-26-77

Travel Time: 2.00 Hrs

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D}_2\text{O}$ g m^{-3}	$\Delta \text{D}_2\text{O}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900	0.44	0.82	0.41	0.86	0.29	
1000		2.60	1.30	1.75	0.60	
1100		3.90	1.95	2.40	0.82	
1200		5.20	2.60	3.05	1.04	
1300		5.80	2.90	3.35	1.14	
1400		6.25	3.13	3.57	1.21	
1500		5.28	2.64	3.09	1.05	
1600		4.20	2.10	2.55	0.87	
1700	0.44	2.10	1.05	1.50	0.51	
1800						
1900	0.25					
2000	0.32					
2100	0.53					
2200	0.75					
2300	0.71					
2400	0.70					$\Sigma P = 7.53 \text{ g m}^{-2} \text{ day}^{-1}$
2500	0.50					$\bar{R} = 0.44 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	0.28					
2700	0.29					
2800	0.29					
2900	0.35					
3000	0.45					
3100	0.36					
3200	0.44	-0.52	0.26	0.71	0.24	
3300		0.88	0.44	0.89	0.30	
3400		2.50	1.25	1.70	0.58	
3500		4.00	2.00	2.45	0.83	
3600		5.45	2.73	3.17	1.08	
3700		5.50	2.75	3.20	1.09	
3800		5.45	2.73	3.17	1.08	
3900		4.50	2.25	2.70	0.92	
4000		3.50	1.75	2.20	0.75	
4100	0.44	1.90	0.95	1.40	0.48	
4200						
4300						
4400						
4500						
4600						$\Sigma P = 7.35 \text{ g m}^{-2} \text{ day}^{-1}$
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

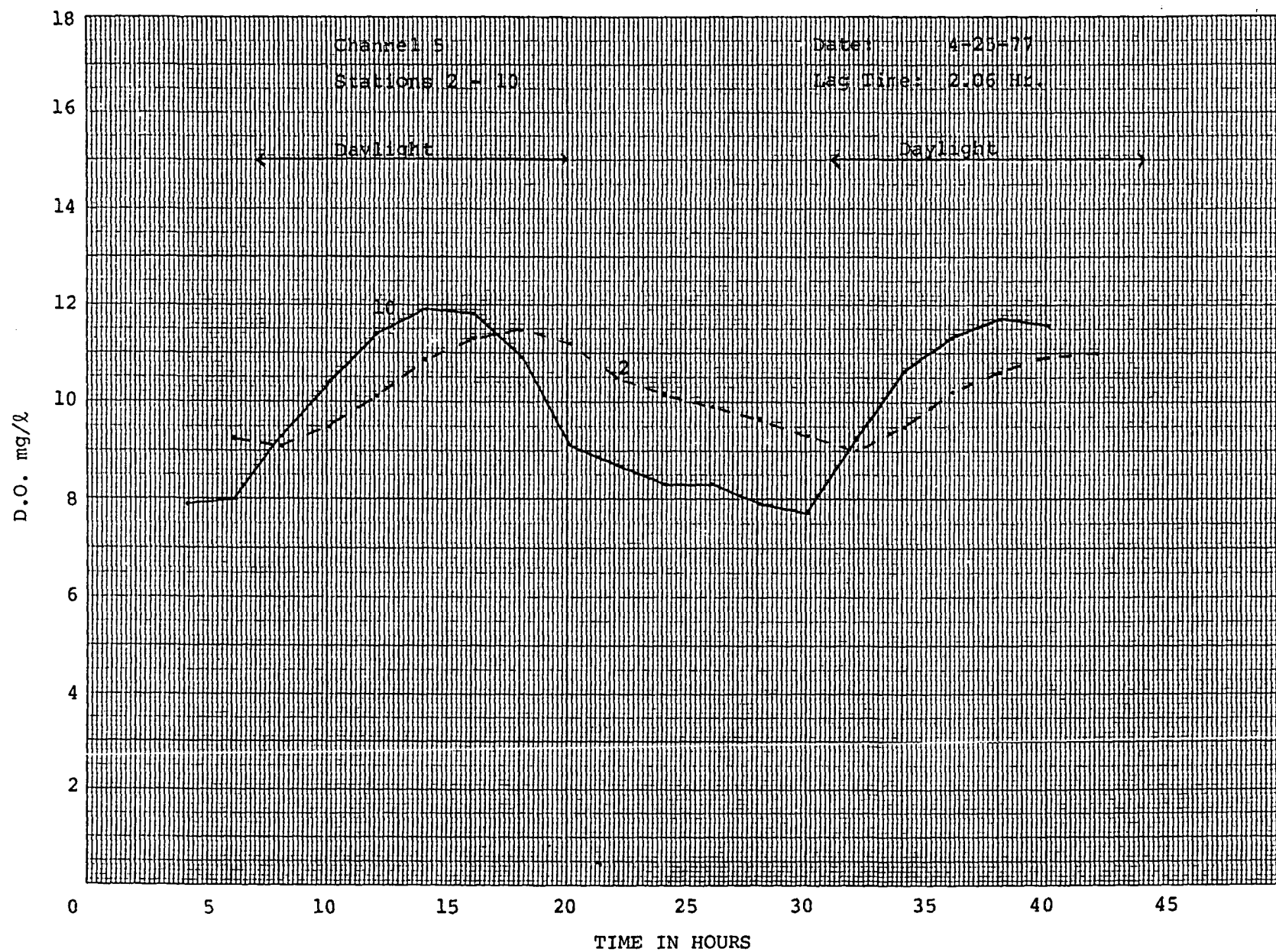
LOCATION OF REACH: Stations 10 to 18 in Channel 8

Date: 1/26/77

Travel Time: 2.00 Hrs

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900	0.36	2.06	1.03	1.39	0.50	
1000		3.22	1.11	1.47	0.53	
1100		3.85	1.93	2.29	0.82	
1200		4.46	2.23	2.59	0.93	
1300		3.75	1.88	2.24	0.81	
1400		2.83	1.42	1.78	0.64	
1500		2.10	1.05	1.41	0.51	
1600		1.37	0.69	1.05	0.38	
1700	0.36	-0.01	-0.01	0.36	0.13	
1800						
1900	0.62					
2000	0.10					
2100	0.05					
2200	0.05					
2300	0.30					
2400	0.59					$\Sigma P = 5.25 \text{ g m}^{-2} \text{ day}^{-1}$
2500	0.66					$\bar{R} = 0.36 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	0.66					
2700	0.50					
2800	0.31					
2900	0.29					
3000	0.30					
3100	0.25					
3200	0.36	-0.34	-0.17	0.19	0.07	
3300		1.10	0.55	0.91	0.33	
3400		2.75	1.38	1.74	0.63	
3500		3.50	1.75	2.11	0.76	
3600		4.20	2.10	2.46	0.89	
3700		4.00	2.00	2.36	0.85	
3800		3.68	1.84	2.20	0.79	
3900		3.11	1.56	1.92	0.69	
4000		2.45	1.23	1.59	0.57	
4100	0.36	0.85	0.43	0.79	0.28	
4200						
4300						
4400						
4500						
4600						$\Sigma P = 5.86 \text{ g m}^{-2} \text{ day}^{-1}$
4700						

**Daylight savings time.



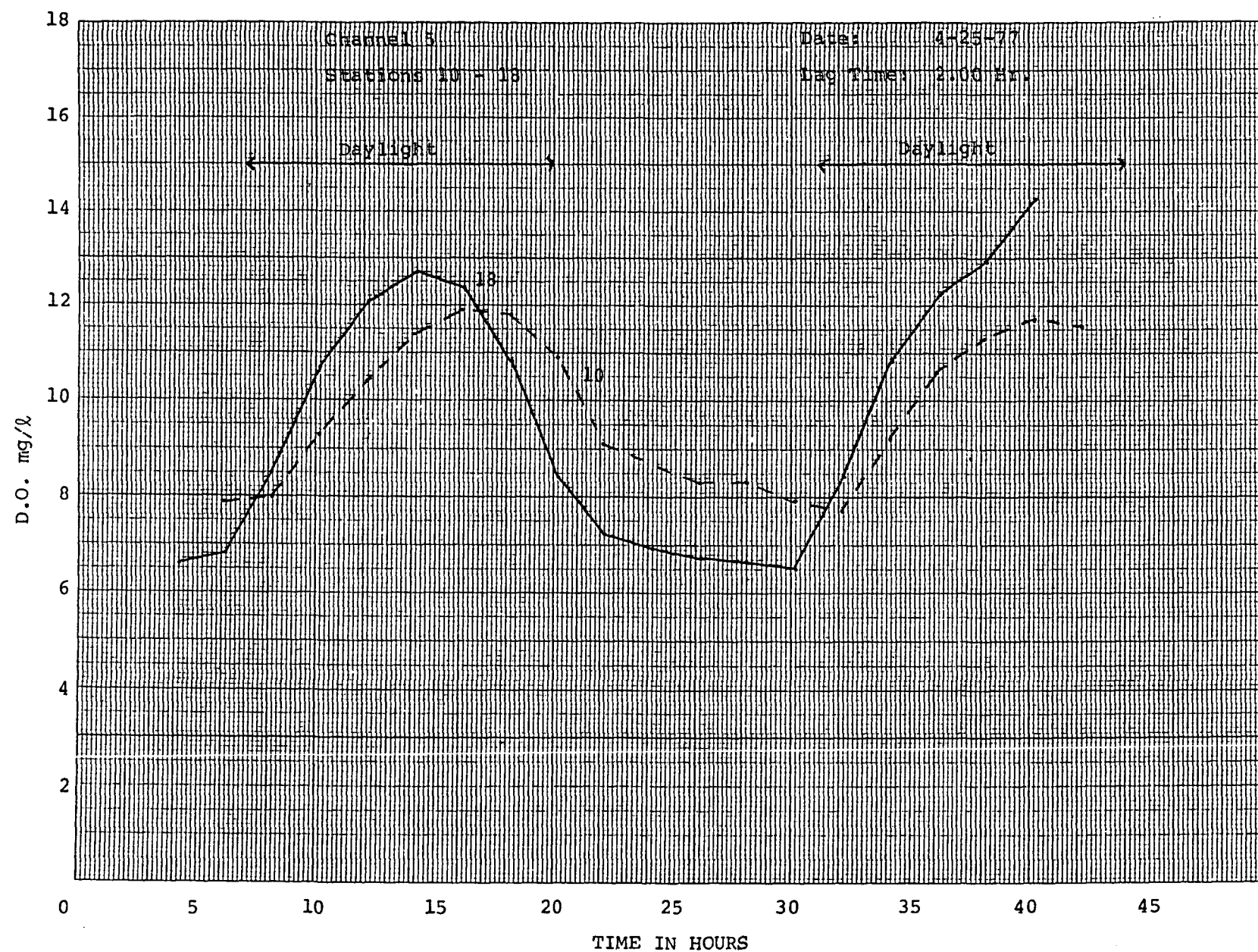
HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL
LOCATION OF REACH: Station 2 to 10 in Channel 5

Date: 4-25-77

Travel Time: 2.06 Hrs.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	ΔD $g\ m^{-3}$	ΔD $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700	0.84	-0.63	-0.37	0.53	0.18	
0800		0.12	0.06	0.90	0.31	
0900		0.49	0.24	1.08	0.37	
1000		0.81	0.39	1.23	0.42	
1100		1.05	0.51	1.35	0.46	
1200		1.26	0.61	1.45	0.49	
1300		1.17	0.57	1.41	0.48	
1400		1.06	0.51	1.35	0.46	
1500		0.83	0.40	1.24	0.42	
1600		0.55	0.27	1.11	0.38	
1700		0.05	0.02	0.86	0.29	
1800		-0.50	-0.24	0.60	0.20	
1900	0.84	-1.22	-0.59	0.25	0.09	
2000		-1.98	-0.96	-0.12		
2100						
2200	0.87					
2300	0.87					
2400	0.90					$\Sigma P = 4.55\ g\ m^{-2}\ day^{-1}$
2500	0.84					$\bar{R} = 0.84\ g\ m^{-3}\ hr^{-1}$
2600	0.78					
2700	0.81					
2800	0.85					
2900	0.82					
3000	0.78					
3100	0.84	-0.78	-0.38	0.46	0.16	
3200		0.12	0.06	0.90	0.31	
3300		0.64	0.31	1.15	0.39	
3400		1.08	0.52	1.36	0.46	
3500		1.12	0.54	1.38	0.47	
3600		1.10	0.53	1.37	0.47	
3700		1.10	0.53	1.37	0.47	
3800		1.07	0.52	1.36	0.46	
3900		0.92	0.45	1.29	0.44	
4000	0.84	0.68	0.33	1.17	0.40	
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 4.03\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

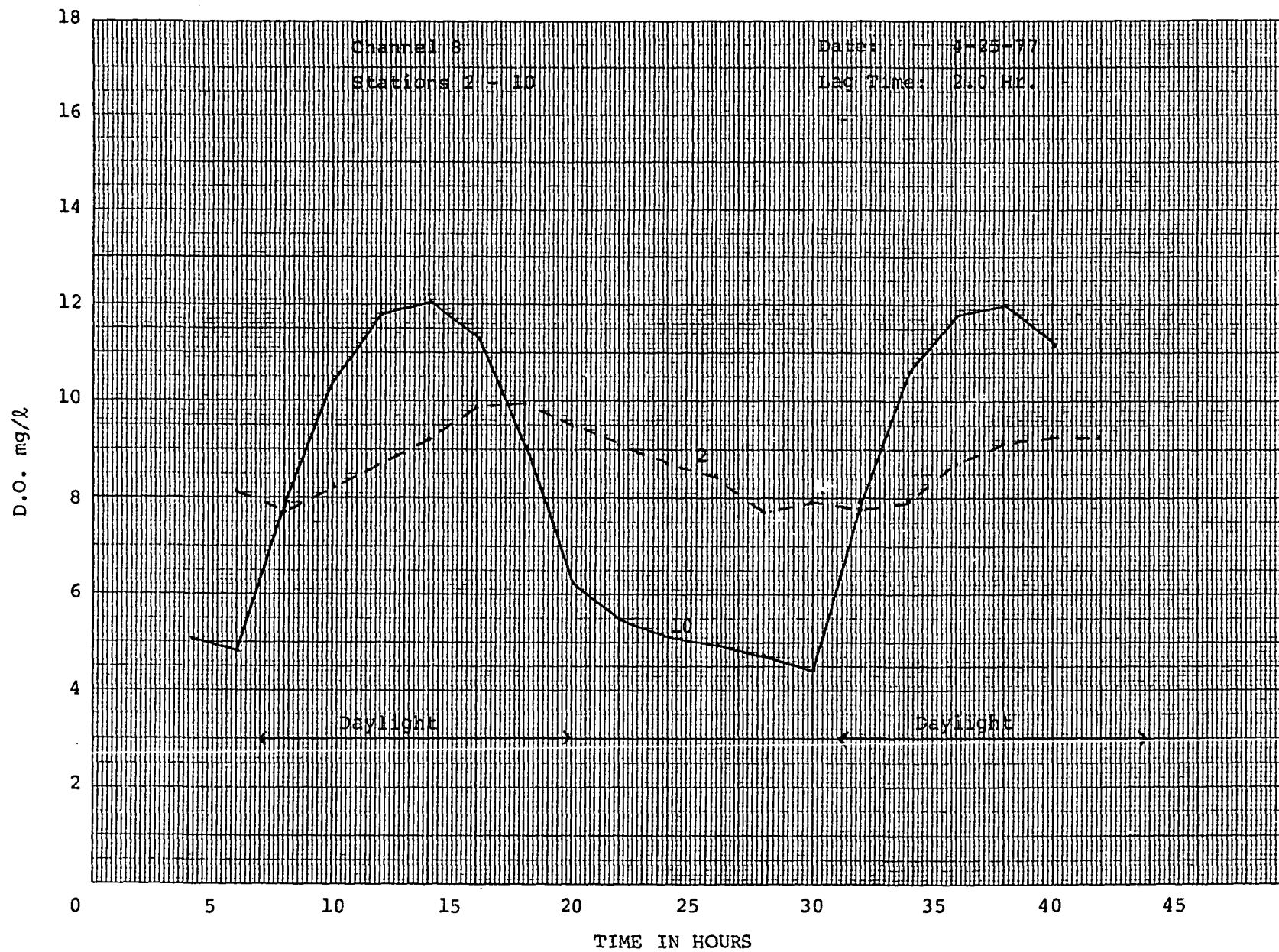
LOCATION OF REACH: Station 10 to 18 in Channel 5

Date: 4-25-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700	0.84	-0.42	-0.21	0.63	0.23	
0800		0.35	0.18	1.02	0.37	
0900		0.88	0.44	1.28	0.46	
1000		1.27	0.64	1.48	0.53	
1100		1.49	0.75	1.59	0.57	
1200		1.63	0.82	1.66	0.60	
1300		1.41	0.71	1.55	0.56	
1400		1.34	0.67	1.51	0.54	
1500		1.00	0.50	1.34	0.48	
1600		0.55	0.28	1.12	0.40	
1700		-0.07	-0.04	0.81	0.29	
1800		-0.82	-0.41	0.43	0.15	
1900	0.84	-1.51	-0.76	0.09	0.03	
2000		-2.31	-1.16	-0.32		
2100						
2200	0.94					
2300	0.91					
2400	0.88					$\Sigma P = 5.21 \text{ g m}^{-2} \text{ day}^{-1}$
2500	0.83					$\bar{R} = 0.84 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	0.79					
2700	0.76					
2800	0.81					
2900	0.84					
3000	0.83					
3100	0.84	-0.55	-0.28	0.51	0.18	
3200		0.48	0.24	1.08	0.39	
3300		1.02	0.51	1.35	0.49	
3400		1.46	0.73	1.57	0.57	
3500		1.57	0.79	1.63	0.59	
3600		1.56	0.78	1.62	0.58	
3700		1.60	0.80	1.64	0.59	
3800		1.57	0.79	1.63	0.59	
3900		1.98	0.99	1.83	0.66	
4000	0.84	2.43	1.22	2.06	0.74	
4100						
4200						
4300						
4400						
4500						
4600						$\Sigma P = 5.38 \text{ g m}^{-2} \text{ day}^{-1}$
4700						

**Daylight savings time.



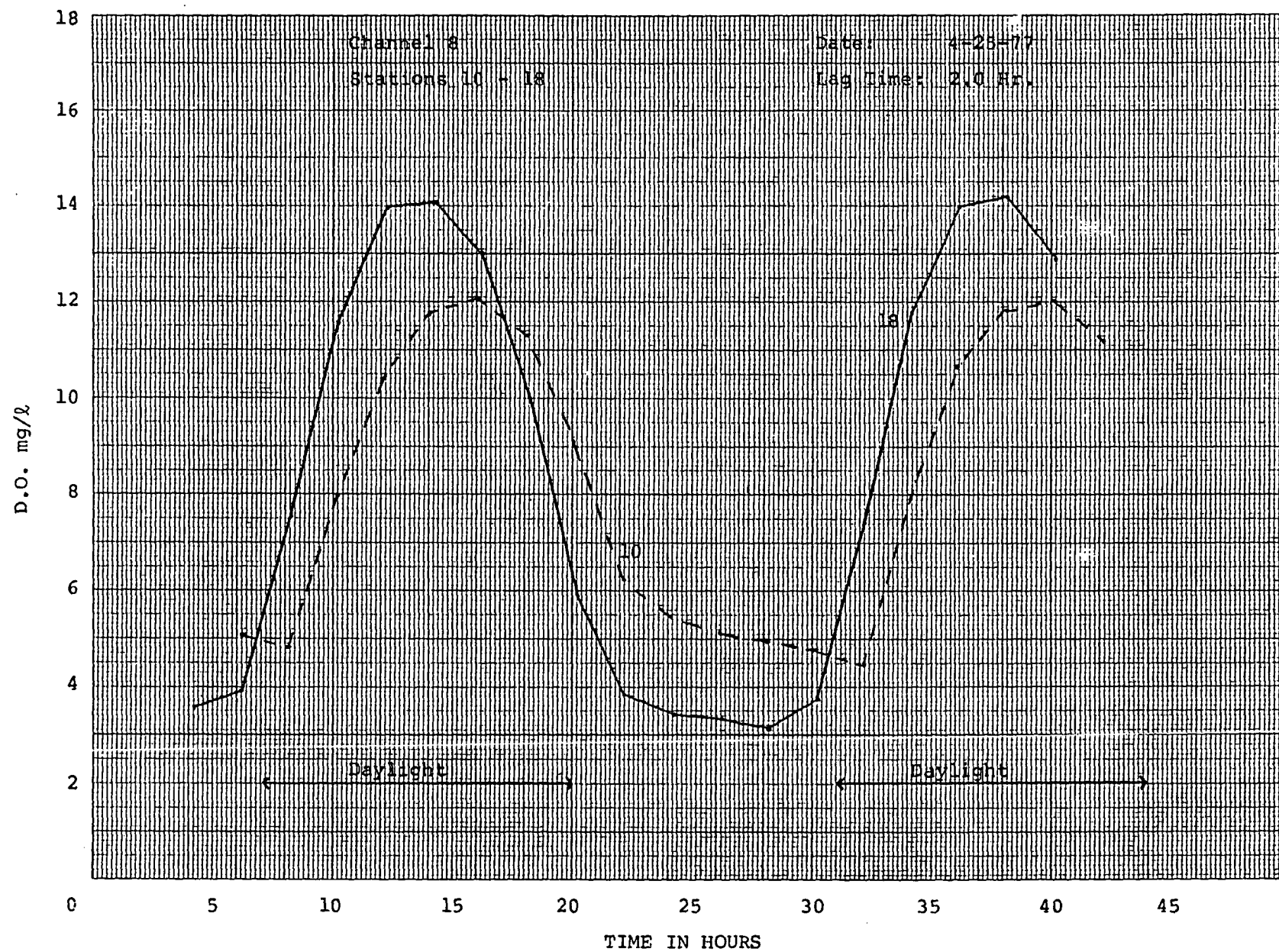
HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL
LOCATION OF REACH: Station 2 to 10 in Channel 8

Date: 4-25-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta D.O.$ g m^{-3}	$\Delta D.O.$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						D.O. below 3 mg/l were not used in computing R-value.
0100						
0200						
0300						
0400						
0500						
0600						
0700	1.72	-1.72	-0.86	0.86	0.29	
0800		0.05	0.03	1.74	0.59	
0900		1.07	0.54	2.25	0.77	
1000		2.10	1.05	2.77	0.94	
1100		2.60	1.30	3.02	1.03	
1200		3.07	1.54	3.26	1.11	
1300		2.96	1.48	3.20	1.09	
1400		2.83	1.42	3.13	1.06	
1500		2.02	1.01	2.73	0.93	
1600		1.50	1.25	2.966	1.01	
1700		-0.36	-0.18	1.54	0.52	
1800		-0.64	-0.32	1.40	0.48	
1900	1.72	-1.86	-0.93	0.79	0.27	
2000						
2100						
2200	1.81					
2300	1.81					
2400	1.81					$\Sigma P = 10.09 \text{ g m}^{-2} \text{ day}^{-1}$
2500	1.79					$\bar{R} = 1.72 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	1.74					
2700	1.63					
2800	1.49					
2900	1.62					
3000	1.74					
3100	1.72	-1.82	-0.91	0.81	0.28	
3200		0.00	0.80	1.72	0.58	
3300		1.23	0.62	2.33	0.79	
3400		2.55	1.275	2.991	1.02	
3500		2.80	1.40	3.12	1.06	
3600		3.00	1.50	3.22	1.09	
3700		2.96	1.48	3.20	1.09	
3800		2.88	1.44	3.16	1.07	
3900		2.44	1.22	2.936	1.00	
4000	1.72	2.00	1.00	2.72	0.92	
4100						
4200						
4300						
4400						
4500						
4600						$\Sigma P = 8.90 \text{ g m}^{-2} \text{ day}^{-1}$
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

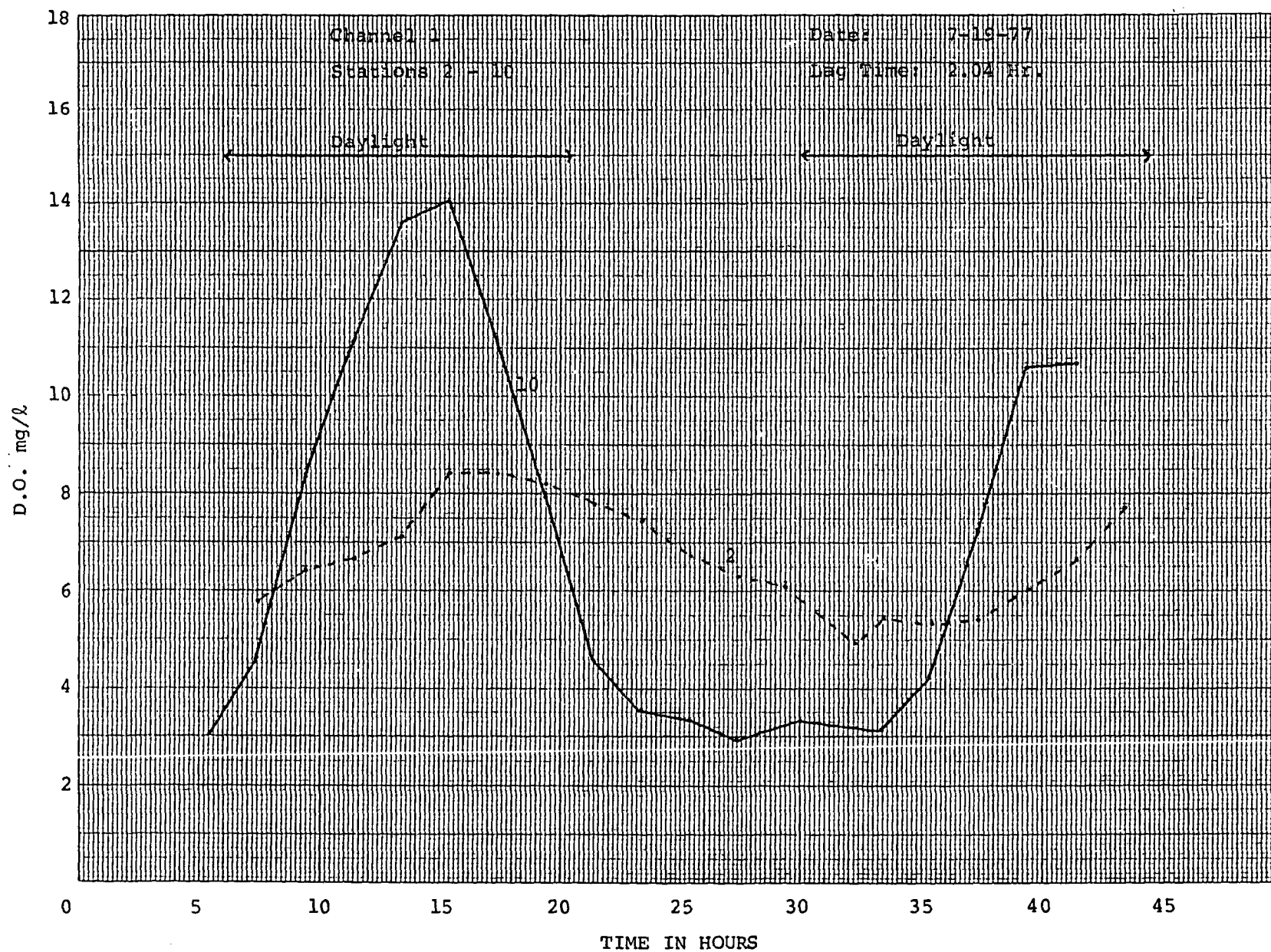
LOCATION OF REACH: Station 10 to 18 in Channel 8

Date: 4-25-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R_3 $g\ m^{-3}\ hr^{-1}$	$\Delta D_3 O_2$ $g\ m^{-3}$	$\Delta D_3 O_2$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700	↑ 0.92	0.37	0.19	1.11	0.40	
0800		2.32	1.16	2.08	0.75	
0900		2.95	1.48	2.40	0.86	
1000		3.40	1.70	2.62	0.94	
1100		3.45	1.73	2.65	0.95	
1200		3.45	1.73	2.65	0.95	
1300		3.04	1.52	2.44	0.88	
1400		2.28	1.14	2.06	0.74	
1500		1.78	0.89	1.81	0.65	
1600		1.10	0.55	1.47	0.53	
1700		0.16	0.08	1.00	0.36	
1800	↓ 0.92	-0.96	-0.48	0.44	0.16	
1900		-1.80	-0.90	0.02	0.01	
2000						
2100						
2200	1.20					
2300	1.10					
2400	1.03					$\Sigma P = 8.18\ g\ m^{-2}\ day^{-1}$
2500	0.98					$\bar{R} = 0.92\ g\ m^{-3}\ hr^{-1}$
2600	0.90					
2700	0.90					
2800	0.90					
2900	0.75					
3000	0.55					
3100	↑ 0.92	0.56	0.28	1.20	0.43	
3200		2.56	1.28	2.20	0.79	
3300		3.25	1.63	2.55	0.92	
3400		3.60	1.80	2.72	0.98	
3500		3.55	1.78	2.70	0.97	
3600		3.30	1.65	2.57	0.93	
3700		2.93	1.47	2.39	0.86	
3800		2.43	1.22	2.14	0.77	
3900	↓ 0.92	1.80	0.90	1.82	0.66	
4000		1.00	0.50	1.42	0.51	
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 7.82\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL
LOCATION OF REACH: Station 2 to 10 in Channel 1

Date: 7-19-77

Travel Time: 2.04 Hrs.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
--	-----------------------------	------------------------------	---------------------------------------	-----------------------------	-----------------------------	----------

0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700	1.63	-1.14	-0.56	1.07	0.43	
0800		0.45	0.22	1.85	0.74	
0900		1.96	0.96	2.59	1.04	
1000		3.12	1.53	3.16	1.26	
1100		4.35	2.13	3.76	1.50	
1200		5.32	2.61	4.24	1.70	
1300		6.34	3.11	4.74	1.90	
1400		5.96	2.92	4.55	1.82	
1500		5.57	2.73	4.36	1.74	
1600		4.10	2.01	3.64	1.46	
1700		2.63	1.29	2.92	1.17	
1800		1.16	0.57	2.20	0.88	
1900		-0.29	-0.14	1.49	0.60	
2000		-1.75	-0.86	0.77	0.31	
2100	1.63	-3.22	-1.58	0.55	0.02	
2200	1.63					

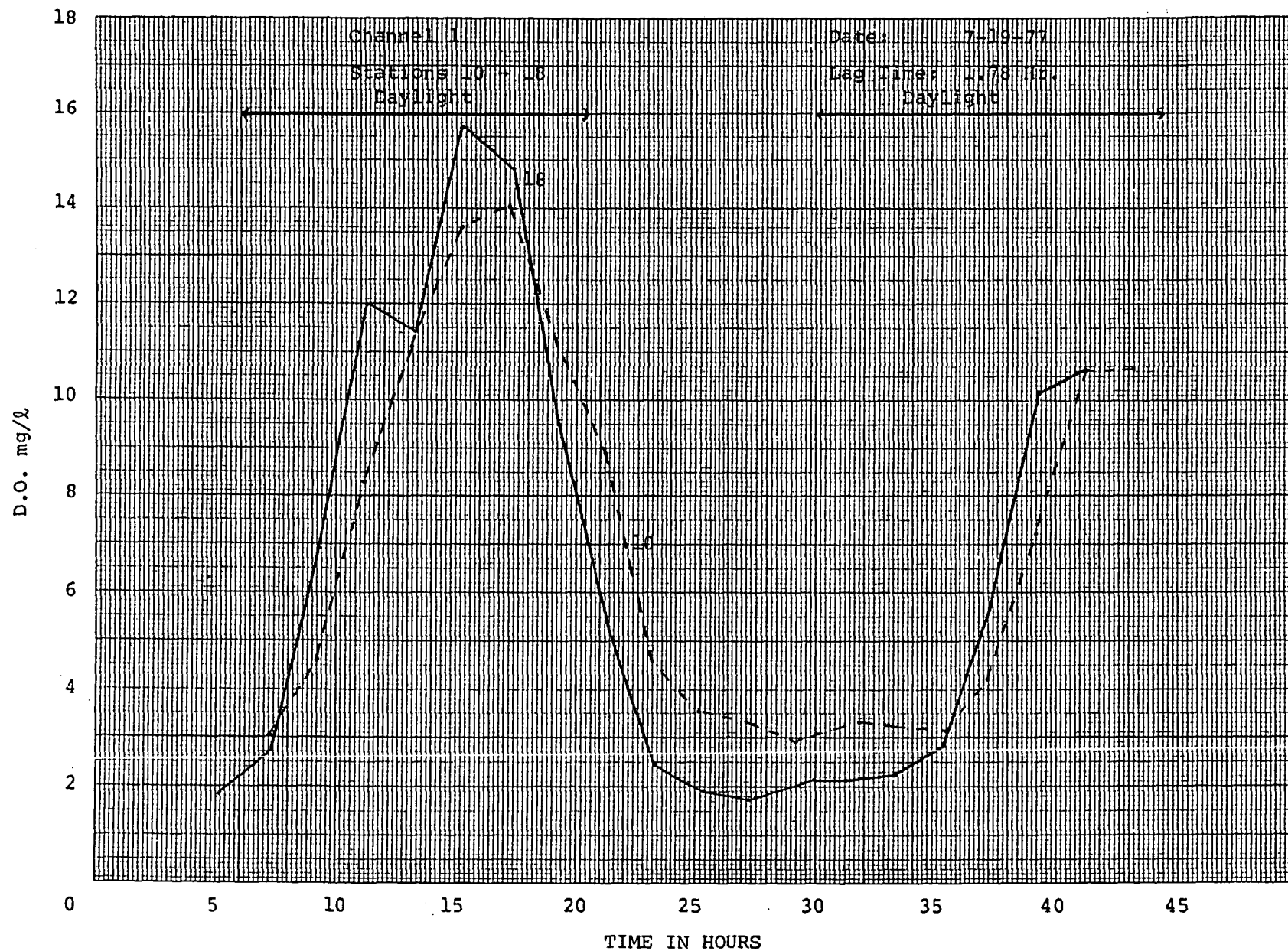
$$\Sigma P = 16.57\ g\ m^{-2}\ day^{-1}$$

$$R = 1.63\ g\ m^{-3}\ hr^{-1}$$

2300						
2400						
2500						
2600						
2700						
2800						
2900						
3000	1.63	-2.65	-1.30	0.33	0.13	
3100		-2.54	-1.25	0.38	0.15	
3200		-2.43	-1.19	0.44	0.18	
3300		-2.30	-1.13	0.50	0.20	
3400		-1.70	-0.83	0.80	0.32	
3500		-1.10	-0.54	1.09	0.44	
3600		0.33	0.16	1.79	0.72	
3700		1.80	0.88	2.51	1.00	
3800		3.19	1.56	3.19	1.28	
3900		4.58	2.24	3.88	1.55	
4000		4.30	2.11	3.74	1.50	
4100	1.63	4.05	1.98	3.62	1.45	
4200						
4300						
4400						
4500						
4600						
4700						

$$\Sigma P = 8.92\ g\ m^{-2}\ day^{-1}$$

**Daylight savings time.



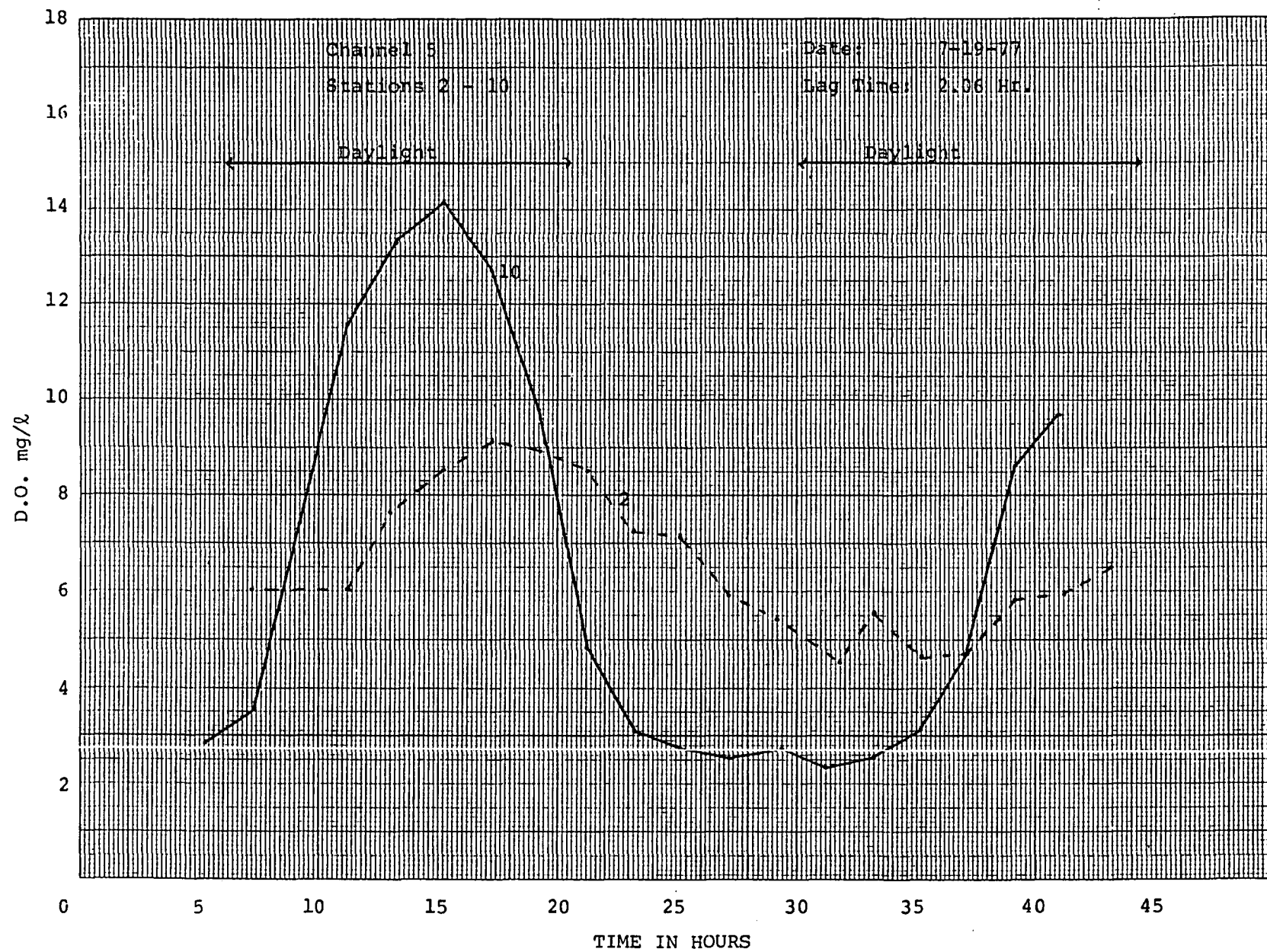
HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL
ON OF REACH: Stations 10 to 18 in Channel 1

Date: 7-19-77

Travel Time: 1.78 Hrs.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						
0100						
0200						
0300						
0400						
0500						
0600						
0700	0.53	-0.48	-0.27	0.27	0.10	
0800	1.02	0.20	0.11	1.13	0.43	
0900		1.41	0.79	1.82	0.69	
1000		1.99	1.12	2.14	0.81	
1100		2.62	1.47	2.49	0.95	
1200		2.94	1.65	2.68	1.02	
1300		2.51	1.41	2.44	0.93	
1400		2.24	1.26	2.28	0.87	
1500		1.94	1.09	2.11	0.80	
1600		1.73	0.97	1.99	0.76	
1700		1.03	0.58	1.60	0.61	
1800		0.59	0.33	1.35	0.51	
1900		-0.59	-0.33	0.70	0.27	
2000		-1.26	-0.71	0.32	0.12	
2100	1.02	-1.73	-0.97	0.05	0.02	
2200						
2300						
2400						$\Sigma P = 8.89\ g\ m^{-2}\ day^{-1}$
2500						
2600						$R = 1.02\ g\ m^{-3}\ hr^{-1}$
2700						
2800						
2900						
3000	1.02	-1.14	-0.64	0.38	0.14	
3100		-1.13	-0.64	0.38	0.14	
3200		-1.06	-0.60	0.42	0.16	
3300		-1.01	-0.57	0.45	0.17	
3400		-0.79	-0.44	0.58	0.22	
3500		-0.43	-0.24	0.78	0.30	
3600		0.00	0.00	1.02	0.39	
3700		0.95	0.53	1.55	0.59	
3800		1.45	0.82	1.84	0.70	
3900		2.13	1.20	2.22	0.84	
4000		1.67	0.94	1.96	0.74	
4100	1.02	0.18	0.10	1.12	0.43	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 4.82\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

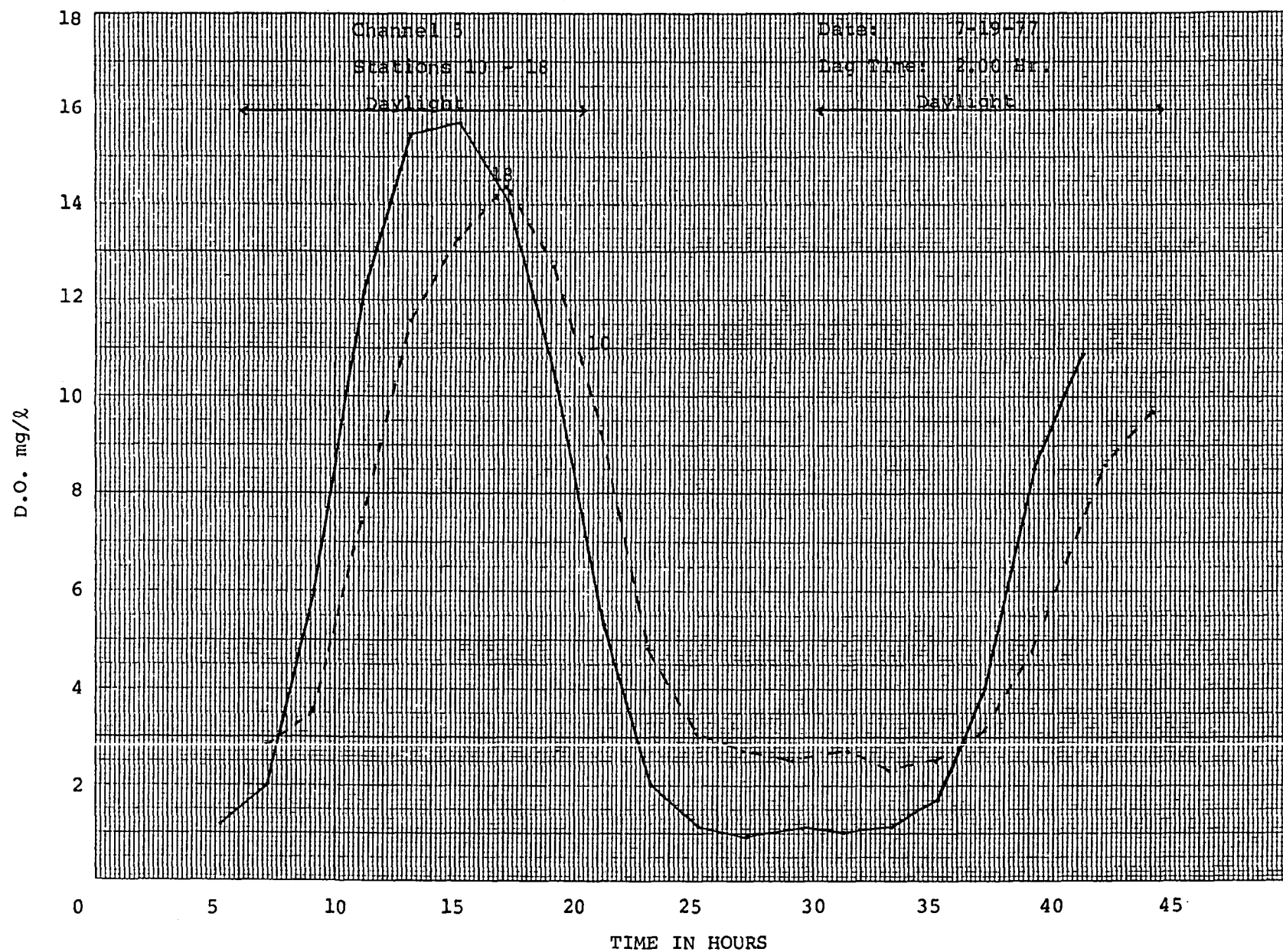
LOCATION OF REACH: Station 2 to 10 in Channel 5

Date: 7-19-77

Travel Time: 2.06

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						D.O. below 3 mg/l were not used in computing the R-values.
0100						
0200						
0300						
0400						
0500						
0600		2.00				
0700			-2.60	-1.26	0.70	0.28
0800			-0.95	-0.46	1.54	0.59
0900			1.05	0.51	2.51	0.95
1000			2.35	1.14	3.14	1.19
1100			3.65	1.77	3.77	1.43
1200			4.24	2.06	4.06	1.54
1300			4.70	2.28	4.28	1.63
1400			4.88	2.37	4.37	1.66
1500			4.99	2.42	4.42	1.68
1600			4.55	2.21	4.21	1.60
1700			3.98	1.93	3.93	1.49
1800			2.64	1.28	3.28	1.25
1900			1.07	0.52	2.52	0.96
2000			-0.45	-0.22	1.78	0.68
2100			-2.00	-0.97	1.03	0.39
2200		2.00	-3.17	-1.54	0.46	0.17
2300		1.98				
2400		2.14				$\Sigma P = 17.49\ g\ m^{-2}\ day^{-1}$
2500						$\bar{R} = 2.00\ g\ m^{-3}\ hr^{-1}$
2600						
2700						
2800						
2900						
3000		2.00	-2.62	-1.27	0.73	0.28
3100			-2.41	-1.17	0.83	0.32
3200			-2.02	-0.98	1.02	0.39
3300			-1.51	-0.73	1.27	0.48
3400			-0.90	-0.44	1.56	0.59
3500			-0.10	-0.05	1.95	0.74
3600			1.10	0.53	2.53	0.96
3700			2.50	1.21	3.21	1.22
3800			3.19	1.55	3.55	1.35
3900		2.00	3.70	1.80	3.80	1.44
4000						
4100						
4200						
4300						
4400						
4500						
4600						$\Sigma P = 7.77\ g\ m^{-2}\ day^{-1}$
4700						

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

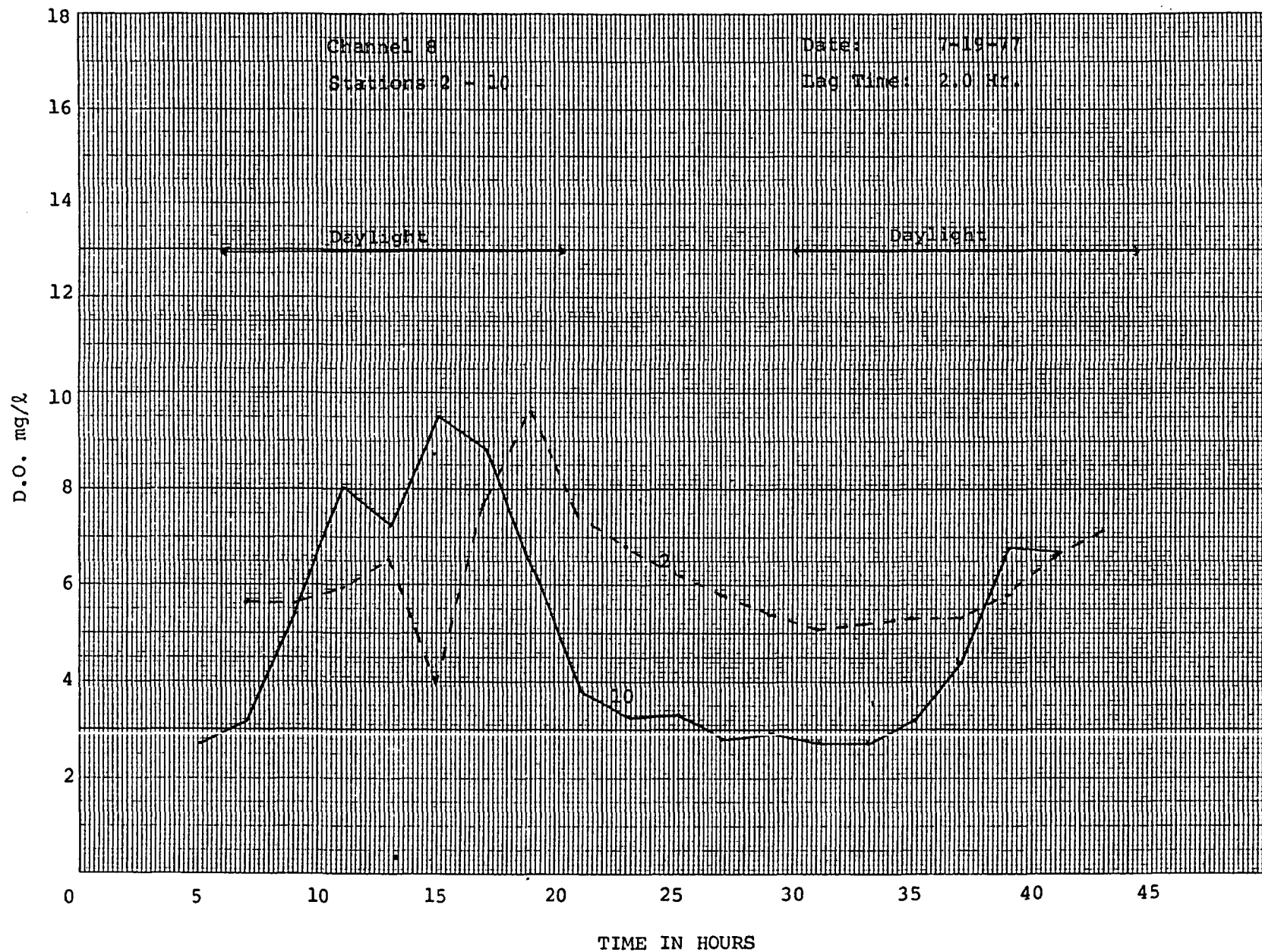
LOCATION OF REACH: Stations 10 to 18 in Channel 5

Date: 7-19-77

Travel Time: 2.01 Hrs.

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						D.O. below 3 mg/l were not used in computing the R-value.
0100						
0200						
0300						
0400						
0500						
0600		1.70				
0700			-0.94	1.23	0.46	
0800			-0.22	1.59	0.59	
0900			1.86	2.63	0.97	
1000			2.76	3.08	1.14	
1100			3.90	3.65	1.35	
1200			4.06	3.73	1.38	
1300			3.60	3.50	1.30	
1400			3.30	3.35	1.24	
1500			2.52	2.96	1.10	
1600			1.60	2.50	0.93	
1700			0.40	1.90	0.70	
1800		1.70	-0.60	1.40	0.52	
1900				0.77	0.28	
2000				0.41	0.15	
2100						
2200		1.70				
2300						
2400						$\Sigma P = 12.11\ g\ m^{-2}\ day^{-1}$
2500						$\bar{R} = 1.70\ g\ m^{-3}\ hr^{-1}$
2600						
2700						
2800						
2900						
3000		1.70	-1.44	0.98	0.36	
3100			-1.66	0.87	0.32	
3200			-1.49	0.96	0.36	
3300			-1.26	1.07	0.40	
3400			-1.09	1.16	0.43	
3500			-0.89	1.26	0.47	
3600			-0.30	1.55	0.57	
3700			0.56	1.98	0.73	
3800			1.67	2.54	0.94	
3900			3.07	3.24	1.20	
4000			2.86	3.13	1.16	
4100		1.70	2.16	2.78	1.03	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 7.97\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

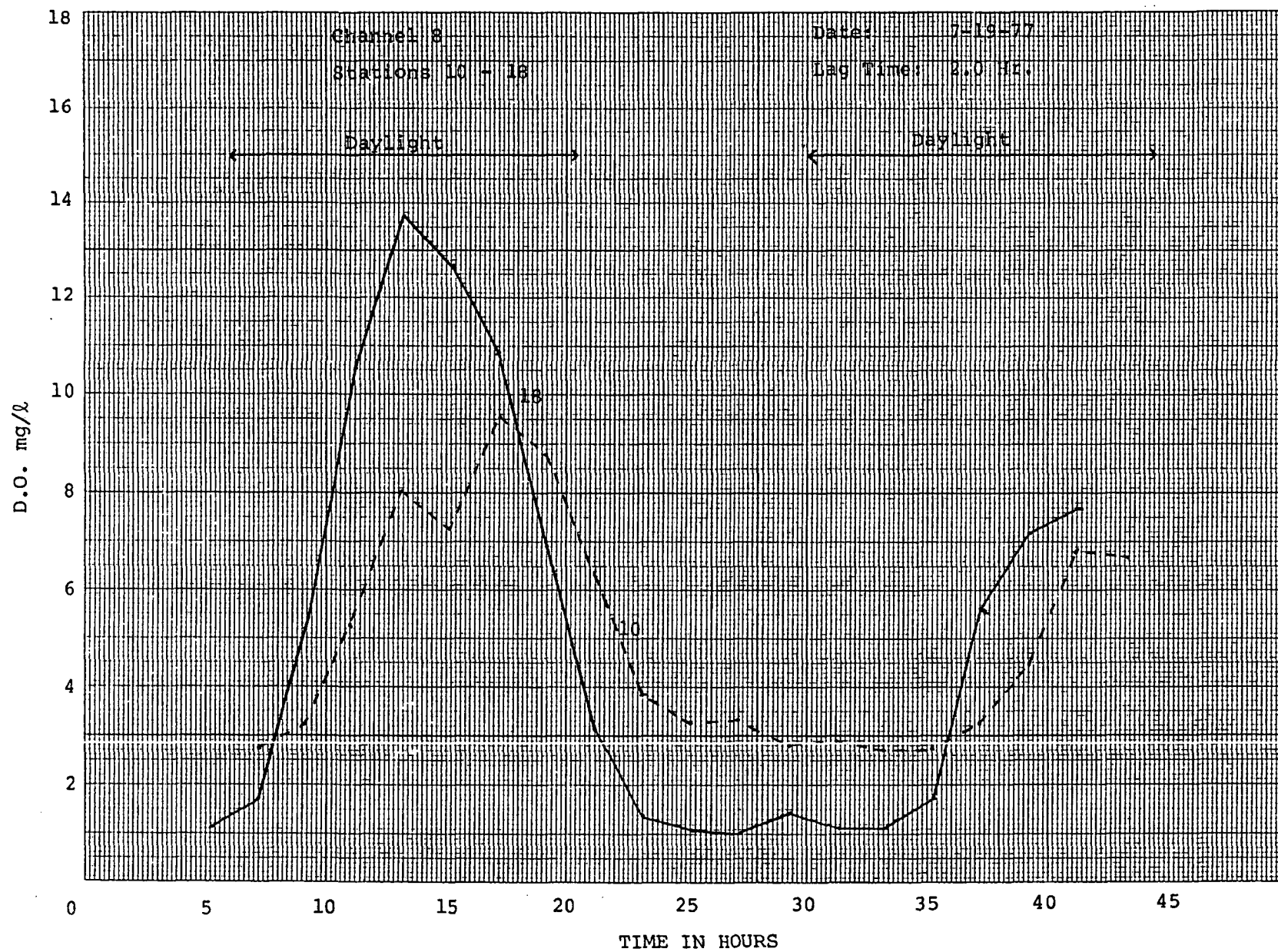
LOCATION OF REACH: Stations 2 to 10 in Channel 8

Date: 7-19-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						1) Depletion in D.O. during the day occurs in both curves..
0100						
0200						
0300						
0400						2) D.O. values below 3 mg/l not used in computing respiration rates.
0500						
0600	1.58					
0700		-2.50	-1.25	0.33	0.13	
0800		-1.35	-0.68	0.90	0.36	
0900		-0.35	-0.18	1.41	0.56	
1000		0.81	0.41	1.99	0.80	
1100		2.00	1.00	2.58	1.03	
1200		1.50	0.75	2.33	0.98	
1300		0.78	0.39	1.97	0.97	
1400		2.90	1.45	3.03	1.21	
1500		5.40	2.70	4.28	1.71	
1600		3.40	1.70	3.28	1.31	
1700		1.22	0.61	2.19	0.88	
1800		-0.85	-0.43	1.16	0.46	
1900		-3.10	-1.55	0.03	0.01	
2000	1.58	-3.30	-1.65			
2100						
2200						
2300	1.76					
2400	1.62					$\Sigma P = 10.41 \text{ g m}^{-2} \text{ day}^{-1}$
2500	1.47					$\bar{R} = 1.58 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	1.47					
2700						
2800						
2900						
3000	1.58	-2.45	-1.23	0.36	0.14	
3100		-2.40	-1.20	0.38	0.15	
3200		-2.43	-1.22	0.37	0.15	
3300		-2.50	-1.25	0.33	0.13	
3400		-2.35	-1.18	0.41	0.16	
3500		-2.15	-1.08	0.51	0.20	
3600		-1.60	-0.80	0.78	0.31	
3700		-1.00	-0.50	1.08	0.43	
3800		-0.10	-0.05	1.53	0.61	
3900		0.84	0.42	2.00	0.80	
4000		0.56	0.28	1.86	0.74	
4100	1.58	0.12	0.06	1.64	0.66	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 4.48 \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

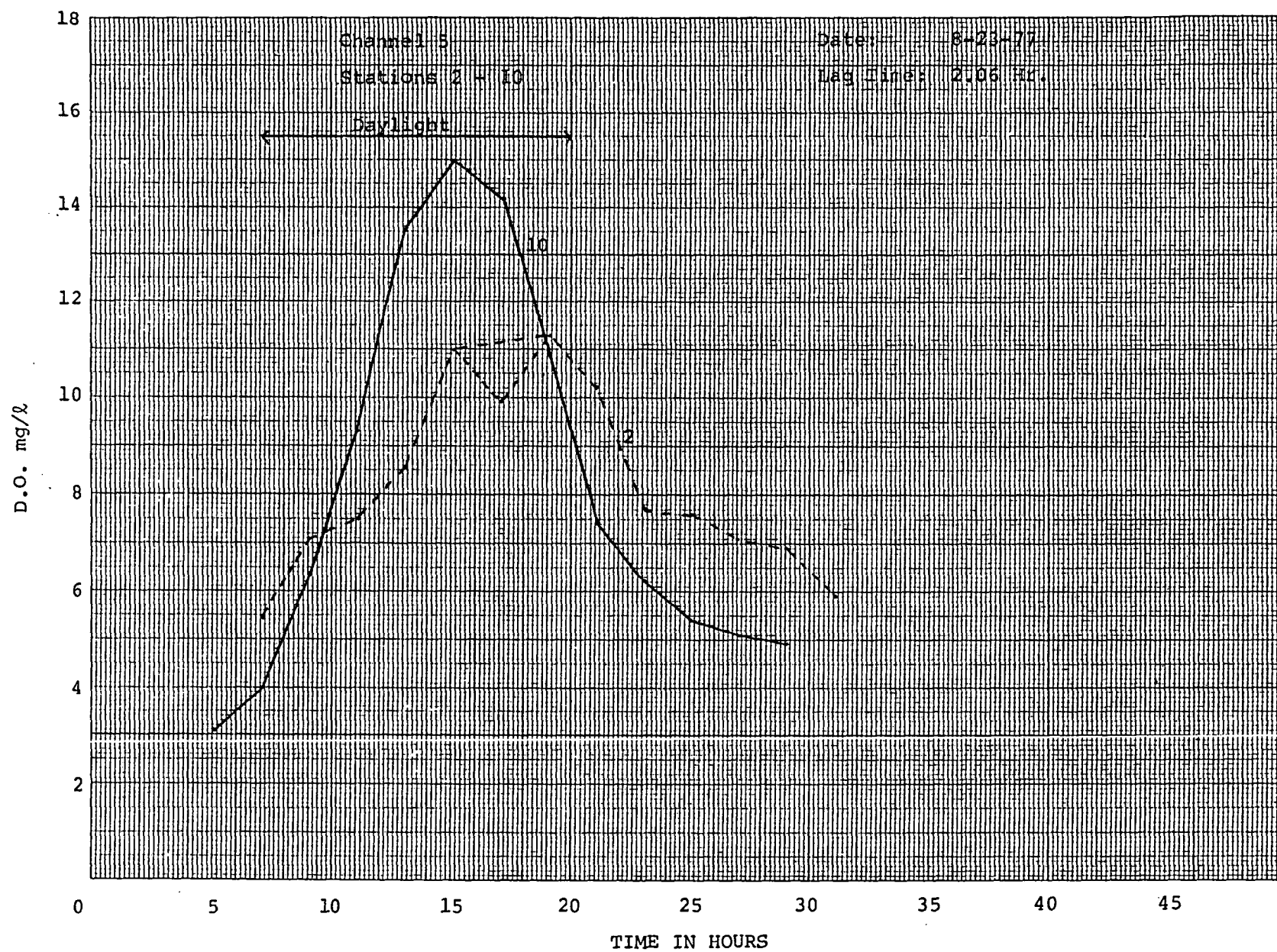
LOCATION OF REACH: Stations 10 to 18 in Channel 8

Date: 7-19-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	$R, g\ m^{-3}\ hr^{-1}$	$\Delta D, O_2, g\ m^{-3}$	$\Delta D, O_2, g\ m^{-3}\ hr^{-1}$	$P, g\ m^{-3}\ hr^{-1}$	$P, g\ m^{-2}\ hr^{-1}$	Comments
0000						1) D.O. values below 3 mg/l would not be used in computing respiration rate due to D.O. limitation.
0100						
0200						
0300						
0400						2) Respiration rate assumed same upstream as downstream.
0500						
0600	1.58					
0700						
0800		0.20	0.10	1.68	0.64	
0900		1.80	0.80	2.48	0.94	
1000		3.10	1.55	3.13	1.19	
1100		4.70	2.35	3.93	1.49	
1200		5.25	2.63	4.21	1.60	
1300		5.50	2.75	4.33	1.65	
1400		5.66	2.83	4.41	1.68	
1500		5.50	2.75	4.33	1.65	
1600		3.80	1.90	3.48	1.32	
1700		1.70	0.85	2.43	0.92	
1800		0.05	0.03	1.61	0.61	
1900		-1.55	-0.78	0.81	0.31	
2000	1.58	-2.35	-1.175	0.41	0.16	
2100						
2200						
2300						
2400						$\Sigma P = 14.16\ g\ m^{-2}\ day^{-1}$
2500						$\bar{R} = 1.58\ g\ m^{-3}\ hr^{-1}$
2600						
2700						
2800						
2900						
3000	1.58	-1.54	-0.77	0.81	0.31	
3100		-1.77	-0.89	0.69	0.26	
3200		-1.70	-0.85	0.73	0.28	
3300		-1.60	-0.80	0.78	0.30	
3400		-1.40	-0.70	0.88	0.33	
3500		-1.07	-0.54	1.05	0.40	
3600		0.25	0.13	1.71	0.65	
3700		2.00	1.00	2.58	0.98	
3800		2.45	1.23	2.81	1.07	
3900		2.65	1.33	2.91	1.11	
4000		1.95	0.98	2.56	0.97	
4100	1.58	0.95	0.48	2.06	0.78	
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = 7.44\ g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

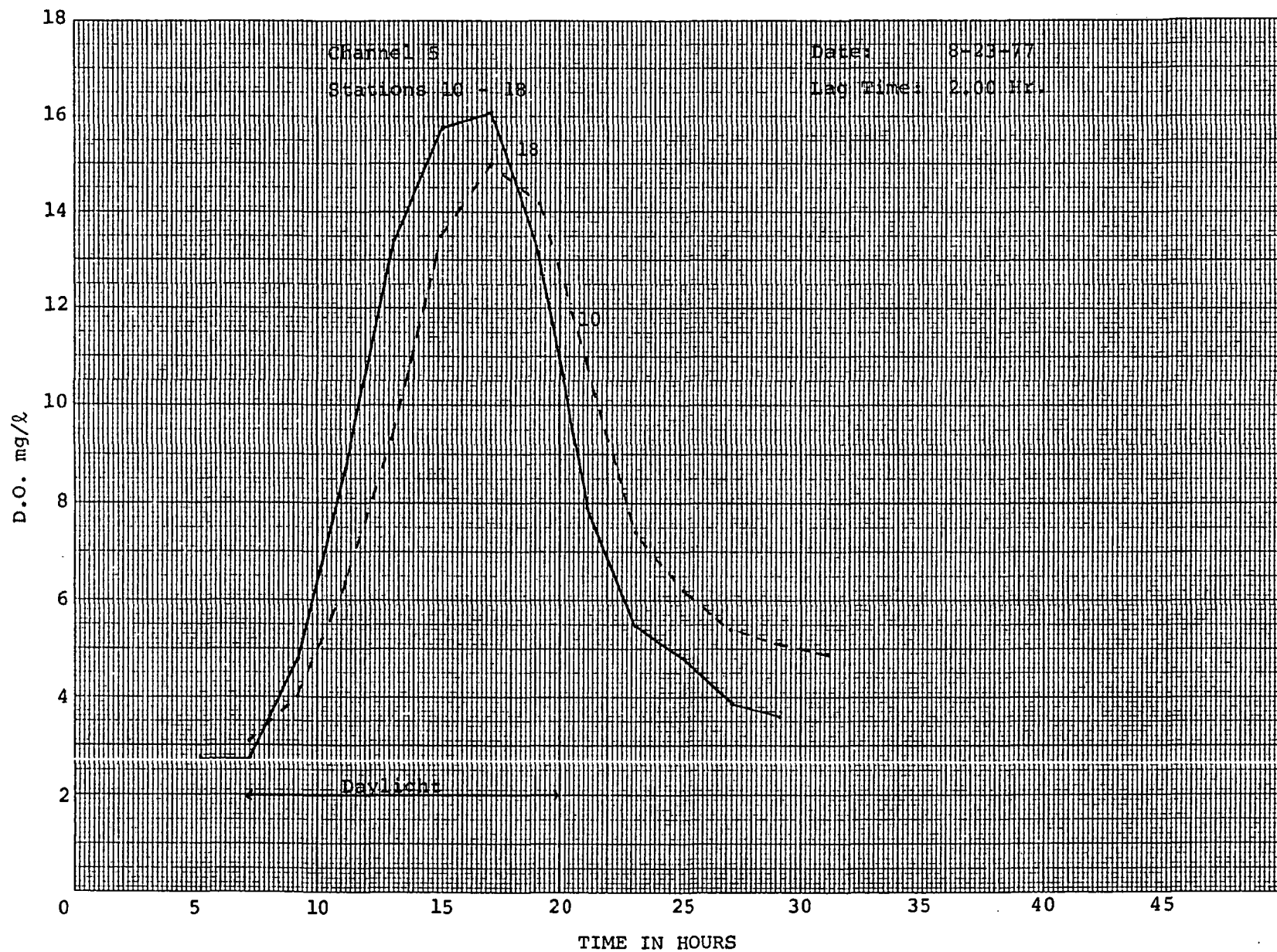
LOCATION OF REACH: Stations 2 to 10 in Channel 5

Date: 8-23-77

Travel Time: 2.06 Hrs

Time at Downstream Station (hrs)	R $g\ m^{-3}\ hr^{-1}$	$\Delta D.O.$ $g\ m^{-3}\ *$	$\Delta D.O.$ $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-3}\ hr^{-1}$	P $g\ m^{-2}\ hr^{-1}$	Comments
0000						
0100						1) D.O. error in Station 2
0200						1610 Hrs.
0300						
0400						
0500						
0600						
0700						
0800	1.06	-1.16	-0.56	0.50	0.19	
0900		-0.81	-0.39	0.67	0.25	
1000		0.35	0.17	1.23	0.47	
1100		1.70	0.83	1.89	0.72	
1200		3.22	1.56	2.62	1.00	
1300		4.82	2.34	3.40	1.29	
1400		4.53	2.20	3.26	1.24	
1500		4.07	1.98	3.04	1.16	
1600		3.61	1.75	2.81	1.07	
1700		3.11	1.51	2.57	0.98	
1800		1.61	0.78	1.84	0.70	
1900		-0.12	-0.06	1.00	0.38	
2000	1.06	-1.42	-0.69	0.37	0.14	
2100						
2200	1.12					
2300	1.31					
2400	0.90					$\Sigma P = 9.59\ g\ m^{-2}\ day^{-1}$
2500	1.08					$\bar{R} = 1.06\ g\ m^{-3}\ hr^{-1}$
2600	1.06					
2700	1.02					
2800	1.01					
2900	1.01					
3000						
3100						
3200						
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = g\ m^{-2}\ day^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

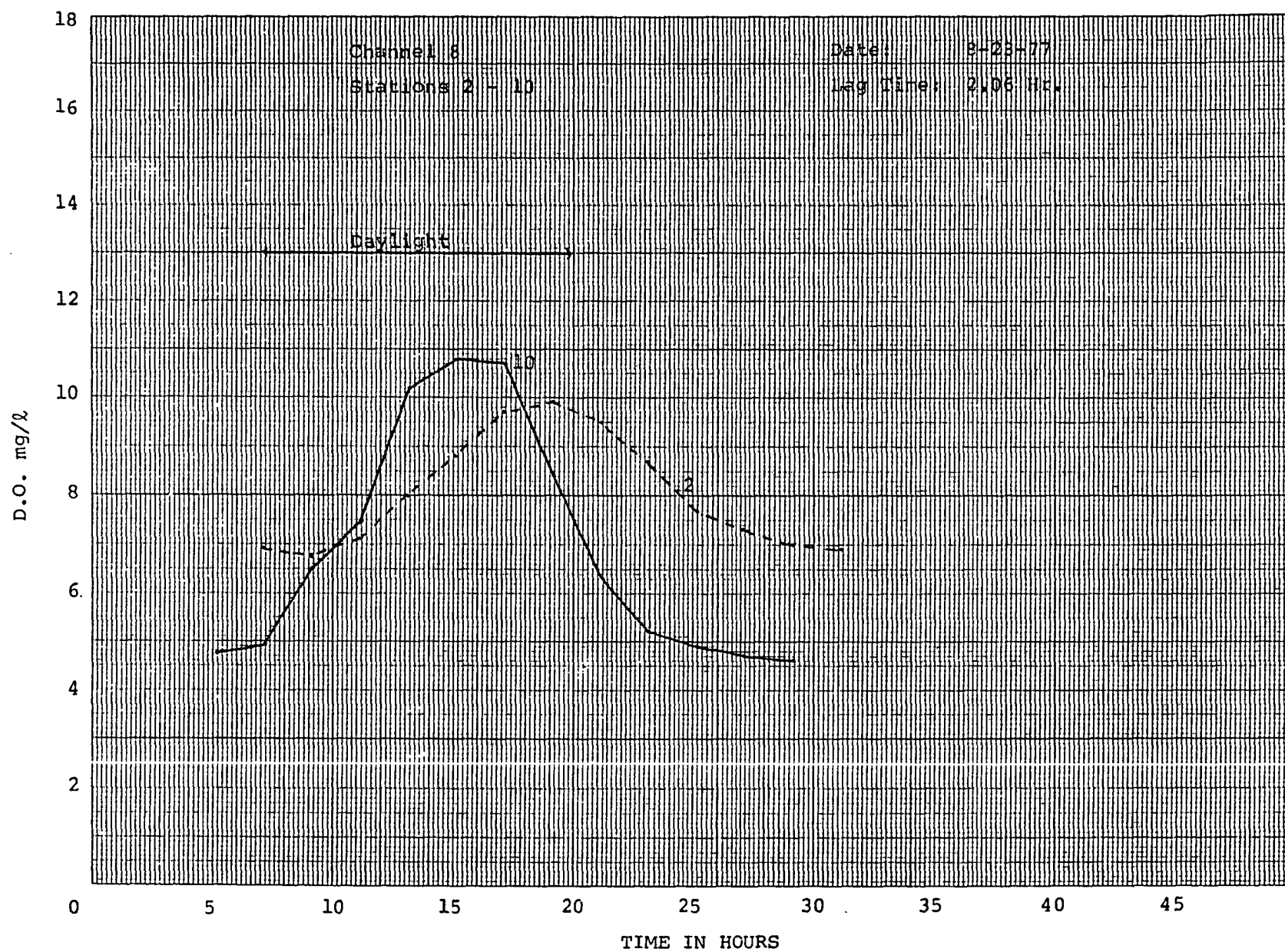
LOCATION OF REACH: Stations 10 to 18 in Channel 5

Date: 8-23-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta \text{D.O.}$ g m^{-3}	$\Delta \text{D.O.}$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
0000						**
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800	0.86	0.60	0.30	1.16	0.43	
0900		0.64	0.32	1.18	0.44	
1000		1.38	0.69	1.55	0.57	
1100		2.20	1.10	1.96	0.73	
1200		2.95	1.48	2.34	0.87	
1300		3.75	1.88	2.74	1.01	
1400		3.21	1.61	2.47	0.91	
1500		2.29	1.15	2.01	0.74	
1600		1.78	0.89	1.75	0.65	
1700		1.21	0.61	1.47	0.54	
1800		0.25	0.13	0.99	0.37	
1900		-0.85	-0.43	0.44	0.16	
2000	0.86	-1.18	-0.95	-0.11		
2100						
2200	1.26					
2300	0.99					
2400	0.86					$\Sigma P = 7.42 \text{ g m}^{-2} \text{ day}^{-1}$
2500	0.72					$\bar{R} = 0.86 \text{ g m}^{-3} \text{ hr}^{-1}$
2600	0.73					
2700	0.74					
2800	0.75					
2900						
3000						
3100						
3200						
3300						
3400						
3500						
3600						
3700						
3800						
3900						
4000						
4100						
4200						
4300						
4400						
4500						
4600						
4700						$\Sigma P = \text{ g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 2 to 10 in Channel 8

Date: 8-23-77

Travel Time: 2.06 Hrs

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	ΔD g m^{-3}	ΔD $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments
--	---	---------------------------------	--	---	---	----------

0000 **

0100

0200

0300

0400

0500

0600

0700

0800 1.39 -1.28 -0.62 0.77 0.31

0900 -0.41 -0.20 1.19 0.48

1000 -0.02 -0.01 1.38 0.55

1100 0.30 0.15 1.54 0.62

1200 1.03 0.50 1.89 0.76

1300 1.98 0.96 2.35 0.94

1400 2.09 1.01 2.40 0.96

1500 1.98 0.96 2.35 0.94

1600 1.54 0.75 2.14 0.86

1700 1.05 0.51 1.90 0.76

1800 -0.05 -0.02 1.37 0.55

1900 -1.27 -0.62 0.77 0.31

2000 1.39 -2.18 -1.06 0.33 0.13

2100

2200 1.59

2300 1.67

2400 1.53 $P = 8.17 \text{ g m}^{-2} \text{ day}^{-1}$

2500 1.37 $\bar{R} = 1.39 \text{ g m}^{-3} \text{ hr}^{-1}$

2600 1.31

2700 1.21

2800 1.21

2900 1.21

3000

3100

3200

3300

3400

3500

3600

3700

3800

3900

4000

4100

4200

4300

4400

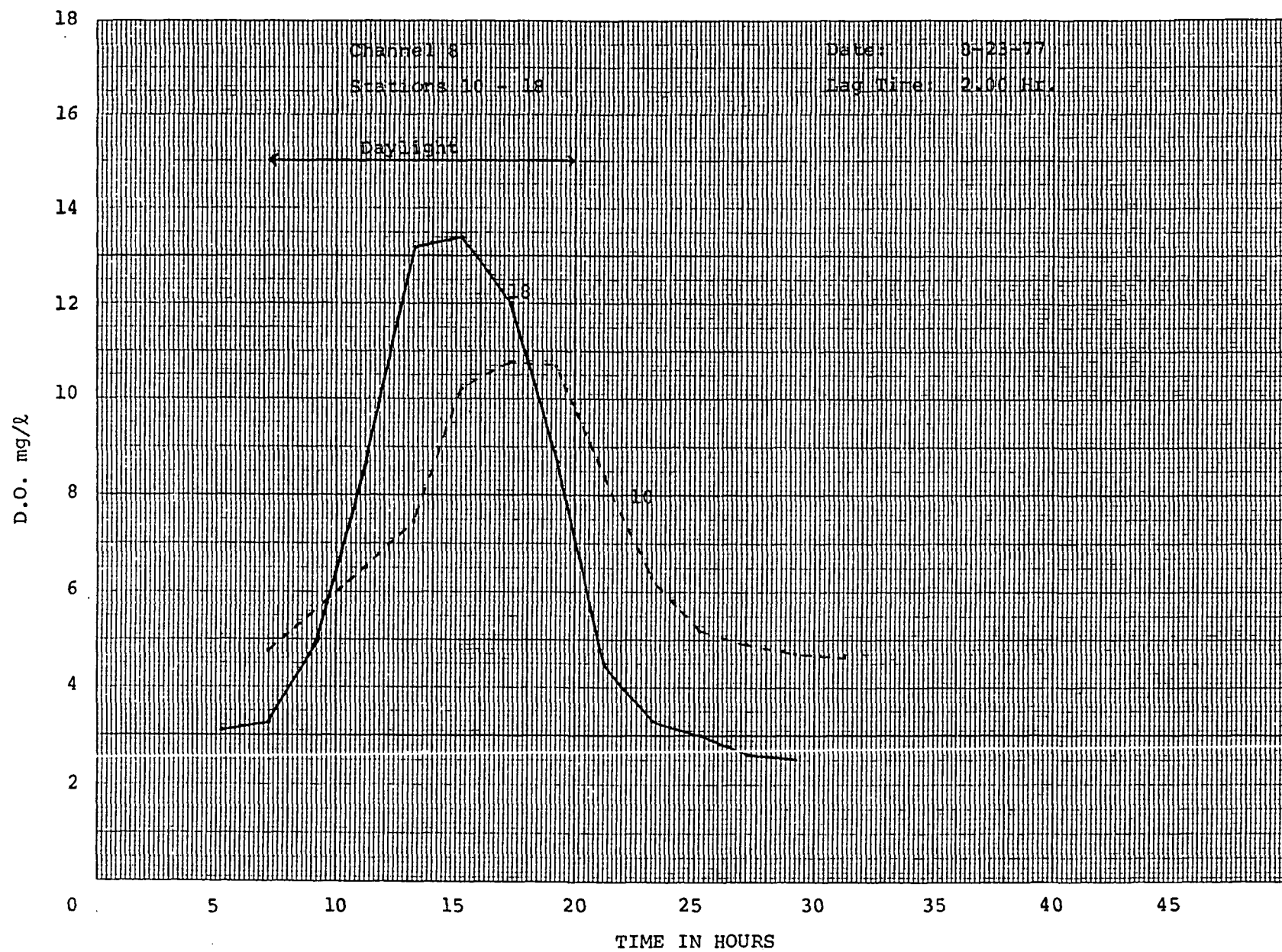
4500

4600

4700

$P = \text{g m}^{-2} \text{ day}^{-1}$

**Daylight savings time.



HOURLY RESPIRATION & PHOTOSYNTHETIC RATES FROM D.O. DIFFERENTIAL

LOCATION OF REACH: Station 10 to 18 in Channel 8

Date: 8-23-77

Travel Time: 2.00 Hrs.

Time at Downstream Station (hrs)	R $\text{g m}^{-3} \text{hr}^{-1}$	$\Delta D.O.$ g m^{-3}	$\Delta D.O.$ $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-3} \text{hr}^{-1}$	P $\text{g m}^{-2} \text{hr}^{-1}$	Comments	
0000	**					D.O. values below 3 mg/l not used in calculating R-value	
0100							
0200							
0300							
0400							
0500							
0600							
0700	1.59	-1.17	-0.59	1.00	0.38		
0800		-0.78	-0.39	1.20	0.46		
0900		0.39	0.20	1.79	0.68		
1000		1.80	0.90	2.49	0.95		
1100		3.50	1.75	3.34	1.27		
1200		4.77	2.39	3.98	1.51		
1300		4.79	2.40	3.99	1.52		
1400		3.50	1.75	3.34	1.27		
1500		2.46	1.23	2.82	1.07		
1600		1.52	0.76	2.35	0.89		
1700		0.16	0.08	1.67	0.63		
1800		-1.52	-0.76	0.83	0.32		
1900	1.59	-2.62	-1.31	0.28	0.11		
2000	1.81					$\Sigma P = 11.06 \text{ g m}^{-2} \text{ day}^{-1}$ $\bar{R} = 1.59 \text{ g m}^{-3} \text{ hr}^{-1}$	
2100							
2200							
2300							
2400	1.43						
2500	1.54						
2600							
2700							
2800							
2900							
3000							
3100							
3200							
3300							
3400							
3500							
3600							
3700							
3800							
3900							
4000							
4100							
4200							
4300							
4400							
4500							
4600							
4700						$\Sigma P = \text{g m}^{-2} \text{ day}^{-1}$	

**Daylight savings time.

APPENDIX C

HYDRAULIC MEAN DEPTHS FOR 1976-77

DIEL D.O. CURVE ANALYSIS

HYDRAULIC MEAN DEPTHS FOR 1976-77 DIEL D.O. CURVE ANALYSIS (METERS)

Date	Channel Nos.			
Station Nos.	1	4	5	8
7-28-76				
6 10	0.53 a	0.53 a	0.53 a	0.53 a
14 18	0.49 a	0.49 a	0.49 a	0.49 a
8-5-76				
6 10	0.53 a	0.53 a	0.53 a	0.53 a
14 18	0.49 a	0.49 a	0.49 a	0.49 a
10-27-76				
2 10			0.34 b	0.34 b
10 18			0.36 b	0.36 b
1-26-77				
2 10			0.34 b	0.34 b
10 18			0.36 b	0.36 b
4-25-77				
2 10			0.34 b	0.34 b
10 18			0.36 b	0.36 b
7-19-77				
2 10	0.40 c		0.38 c	0.40 c
10 18	0.38 c		0.37 c	0.38 c
8-23-77				
2 10			0.38 c	0.40 c
10 18			0.37 c	0.38 c

a - Determined from 10-4-76 and 10-18-76 morphological survey in Channel 1.

b - Determined from 4-6-77 morphological survey in Channel 1.

c - Determined from 8-4-77 and 8-5-77 morphological survey in Channels 5 and 8.

APPENDIX D

COEFFICIENT DERIVATION FOR
ADJUSTMENT OF PARTIAL DAILY
RATES OF PHOTOSYNTHESIS TO
TOTAL DAILY RATES OF PHOTOSYNTHESIS

(EXAMPLE)

HOURLY PHOTOSYNTHETIC RATES ($\text{gm}^{-2} \text{hr}^{-1}$) FROM D.O.

DIFFERENTIAL ON APRIL 25, 1977.

Time at Downstream Station (hrs.)	Channel 5 Station 2 to 10	Channel 5 Station 10 to 18	Channel 8 Station 2 to 10	Channel 8 Station 10 to 18
0000				
0100				
0200				
0300				
0400				
0500				
0600				
0700	0.18	0.23	0.29	0.40
0800	0.31	0.37	0.59	0.75
0900	0.37	0.46	0.77	0.86
1000	0.42	0.53	0.94	0.94
1100	0.46	0.57	1.03	0.95
1200	0.49	0.60	1.11	0.95
1300	0.48	0.56	1.09	0.88
1400	0.46	0.54	1.06	0.74
1500	0.42	0.48	0.93	0.65
1600	0.38	0.40	1.01	0.53
1700	0.29	0.29	0.52	0.36
1800	0.20	0.15	0.48	0.16
1900	0.09	0.03	0.27	0.01
2000				
2100				
2200				
2300				
2400				
$\Sigma P(\text{total})$	4.55	5.21	10.09	8.18
$\Sigma P(10 \text{ hours})$	3.97	4.74	8.82	7.65
=	=	=	=	=
	1.15	1.10	1.14	1.07

$$\text{Mean Coefficient Value} = \frac{4.46}{4} = 1.12$$

The 4-26-77 data set contained only 10 of the 13 daylight hours. The coefficient was derived by dividing the total daily photosynthetic rates for each segment by the sum of the first 10 hourly photosynthetic rates. The four coefficients were averaged to determine a mean coefficient value that represents the fraction by which the 4-26-77 photosynthetic rates were initially underestimated.

APPENDIX E

DORM INPUT DATA AND
SIMULATION PRINTOUTS FOR 8 RUNS
(INPUT DATA FORMAT FOLLOWS SPECIFICATIONS IN
APPENDIX B OF GULLIVER ET AL, 1980)

DORM INPUT DATA FOR APRIL 25 and 26, 1977

IN CHANNEL 5 FROM STATION 2 TO 10

115.	0.01	720.	25.0	800.	0.46	36.5	2.00
4.00	45.0	93.0	90.0	0.001	1.00	0.00	1.045
0.00	544.	744.					
5.44E-4	3.80E-5	1.42E00					
8	19	18	20	2	2	3	0
17.7	3.39	17.7	3.99	18.4	4.00	17.2	3.31
10.7	6.60	10.7	6.20	11.2	6.70	11.3	6.40
91.	88.	84.	74.	67.	67.	67.	51.
100	100	100	100	100	100	100	100
5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4
CHANNEL 5 APRIL 25 1977							
9.25	9.08	8.91	8.74	8.58	8.41	8.24	8.07
14.8							12.6
13.5							12.5
13.2							12.4
13.3							13.4
14.1							15.0
14.8							16.1
15.1							16.4
15.0							15.6
14.5							14.4
14.4							13.6
14.5							13.3
14.3							13.2
14.3							13.4
14.0							13.2
13.6							13.2
13.8							14.2
14.4							15.6
15.4							17.0
16.0							17.6
16.2							17.0
2.0	2.7	2.5	3.2	3.8	5.2	5.6	4.5
3.0	3.4	3.8	5.6	5.8	4.5	3.7	
332.	333.	346.	349.	351.	324.	324.	320.
185.	162.	178.	182.	219.	252.	279.	
9.25	9.10	9.50	10.10	10.85	11.30	11.50	11.20
9.30	9.00	9.50	10.20	10.60	10.90	11.00	
4.03	4.03	8.03	10.03	12.03	14.03	16.03	18.03
28.03	30.03	32.03	34.03	36.03	38.03	40.03	
8.00	9.30	10.40	11.40	11.90	11.80	10.90	9.10
7.70	9.20	10.60	11.30	11.70	11.55		
6.12	8.12	10.12	12.12	14.12	16.12	18.12	20.12
30.12	32.12	34.12	36.12	38.12	40.12		

DORM SIMULATION PRINTOUT FOR APRIL 25 AND 26, 1977

IN CHANNEL 5 FROM STATIONS 2 TO 10

CHANNEL 5

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = APRIL 25 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION (G/M**3)
 DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
 EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
 (1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
 P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
 T = WATER TEMPERATURE (DEG. C)
 TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720. SEC
 COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
 EPS = 1.00
 DSTAR = .01
 MAXIMUM ERROR IN K OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
 MAXIMUM ITERATIONS = 20
 CONSTANT FOR ARRHENIUS RELATION = 1.045
 CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
 ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	2	3	4	5	6	7	8	9	10
INITIAL D.O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	9.25	9.08	8.91	8.74	8.58	8.41	8.24	8.07	7.90
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (MM)	1.64	.31	1.64	.37	1.71	.37	1.60	.31	
SURFACE WIDTH (M)	3.26	2.01	3.26	1.89	3.41	2.04	3.44	1.95	

SEGMENT DIRECTION (DEG)	91.	88.	84.	74.	67.	67.	67.	51.
WATER SURFACE SLOPE	00051	00051	00051	00051	00051	00051	00051	00051

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MB)
5.00	2.00	332.00	991.67
7.00	2.70	333.00	991.67
9.00	2.50	346.00	991.67
11.00	3.20	349.00	991.67
13.00	3.80	351.00	991.67
15.00	5.20	324.00	991.67
17.00	5.60	324.00	991.67
19.00	4.50	320.00	991.67
21.00	3.00	352.00	991.67
23.00	2.00	197.00	991.67
1.00	1.80	178.00	991.67
3.00	2.40	198.00	991.67
5.00	3.00	185.00	991.67
7.00	3.40	162.00	991.67
9.00	3.80	178.00	991.67
11.00	5.60	182.00	991.67
13.00	5.80	219.00	991.67
15.00	4.50	252.00	991.67
17.00	3.70	279.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
3.05	9.25	5.20	8.00
5.05	9.10	7.20	9.30
7.05	9.50	9.20	10.40
9.05	10.10	11.20	11.40
11.05	10.85	13.20	11.90
13.05	11.30	15.20	11.80
15.05	11.50	17.20	10.90
17.05	11.20	19.20	9.10
19.05	10.50	21.20	8.70
21.05	10.15	23.20	8.30
23.05	9.90	25.20	8.30
25.05	9.65	27.20	7.90
27.05	9.30	29.20	7.70
29.05	9.00	31.20	9.20
31.05	9.50	33.20	10.60
33.05	10.20	35.20	11.30
35.05	10.60	37.20	11.70
37.05	10.90	39.20	11.55
39.05	11.00	0	1

STANDARD RESPIRATION RATE =	.4600 G/(M**HR) AT 20 DEG C	MEAN ERROR =	.0183	5 ITERATIONS
STANDARD RESPIRATION RATE =	.4417 G/(M**HR) AT 20 DEG C	MEAN ERROR =	.0003	8 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .4417 G/(M**HR) AT 20 DEG C
 SUNRISE TIME = 5.07
 SUNSET TIME = 10.86
 8 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES				
TIME	P G/(M**HR)	R G/(M**HR)	RESIDUAL G/M**3	IR HR
5.20	.067	.327	-.000	1.974
7.20	.356	.323	.000	1.974
9.20	.495	.329	-.000	1.974
11.20	.601	.345	-.000	1.974
13.20	.588	.359	-.000	1.974
15.20	.496	.365	.000	1.974
17.20	.278	.360	.000	1.974
19.20	0	.348	-.207	1.974
21.20	0	.340	.015	1.974
23.20	0	.338	-.083	1.974
1.20	0	.336	.125	1.974
3.20	0	.336	-.052	1.974
5.20	.002	.334	-.000	1.974
7.20	.367	.331	.000	1.974
9.20	.551	.338	-.000	1.974
11.20	.581	.353	-.000	1.974
13.20	.626	.371	-.000	1.974
15.20	.533	.372	.000	1.974

DAY 1
 TOTAL DAILY RESPIRATION = 0.2028G/M**2
 TOTAL DAILY PHOTOSYNTHESIS = 5.7736G/M**2
 P/R RATIO = .7033

DAY 2
 TOTAL DAILY RESPIRATION = 8.6549G/M**2
 TOTAL DAILY PHOTOSYNTHESIS = 5.3386G/M**2
 P/R RATIO = .6163

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**2*HR)),
 SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D.O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO.	2	3	4	5	6	7	8	9
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0310	.0121	.0460	.0212	.0609	.0249	.0497	.0261
SE COEFFICIENT	.0772	.0771	.0770	.0769	.0768	.0767	.0767	.0766
SAT. D.O. CONC.	9.90	9.96	10.02	10.08	10.15	10.21	10.27	10.34
TEMPERATURE	14.66	14.39	14.11	13.84	13.56	13.29	13.01	12.74
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0324	.0132	.0460	.0195	.0532	.0209	.0549	.0208
SE COEFFICIENT	.0774	.0771	.0769	.0767	.0767	.0766	.0766	.0766
SAT. D.O. CONC.	10.17	10.20	10.23	10.26	10.29	10.32	10.35	10.38
TEMPERATURE	13.44	13.31	13.19	13.06	12.94	12.81	12.69	12.56
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0204	.0043	.0210	.0082	.0217	.0081	.0218	.0078
SE COEFFICIENT	.0767	.0767	.0767	.0766	.0766	.0766	.0766	.0768
SAT. D.O. CONC.	10.24	10.27	10.29	10.31	10.34	10.36	10.39	10.41
TEMPERATURE	13.15	13.05	12.95	12.85	12.75	12.65	12.55	12.45
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0025	-.0034	-.0126	-.0060	-.0168	-.0071	-.0193	-.0075
SE COEFFICIENT	.0768	.0767	.0767	.0767	.0768	.0768	.0768	.0780
SAT. D.O. CONC.	10.21	10.20	10.20	10.20	10.19	10.19	10.19	10.19
TEMPERATURE	13.31	13.32	13.33	13.34	13.36	13.37	13.38	13.39
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0397	-.0140	-.0481	-.0204	-.0549	-.0215	-.0574	-.0217
SE COEFFICIENT	.0770	.0770	.0770	.0770	.0771	.0772	.0772	.0804
SAT. D.O. CONC.	10.01	9.98	9.96	9.93	9.91	9.88	9.86	9.83
TEMPERATURE	14.16	14.27	14.38	14.49	14.61	14.72	14.83	14.94
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0239	-.0239	-.0271	-.0288	-.0241	-.0284	-.0249	-.0266
SE COEFFICIENT	.0947	.0916	.0877	.0798	.0776	.0776	.0777	.0774
SAT. D.O. CONC.	9.85	9.81	9.78	9.74	9.71	9.67	9.64	9.60
TEMPERATURE	14.88	15.04	15.21	15.37	15.53	15.69	15.86	16.02
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0789	-.0242	-.0753	-.0266	-.0664	-.0246	-.0641	-.0222
SE COEFFICIENT	.0981	.0947	.0902	.0807	.0778	.0779	.0779	.0774
SAT. D.O. CONC.	9.78	9.75	9.71	9.68	9.64	9.61	9.58	9.54
TEMPERATURE	15.18	15.34	15.51	15.67	15.83	15.99	16.16	16.32

TIME = 19.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0498	-.0135	-.0388	-.0124	-.0283	-.0090	-.0213	-.0063	
SE COEFFICIENT	.0922	.0898	.0864	.0801	.0778	.0779	.0779	.0772	
SAT. D.O. CONC.	9.81	9.80	9.78	9.77	9.75	9.73	9.72	9.70	
TEMPERATURE	15.04	15.11	15.19	15.26	15.34	15.41	15.49	15.56	
TIME = 21.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0146	-.0018	-.0001	.0029	.0126	.0072	.0227	.0100	
SE COEFFICIENT	.0770	.0770	.0770	.0770	.0770	.0770	.0770	.0784	
SAT. D.O. CONC.	9.93	9.94	9.94	9.94	9.95	9.95	9.95	9.95	
TEMPERATURE	14.49	14.48	14.47	14.46	14.44	14.43	14.42	14.41	
TIME = 23.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0002	.0031	.0172	.0102	.0329	.0152	.0449	.0183	
SE COEFFICIENT	.0770	.0770	.0770	.0772	.0775	.0775	.0774	.0788	
SAT. D.O. CONC.	9.97	9.99	10.01	10.03	10.06	10.08	10.10	10.13	
TEMPERATURE	14.35	14.25	14.15	14.05	13.95	13.85	13.75	13.65	
TIME = 1.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0087	.0060	.0268	.0141	.0432	.0192	.0555	.0219	
SE COEFFICIENT	.0770	.0770	.0769	.0769	.0769	.0768	.0768	.0770	
SAT. D.O. CONC.	9.95	9.98	10.02	10.05	10.09	10.12	10.15	10.19	
TEMPERATURE	14.43	14.27	14.12	13.97	13.82	13.68	13.53	13.38	
TIME = 3.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0215	.0027	.0384	.0185	.0547	.0232	.0657	.0262	
SE COEFFICIENT	.0770	.0770	.0770	.0776	.0784	.0784	.0784	.0813	
SAT. D.O. CONC.	9.99	10.02	10.06	10.09	10.12	10.15	10.18	10.21	
TEMPERATURE	14.23	14.09	13.96	13.82	13.68	13.54	13.41	13.27	
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0343	.0135	.0499	.0226	.0642	.0263	.0728	.0289	
SE COEFFICIENT	.0769	.0769	.0769	.0771	.0778	.0778	.0777	.0819	
SAT. D.O. CONC.	9.99	10.02	10.04	10.07	10.09	10.12	10.14	10.17	
TEMPERATURE	14.24	14.13	14.02	13.91	13.79	13.68	13.57	13.46	
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0342	.0125	.0444	.0191	.0525	.0209	.0523	.0213	
SE COEFFICIENT	.0772	.0770	.0769	.0768	.0768	.0768	.0767	.0772	
SAT. D.O. CONC.	10.06	10.08	10.10	10.13	10.15	10.17	10.20	10.22	
TEMPERATURE	13.95	13.85	13.75	13.65	13.55	13.45	13.35	13.25	
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0142	.0044	.0144	.0054	.0145	.0053	.0145	.0056	
SE COEFFICIENT	.0768	.0768	.0768	.0769	.0776	.0776	.0775	.0840	
SAT. D.O. CONC.	10.14	10.15	10.17	10.18	10.19	10.20	10.21	10.22	
TEMPERATURE	13.57	13.52	13.47	13.42	13.38	13.32	13.27	13.22	

TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH	- .0108	- .0048	- .0184	- .0089	- .0268	- .0111	- .0302	- .0137	
SE COEFFICIENT	.0769	.0769	.0769	.0797	.0848	.0848	.0848	.1026	
SAT. D.D. CONC	10.09	10.07	10.06	10.05	10.04	10.03	10.02	10.01	
TEMPERATURE	13.82	13.87	13.92	13.97	14.03	14.07	14.12	14.18	
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH	- .0417	- .0163	- .0611	- .0294	- .0852	- .0341	- .0923	- .0365	
SE COEFFICIENT	.1010	.1045	.1090	.1194	.1255	.1254	.1254	.1349	
SAT. D.D. CONC	9.94	9.91	9.87	9.84	9.81	9.77	9.74	9.71	
TEMPERATURE	14.47	14.62	14.77	14.93	15.07	15.22	15.37	15.53	
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH	- .0203	- .0249	- .0870	- .0372	- .1002	- .0391	- .1045	- .0364	
SE COEFFICIENT	.1112	.1123	.1134	.1149	.1146	.1145	.1145	.1100	
SAT. D.D. CONC	9.71	9.67	9.63	9.59	9.55	9.50	9.46	9.42	
TEMPERATURE	15.50	15.70	15.90	16.10	16.30	16.50	16.70	16.90	
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH	- .0482	- .0205	- .0654	- .0247	- .0613	- .0225	- .0587	- .0187	
SE COEFFICIENT	.1021	.1015	.1007	.0974	.0944	.0944	.0943	.0860	
SAT. D.D. CONC	9.59	9.55	9.50	9.46	9.42	9.38	9.34	9.30	
TEMPERATURE	16.10	16.30	16.50	16.70	16.90	17.10	17.30	17.50	

DORM INPUT DATA FOR APRIL 25 and 26, 1977

IN CHANNEL 5 FROM STATION 10 TO 18

115.	0.01	720.	25.0	800.	0.40	36.5	2.00
4.00	45.0	93.0	90.0	0.001	1.00	0.00	1.045
0.00	544.	744.					
5.44E-4	3.80E-5	1.49E00					
8	19	18	20	10	2	3	0
17.4	3.63	19.0	3.35	19.2	3.59	18.1	2.60
10.9	5.90	11.1	5.90	10.8	5.90	10.7	5.40
35.	16.	81.	351.	351.	351.	351.	351.
100.	100.	100.	100.	100.	100.	100.	100.
5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4
CHANNEL 5 APRIL 25 1977							

7.90	7.74	7.58	7.41	7.25	7.09	6.93	6.76	6.60
12.6						12.4		
12.5						12.2		
12.4						12.1		
13.4						13.4		
15.0						15.9		
16.1						17.8		
16.4						18.4		
15.6						17.4		
14.4						15.7		
13.6						14.5		
13.3						13.4		
13.2						13.1		
13.4						13.2		
13.2						13.1		
13.2						13.2		
14.2						14.7		
15.6						16.9		
17.0						18.8		
17.6						19.7		
17.0						19.0		
2.0	2.7	2.5	3.2	3.8	5.2	5.6	4.5	3.0
3.0	3.4	3.8	5.6	5.8	4.5	3.7		
332.	333.	346.	349.	351.	324.	324.	320.	352.
185.	162.	178.	182.	219.	252.	279.		
7.90	8.60	9.30	10.40	11.40	11.90	11.80	10.90	9.10
7.90	7.70	9.20	10.60	11.30	11.70	11.55		
4.12	6.12	8.12	10.12	12.14	12.16	12.18	12.20	12.22
28.	1230.	1232.	1234.	1236.	1238.	1240.	12	
6.80	8.50	10.70	12.05	12.70	12.35	10.80	8.40	7.20
6.50	8.40	10.80	12.20	12.90	14.45			
6.21	8.21	10.21	12.21	14.21	16.21	18.21	20.21	22.21
30.	2132.	2134.	2136.	2138.	2140.	21		

DORM SIMULATION PRINTOUT FOR APRIL 25 and 26, 1977

IN CHANNEL 5 FROM STATIONS 10 TO 18

CHANNEL 5

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = APRIL 25 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION (G/M**3)

DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER

EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD

(1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)

P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**M*HR))

T = WATER TEMPERATURE (DEG. C)

TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720. SEC

COMPUTATIONAL DISTANCE INCREMENT = 7.6 M

EPS = 1.00

DSTAR = .01

MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**M*HR)

MAXIMUM ITERATIONS = 20

CONSTANT FOR ARKHENIUS RELATION = 1.045

CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3

ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	10	11	12	13	14	15	16	17	18
INITIAL D.O. AT UPSTREAM									

END OF SEGMENT (G/M**3)	7.90	7.74	7.58	7.41	7.25	7.09	6.93	6.76	6.60
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5
CROSS-SECT. AREA (M**2)	1.62	.34	1.77	.31	1.78	.33	1.68	.24	
SURFACE WIDTH (M)	3.32	1.80	3.38	1.80	3.29	1.80	3.26	1.65	
SEGMENT DIRECTION (DEG)	35.	16.	81.	351.	351.	351.	351.	351.	
WATER SURFACE SLOPE	.00051	.00051	.00051	.00051	.00051	.00051	.00051	.00051	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MR)
5.00	2.00	332.00	991.67
7.00	2.70	333.00	991.67
9.00	2.50	346.00	991.67
11.00	3.20	349.00	991.67
13.00	3.80	351.00	991.67
15.00	5.20	324.00	991.67
17.00	5.60	324.00	991.67
19.00	4.50	320.00	991.67
21.00	3.00	352.00	991.67
23.00	2.00	197.00	991.67
1.00	1.80	178.00	991.67
3.00	2.40	198.00	991.67
5.00	3.00	185.00	991.67
7.00	3.40	162.00	991.67
9.00	3.80	178.00	991.67
11.00	5.60	182.00	991.67
13.00	5.80	219.00	991.67
15.00	4.50	252.00	991.67
17.00	3.70	279.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)			
UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
3.20	7.90	5.35	6.80
5.20	8.00	7.35	8.50
7.20	9.30	9.35	10.70
9.20	10.40	11.35	12.05
11.20	11.40	13.35	12.70
13.20	11.90	15.35	12.35
15.20	11.80	17.35	10.80
17.20	10.90	19.35	8.40
19.20	9.10	21.35	7.20
21.20	8.70	23.35	6.90
23.20	8.30	25.35	6.70
25.20	8.30	27.35	6.60
27.20	7.90	29.35	6.50
29.20	7.70	31.35	8.40
31.20	9.20	33.35	10.80
33.20	10.60	35.35	12.20
35.20	11.30	37.35	12.90
37.20	11.70	39.35	14.45
39.20	11.55	0	I
STANDARD RESPIRATION RATE = .4000 G/(M**HR) AT 20 DEG C MEAN ERROR = -.1272 5 ITERATIONS			
STANDARD RESPIRATION RATE = .5272 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0028 8 ITERATIONS			
STANDARD RESPIRATION RATE = .5299 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0001 10 ITERATIONS			
RESULTS OF COMPUTATIONS:			
STANDARD RESPIRATORY RATE = .5299 G/(M**HR) AT 20 DEG C			
SUNRISE TIME = 5.07			
SUNSET TIME = 18.86			
10 ITERATIONS			

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P ----G/(M**HR)----	R G/M**3	RESIDUAL G/M**3	TR HR
5.35	.091	.379	.000	1.999
7.35	.426	.379	-.000	1.999
9.35	.680	.397	.000	1.999
11.35	.786	.431	.000	1.999
13.35	.791	.460	.000	1.999
15.35	.642	.470	.000	1.999
17.35	.309	.455	.000	1.999
19.35	0	.429	-.236	1.999
21.35	0	.410	-.094	1.999
23.35	0	.397	.017	1.999
1.35	0	.323	.052	1.999
3.35	0	.394	.019	1.999
5.35	.044	.392	.000	1.999
7.35	.473	.395	-.000	1.999
9.35	.741	.415	.000	1.999
11.35	.825	.448	.000	1.999
13.35	.878	.480	-.000	1.999
15.35	1.117	.468	-.000	1.999

DAY 1

TOTAL DAILY RESPIRATION = 9.9805G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 7.4819G/M**2

P/R RATIO = .7497

DAY 2

TOTAL DAILY RESPIRATION = 10.8060G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 8.1561G/M**2

P/R RATIO = .7548

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**HR)),
 SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D.O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO.	10	11	12	13	14	15	16	17
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0221	.0381	.1024	.0403	.1309	.0467	.1341	.0397
SE COEFFICIENT	.0740	.0749	.0739	.0774	.0774	.0774	.0774	.0774
SAT. D.O. CONC.	10.38	10.38	10.39	10.39	10.40	10.41	10.41	10.42
TEMPERATURE	12.59	12.56	12.54	12.51	12.49	12.46	12.44	12.41

TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0737	.0320	.0893	.0357	.1166	.0419	.1210	.0360	
SE COEFFICIENT	.0744	.0780	.0739	.0843	.0843	.0843	.0843	.0843	
SAT. D.O. CONC.	10.40	10.41	10.42	10.43	10.44	10.45	10.46	10.47	
TEMPERATURE	12.48	12.44	12.41	12.37	12.33	12.29	12.26	12.22	
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0316	.0131	.0355	.0135	.0451	.0162	.0487	.0146	
SE COEFFICIENT	.0758	.0798	.0738	.0833	.0833	.0834	.0834	.0834	
SAT. D.O. CONC.	10.43	10.44	10.44	10.45	10.46	10.47	10.48	10.49	
TEMPERATURE	12.38	12.34	12.31	12.27	12.23	12.19	12.16	12.12	
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0213	-.0107	-.0269	-.0127	-.0407	-.0149	-.0410	-.0123	
SE COEFFICIENT	.0803	.0876	.0741	.0923	.0923	.0923	.0923	.0923	
SAT. D.O. CONC.	10.18	10.18	10.18	10.18	10.18	10.18	10.18	10.18	
TEMPERATURE	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0737	-.0345	-.0788	-.0379	-.1224	-.0441	-.1255	-.0375	
SE COEFFICIENT	.0859	.0953	.0745	.1003	.1003	.1003	.1003	.1002	
SAT. D.O. CONC.	9.81	9.79	9.76	9.74	9.71	9.69	9.67	9.64	
TEMPERATURE	15.06	15.17	15.28	15.39	15.51	15.62	15.73	15.84	
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0872	-.0433	-.1126	-.0543	-.1746	-.0622	-.1773	-.0525	
SE COEFFICIENT	.0765	.0917	.0818	.1123	.1122	.1121	.1120	.1120	
SAT. D.O. CONC.	9.57	9.52	9.48	9.43	9.39	9.35	9.31	9.27	
TEMPERATURE	16.21	16.42	16.63	16.84	17.06	17.27	17.48	17.69	
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0769	-.0382	-.0971	-.0466	-.1491	-.0523	-.1490	-.0435	
SE COEFFICIENT	.0772	.0949	.0837	.1176	.1175	.1174	.1173	.1172	
SAT. D.O. CONC.	9.50	9.45	9.40	9.35	9.30	9.25	9.20	9.15	
TEMPERATURE	16.52	16.77	17.02	17.27	17.52	17.77	18.02	18.27	
TIME = 19.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0229	-.0098	-.0281	-.0112	-.0368	-.0124	-.0366	-.0102	
SE COEFFICIENT	.0749	.0833	.0813	.1009	.1009	.1008	.1007	.1007	
SAT. D.O. CONC.	9.67	9.62	9.57	9.53	9.48	9.44	9.39	9.35	
TEMPERATURE	15.71	15.94	16.16	16.39	16.61	16.84	17.06	17.29	
TIME = 21.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0350	.0166	.0417	.0185	.0587	.0214	.0597	.0181	
SE COEFFICIENT	.0800	.0861	.0744	.0894	.0894	.0893	.0893	.0893	
SAT. D.O. CONC.	9.94	9.90	9.87	9.83	9.79	9.76	9.72	9.69	
TEMPERATURE	14.48	14.64	14.81	14.97	15.13	15.29	15.46	15.62	
TIME = 23.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0626	.0272	.0767	.0289	.0944	.0345	.0992	.0300	
SE COEFFICIENT	.0775	.0783	.0742	.0769	.0769	.0769	.0769	.0769	
SAT. D.O. CONC.	10.12	10.10	10.07	10.05	10.02	10.00	9.97	9.95	
TEMPERATURE	13.66	13.77	13.88	13.99	14.11	14.22	14.33	14.44	

TIME = 1.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0715	.0313	.0208	.0343	.1135	.0419	.1219	.0371	
SE COEFFICIENT	.0750	.0763	.0740	.0767	.0767	.0767	.0767	.0767	
SAT. D.O. CONC.	10.21	10.20	10.20	10.20	10.19	10.19	10.19	10.19	
TEMPERATURE	13.31	13.32	13.33	13.34	13.36	13.37	13.38	13.39	
TIME = 3.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0855	.0320	.0292	.0384	.1268	.0466	.1356	.0412	
SE COEFFICIENT	.0811	.0822	.0743	.0795	.0795	.0795	.0795	.0795	
SAT. D.O. CONC.	10.23	10.23	10.24	10.24	10.24	10.25	10.25	10.25	
TEMPERATURE	13.19	13.18	13.17	13.16	13.14	13.13	13.12	13.11	
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0237	.0320	.0823	.0357	.1166	.0419	.1210	.0360	
SE COEFFICIENT	.0744	.0780	.0739	.0843	.0843	.0843	.0843	.0843	
SAT. D.O. CONC.	10.40	10.41	10.42	10.43	10.44	10.45	10.46	10.47	
TEMPERATURE	12.48	12.44	12.41	12.37	12.33	12.29	12.26	12.22	
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0316	.0131	.0355	.0135	.0451	.0162	.0487	.0146	
SE COEFFICIENT	.0758	.0798	.0738	.0833	.0833	.0834	.0834	.0834	
SAT. D.O. CONC.	10.43	10.44	10.44	10.45	10.46	10.47	10.48	10.49	
TEMPERATURE	12.38	12.34	12.31	12.27	12.23	12.19	12.16	12.12	
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0213	-.0107	-.0269	-.0127	-.0407	-.0149	-.0410	-.0123	
SE COEFFICIENT	.0803	.0876	.0741	.0923	.0923	.0923	.0923	.0923	
SAT. D.O. CONC.	10.18	10.18	10.18	10.18	10.18	10.18	10.18	10.18	
TEMPERATURE	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0737	-.0345	-.0788	-.0379	-.1224	-.0441	-.1255	-.0375	
SE COEFFICIENT	.0859	.0953	.0745	.1003	.1003	.1003	.1003	.1002	
SAT. D.O. CONC.	9.81	9.79	9.76	9.74	9.71	9.69	9.67	9.64	
TEMPERATURE	15.06	15.17	15.28	15.39	15.51	15.62	15.73	15.84	
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0872	-.0433	-.1126	-.0543	-.1746	-.0622	-.1773	-.0525	
SE COEFFICIENT	.0765	.0917	.0818	.1123	.1122	.1121	.1120	.1120	
SAT. D.O. CONC.	9.57	9.52	9.48	9.43	9.39	9.35	9.31	9.27	
TEMPERATURE	16.21	16.42	16.63	16.84	17.06	17.27	17.48	17.69	
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0769	-.0382	-.0971	-.0466	-.1491	-.0523	-.1490	-.0435	
SE COEFFICIENT	.0772	.0949	.0837	.1176	.1175	.1174	.1173	.1172	
SAT. D.O. CONC.	9.50	9.45	9.40	9.35	9.30	9.25	9.20	9.15	
TEMPERATURE	16.52	16.77	17.02	17.27	17.52	17.77	18.02	18.27	

TIME = 19.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0229	.0028	.0201	.0112	.0368	.0124	.0366	.0102	
SE COEFFICIENT	.0749	.0833	.0813	.1009	.1009	.1008	.1007	.1007	
SAT. D.O. CONC.	9.67	9.62	9.57	9.53	9.48	9.44	9.39	9.35	
TEMPERATURE	15.71	15.94	16.16	16.39	16.61	16.84	17.06	17.29	
TIME = 21.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0350	.0164	.0417	.0185	.0587	.0214	.0597	.0181	
SE COEFFICIENT	.0800	.0861	.0744	.0894	.0894	.0893	.0893	.0893	
SAT. D.O. CONC.	9.94	9.90	9.87	9.83	9.79	9.76	9.72	9.69	
TEMPERATURE	14.48	14.64	14.81	14.97	15.13	15.29	15.46	15.62	
TIME = 23.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0626	.0272	.0267	.0289	.0244	.0345	.0292	.0300	
SE COEFFICIENT	.0775	.0783	.0742	.0769	.0769	.0769	.0769	.0769	
SAT. D.O. CONC.	10.12	10.10	10.07	10.05	10.02	10.00	9.97	9.95	
TEMPERATURE	13.66	13.77	13.88	13.99	14.11	14.22	14.33	14.44	
TIME = 1.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0715	.0313	.0208	.0343	.1135	.0419	.1219	.0371	
SE COEFFICIENT	.0750	.0763	.0740	.0767	.0767	.0767	.0767	.0767	
SAT. D.O. CONC.	10.21	10.20	10.20	10.20	10.19	10.19	10.19	10.19	
TEMPERATURE	13.31	13.32	13.33	13.34	13.36	13.37	13.38	13.39	
TIME = 3.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0855	.0320	.0292	.0384	.1268	.0466	.1356	.0412	
SE COEFFICIENT	.0811	.0822	.0743	.0795	.0795	.0795	.0795	.0795	
SAT. D.O. CONC.	10.23	10.23	10.24	10.24	10.24	10.25	10.25	10.25	
TEMPERATURE	13.19	13.18	13.17	13.16	13.14	13.13	13.12	13.11	
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.1001	.0432	.1068	.0453	.1474	.0534	.1542	.0465	
SE COEFFICIENT	.0845	.0889	.0741	.0885	.0885	.0885	.0885	.0885	
SAT. D.O. CONC.	10.19	10.19	10.20	10.20	10.21	10.22	10.22	10.23	
TEMPERATURE	13.39	13.36	13.34	13.31	13.29	13.26	13.24	13.21	
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0788	.0361	.0897	.0402	.1305	.0468	.1349	.0402	
SE COEFFICIENT	.0787	.0873	.0740	.0946	.0946	.0946	.0946	.0946	
SAT. D.O. CONC.	10.23	10.23	10.24	10.24	10.24	10.25	10.25	10.25	
TEMPERATURE	13.19	13.18	13.17	13.16	13.14	13.13	13.12	13.11	
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0293	.0125	.0282	.0129	.0437	.0157	.0478	.0143	
SE COEFFICIENT	.0901	.0982	.0740	.1005	.1005	.1005	.1005	.1005	
SAT. D.O. CONC.	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23	
TEMPERATURE	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	

TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0450	-.0225	-.0398	-.0253	-.0809	-.0293	-.0810	-.0241	
SE COEFFICIENT	.1141	.1260	.0745	.1270	.1270	.1270	.1269	.1269	
SAT. D.O. CONC.	9.99	9.98	9.97	9.95	9.94	9.92	9.91	9.90	
TEMPERATURE	14.23	14.29	14.36	14.42	14.48	14.54	14.61	14.67	
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.1156	-.0421	-.1220	-.0418	-.1368	-.0499	-.1432	-.0430	
SE COEFFICIENT	.1313	.1238	.1076	.1012	.1012	.1011	.1011	.1011	
SAT. D.O. CONC.	9.68	9.64	9.61	9.57	9.54	9.51	9.47	9.44	
TEMPERATURE	15.68	15.84	16.01	16.17	16.33	16.49	16.66	16.82	
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.1125	-.0428	-.1206	-.0433	-.1445	-.0535	-.1555	-.0471	
SE COEFFICIENT	.0971	.0834	.1092	.0750	.0751	.0751	.0752	.0752	
SAT. D.O. CONC.	9.38	9.34	9.29	9.25	9.20	9.16	9.12	9.07	
TEMPERATURE	17.11	17.34	17.56	17.79	18.01	18.24	18.46	18.69	
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0785	-.0321	-.1221	-.0346	-.1158	-.0430	-.1278	-.0393	
SE COEFFICIENT	.0765	.0751	.0958	.0754	.0755	.0755	.0756	.0757	
SAT. D.O. CONC.	9.26	9.21	9.16	9.11	9.06	9.01	8.96	8.91	
TEMPERATURE	17.73	17.99	18.26	18.52	18.78	19.04	19.31	19.57	

DORM INPUT DATA FOR APRIL 25 and 26, 1977

IN CHANNEL 8 FROM STATIONS 2 TO 10

115.	0.01	770.	25.0	800.	0.70	36.5	2.00
4.00	45.0	93.0	70.0	0.001	1.00	0.00	1.045
0.00	544.	744.					
5.44E-4	3.80E-5	1.49E00					
0	19	10	20	2	2	3	0
17.7	3.39	17.7	3.99	18.4	4.00	17.2	3.31
10.7	6.60	10.7	6.70	11.2	6.70	11.3	6.40
91.	88.	84.	74.	67.	67.	67.	51.
100.	100.	100.	100.	100.	100.	100.	100.
5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4

CHANNEL 8 APRIL 25 1977

8.10	7.72	7.34	6.96	6.58	6.20	5.81	5.43	5.05
19.6								17.2
19.2								17.4
18.8								17.1
18.9								18.1
19.5								19.5
20.3								20.5
20.5								20.8
20.6								20.2
20.2								20.0
20.0								18.4
19.9								18.0
20.0								17.8
19.9								17.9
19.6								17.8
19.2								17.8
19.4								19.1
20.0								20.0
20.8								21.4
21.0								22.0
21.8								21.6
2.0	2.7	2.5	3.2	3.8	5.2	5.6	4.5	3.0
3.0	3.4	3.8	5.6	5.8	4.5	3.7		
332.	335.	346.	347.	351.	324.	324.	320.	252.
185.	162.	178.	182.	219.	252.	279.		
8.10	7.70	8.20	8.70	9.20	9.85	9.95	9.50	9.10
7.90	7.75	7.90	8.70	9.10	9.25	9.25		
4.03	4.03	0.0310	0.0312	0.0314	0.0316	0.0318	0.0320	0.0322
28.0330	0.0332	0.0334	0.0336	0.0338	0.0340	0.03		
4.80	7.9010	4011	8012	0511	30	9.05	6.02	5.45
4.40	7.9010	6011	8012	0011	20			
6.12	8.1210	1212	1214	1216	1218	1220	1222	1224
30.1232	1234	1236	1238	1240	12			

DORM SIMULATION PRINTOUT FOR APRIL 25 and 26, 1977

IN CHANNEL 8 FROM STATIONS 2 TO 10

CHANNEL 8

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = APRIL 25 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION (G/M**3)
DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
(1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
T = WATER TEMPERATURE (DEG. C)
TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720. SEC
COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
EPS = 1.00
DSTAR = .01
MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
MAXIMUM ITERATIONS = 20
CONSTANT FOR ARRHENIUS RELATION = 1.045
CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0. G/M**3
ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	2	3	4	5	6	7	8	9	10
INITIAL D.O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	8.10	7.72	7.34	6.96	6.58	6.20	5.81	5.43	5.05
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**2)	1.64	.31	1.64	.37	1.71	.37	1.60	.31	
SURFACE WIDTH (M)	3.26	2.01	3.26	1.87	3.41	2.04	3.44	1.95	
SEGMENT DIRECTION (DEG)	91.	88.	84.	74.	67.	67.	67.	51.	
WATER SURFACE SLOPE	00051	00051	00051	00051	00051	00051	00051	00051	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MM)
5.00	2.00	332.00	991.67
7.00	2.70	333.00	991.67
9.00	2.50	346.00	991.67
11.00	3.20	349.00	991.67
13.00	3.80	351.00	991.67
15.00	5.20	324.00	991.67
17.00	5.60	324.00	991.67
19.00	4.50	320.00	991.67
21.00	3.00	252.00	991.67
23.00	2.00	197.00	991.67
1.00	1.80	178.00	991.67
3.00	2.40	198.00	991.67
5.00	3.00	185.00	991.67
7.00	3.40	162.00	991.67
9.00	3.80	178.00	991.67
11.00	5.60	182.00	991.67
13.00	5.80	219.00	991.67
15.00	4.50	252.00	991.67
17.00	3.70	272.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
3.05	8.10	5.20	4.80
5.05	7.70	7.20	7.90
7.05	8.20	9.20	10.40
9.05	8.70	11.20	11.80
11.05	9.20	13.20	12.05
13.05	9.85	15.20	11.30
15.05	9.95	17.20	9.05
17.05	9.50	19.20	6.02
19.05	9.10	21.20	5.45
21.05	8.75	23.20	5.10
23.05	8.40	25.20	4.95
25.05	7.70	27.20	4.70
27.05	7.90	29.20	4.40
29.05	7.75	31.20	7.90
31.05	7.90	33.20	10.60
33.05	8.70	35.20	11.80
35.05	9.10	37.20	12.00
37.05	9.25	39.20	11.20
39.05	9.25	0	1

STANDARD RESPIRATION RATE = .7000 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0089 6 ITERATIONS

STANDARD RESPIRATION RATE = .7089 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0002 9 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .7089 G/(M**HR) AT 20 DEG C
SUNRISE TIME = .507

SUNSET TIME = 18.86
9 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P	R	RESIDUAL	IR
	----G/(M**HR)----		G/M**3	HR
5.20	0	.657	-.022	1.974
7.20	.717	.650	.000	1.974
9.20	1.104	.662	-.000	1.974
11.20	1.298	.689	.000	1.974
13.20	1.264	.716	-.000	1.974
15.20	1.017	.728	.000	1.974
17.20	.539	.722	-.000	1.974
19.20	0	.712	-.007	1.974
21.20	0	.689	-.080	1.974
23.20	0	.678	-.170	1.974
1.20	0	.675	.018	1.974
3.20	0	.674	.226	1.974
5.20	0	.670	-.134	1.974
7.20	.739	.665	.000	1.974
9.20	1.214	.682	-.000	1.974
11.20	1.323	.706	.000	1.974
13.20	1.332	.738	.000	1.974
15.20	1.102	.740	-.000	1.974

DAY 1

TOTAL DAILY RESPIRATION = 14.5019G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 11.8798G/M**2

P/R RATIO = .7199

DAY 2

TOTAL DAILY RESPIRATION = 17.2770G/M**2
 TOTAL DAILY PHOTOSYNTHESIS = 11.4209G/M**2
 P/R RATIO = .6610

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**2*HR)),
 SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D.O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO. 2 3 4 5 6 7 8 9

TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	.0472	.0196	.0772	.0348	.1070	.0444	.1251	.0472
SE. COEFFICIENT	.0783	.0781	.0780	.0779	.0779	.0778	.0777	.0777
SAT. D.O. CONC.	9.93	9.99	9.04	9.10	9.16	9.21	9.27	9.33
TEMPERATURE	19.45	19.15	18.85	18.55	18.25	17.95	17.65	17.35

TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	.0470	.0181	.0463	.0295	.0829	.0338	.0943	.0355
SE. COEFFICIENT	.0785	.0783	.0781	.0779	.0778	.0778	.0777	.0777
SAT. D.O. CONC.	9.00	9.04	9.08	9.13	9.17	9.21	9.26	9.30
TEMPERATURE	19.09	18.86	18.64	18.41	18.19	17.96	17.74	17.51

TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	.0258	.0048	.0199	.0045	.0153	.0049	.0134	.0048
SE. COEFFICIENT	.0780	.0779	.0779	.0778	.0778	.0777	.0777	.0778
SAT. D.O. CONC.	9.07	9.11	9.15	9.19	9.24	9.28	9.32	9.36
TEMPERATURE	18.69	18.48	18.27	18.06	17.84	17.63	17.42	17.21

TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	.0015	.0036	.0203	.0124	.0394	.0184	.0530	.0213
SE. COEFFICIENT	.0780	.0780	.0780	.0779	.0779	.0779	.0779	.0788
SAT. D.O. CONC.	9.04	9.06	9.08	9.10	9.12	9.14	9.16	9.18
TEMPERATURE	18.85	18.75	18.65	18.55	18.45	18.35	18.25	18.15

TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	-.0260	-.0127	-.0509	-.0249	-.0732	-.0316	-.0895	-.0358
SE. COEFFICIENT	.0782	.0782	.0782	.0782	.0782	.0782	.0782	.0809
SAT. D.O. CONC.	8.92	8.92	8.92	8.92	8.92	8.92	8.92	8.92
TEMPERATURE	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50

TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)

SURFACE EXCH.	-.0563	-.0209	-.0725	-.0297	-.0812	-.0333	-.0923	-.0347
SE. COEFFICIENT	.0738	.0909	.0873	.0804	.0787	.0787	.0787	.0784
SAT. D.O. CONC.	8.78	8.77	8.77	8.76	8.76	8.75	8.75	8.74
TEMPERATURE	20.31	20.34	20.36	20.39	20.41	20.44	20.46	20.49

TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0513	-.0162	-.0516	-.0189	-.0489	-.0189	-.0513	-.0188	
SE COEFFICIENT	.0970	.0938	.0896	.0812	.0788	.0788	.0788	.0785	
SAT. D.O. CONC.	8.74	8.73	8.73	8.72	8.71	8.71	8.70	8.69	
TEMPERATURE	20.52	20.56	20.59	20.63	20.67	20.71	20.74	20.78	
TIME = 19.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	-.0239	-.0027	.0014	.0049	.0198	.0106	.0317	.0128	
SE COEFFICIENT	.0914	.0892	.0863	.0807	.0789	.0788	.0788	.0783	
SAT. D.O. CONC.	8.73	8.74	8.75	8.76	8.76	8.77	8.78	8.79	
TEMPERATURE	20.57	20.52	20.47	20.42	20.37	20.33	20.28	20.23	
TIME = 21.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0007	.0076	.0413	.0244	.0725	.0355	.1029	.0396	
SE COEFFICIENT	.0899	.0905	.0912	.0920	.0919	.0919	.0919	.0896	
SAT. D.O. CONC.	8.80	8.80	8.81	8.81	8.82	8.82	8.82	8.83	
TEMPERATURE	20.19	20.16	20.14	20.11	20.09	20.06	20.04	20.01	
TIME = 23.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0160	.0116	.0525	.0278	.0856	.0381	.1103	.0440	
SE COEFFICIENT	.0783	.0782	.0782	.0783	.0785	.0785	.0784	.0795	
SAT. D.O. CONC.	8.85	8.89	8.92	8.96	9.00	9.03	9.07	9.11	
TEMPERATURE	19.90	19.70	19.50	19.30	19.10	18.90	18.70	18.50	
TIME = 1.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0365	.0177	.0710	.0345	.1015	.0435	.1233	.0476	
SE COEFFICIENT	.0782	.0782	.0781	.0781	.0780	.0780	.0779	.0780	
SAT. D.O. CONC.	8.87	8.91	8.96	9.00	9.05	9.09	9.14	9.18	
TEMPERATURE	19.78	19.54	19.31	19.07	18.83	18.59	18.36	18.12	
TIME = 3.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0483	.0218	.0858	.0409	.1198	.0504	.1414	.0554	
SE COEFFICIENT	.0783	.0782	.0782	.0786	.0792	.0792	.0791	.0815	
SAT. D.O. CONC.	8.86	8.91	8.96	9.01	9.06	9.11	9.16	9.22	
TEMPERATURE	19.86	19.59	19.31	19.04	18.76	18.49	18.21	17.94	
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0475	.0224	.0886	.0423	.1241	.0523	.1471	.0584	
SE COEFFICIENT	.0782	.0782	.0781	.0782	.0787	.0787	.0786	.0821	
SAT. D.O. CONC.	8.87	8.92	8.96	9.01	9.06	9.10	9.15	9.20	
TEMPERATURE	19.77	19.52	19.27	19.02	18.77	18.52	18.27	18.02	
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0475	.0180	.0458	.0283	.0828	.0341	.0761	.0368	

SE COEFFICIENT	.0784	.0782	.0781	.0780	.0779	.0779	.0778	.0782
SAT. D.O. CONC.	8.92	8.92	9.01	9.05	9.09	9.14	9.18	9.22
TEMPERATURE	19.49	19.26	19.04	18.81	18.59	18.36	18.14	17.91
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0281	.0069	.0186	.0053	.0109	.0022	.0049	.0022
SE COEFFICIENT	.0781	.0780	.0780	.0780	.0785	.0785	.0785	.0839
SAT. D.O. CONC.	8.99	9.03	9.06	9.09	9.13	9.16	9.19	9.23
TEMPERATURE	19.11	18.94	18.76	18.59	18.41	18.24	18.06	17.89
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0007	-.0048	-.0254	-.0152	-.0508	-.0233	-.0672	-.0318
SE COEFFICIENT	.0781	.0781	.0781	.0799	.0847	.0847	.0847	.1014
SAT. D.O. CONC.	8.94	8.95	8.96	8.96	8.97	8.98	8.99	8.99
TEMPERATURE	19.38	19.34	19.31	19.27	19.23	19.19	19.16	19.12
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0244	-.0149	-.0666	-.0372	-.1169	-.0510	-.1452	-.0606
SE COEFFICIENT	.0997	.1031	.1075	.1175	.1234	.1234	.1234	.1327
SAT. D.O. CONC.	8.83	8.83	8.83	8.83	8.83	8.83	8.83	8.83
TEMPERATURE	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0384	-.0183	-.0737	-.0360	-.1055	-.0451	-.1282	-.0477
SE COEFFICIENT	.1096	.1106	.1118	.1132	.1130	.1130	.1129	.1087
SAT. D.O. CONC.	8.68	8.67	8.66	8.64	8.63	8.62	8.60	8.59
TEMPERATURE	20.84	20.91	20.99	21.06	21.14	21.21	21.29	21.36
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	-.0311	-.0084	-.0275	-.0108	-.0282	-.0113	-.0330	-.0120
SE COEFFICIENT	.1007	.1003	.0995	.0965	.0936	.0936	.0936	.0859
SAT. D.O. CONC.	8.52	8.51	8.51	8.50	8.50	8.49	8.49	8.49
TEMPERATURE	21.81	21.84	21.86	21.89	21.91	21.94	21.96	21.99

DORM INPUT DATA FOR APRIL 25 and 26, 1977

IN CHANNEL 8 FROM STATIONS 10 TO 18

115.	0.01	720.	25.0	800.	0.40	36.5	2.00
4.00	45.0	93.0	90.0	0.001	1.00	0.00	1.045
0.00	544.	744.					
5.44E-4	3.80E-5	1.42E00					
8	19	18	20	10	2	3	0
17.4	3.63	19.0	3.35	19.2	3.59	18.1	2.60
10.9	5.90	11.1	5.90	10.8	5.90	10.7	5.40
35.	16.	81.	351.	351.	351.	351.	351.
100.	100.	100.	100.	100.	100.	100.	100.
5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4	5.08E-4
CHANNEL 8 APRIL 25 1977							
5.05	4.86	4.68	4.49	4.30	4.11	3.93	3.74
17.2							16.3
17.4							16.2
17.1							16.1
18.1							16.6
19.5							17.7
20.5							18.9
20.8							19.7
20.2							19.6
20.0							19.2
18.4							18.4
18.0							17.6
17.8							17.3
17.2							17.1
17.8							17.0
17.8							16.9
19.1							17.7
20.0							20.2
21.4							22.1
22.0							23.0
21.6							22.5
2.0	2.7	2.5	3.2	3.8	5.2	5.6	4.5
3.0	3.4	3.8	5.6	5.8	4.5	3.7	
332	334	346	349	351	324	324	320
185.	162.	178.	182.	219.	252.	279.	
5.05	4.80	7.90	10.40	11.80	12.05	11.30	9.05
4.70	4.40	7.90	10.60	11.80	12.00	11.20	
4.12	4.12	8.12	10.12	12.14	12.16	12.18	12.20
28.	1230.	1232.	1234.	1236.	1238.	1240.	12
3.90	7.50	11.60	14.00	16.10	18.00	5.90	3.80
3.70	7.40	11.80	14.00	16.10	18.00	3.30	3.10
6.21	8.21	10.21	12.21	14.21	16.21	18.21	21
30.	2132.	2134.	2136.	2138.	2140.	21	

DORM SIMULATION PRINTOUT FOR APRIL 25 and 26, 1977
IN CHANNEL 8 FROM STATIONS 10 TO 18

CHANNEL 8

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = APRIL 25 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION (G/M**3)
~~DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER~~
 EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
 (1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
 P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
 T = WATER TEMPERATURE (DEG. C)
 TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720. SEC
 COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
 EPS = 1.00
 DSTAR = .01
 MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
 MAXIMUM ITERATIONS = 20
 CONSTANT FOR ARRHENIUS RELATION = 1.045
 CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
 ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	10	11	12	13	14	15	16	17	18
INITIAL D.O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	5.05	4.86	4.68	4.49	4.30	4.11	3.93	3.74	3.55
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**2)	1.62	.34	1.77	.31	1.78	.33	1.68	.24	
SURFACE WIDTH (M)	3.32	1.80	3.38	1.80	3.29	1.80	3.26	1.65	
SEGMENT DIRECTION (DEG)	35.	16.	81.	351.	351.	351.	351.	351.	
WATER SURFACE SLOPE	.00051	.00051	.00051	.00051	.00051	.00051	.00051	.00051	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MB)
5.00	2.00	332.00	991.67
7.00	2.70	333.00	991.67
9.00	2.50	346.00	991.67
11.00	3.20	349.00	991.67
13.00	3.80	351.00	991.67
15.00	5.20	324.00	991.67
17.00	5.60	324.00	991.67
19.00	4.50	320.00	991.67
21.00	3.00	352.00	991.67
23.00	2.00	197.00	991.67
1.00	1.80	178.00	991.67
3.00	2.40	198.00	991.67
5.00	3.00	185.00	991.67
7.00	3.40	162.00	991.67
9.00	3.80	178.00	991.67
11.00	5.60	182.00	991.67
13.00	5.80	219.00	991.67
15.00	4.50	252.00	991.67
17.00	3.70	279.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	DO	TIME	DO
3.20	5.05	5.35	3.90
5.20	4.80	7.35	7.50
7.20	7.90	9.35	11.60
9.20	10.40	11.35	14.00
11.20	11.80	13.35	14.10
13.20	12.05	15.35	13.00
15.20	11.30	17.35	10.00
17.20	9.05	19.35	5.90
19.20	6.20	21.35	3.80
21.20	5.45	23.35	3.40
23.20	5.10	25.35	3.30
25.20	4.75	27.35	5.10
27.20	4.70	29.35	3.70
29.20	4.40	31.35	7.40
31.20	7.90	33.35	11.80
33.20	10.60	35.35	14.00
35.20	11.80	37.35	14.20
37.20	12.00	39.35	12.90
39.20	11.20	0	I

STANDARD RESPIRATION RATE =	.4000 G/(M**M*HR) AT 20 DEG C	MEAN ERROR = -.1673	6 ITERATIONS
STANDARD RESPIRATION RATE =	.5673 G/(M**M*HR) AT 20 DEG C	MEAN ERROR = -.0044	10 ITERATIONS
STANDARD RESPIRATION RATE =	.5716 G/(M**M*HR) AT 20 DEG C	MEAN ERROR = -.0001	12 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .5716 G/(M**M*HR) AT 20 DEG C
 SUNRISE TIME = 5.07
 SUNSET TIME = 18.86
 12 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P ----G/(M**M*HR)----	R G/M**3	RESIDUAL G/M**3	TR HR
5-35	.171	.494	.000	1.999
7-35	.933	.494	-.000	1.999
9-35	1.249	.509	.000	1.999
11-35	1.316	.535	.000	1.999
13-35	1.114	.561	.000	1.999
15-35	.869	.575	.000	1.999
17-35	.363	.569	.000	1.999
19-35	0	.560	-.442	1.999
21-35	0	.536	-.288	1.999
23-35	0	.520	.030	1.999
1-35	0	.514	.168	1.999
3-35	0	.512	.069	1.999
5-35	.203	.510	.000	1.999
7-35	.976	.511	-.000	1.999
9-35	1.333	.533	.000	1.999
11-35	1.352	.572	.000	1.999
13-35	1.204	.613	.000	1.999
15-35	.828	.591	-.000	1.999

DAY 1

TOTAL DAILY RESPIRATION = 12.7549G/M**2
 TOTAL DAILY PHOTOSYNTHESIS = 12.0911G/M**2
 P/R RATIO = .9480

DAY 2

TOTAL DAILY RESPIRATION = 13.7545G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 11.7917G/M**2

P/R RATIO = .8573

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**2*HR)),
SURFACE EXCHANGE COEFFICIENT (7HR),
SATURATION D.O. CONCENTRATION (G/M**3),
AND WATER TEMPERATURE (DEG. C)
FOR EACH CHANNEL SEGMENT

SECTION NO.	10	11	12	13	14	15	16	17
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1691	.0681	.1920	.0683	.2177	.0762	.2160	.0631
SE COEFFICIENT	.0750	.0757	.0748	.0777	.0777	.0777	.0777	.0777
SAT. D.O. CONC.	9.37	9.40	9.42	9.44	9.47	9.49	9.51	9.53
TEMPERATURE	17.14	17.03	16.92	16.81	16.69	16.58	16.47	16.36
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1296	.0538	.1474	.0557	.1776	.0618	.1753	.0508
SE COEFFICIENT	.0754	.0783	.0749	.0839	.0839	.0839	.0839	.0839
SAT. D.O. CONC.	9.34	9.37	9.40	9.43	9.46	9.49	9.52	9.55
TEMPERATURE	17.32	17.17	17.02	16.88	16.73	16.58	16.43	16.28
TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0311	.0113	.0305	.0100	.0335	.0109	.0337	.0091
SE COEFFICIENT	.0764	.0798	.0748	.0830	.0830	.0830	.0831	.0831
SAT. D.O. CONC.	9.40	9.42	9.45	9.47	9.50	9.52	9.55	9.57
TEMPERATURE	17.04	16.91	16.79	16.66	16.54	16.41	16.29	16.16
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0651	.0315	.0802	.0364	.1169	.0429	.1203	.0365
SE COEFFICIENT	.0803	.0871	.0750	.0916	.0916	.0916	.0917	.0917
SAT. D.O. CONC.	9.20	9.24	9.28	9.31	9.35	9.39	9.43	9.47
TEMPERATURE	18.01	17.82	17.63	17.44	17.26	17.07	16.88	16.69
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1257	.0587	.1370	.0650	.2104	.0784	.2189	.0680
SE COEFFICIENT	.0855	.0945	.0753	.0995	.0996	.0996	.0997	.0997
SAT. D.O. CONC.	8.94	8.98	9.03	9.07	9.11	9.15	9.20	9.24
TEMPERATURE	19.39	19.16	18.94	18.71	18.49	18.26	18.04	17.81
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1193	.0585	.1531	.0736	.2382	.0858	.2467	.0740
SE COEFFICIENT	.0771	.0910	.0817	.1113	.1113	.1114	.1115	.1115
SAT. D.O. CONC.	8.76	8.80	8.83	8.87	8.90	8.94	8.98	9.01
TEMPERATURE	20.40	20.20	20.00	19.80	19.60	19.40	19.20	19.00

TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0748	.0376	.0989	.0484	.1585	.0570	.1663	.0498
SE COEFFICIENT	.0777	.0742	.0835	.1165	.1165	.1166	.1166	.1167
SAT. D.O. CONC.	8.70	8.73	8.75	8.77	8.80	8.82	8.85	8.87
TEMPERATURE	20.73	20.59	20.46	20.32	20.18	20.04	19.91	19.77
TIME = 19.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.0218	.0070	.0206	.0081	.0197	.0058	.0078	.0021
SE COEFFICIENT	.0758	.0831	.0813	.1000	.1000	.1001	.1001	.1001
SAT. D.O. CONC.	8.80	8.82	8.83	8.84	8.86	8.87	8.88	8.90
TEMPERATURE	20.16	20.09	20.01	19.94	19.86	19.79	19.71	19.64
TIME = 21.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1075	.0470	.1173	.0479	.1496	.0523	.1436	.0417
SE COEFFICIENT	.0801	.0856	.0754	.0887	.0887	.0887	.0887	.0888
SAT. D.O. CONC.	8.84	8.86	8.88	8.89	8.91	8.93	8.95	8.97
TEMPERATURE	19.95	19.85	19.75	19.65	19.55	19.45	19.35	19.25
TIME = 23.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1474	.0612	.1692	.0610	.1956	.0696	.1967	.0580
SE COEFFICIENT	.0779	.0786	.0752	.0773	.0773	.0773	.0773	.0773
SAT. D.O. CONC.	9.13	9.13	9.13	9.13	9.13	9.13	9.13	9.13
TEMPERATURE	18.40	18.40	18.40	18.40	18.40	18.40	18.40	18.40
TIME = 1.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1566	.0653	.1850	.0670	.2170	.0780	.2233	.0665
SE COEFFICIENT	.0759	.0768	.0750	.0772	.0772	.0772	.0772	.0772
SAT. D.O. CONC.	9.21	9.22	9.23	9.24	9.25	9.26	9.27	9.28
TEMPERATURE	17.98	17.92	17.87	17.82	17.77	17.73	17.68	17.63
TIME = 3.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1764	.0733	.1945	.0723	.2340	.0840	.2405	.0716
SE COEFFICIENT	.0810	.0820	.0752	.0796	.0796	.0796	.0796	.0796
SAT. D.O. CONC.	9.25	9.26	9.27	9.29	9.30	9.31	9.32	9.34
TEMPERATURE	17.77	17.71	17.64	17.58	17.52	17.46	17.39	17.33
TIME = 5.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1955	.0824	.1997	.0806	.2572	.0911	.2591	.0766
SE COEFFICIENT	.0841	.0883	.0750	.0879	.0879	.0879	.0879	.0879
SAT. D.O. CONC.	9.23	9.25	9.27	9.29	9.31	9.33	9.35	9.37
TEMPERATURE	17.85	17.75	17.65	17.55	17.45	17.35	17.25	17.15
TIME = 7.00 FLOW RATE = .0343 (M**3/SEC)								
SURFACE EXCH.	.1394	.0607	.1498	.0632	.2011	.0699	.1983	.0574
SE COEFFICIENT	.0789	.0867	.0750	.0937	.0937	.0938	.0938	.0938
SAT. D.O. CONC.	9.25	9.27	9.29	9.31	9.33	9.35	9.37	9.39
TEMPERATURE	17.75	17.65	17.55	17.45	17.35	17.25	17.15	17.05

TIME = 9.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0285	.0105	.0240	.0091	.0312	.0099	.0313	.0081	
SE COEFFICIENT	.0894	.0971	.0750	.0994	.0994	.0995	.0995	.0995	
SAT. D-O. CONC.	9.26	9.28	9.30	9.32	9.34	9.37	9.39	9.41	
TEMPERATURE	17.74	17.63	17.52	17.41	17.29	17.18	17.07	16.96	
TIME = 11.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0525	.0942	.0575	.1836	.0666	.1856	.0557		
SE COEFFICIENT	.1124	.1240	.0754	.1252	.1252	.1253	.1254	.1255	
SAT. D-O. CONC.	9.01	9.05	9.08	9.11	9.14	9.18	9.21	9.25	
TEMPERATURE	19.01	18.84	18.66	18.49	18.31	18.14	17.96	17.79	
TIME = 13.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.1974	.0799	.2067	.0706	.2307	.0843	.2427	.0734	
SE COEFFICIENT	.1292	.1221	.1064	.1002	.1002	.1002	.1002	.1002	
SAT. D-O. CONC.	8.83	8.82	8.82	8.82	8.81	8.81	8.80	8.80	
TEMPERATURE	20.01	20.04	20.06	20.09	20.11	20.14	20.16	20.19	
TIME = 15.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.1529	.0552	.2098	.0523	.1715	.0624	.1815	.0548	
SE COEFFICIENT	.0962	.0832	.1079	.0759	.0759	.0759	.0760	.0760	
SAT. D-O. CONC.	8.58	8.56	8.55	8.53	8.52	8.50	8.49	8.47	
TEMPERATURE	21.44	21.53	21.62	21.71	21.79	21.88	21.97	22.06	
TIME = 17.00 FLOW RATE = .0343 (M**3/SEC)									
SURFACE EXCH.	.0820	.0318	.1164	.0324	.1069	.0387	.1145	.0345	
SE COEFFICIENT	.0771	.0760	.0950	.0763	.0763	.0763	.0763	.0764	
SAT. D-O. CONC.	8.47	8.45	8.43	8.41	8.39	8.37	8.35	8.33	
TEMPERATURE	22.06	22.19	22.31	22.44	22.56	22.69	22.81	22.94	

DORM INPUT DATA FOR AUGUST 23, 1977
IN CHANNEL 5 FROM STATIONS 2 TO 10

200.	0.01	720.	25.	800.	0.46	24.5	2.00
5.00	45.0	93.0	90.0	0.001	1.00	00.0	1.045
00.0	600.	744.					
5.44E-4	3.8E-5	1.47E0					
8	13	12	20	2	1	3	0
23.0	5.20	21.8	3.80	17.2	4.10	19.8	3.80
11.5	7.9	12.1	6.7	11.2	6.9	11.5	7.2
91.	88.	84.	74.	67.	67.	67.	51.
100.	100.	100.	100.	100.	100.	100.	100.
5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4
CHANNEL 5 AUGUST 23 1977							

5.45	5.16	4.86	4.57	4.28	3.98	3.69	3.39	3.10
19.9							19.2	
19.5							18.9	
19.3							19.0	
19.4							19.7	
20.2							20.7	
21.0							21.5	
21.7							21.8	
21.7							21.3	
21.2							20.7	
20.9							20.4	
20.6							20.0	
20.2							19.7	
19.7							19.3	
19.6							19.2	
2.5	2.5	2.0	3.0	3.5	3.7	3.0	2.7	2.0
1.5							1.7	1.5
40.	77.	360.	342.	361.	330.	361.	34.	34.
27.							34.	375.
5.45	7.10	7.50	8.55	11.00	11.13	11.30	10.20	7.70
5.90							7.60	7.10
5.03	7.03	7.03	11.03	11.03	11.03	11.03	11.03	11.03
29.03								
4.00	4.35	9.30	13.50	15.00	14.20	10.90	7.40	6.20
7.12	9.12	11.12	13.12	15.12	17.12	19.12	21.12	23.12

DORM SIMULATION PRINTOUT FOR AUGUST 23, 1977
IN CHANNEL 5 FROM STATIONS 2 TO 10

CHANNEL 5

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = AUGUST 23 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION (G/M**3)
DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
(1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
T = WATER TEMPERATURE (DEG C)
TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720 SEC
COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
EPS = 1.00
DSTAR = .01
MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
MAXIMUM ITERATIONS = 20
CONSTANT FOR ARRHENIUS RELATION = 1.045
CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	2	3	4	5	6	7	8	9	10
INITIAL D. O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	5.45	5.16	4.86	4.57	4.28	3.98	3.69	3.39	3.10
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**2)	2.14	.40	2.03	.35	1.60	.38	1.84	.35	
SURFACE WIDTH (M)	3.51	2.41	3.69	2.04	3.41	2.10	3.51	2.19	
SEGMENT DIRECTION (DEG)	91.	88.	84.	74.	67.	67.	67.	51.	
WATER SURFACE SLOPE	00057	00057	00057	00057	00057	00057	00057	00057	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MB)
6.00	2.50	40.00	991.67
8.00	2.50	77.00	991.67
10.00	2.00	340.00	991.67
12.00	3.00	342.00	991.67
14.00	3.50	311.00	991.67
16.00	3.70	330.00	991.67
18.00	3.00	361.00	991.67
20.00	2.70	34.00	991.67
22.00	2.00	34.00	991.67
24.00	1.70	34.00	991.67
2.00	1.50	325.00	991.67
4.00	1.50	27.00	991.67
6.00	1.50	27.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
4.05	5.45	6.20	4.00
6.05	7.10	8.20	6.35
8.05	7.50	10.20	9.30
10.05	8.55	12.20	13.50
12.05	11.00	14.20	15.00
14.05	11.13	16.20	14.20
16.05	11.30	18.20	10.90
18.05	10.20	20.20	7.40
20.05	7.70	22.20	6.20
22.05	7.60	24.20	5.40
24.05	7.10	26.20	5.10
26.05	6.90	28.20	4.90
28.05	5.90	0	I

STANDARD RESPIRATION RATE = .4600 G/(M**HR) AT 20 DEG C MEAN ERROR = .0264 6 ITERATIONS

STANDARD RESPIRATION RATE = .4336 G/(M**HR) AT 20 DEG C MEAN ERROR = .0007 9 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .4336 G/(M**HR) AT 20 DEG C
 SUNRISE TIME = 4.61
 SUNSET TIME = 19.58
 9 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P G/(M**HR)	R G/(M**HR)	RESIDUAL G/(M**3)	TR HR
6.20	0	.420	-.072	2.062
8.20	.246	.418	-.000	2.062
10.20	.785	.421	.000	2.062
12.20	1.456	.439	-.000	2.062
14.20	1.345	.456	.000	2.062
16.20	1.105	.466	.000	2.062
18.20	.400	.464	.000	2.062
20.20	0	.454	-.377	2.062
22.20	.0	.447	-.362	2.062
.20	0	.440	-.062	2.062
2.20	0	.433	-.093	2.062
4.20	0	.413	-.180	2.062

DAY 1

TOTAL DAILY RESPIRATION = 10.54206/M**2

TOTAL DAILY PHOTOSYNTHESIS = 10.71516/M**2

P/R RATIO = 1.0164

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**HR)),

SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D. O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO. 2 3 4 5 6 7 8 9

TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)

SURFACE EXCH.	.1367	.0508	.1548	.0554	.1634	.0679	.2082	.0694
SE COEFFICIENT	.0794	.0800	.0804	.0823	.0836	.0836	.0836	.0858
SAT. D.O. CONC.	8.86	8.87	8.89	8.91	8.92	8.94	8.95	8.97
TEMPERATURE	19.86	19.77	19.68	19.59	19.51	19.42	19.33	19.24

TIME = 8.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	.0966	.0375	.1158	.0412	.1207	.0511	.1589	.0516	
SE COEFFICIENT	.0855	.0858	.0861	.0862	.0859	.0859	.0859	.0838	
SAT. D.O. CONC.	8.93	8.94	8.96	8.97	8.98	9.00	9.01	9.03	
TEMPERATURE	19.46	19.32	19.31	19.24	19.16	19.09	19.01	18.94	
TIME = 10.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	.0517	.0171	.0474	.0149	.0412	.0163	.0507	.0168	
SE COEFFICIENT	.0784	.0784	.0783	.0783	.0784	.0784	.0783	.0787	
SAT. D.O. CONC.	8.96	8.97	8.98	8.98	8.99	9.00	9.00	9.01	
TEMPERATURE	19.28	19.24	19.21	19.17	19.13	19.09	19.04	19.02	
TIME = 12.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0306	-.0143	-.0463	-.0184	-.0558	-.0251	-.0765	-.0261	
SE COEFFICIENT	.0785	.0784	.0784	.0784	.0784	.0784	.0787	.0785	
SAT. D.O. CONC.	8.94	8.95	8.95	8.96	8.96	8.97	8.97	8.98	
TEMPERATURE	19.39	19.34	19.34	19.31	19.29	19.26	19.24	19.21	
TIME = 14.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.1109	-.0451	-.1393	-.0508	-.1503	-.0645	-.1966	-.0691	
SE COEFFICIENT	.0786	.0786	.0786	.0788	.0793	.0793	.0793	.0838	
SAT. D.O. CONC.	8.79	8.78	8.77	8.76	8.75	8.73	8.72	8.71	
TEMPERATURE	20.23	20.29	20.36	20.42	20.48	20.54	20.61	20.67	
TIME = 16.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.1382	-.0539	-.1631	-.0577	-.1685	-.0716	-.2206	-.0736	
SE COEFFICIENT	.0814	.0805	.0797	.0789	.0788	.0788	.0789	.0789	
SAT. D.O. CONC.	8.65	8.64	8.63	8.62	8.61	8.60	8.58	8.57	
TEMPERATURE	21.03	21.09	21.16	21.22	21.28	21.34	21.41	21.47	
TIME = 18.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.1177	-.0428	-.1252	-.0426	-.1219	-.0505	-.1553	-.0530	
SE COEFFICIENT	.0789	.0789	.0789	.0790	.0792	.0792	.0792	.0815	
SAT. D.O. CONC.	8.53	8.53	8.53	8.53	8.52	8.52	8.52	8.52	
TEMPERATURE	21.71	21.72	21.73	21.74	21.76	21.77	21.78	21.79	
TIME = 20.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0354	-.0123	-.0364	-.0118	-.0335	-.0129	-.0410	-.0137	
SE COEFFICIENT	.0797	.0800	.0806	.0825	.0840	.0840	.0840	.0871	
SAT. D.O. CONC.	8.54	8.55	8.56	8.56	8.57	8.58	8.59	8.60	
TEMPERATURE	21.68	21.62	21.58	21.52	21.48	21.43	21.38	21.32	
TIME = 22.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	.0424	.0168	.0501	.0181	.0522	.0221	.0447	.0213	
SE COEFFICIENT	.0788	.0788	.0788	.0787	.0808	.0808	.0808	.0814	

SAT. D.O. CONC.	8.63	8.64	8.65	8.66	8.67	8.68	8.69	8.70
TEMPERATURE	21.17	21.11	21.04	20.98	20.92	20.86	20.79	20.73
TIME = 24.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.0675	.0270	.0031	.0299	.0077	.0372	.1134	.0377
SE COEFFICIENT	.0788	.0788	.0789	.0791	.0794	.0794	.0793	.0799
SAT. D.O. CONC.	8.68	8.69	8.70	8.71	8.72	8.73	8.74	8.75
TEMPERATURE	20.82	20.81	20.74	20.68	20.62	20.56	20.49	20.43
TIME = 2.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.0839	.0319	.0956	.0338	.0983	.0416	.1280	.0427
SE COEFFICIENT	.0787	.0786	.0786	.0786	.0787	.0787	.0786	.0789
SAT. D.O. CONC.	8.73	8.74	8.76	8.77	8.78	8.80	8.81	8.82
TEMPERATURE	20.56	20.49	20.41	20.34	20.26	20.19	20.11	20.04
TIME = 4.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1113	.0399	.1154	.0395	.1127	.0467	.1415	.0466
SE COEFFICIENT	.0786	.0786	.0786	.0787	.0788	.0787	.0787	.0791
SAT. D.O. CONC.	8.80	8.81	8.82	8.83	8.85	8.86	8.87	8.88
TEMPERATURE	20.17	20.11	20.04	19.98	19.92	19.86	19.79	19.73
TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1724	.0568	.1529	.0485	.1319	.0521	.1523	.0484
SE COEFFICIENT	.0785	.0785	.0785	.0786	.0787	.0787	.0786	.0790
SAT. D.O. CONC.	8.89	8.90	8.91	8.92	8.93	8.94	8.95	8.95
TEMPERATURE	19.68	19.63	19.57	19.52	19.48	19.42	19.38	19.32

DORM INPUT DATA FOR AUGUST 23, 1977
IN CHANNEL 5 FROM STATIONS 10 TO 18

200.	0.01	720.	25.0	800.	0.41	24.5	2.00
5.00	45.0	93.0	90.0	0.001	1.00	00.0	1.045
00.0	600.	744.					
5.44E-4	3.80E-5	1.45E00					
8	13	12	20	10	1	3	0
23.0	5.20	20.5	4.40	19.8	3.60	10.8	3.00
11.9	6.80	11.9	7.50	11.8	6.60	12.1	6.10
35.	14.	1.	351	351	351	351	315
100.	100.	100.	100.	100.	100.	100.	100.
5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4

CHANNEL 5 AUGUST 23 1977

3.10	3.06	3.01	2.97	2.93	2.88	2.84	2.79	2.75
19.2								18.8
19.0								18.6
19.0								18.6
19.2								19.2
20.7								19.7
21.5								21.7
21.8								22.0
21.3								21.5
20.7								20.6
20.4								20.1
20.0								19.7
19.7								19.3
19.3								19.1
19.2								19.0
2.5	2.5	2.0	3.0	3.5	3.7	3.0	2.7	2.0
1.5								1.7
45	77	340	342	341	330	341	34	34
27.								34
3.10	4.00	4.35	2.30	13.50	15.00	14.20	10.90	7.40
4.90								6.20
5.12	7.12	8.12	11.12	13.12	15.12	17.12	19.12	21.12
29.12								23.12
2.75	4.75	6.75	8.75	10.75	12.75	14.75	16.75	18.75
7.21	9.21	11.21	13.21	15.21	17.21	19.21	21.21	23.21

DORM SIMULATION PRINTOUT FOR AUGUST 23, 1977
IN CHANNEL 5 FROM STATIONS 10 TO 18

CHANNEL 5

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = AUGUST 23 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION G/M**3)
DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
(1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
T = WATER TEMPERATURE (DEG C)
TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720 SEC
COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
EPS = 1.00
DSTAR = .01
MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
MAXIMUM ITERATIONS = 20
CONSTANT FOR ARRHENIUS RELATION = 1.045
CONSTANT REPRESENTING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	10	11	12	13	14	15	16	17	18
INITIAL D.O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	3.10	3.06	3.01	2.97	2.93	2.88	2.84	2.79	2.75
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**2)	2.14	.53	1.90	.41	1.94	.33	1.75	.28	
SURFACE WIDTH (M)	3.63	2.07	3.63	2.29	3.60	2.01	3.69	1.86	
SEGMENT DIRECTION (DEG)	35.	16.	1.	351.	351.	351.	351.	351.	
WATER SURFACE SLOPE	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MM)
6.00	2.50	45.00	991.67
8.00	2.50	77.00	991.67
10.00	2.00	360.00	991.67
12.00	3.00	342.00	991.67
14.00	3.50	361.00	991.67
16.00	3.70	330.00	991.67
18.00	3.00	361.00	991.67
20.00	2.70	34.00	991.67
22.00	2.00	34.00	991.67
24.00	1.70	34.00	991.67
2.00	1.50	325.00	991.67
4.00	1.50	27.00	991.67
6.00	1.50	27.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
4.20	3.10	6.35	2.75
6.20	4.00	8.35	4.25
8.20	6.35	10.35	8.70
10.20	2.30	12.35	13.40
12.20	13.50	14.35	15.80
14.20	15.00	16.35	16.10
16.20	14.20	18.35	13.10
18.20	10.20	20.35	7.90
20.20	7.40	22.35	5.50
22.20	6.20	24.35	4.80
24.20	5.40	26.35	3.90
26.20	5.10	28.35	3.60
28.20	4.90	0	1

STANDARD RESPIRATION RATE = .4100 G/(M**M*HR) AT 20 DEG C MEAN ERROR = -.0093 6 ITERATIONS

STANDARD RESPIRATION RATE = .4193 G/(M**M*HR) AT 20 DEG C MEAN ERROR = -.0004 8 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .4193 G/(M**2*HR) AT 20 DEG C
 SUNRISE TIME = 4.61
 SUNSET TIME = 19.58
 8 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P G/(M**2*HR)	R G/(M**2*HR)	RESIDUAL G/M**3	TR HR
6.35	.143	.398	.000	2.062
8.35	.409	.398	-.000	2.062
10.35	.836	.406	.000	2.062
12.35	1.276	.423	.000	2.062
14.35	1.092	.446	.000	2.062
16.35	.894	.454	.000	2.062
18.35	.392	.446	-.000	2.062
20.35	0	.433	-.656	2.062
22.35	0	.424	-.154	2.062
.35	0	.417	.325	2.062
2.35	0	.411	.027	2.062
4.35	0	.381	-.203	2.062

DAY 1

TOTAL DAILY RESPIRATION = 10.0807G/M**2
 TOTAL DAILY PHOTOSYNTHESIS = 10.1499G/M**2
 P/R RATIO = 1.0048

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**2*HR)),
 SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D. O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO.	10	11	12	13	14	15	16	17
TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.2843	.1220	.2465	.0841	.2432	.0602	.2305	.0738
SE COEFFICIENT	.0856	.0830	.0803	.0789	.0782	.0782	.0782	.0782
SAT. D.O. CONC.	8.98	8.99	9.00	9.01	9.02	9.03	9.04	9.05
TEMPERATURE	19.18	19.12	19.07	19.02	18.98	18.92	18.88	18.82
TIME = 8.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.2090	.0929	.1975	.0698	.2049	.0685	.1991	.0645
SE COEFFICIENT	.0806	.0784	.0780	.0780	.0780	.0780	.0780	.0780
SAT. D.O. CONC.	9.02	9.03	9.04	9.05	9.06	9.07	9.08	9.09
TEMPERATURE	18.98	18.92	18.88	18.82	18.77	18.73	18.68	18.62

TIME = 10.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	.0917	.0445	.0993	.0352	.1064	.0359	.1074	.0352
SE COEFFICIENT	.0795	.0810	.0815	.0813	.0813	.0813	.0813	.0813
SAT. D.O. CONC.	9.02	9.03	9.04	9.05	9.06	9.07	9.08	9.09
TEMPERATURE	18.98	18.92	18.88	18.82	18.77	18.73	18.68	18.62
TIME = 12.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	-.0739	-.0322	-.0636	-.0226	-.0607	-.0201	-.0539	-.0175
SE COEFFICIENT	.0803	.0858	.0898	.0914	.0914	.0914	.0914	.0914
SAT. D.O. CONC.	8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98
TEMPERATURE	19.20	19.20	19.20	19.20	19.20	19.20	19.20	19.20
TIME = 14.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	-.2678	-.1240	-.2548	-.0874	-.2467	-.0812	-.2284	-.0735
SE COEFFICIENT	.0704	.0947	.0983	.0924	.0927	.0927	.0927	.0927
SAT. D.O. CONC.	8.72	8.74	8.76	8.78	8.81	8.83	8.85	8.87
TEMPERATURE	20.44	20.51	20.39	20.24	20.14	20.01	19.89	19.74
TIME = 16.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	-.2927	-.1428	-.3225	-.1175	-.3387	-.1123	-.3218	-.1038
SE COEFFICIENT	.0794	.0844	.0937	.0975	.0975	.0975	.0975	.0975
SAT. D.O. CONC.	8.57	8.56	8.56	8.55	8.55	8.54	8.54	8.54
TEMPERATURE	21.51	21.54	21.54	21.59	21.61	21.64	21.66	21.69
TIME = 18.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	-.2420	-.1184	-.2584	-.0914	-.2697	-.0906	-.2447	-.0862
SE COEFFICIENT	.0858	.0903	.0916	.0910	.0910	.0910	.0910	.0910
SAT. D.O. CONC.	8.52	8.51	8.51	8.50	8.50	8.49	8.49	8.49
TEMPERATURE	21.81	21.84	21.84	21.89	21.91	21.94	21.96	21.99
TIME = 20.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	-.0744	-.0381	-.0870	-.0315	-.0993	-.0346	-.1065	-.0357
SE COEFFICIENT	.0881	.0867	.0837	.0815	.0815	.0815	.0815	.0815
SAT. D.O. CONC.	8.60	8.60	8.59	8.59	8.58	8.58	8.57	8.57
TEMPERATURE	21.31	21.34	21.36	21.39	21.41	21.44	21.46	21.49
TIME = 22.00 FLOW RATE = 0378 (M**3/SEC)								
SURFACE EXCH.	.0701	.0292	.0554	.0186	.0489	.0153	.0386	.0115
SE COEFFICIENT	.0816	.0810	.0792	.0792	.0792	.0792	.0792	.0792
SAT. D.O. CONC.	8.71	8.71	8.71	8.71	8.72	8.72	8.72	8.72
TEMPERATURE	20.48	20.48	20.47	20.46	20.44	20.43	20.42	20.41

TIME = 24.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1339	.0607	.1251	.0443	.1283	.0430	.1231	.0400
SE COEFFICIENT	.0800	.0796	.0791	.0787	.0787	.0787	.0787	.0787
SAT. D.O. CONC.	8.76	8.77	8.78	8.78	8.79	8.80	8.80	8.81
TEMPERATURE	20.38	20.34	20.31	20.27	20.23	20.19	20.16	20.12
TIME = 2.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1646	.0746	.1573	.0560	.1644	.0556	.1620	.0532
SE COEFFICIENT	.0789	.0792	.0791	.0788	.0788	.0788	.0788	.0788
SAT. D.O. CONC.	8.83	8.84	8.85	8.86	8.86	8.87	8.88	8.88
TEMPERATURE	19.98	19.94	19.91	19.87	19.83	19.79	19.76	19.72
TIME = 4.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1820	.0825	.1744	.0627	.1830	.0620	.1812	.0596
SE COEFFICIENT	.0791	.0720	.0787	.0785	.0785	.0785	.0785	.0785
SAT. D.O. CONC.	8.89	8.90	8.91	8.92	8.93	8.94	8.95	8.95
TEMPERATURE	19.68	19.63	19.57	19.52	19.48	19.42	19.38	19.32
TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1929	.0865	.1799	.0629	.1832	.0613	.1782	.0582
SE COEFFICIENT	.0790	.0790	.0787	.0784	.0784	.0784	.0784	.0784
SAT. D.O. CONC.	8.96	8.97	8.97	8.98	8.98	8.98	8.99	8.99
TEMPERATURE	19.29	19.26	19.24	19.21	19.19	19.16	19.14	19.11

DORM INPUT DATA FOR AUGUST 23, 1977

IN CHANNEL 8 FROM STATIONS 2 TO 10

200.	0.01	720.	25.0	800.	0.39	24.5	2.00
5.00	45.0	93.0	70.0	0.001	1.00	00.0	1.045
00.0	600.	744.					
5.44E-4	3.80E-5	1.49E00					
8	13	12	20	2	1	3	0
19.0	3.32	21.0	3.77	23.5	3.52	23.4	2.82
11.0	6.40	10.4	6.60	11.6	6.20	12.3	5.70
92.	92.	90.	80.	72.	69.	69.	58.
100.	100.	100.	100.	100.	100.	100.	100.
5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4
CHANNEL 8 AUGUST 23 1977							

6.90	6.63	6.36	6.09	5.83	5.56	5.29	5.02	4.75
29.0								27.0
28.6								26.6
28.4								26.8
28.8								27.2
29.3								27.8
30.0								28.2
30.2								28.4
30.6								28.8
30.9								29.3
30.8								29.2
30.0								28.3
28.7								26.1
26.0								24.8
25.6								25.2
2.5	2.5	2.0	3.0	3.5	3.7	3.0	2.7	2.0
1.5								1.7
45.	77.	360.	342.	361.	330.	361.	34.	34.
27.								34.
6.90	6.75	7.10	8.00	8.80	9.70	9.90	9.50	8.70
6.90								7.70
5.03	7.03	9.03	11.03	13.03	15.03	17.03	19.03	21.03
29.03								23.03
4.90	6.50	7.45	10.20	10.80	10.70	8.40	6.30	5.20
7.15	9.15	11.15	13.15	15.15	17.15	19.15	21.15	23.15

DORM SIMULATION PRINTOUT FOR AUGUST 23, 1977

IN CHANNEL 8 FROM STATIONS 2 TO 10

CHANNEL 8

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = AUGUST 23 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION G/M**3
 USTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
 EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
 (1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
 P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**HR))
 T = WATER TEMPERATURE (DEG. C)
 TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720 SEC
 COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
 EPS = 1.00
 USTAR = .01
 MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**HR)
 MAXIMUM ITERATIONS = 20
 CONSTANT FOR ARRHENIUS RELATION = 1.045
 CONSTANT REPRESENTING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
 ORDER OF EQUATION FIT TO UPSIDEAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	2	3	4	5	6	7	8	9	10
INITIAL D. O. AT UPSIDEAM									
END OF SEGMENT (G/M**3)	6.90	6.63	6.36	6.09	5.83	5.56	5.29	5.02	4.75
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**2)	1.77	.31	1.95	.35	2.18	.33	2.17	.27	
SURFACE WIDTH (M)	3.35	1.95	3.17	2.01	3.54	1.89	3.75	1.74	
SEGMENT DIRECTION (DEG)	92.	92.	90.	80.	72.	69.	69.	58.	
WATER SURFACE SLOPE	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY	WIND DIRECTION	AIR PRESSURE
	(M/SEC)	(DEGREES)	(MM)
6.00	2.50	45.00	991.67
8.00	2.50	77.00	991.67
10.00	2.00	360.00	991.67
12.00	3.00	342.00	991.67
14.00	3.50	361.00	991.67
16.00	3.70	330.00	991.67
18.00	3.00	361.00	991.67
20.00	2.70	34.00	991.67
22.00	2.00	34.00	991.67
24.00	1.70	34.00	991.67
2.00	1.50	375.00	991.67
4.00	1.50	27.00	991.67
6.00	1.50	27.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
4.05	6.90	6.25	4.90
6.05	6.75	8.25	6.50
8.05	7.10	10.25	7.45
10.05	8.00	12.25	10.20
12.05	8.80	14.25	10.80
14.05	9.70	16.25	10.70
16.05	9.90	18.25	8.40
18.05	9.50	20.25	6.30
20.05	8.70	22.25	5.20
22.05	7.70	24.25	4.90
24.05	7.30	26.25	4.70
26.05	7.00	28.25	4.60
28.05	6.90	0	1

STANDARD RESPIRATION RATE = .3900 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0215 6 ITERATIONS

STANDARD RESPIRATION RATE = .4115 G/(M**HR) AT 20 DEG C MEAN ERROR = -.0007 9 ITERATIONS

RESULTS OF COMPUTATIONS:

STANDARD RESPIRATORY RATE = .4115 G/(M**HR) AT 20 DEG C
 SUNRISE TIME = 4.61
 SUNSET TIME = 19.58
 9 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P	R	RESIDUAL	TR
	----G/(M**HR)----		G/M**3	HR
6.25	.135	.577	.000	2.096
8.25	.540	.575	-.000	2.096
10.25	.650	.583	.000	2.096
12.25	1.145	.597	.000	2.096
14.25	1.054	.611	-.000	2.096
16.25	.888	.619	.000	2.096
18.25	.322	.628	-.000	2.096
20.25	0	.639	-.022	2.096
22.25	0	.638	-.235	2.096
.25	0	.617	.149	2.096
2.25	.0	.576	.151	2.096
4.25	0	.511	-.090	2.096

DAY 1

TOTAL DAILY RESPIRATION = 14.3600G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 9.5181G/M**2

P/R RATIO = .6628

COMPUTED VALUES OF SURFACE D. O. EXCHANGE (G/(M**HR)),
 SURFACE EXCHANGE COEFFICIENT (/HR),
 SATURATION D. O. CONCENTRATION (G/M**3),
 AND WATER TEMPERATURE (DEG. C)
 FOR EACH CHANNEL SEGMENT

SECTION NO.	2	3	4	5	6	7	8	9
TIME = 4.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.0300	.0126	.0593	.0213	.0875	.0283	.1048	.0316
SE COEFFICIENT	.0780	.0779	.0781	.0792	.0803	.0806	.0806	.0817
SAT. D.O. CONC.	7.44	7.47	7.51	7.54	7.58	7.61	7.65	7.69
TEMPERATURE	28.88	28.62	28.37	28.13	27.87	27.63	27.37	27.13

TIME = 8.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	.0296	.0121	.0541	.0183	.0726	.0232	.0859	.0254	
SE COEFFICIENT	.0816	.0816	.0818	.0822	.0822	.0821	.0821	.0811	
SAT. D.O. CONC.	7.49	7.53	7.56	7.60	7.64	7.67	7.71	7.74	
TEMPERATURE	28.48	28.22	27.97	27.73	27.48	27.23	26.98	26.73	
TIME = 10.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	.0047	.0027	.0149	.0054	.0237	.0079	.0315	.0097	
SE COEFFICIENT	.0768	.0768	.0767	.0767	.0766	.0766	.0766	.0766	
SAT. D.O. CONC.	7.52	7.55	7.57	7.60	7.63	7.66	7.69	7.72	
TEMPERATURE	28.30	28.10	27.90	27.70	27.50	27.30	27.10	26.90	
TIME = 12.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0339	-.0112	-.0429	-.0130	-.0457	-.0134	-.0432	-.0117	
SE COEFFICIENT	.0770	.0770	.0769	.0768	.0767	.0767	.0766	.0766	
SAT. D.O. CONC.	7.46	7.49	7.52	7.55	7.57	7.60	7.63	7.66	
TEMPERATURE	28.70	28.50	28.30	28.10	27.90	27.70	27.50	27.30	
TIME = 14.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0737	-.0250	-.0991	-.0304	-.1115	-.0335	-.1146	-.0330	
SE COEFFICIENT	.0770	.0770	.0769	.0769	.0770	.0771	.0771	.0785	
SAT. D.O. CONC.	7.39	7.42	7.44	7.47	7.50	7.52	7.55	7.58	
TEMPERATURE	29.21	29.02	28.83	28.64	28.46	28.27	28.08	27.89	
TIME = 16.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.1040	-.0334	-.1279	-.0370	-.1324	-.0387	-.1325	-.0371	
SE COEFFICIENT	.0791	.0791	.0786	.0773	.0770	.0769	.0769	.0768	
SAT. D.O. CONC.	7.30	7.33	7.36	7.39	7.42	7.45	7.48	7.52	
TEMPERATURE	29.89	29.66	29.44	29.21	28.99	28.76	28.54	28.31	
TIME = 18.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0998	-.0296	-.1091	-.0298	-.1027	-.0282	-.0941	-.0255	
SE COEFFICIENT	.0772	.0772	.0771	.0771	.0771	.0771	.0771	.0777	
SAT. D.O. CONC.	7.27	7.30	7.33	7.36	7.39	7.42	7.46	7.49	
TEMPERATURE	30.09	29.86	29.64	29.41	29.19	28.96	28.74	28.51	
TIME = 20.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0767	-.0192	-.0621	-.0134	-.0377	-.0068	-.0164	-.0019	
SE COEFFICIENT	.0777	.0777	.0778	.0787	.0788	.0803	.0803	.0821	
SAT. D.O. CONC.	7.21	7.24	7.27	7.31	7.34	7.37	7.40	7.43	
TEMPERATURE	30.42	30.26	30.04	29.81	29.59	29.36	29.14	28.91	
TIME = 22.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0412	-.0074	-.0158	.0007	.0149	.0092	.0411	.0152	
SE COEFFICIENT	.0775	.0774	.0774	.0776	.0779	.0780	.0779	.0785	
SAT. D.O. CONC.	7.17	7.20	7.23	7.25	7.28	7.31	7.34	7.36	
TEMPERATURE	30.80	30.60	30.40	30.20	30.00	29.80	29.60	29.40	
TIME = 24.00 FLOW RATE = 0378 (M**3/SEC)									
SURFACE EXCH.	-.0101	.0022	.0212	.0112	.0525	.0198	.0776	.0252	
SE COEFFICIENT	.0774	.0774	.0773	.0774	.0775	.0775	.0775	.0777	
SAT. D.O. CONC.	7.18	7.21	7.24	7.27	7.29	7.32	7.35	7.38	
TEMPERATURE	30.70	30.50	30.30	30.10	29.90	29.70	29.50	29.30	

TIME = 2.00 FLOW RATE = .0378 (M**3/SEC)									
SURFACE EXCH.	.0107	.0087	.0489	.0187	.0796	.0275	.1040	.0323	
SE COEFFICIENT	.0772	.0771	.0771	.0770	.0770	.0770	.0769	.0770	
SAT. D.O. CONC.	7.29	7.32	7.35	7.38	7.41	7.44	7.47	7.50	
TEMPERATURE	29.89	29.68	29.47	29.26	29.04	28.83	28.62	28.41	
TIME = 4.00 FLOW RATE = .0378 (M**3/SEC)									
SURFACE EXCH.	.0268	.0135	.0651	.0237	.0981	.0328	.1226	.0374	
SE COEFFICIENT	.0769	.0768	.0767	.0767	.0767	.0766	.0766	.0767	
SAT. D.O. CONC.	7.48	7.53	7.58	7.62	7.67	7.72	7.76	7.81	
TEMPERATURE	28.54	28.21	27.89	27.56	27.24	26.91	26.59	26.26	
TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)									
SURFACE EXCH.	.0429	.0173	.0743	.0244	.0958	.0305	.1116	.0333	
SE COEFFICIENT	.0763	.0763	.0762	.0762	.0763	.0763	.0762	.0764	
SAT. D.O. CONC.	7.86	7.89	7.91	7.93	7.95	7.98	8.00	8.02	
TEMPERATURE	25.92	25.77	25.62	25.47	25.33	25.17	25.02	24.87	

DORM INPUT DATA FOR AUGUST 23, 1977
IN CHANNEL 8 FROM STATIONS 10 TO 18

200.	0.01	720.	25.0	800.	0.80	24.5	2.00
5.00	45.0	93.0	90.0	0.001	1.00	0.00	1.045
00.0	600.	744.					
5.44E-4	3.80E-5	1.49E00					
0	13	12	20	10	1	3	0
21.6	3.11	20.6	2.16	18.9	4.07	23.5	2.16 18.4
11.3	5.80	10.4	5.60	11.0	6.20	11.3	6.00 10.9
44.	29.	15.	5.	350.	350.	350.	350. 350.
100.	100.	100.	100.	100.	100.	100.	100.
5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4	5.67E-4
CHANNEL 8 AUGUST 23 1977							
4.75	4.54	4.34	4.13	3.93	3.72	3.51	3.31 3.10
27.0							26.3
26.6							26.1
26.8							26.3
27.2							26.6
27.8							27.0
28.2							27.6
28.4							27.6
28.8							28.2
29.3							28.6
29.2							28.6
28.3							27.2
26.1							26.2
24.8							26.9
25.2							26.8
2.5	2.5	2.0	3.0	3.5	3.7	3.0	2.7 2.0 1.7 1.5 1.5
1.5							
45.	77.	360.	342.	361.	330.	361.	34. 34. 34. 375. 27.
27.							
4.75	4.90	6.50	7.45	10.20	10.80	10.70	8.40 6.30 5.20 4.90 4.70
4.60							
5.15	7.15	9.15	11.15	13.15	15.15	17.15	19.15 21.15 23.15 25.15 27.15
29.15							
3.25	5.95	8.65	13.20	13.40	12.00	8.70	4.50 3.30 3.00 2.60 2.50
7.21	9.24	11.24	13.24	15.24	17.24	19.24	21.24 23.24 25.24 27.24 29.24

DORM SIMULATION PRINTOUT FOR AUGUST 23, 1977
IN CHANNEL 8 FROM STATIONS 10 TO 18

CHANNEL 8

ESTIMATION OF CHANNEL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

BY NUMERICALLY ROUTING DIEL DISSOLVED OXYGEN MEASUREMENTS

BETWEEN TWO STATIONS

STARTING DATE = AUGUST 23 1977

LIST OF SYMBOLS:

C = D.O. CONCENTRATION G/M**3)
DSTAR = DIMENSIONLESS LONGITUDINAL DISPERSION NUMBER
EPS = COEFFICIENT WHICH SPECIFIES TIME STEP METHOD
(1.0 FOR FULLY IMPLICIT, 0.5 FOR CRANK-NICOLSON IMPLICIT)
P = PHOTOSYNTHETIC RATE OF CHANNEL REACH (G/(M**M*HR))
T = WATER TEMPERATURE (DEG. C)
TR = HYDRAULIC RESIDENCE TIME OF CHANNEL REACH (HR)

INPUT DATA

COMPUTATIONAL TIME INCREMENT = 720. SEC
COMPUTATIONAL DISTANCE INCREMENT = 7.6 M
EPS = 1.00
DSTAR = .01
MAXIMUM ERROR IN R OR P FOR ITERATION CONVERGENCE = .0010 G/(M**M*HR)
MAXIMUM ITERATIONS = 20
CONSTANT FOR ARRHENIUS RELATION = 1.045
CONSTANT REPRESENTATING RESPIRATION INHIBITION DUE TO LOW D. O. CONC. = 0 G/M**3
ORDER OF EQUATION FIT TO UPSTREAM D. O. MEASUREMENTS = 3

INPUT DATA FOR EACH SEGMENT

SEGMENT NUMBER	10	11	12	13	14	15	16	17	18
INITIAL D.O. AT UPSTREAM									
END OF SEGMENT (G/M**3)	4.75	4.54	4.34	4.13	3.93	3.72	3.51	3.31	3.10
SEGMENT LENGTH (M)	30.5	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
CROSS-SECT. AREA (M**M)	2.01	.29	1.91	.20	1.76	.38	2.18	.20	
SURFACE WIDTH (M)	3.44	1.77	3.17	1.71	3.35	1.89	3.44	1.83	
SEGMENT DIRECTION (DEG)	44.	29.	15.	5.	350.	350.	350.	350.	
WATER SURFACE SLOPE	.00057	.00057	.00057	.00057	.00057	.00057	.00057	.00057	

WEATHER DATA INPUT TO MODEL

TIME	WIND VELOCITY (M/SEC)	WIND DIRECTION (DEGREES)	AIR PRESSURE (MB)
6.00	2.50	45.00	991.67
8.00	2.50	77.00	991.67
10.00	2.00	360.00	991.67
12.00	3.00	342.00	991.67
14.00	3.50	341.00	991.67
16.00	3.70	330.00	991.67
18.00	3.00	341.00	991.67
20.00	2.70	34.00	991.67
22.00	2.00	34.00	991.67
24.00	1.70	34.00	991.67
2.00	1.50	375.00	991.67
4.00	1.50	27.00	991.67
6.00	1.50	27.00	991.67

MEASURED DISSOLVED OXYGEN (G/M**3)

UPSTREAM		DOWNSTREAM	
TIME	D.O.	TIME	D.O.
4.25	4.75	6.35	3.25
6.25	4.90	8.40	5.95
8.25	6.50	10.40	8.65
10.25	7.45	12.40	13.20
12.25	10.20	14.40	13.40
14.25	10.80	16.40	12.00
16.25	10.70	18.40	8.70
18.25	8.40	20.40	4.50
20.25	6.30	22.40	3.30
22.25	5.20	24.40	3.00
24.25	4.90	26.40	2.60
26.25	4.70	28.40	2.50
28.25	4.60	0	1

STANDARD RESPIRATION RATE =	.8000 G/(M**M*HR) AT 20 DEG C	MEAN ERROR =	.3557	6 ITERATIONS
STANDARD RESPIRATION RATE =	.4443 G/(M**M*HR) AT 20 DEG C	MEAN ERROR =	.0118	10 ITERATIONS
STANDARD RESPIRATION RATE =	.4325 G/(M**M*HR) AT 20 DEG C	MEAN ERROR =	.0002	12 ITERATIONS

RESULTS OF COMPUTATIONS

STANDARD RESPIRATORY RATE = .4325 G/(M**HR) AT 20 DEG C

SUNRISE TIME = 4.61

SUNSET TIME = 19.58

12 ITERATIONS

ROUTED TOTAL COMMUNITY PHOTOSYNTHETIC AND RESPIRATORY RATES

TIME	P ----G/(M**HR)----	R G/M**3	RESIDUAL G/M**3	TR HR
8.35	.177	.574	-.000	2.003
8.40	.748	.577	.000	2.003
10.40	1.051	.586	-.000	2.003
12.40	1.839	.598	-.000	2.003
14.40	1.358	.610	-.000	2.003
16.40	.923	.616	-.000	2.003
18.40	.278	.628	-.000	2.003
20.40	0	.639	-.865	2.003
22.40	0	.637	-.172	2.003
.40	0	.609	.353	2.003
2.40	0	.572	.098	2.003
4.40	0	.518	-.263	2.003

DAY 1

TOTAL DAILY RESPIRATION = 14.3493G/M**2

TOTAL DAILY PHOTOSYNTHESIS = 12.8469G/M**2

P/R RATIO = .8953

COMPUTED VALUES OF SURFACE D.O. EXCHANGE (G/(M**HR)),

SURFACE EXCHANGE COEFFICIENT (/HR),

SATURATION D.O. CONCENTRATION (G/M**3),

AND WATER TEMPERATURE (DEG. C)

FOR EACH CHANNEL SEGMENT

SECTION NO. 10 11 12 13 14 15 16 17

TIME = 6.00 FLOW RATE = .0378 (M**3/SEC)

SURFACE EXCH.	.1470	.0436	.1652	.0338	.1538	.0615	.2018	.0367
SE COEFFICIENT	.0825	.0817	.0800	.0786	.0771	.0771	.0771	.0771
SAT. D.O. CONC.	7.71	7.72	7.74	7.75	7.76	7.77	7.79	7.80
TEMPERATURE	26.96	26.87	26.78	26.69	26.61	26.52	26.43	26.34

TIME = 8.00 FLOW RATE = .0378 (M**3/SEC)

SURFACE EXCH.	.1124	.0329	.1255	.0256	.1181	.0471	.1558	.0284
SE COEFFICIENT	.0795	.0777	.0768	.0766	.0766	.0765	.0765	.0765
SAT. D.O. CONC.	7.77	7.78	7.79	7.80	7.80	7.81	7.82	7.83
TEMPERATURE	26.57	26.51	26.44	26.38	26.32	26.26	26.19	26.13

TIME = 10.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.0495	.0130	.0477	.0004	.0367	.0135	.0469	.0081
SE COEFFICIENT	.0772	.0779	.0787	.0790	.0788	.0788	.0788	.0788
SAT. D.O. CONC.	7.74	7.75	7.76	7.77	7.77	7.78	7.79	7.80
TEMPERATURE	26.77	26.71	26.64	26.58	26.52	26.46	26.39	26.33
TIME = 12.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	-.0354	-.0149	-.0657	-.0170	-.0858	-.0375	-.1213	-.0238
SE COEFFICIENT	.0772	.0793	.0826	.0848	.0870	.0871	.0871	.0871
SAT. D.O. CONC.	7.68	7.69	7.70	7.71	7.72	7.74	7.75	7.76
TEMPERATURE	27.16	27.09	27.01	26.94	26.86	26.79	26.71	26.64
TIME = 14.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	-.1316	-.0457	-.1869	-.0419	-.1962	-.0816	-.2666	-.0508
SE COEFFICIENT	.0829	.0882	.0918	.0930	.0923	.0923	.0923	.0923
SAT. D.O. CONC.	7.60	7.61	7.62	7.64	7.65	7.67	7.68	7.70
TEMPERATURE	27.75	27.65	27.55	27.45	27.35	27.25	27.15	27.05
TIME = 16.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	-.1520	-.0472	-.1916	-.0419	-.2049	-.0827	-.2718	-.0507
SE COEFFICIENT	.0771	.0707	.0834	.0876	.0927	.0927	.0928	.0928
SAT. D.O. CONC.	7.54	7.55	7.56	7.57	7.58	7.59	7.60	7.61
TEMPERATURE	28.16	28.09	28.01	27.94	27.86	27.79	27.71	27.64
TIME = 18.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	-.1164	-.0351	-.1367	-.0273	-.1233	-.0483	-.1600	-.0290
SE COEFFICIENT	.0803	.0838	.0863	.0872	.0867	.0867	.0867	.0867
SAT. D.O. CONC.	7.51	7.52	7.54	7.55	7.57	7.58	7.60	7.61
TEMPERATURE	28.35	28.25	28.15	28.05	27.95	27.85	27.75	27.65
TIME = 20.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	-.0213	-.0045	-.0163	-.0018	-.0067	-.0015	-.0090	-.0010
SE COEFFICIENT	.0839	.0842	.0830	.0814	.0790	.0789	.0789	.0789
SAT. D.O. CONC.	7.45	7.46	7.47	7.48	7.49	7.51	7.52	7.53
TEMPERATURE	28.76	28.69	28.61	28.54	28.46	28.39	28.31	28.24
TIME = 22.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.0639	.0214	.0834	.0186	.0864	.0358	.1135	.0214
SE COEFFICIENT	.0792	.0793	.0789	.0783	.0776	.0776	.0776	.0776
SAT. D.O. CONC.	7.38	7.40	7.41	7.42	7.43	7.44	7.46	7.47
TEMPERATURE	29.26	29.17	29.08	28.99	28.91	28.82	28.73	28.64
TIME = 24.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1069	.0344	.1355	.0294	.1379	.0567	.1856	.0348
SE COEFFICIENT	.0782	.0782	.0780	.0777	.0773	.0773	.0773	.0773
SAT. D.O. CONC.	7.40	7.41	7.42	7.43	7.44	7.45	7.46	7.47
TEMPERATURE	29.16	29.09	29.01	28.94	28.86	28.79	28.71	28.64
TIME = 2.00 FLOW RATE = .0378 (M**3/SEC)								
SURFACE EXCH.	.1266	.0403	.1595	.0345	.1623	.0469	.2215	.0416
SE COEFFICIENT	.0773	.0775	.0775	.0775	.0772	.0772	.0772	.0772
SAT. D.O. CONC.	7.53	7.55	7.57	7.59	7.61	7.63	7.65	7.67
TEMPERATURE	28.23	28.09	27.96	27.82	27.68	27.54	27.41	27.27

TIME = 4.00	FLOW RATE = .0378 (M**3/SEC)							
SURFACE EXCH.	.1467	.0453	.1762	.0374	.1742	.0711	.2350	.0439
SE-COEFFICIENT	.0770	.0772	.0771	.0770	.0767	.0767	.0767	.0767
SAT. D.O. CONC.	7.84	7.83	7.83	7.83	7.83	7.83	7.82	7.82
TEMPERATURE	26.11	26.12	26.13	26.14	26.16	26.17	26.18	26.19

TIME = 6.00	FLOW RATE = .0378 (M**3/SEC)							
SURFACE EXCH.	.1575	.0471	.1770	.0360	.1634	.0649	.2109	.0386
SE-COEFFICIENT	.0768	.0770	.0770	.0769	.0767	.0768	.0768	.0769
SAT. D.O. CONC.	8.01	7.97	7.93	7.89	7.85	7.82	7.78	7.74
TEMPERATURE	24.93	25.19	25.46	25.72	25.98	26.24	26.51	26.77