Bates College
SCARAB

Walter Lawrance Papers | Muskie Archives and Special Collections Library

10-1965

Pool Studies

Walter A. Lawrance
Bates College

Follow this and additional works at: http://scarab.bates.edu/lawrance

 Part of the Earth Sciences Commons, and the Environmental Sciences Commons

Recommended Citation

Walter A. Lawrance Androscoggin River Studies Twenty Third Annual Report, October, 1965, Androscoggin River Studies, Box 4, Folder 3, Walter A. Lawrance Papers, Edmund S. Muskie Archives and Special Collections Library, Bates College, Lewiston, Maine.

This Article is brought to you for free and open access by the Muskie Archives and Special Collections Library at SCARAB. It has been accepted for inclusion in Walter Lawrance Papers by an authorized administrator of SCARAB. For more information, please contact batesscarab@bates.edu.

TWENTY-THIRD ANNUAL REPORT

Part Two

ANDROSCOGGIN RIVER AND POOL ANALYSES

1965

Introduction. This part of the report contains the results and comparisons of analytical and test data obtained from river water sampled at different locations in the river and pool during 1965.

Dissolved Oxygen, Chemical Demand (C.C.P.) and Biochemical Oxygen Demands* (B.O.D.). A period of eleven weeks was chosen for comparison of the data for water sampled at North Turner Bridge, Turner Center Bridge and Deer Rips Dam. Following the scheme introduced last year Deer Rips station was chosen instead of Gulf Island because of the greater uniformity of the water.

Dissolved Oxygen. Plots of the dissolved oxygen data have been made for most of the sampling stations along the river. The analytical results may be summarized as follows.

1. Bell's Ice House. Although river flows were low throughout most of the season, the water passing this station was at or near saturation. The June 3- September 16 average was 35.11 tons of D.O. per day. The 1964 average was 43.77 tons/day; the flows were higher.

*For additional B.O.D. studies cf. Part Three of this report.

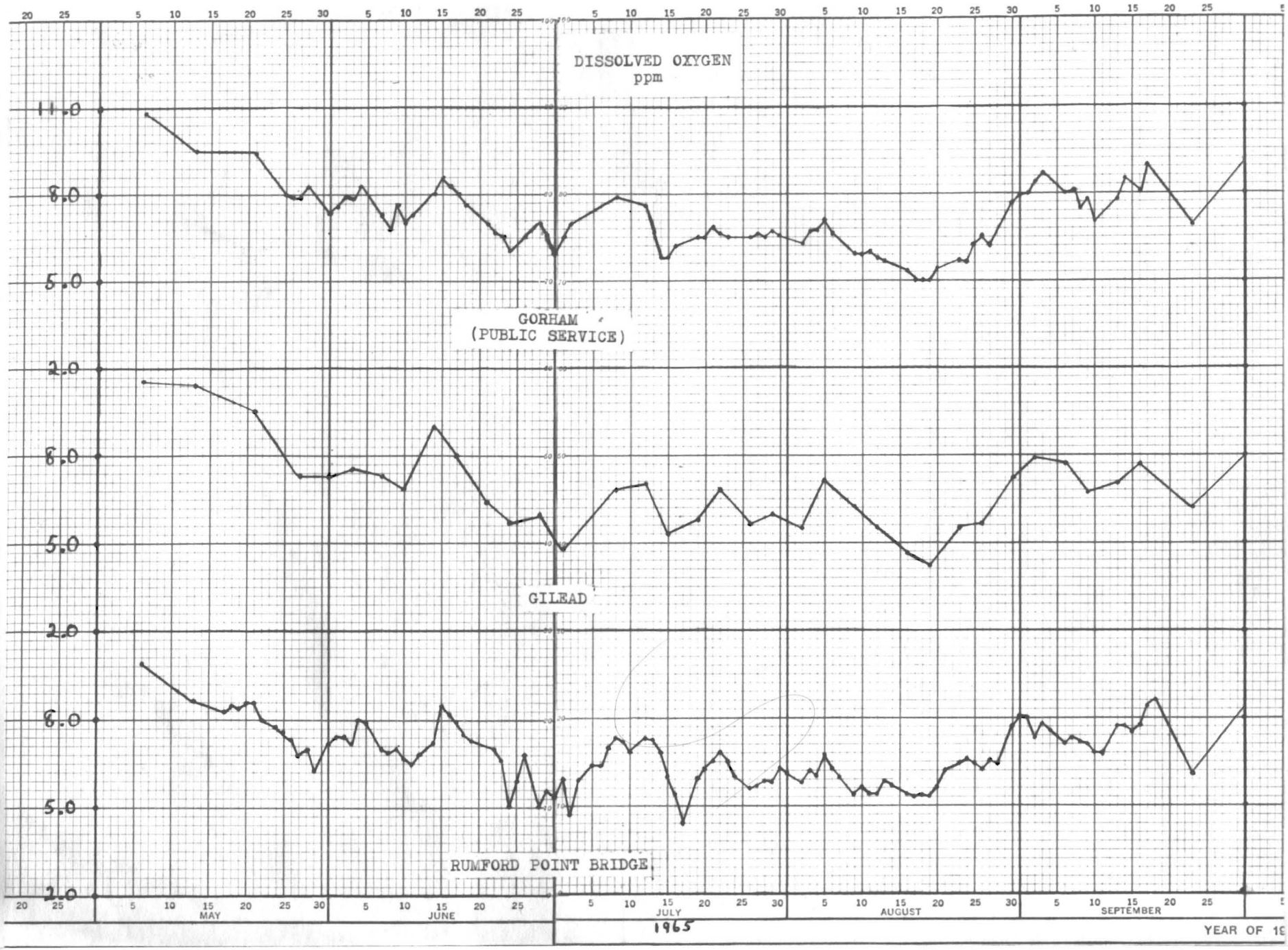
2. Gorham, N.H. During the season there was only one test below five ppm (4.92). Thirteen tests were between five and six ppm, the remainder were above six ppm. The June 1 - September 16 average was 28.83 tons/day. In 1964 the average was 42.91 T/d and 45.12 T/d in 1963.

3. Gilead, Maine. Three tests were recorded between four and five ppm, and nine days when the D.O. was between five and six ppm. Last year there were no reports below six ppm. During the 1965 June-September test period, the average daily dissolved oxygen present in the river water was 29.57 tons. The 1964 average was 42.78 tons per day. There was a slight increase (0.74 T/d) in the D.O. between Gorham and Gilead.

4. Rumford Point Bridge. Analyses were made on six days each week through most of the season. There were no tests below four ppm, and only four between four and five ppm. The record for the past eight years is.

1965	0	days	below	FOUR	ppm
1964	0	"	"	"	"
1963	0	"	"	"	"
1962	17	"	"	"	"
1961	55	"	"	"	"
1960	15	"	"	"	"
1959	29	"	"	"	"
1958	24	"	"	"	"

Although there were more days below six ppm this year, the very low flows did not produce any results below the four ppm floor in existence for the past three years.


DISSOLVED OXYGEN
ppm
11.0
8.0
5.0
GORHAM
(PUBLIC SERVICE)
2.0
8.0
5.0
GILEAD
2.0
8.0
5.0
RUMFORD POINT BRIDGE
2.0
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

35A

5. Virginia Bridge. D.O. determinations were made five days each week during most of the season. There were only three tests recorded below five ppm, eighteen tests were between five and six ppm.

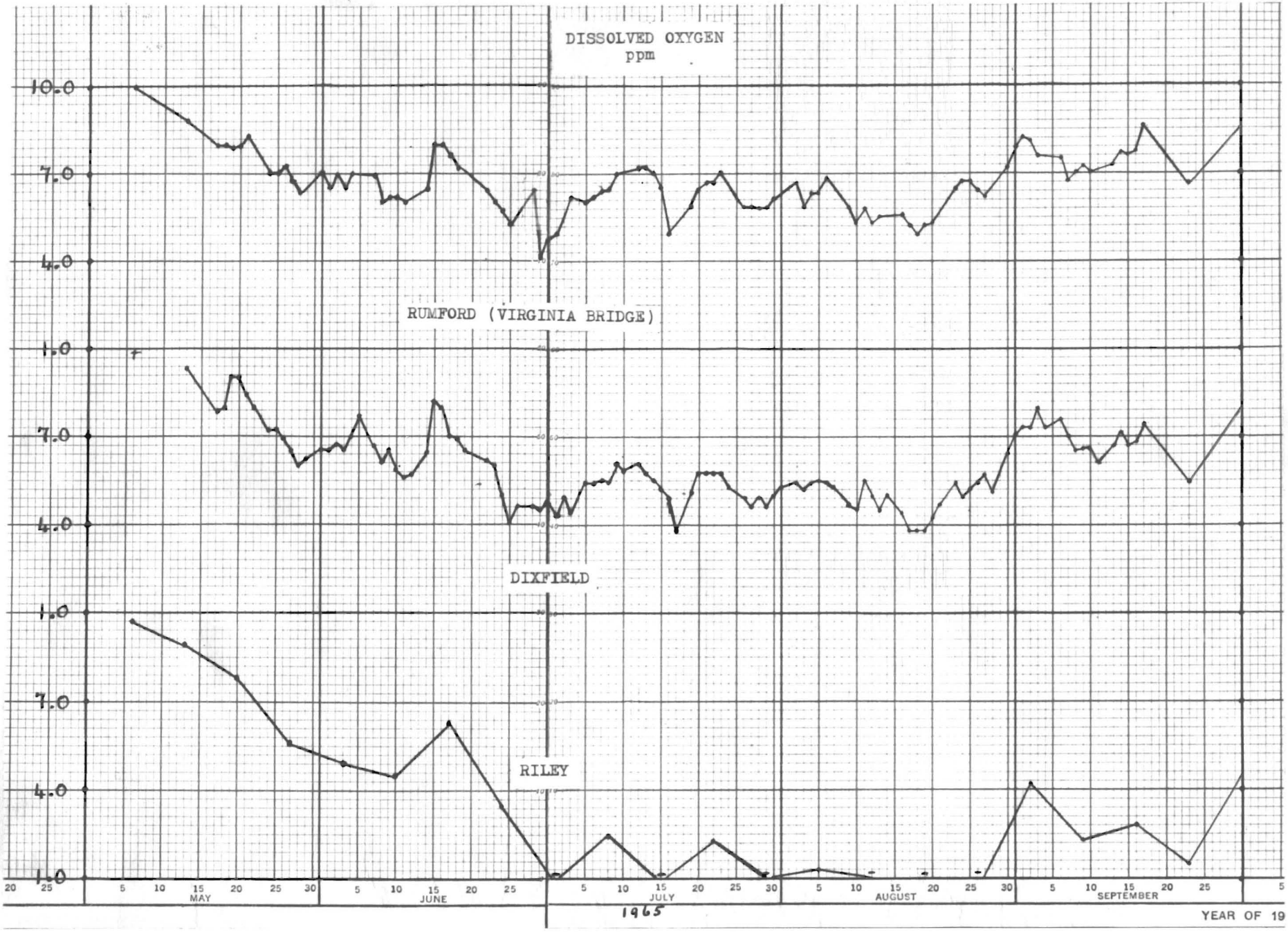
The June 1- September 17 D.O. averaged 32.31 tons/day.

6. Dixfield. On four days the D.O. analyses were recorded below four ppm, and twenty days between four and five ppm. The record since 1951 is listed below.

1965	4	days	below	FOUR	ppm	1957	70	days	below	FOUR	ppm
1964	0	"	"	"	"	1956	49	"	"	"	"
1963	2	"	"	"	"	1955	37	"	"	"	"
1962	12	"	"	"	"	1954	0	"	"	"	"
1961	37	"	"	"	"	1953	30	"	"	"	"
1960	15	"	"	"	"	1952	18	"	"	"	"
1959	36	"	"	"	"	1951	21	"	"	"	"
1958	23	"	"	"	"						

The June 1- September 17 D.O. averaged 28.95 tons/day: the B.O.D. average load was 45.30 tons per day! The 1964 and 1963 averages were 37.63 Tons/day and 39.25 tons/day respectively.

7. Riley. Tests are made at this location only once per week. From June 3 to September 16, sixteen analyses were conducted. Of these, SIX were below ONE ppm. This is mute evidence of the rapid deterioration of river water quality between Dixfield and Riley (about 15.5 miles). The seasons average was 14.01 T/d. During August the average was 2.13 T/d and the B.O.D. 30.25 T/d. Considering the increasing importance of this location, analyses should be made daily instead of weekly.


DISSOLVED OXYGEN
ppm
10.0
7.0
4.0
RUMFORD (VIRGINIA BRIDGE)
1.0
7.0
4.0
DIXFIELD
1.0
7.0
4.0
1.0
RILEY
20 25 5 10 15 20 25 30 5 10 15 20 25 5 10 15 20 25 30 5 10 15 20 25 5 10 15 20 25 5
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

36A

8. Chisholm — The water quality as measured by the dissolved oxygen content was the poorest in many years. The tabulation listed below indicate how serious the condition was in 1965.

Below FOUR ppm			Below ONE ppm		
1965	77	days*	1965	40	days*
1964	40	"	1964	0	"
1963	39	"	1963	5	"
1962	46	"	1962	3	"
1961	61	"	1961	9	"
1960	53	"	1960	7	"

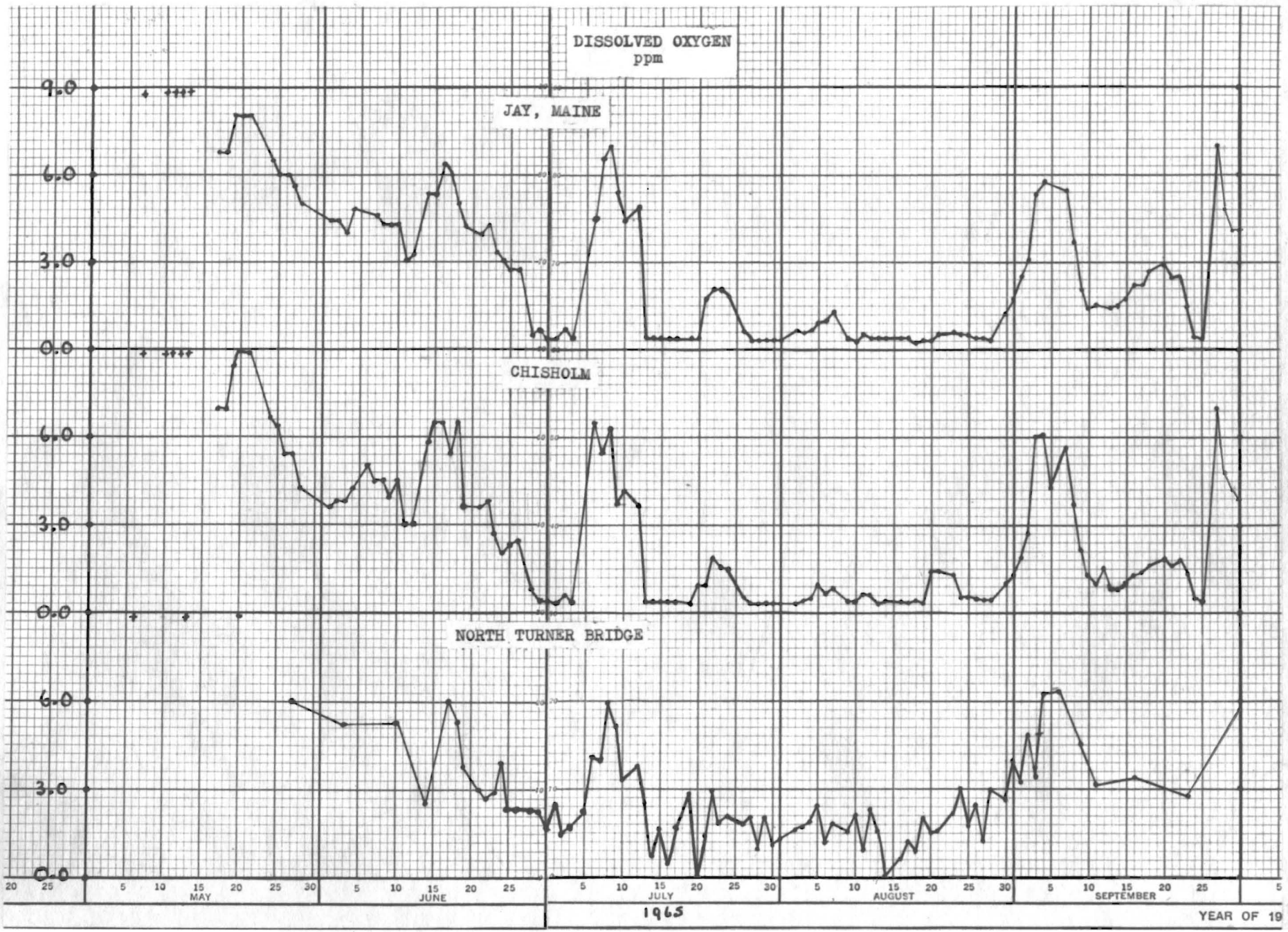
*June 1 to September 21.

9. North Turner Bridge. — The water quality being so poor at Chisholm the improvement between these two stations was not very significant. As indicated below the record is very low especially when compared to previous years.

Below FOUR ppm			Above FIVE ppm		
1965	63	days	1965	8	days
1964	14	days	1964	30*	days
1963	31	days	1963	48	"
1962	37	"	1962	81	"
1961	61	"	1961	54	"

*During the period of operation at the Rumford Mill.

The average daily dissolved oxygen load for an eleven week period was only 11.66 tons/day. For a twelve week period in 1964 and 1963 the loads were 34.45 tons/day and 32.68 tons/day respectively; about a 65% reduction. Stated in ppm the 1949 through 1965 daily average D.O. for an eleven or twelve week period is listed on the next page.


DISSOLVED OXYGEN
ppm
JAY, MAINE
CHISHOLM
NORTH TURNER BRIDGE
9.0
6.0
3.0
0.0
6.0
3.0
0.0
6.0
3.0
0.0
20 25 5 10 15 20 25 30 5 10 15 20 25 5 10 15 20 25 30 5 10 15 20 25 30 5 10 15 20 25 5
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

37A

Dissolved Oxygen, Daily Averages

1965	2.23 ppm	1956	2.43 ppm
1964	5.44 "	1955	1.94 "
1963	4.51 "	1954	5.84 "
1962	4.77 "	1953	1.75 "
1961	3.42 "	1952	1.49 "
1960	4.13 "	1951	2.84 "
1959	3.80 "	1950	3.43 "
1958	3.62 "	1949	2.00 "
1957	1.95 "		

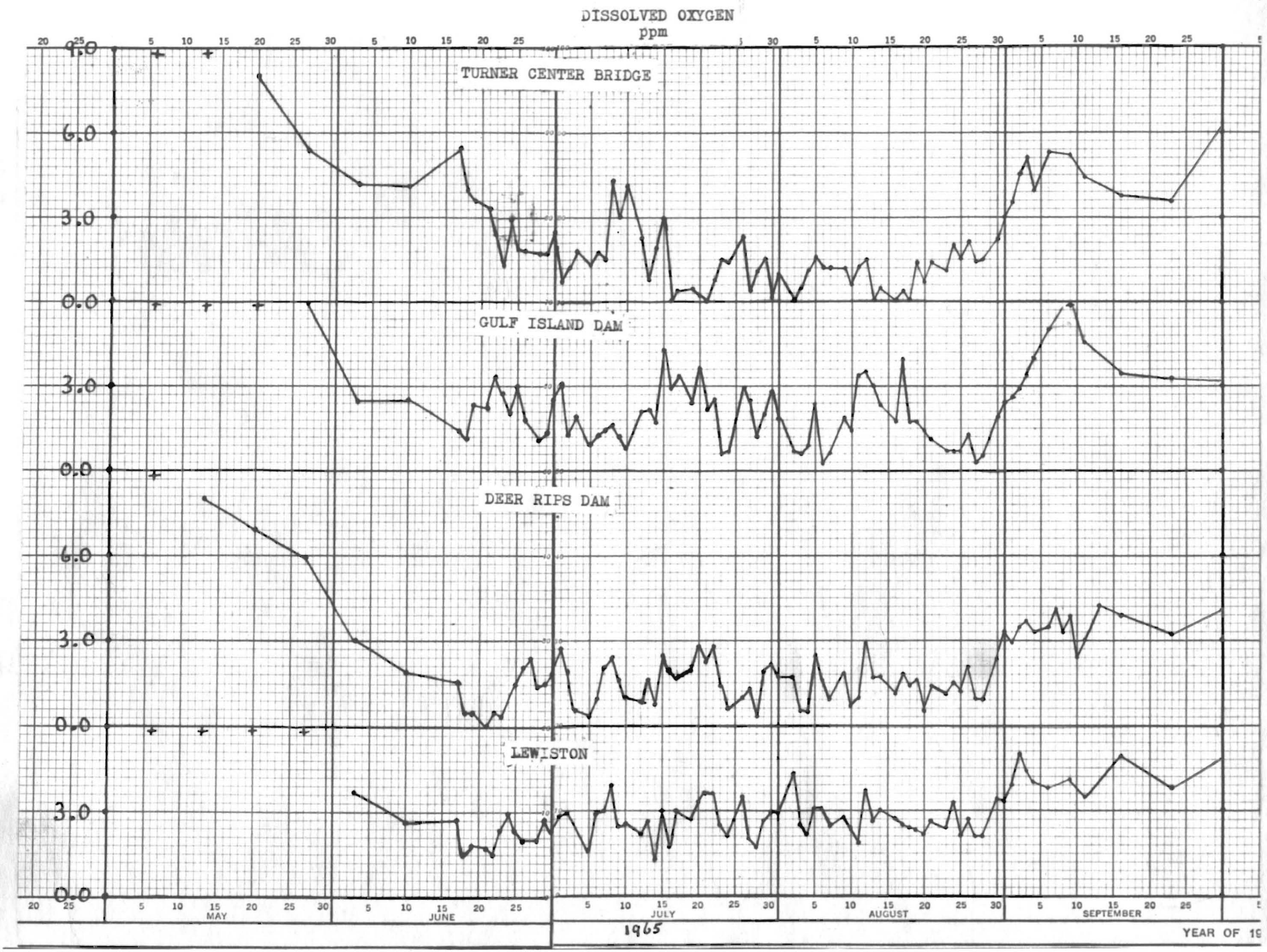
This season the D.O. average was the lowest since 1957.

10. Turner Center Bridge. During the June 3- September 16 test period there were forty-nine analyses below two ppm and nineteen below one ppm. The record from 1958 to date is:

	Below TWO ppm	Below ONE ppm
1965	49 days	19 days
1964	3 "	0 "
1963	9 "	3 "
1962	14 "	2 "
1961	32 "	10 "
1960	16 "	0 "
1959	44 "	29 "
1958	29 "	7 "

During the test period the dissolved oxygen load averaged 8.07 tons per day. The 1964 period averaged 29.08 tons per day and in 1963 the load was 27.12 tons per day.

11. Gulf Island Dam. Considering the very low average D.O. load entering the Pool and the near record low flows the river water D.O. was satisfactory. The daily average D.O. for the June 3- September 16 period was 2.10 ppm only slightly less than that entering (2.23 ppm) at North Turner. With the exception of 1964, this is the highest average D.O. on record. However,


DISSOLVED OXYGEN
ppm
TURNER CENTER BRIDGE
GULF ISLAND DAM
DEER RIPS DAM
LEWISTON
9.0
6.0
3.0
0.0
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

38A

sampling at this location is not as representative as at Deer Rips Dam. In spite of the adverse conditions upstream reaeration in the Pool must have been very considerable. (cf B.O.D. loss in the Pool in Part Four of this report).

Dissolved Oxygen Daily Averages

1965	2.10 ppm	1957	0.22 ppm
1964	2.96 ppm	1956	0.24 ppm
1963	1.88 "	1955	0.17 "
1962	1.70 "	1954	1.17 "
1961	0.51 "	1953	0.24 "
1960	0.73 "	1952	0.09 "
1959	1.46 "	1951	0.13 "
1958	0.32 "	1950	0.12 "

12. Deer Rips Dam. The river water sampled at this station is more representative due to the thorough mixing which occurs at Gulf Island Dam. This season there was only one zero D.O. test, twenty tests were below one ppm and fifty-three below two ppm. The average D.O. load (June-September, 12 weeks) of the water passing this sampling station was 8.88 tons per day. The 1964 and 1963 loads were 16.85 and 13.55 tons per day respectively.

13. Lewiston. The dissolved oxygen present in the river water, sampled at Chestnut Street bridge, was higher than that expected. There were no analyses below one ppm and only ten below two ppm. This is slightly better than last years record.

	Below ONE ppm	Below 0.5 ppm
1965	0 days	0 days
1964	1 "	1 "
1963	18 "	13 "
1962	22 "	12 "
1961	42 "	7 "
1960	54 "	26 "

13. Lisbon Falls. The reaeration South of Lewiston has always been very large due to the rapids and the Dam at Lisbon Falls. River water at this location was near saturation throughout the season.

Conclusions. River water quality, based on dissolved oxygen content, was much lower throughout the entire stem with the possible exceptions of Lisbon Falls. With very few exceptions the stretch between Berlin, New Hampshire and Virginia Bridge, Maine was above five ppm and would sustain a "C" classification even at the very low flows which existed throughout the season. The water quality from Dixfield to North Turner was very low for the greater part of the season. This stretch of the river was below a "D" for a considerable portion of the test period.

The Pool came through the low flow period much better than expected. Reaeration was surprisingly high. The D.O. data (tons/day average) at the important sampling stations is recorded on the next page.

	1965	1964	1963
1. Bell's Ice House	35.11	43.77	44.50
2. Gorham (Public Service)	28.83	42.91	45.12
3. Gilead, Maine	29.57	42.78	38.62
4. Virginia Bridge	32.31	38.38	40.57
5. Dixfield	28.95	37.63	39.25
6. North Turner Bridge	11.66	34.45	32.68
7. Turner Center Bridge	8.07	29.08	27.12
8. Deer Rips Dam	8.88	16.85	13.55

Oxygen Consumed from Permanganate. Since the abandonment of sulphite pulp production at Berlin and Rumford, the principle value of this test resides in the rapid identification and extent of "spills" at the mills.

The loss of O.C.P. during passage of the water through the Pool has been recorded since 1949. The loss during this test season was 4.6 ppm, almost twice that of 1964, but lower than the seventeen year average.

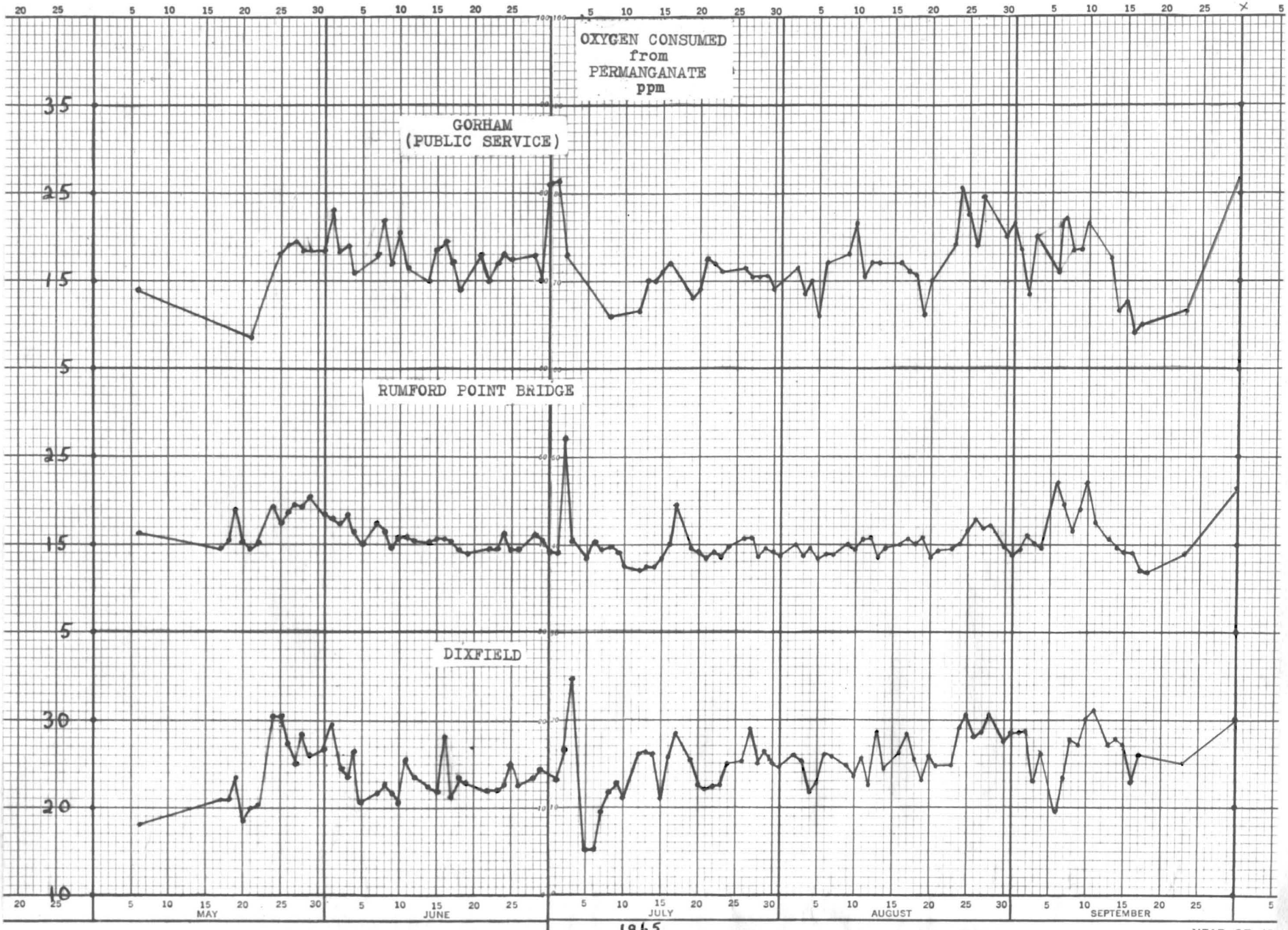
Average Daily Loss (N.T.B.-G.I.D.)
Total O.C.P. ppm

1965*	4.6 ppm	1956	7.5 ppm
1964	2.4 "	1955	5.4 "
1963	3.0 "	1954	6.6 "
1962	3.4 "	1953	3.7 "
1961	4.5 "	1952	5.4 "
1960	7.9 "	1951	7.0 "
1959	5.9 "	1950	7.5 "
1958	4.6 "	1949	5.7 "
1957	5.0 "		

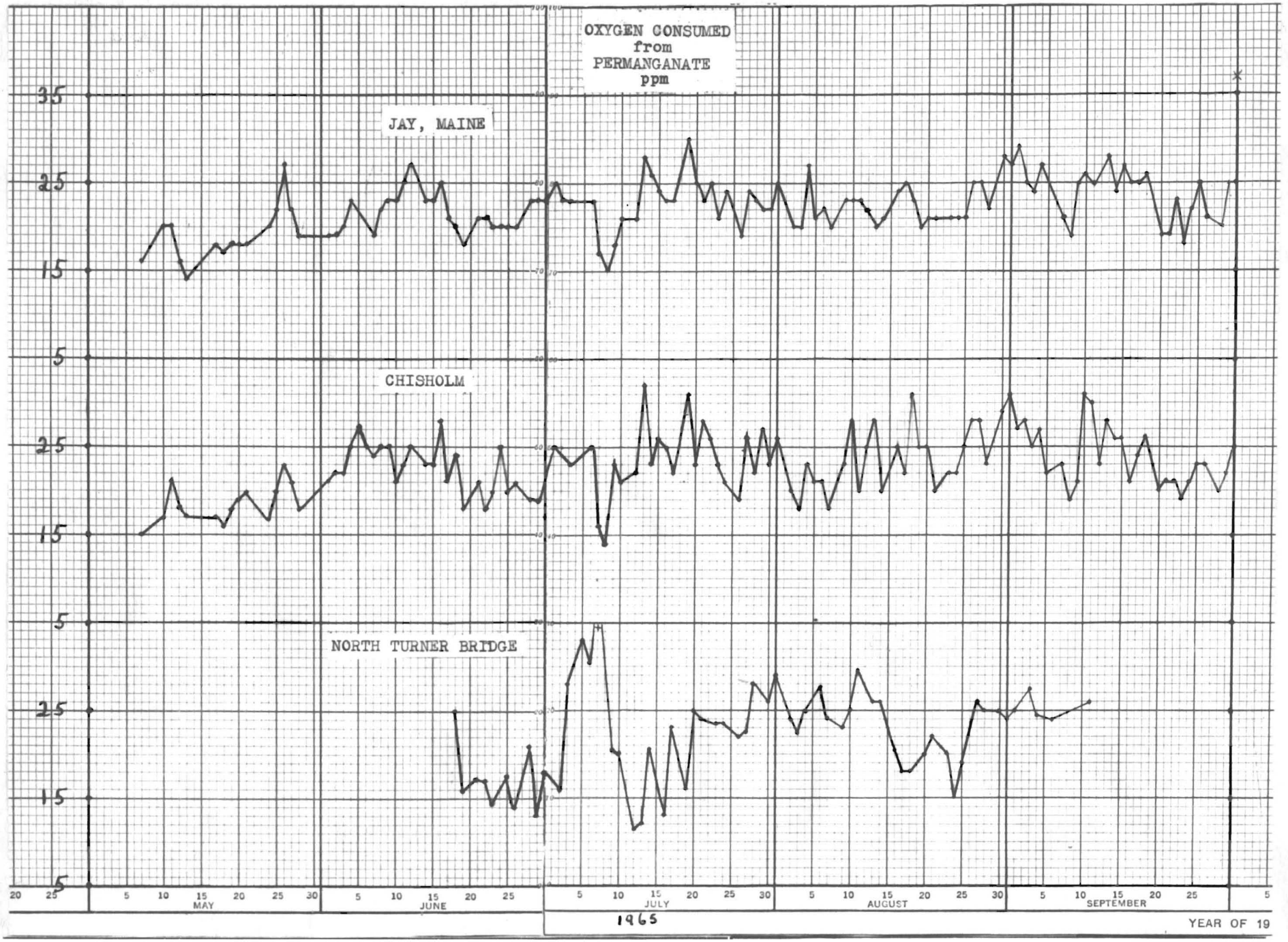
17 year average 5.3 ppm

*N.T.B.-D.R.D.

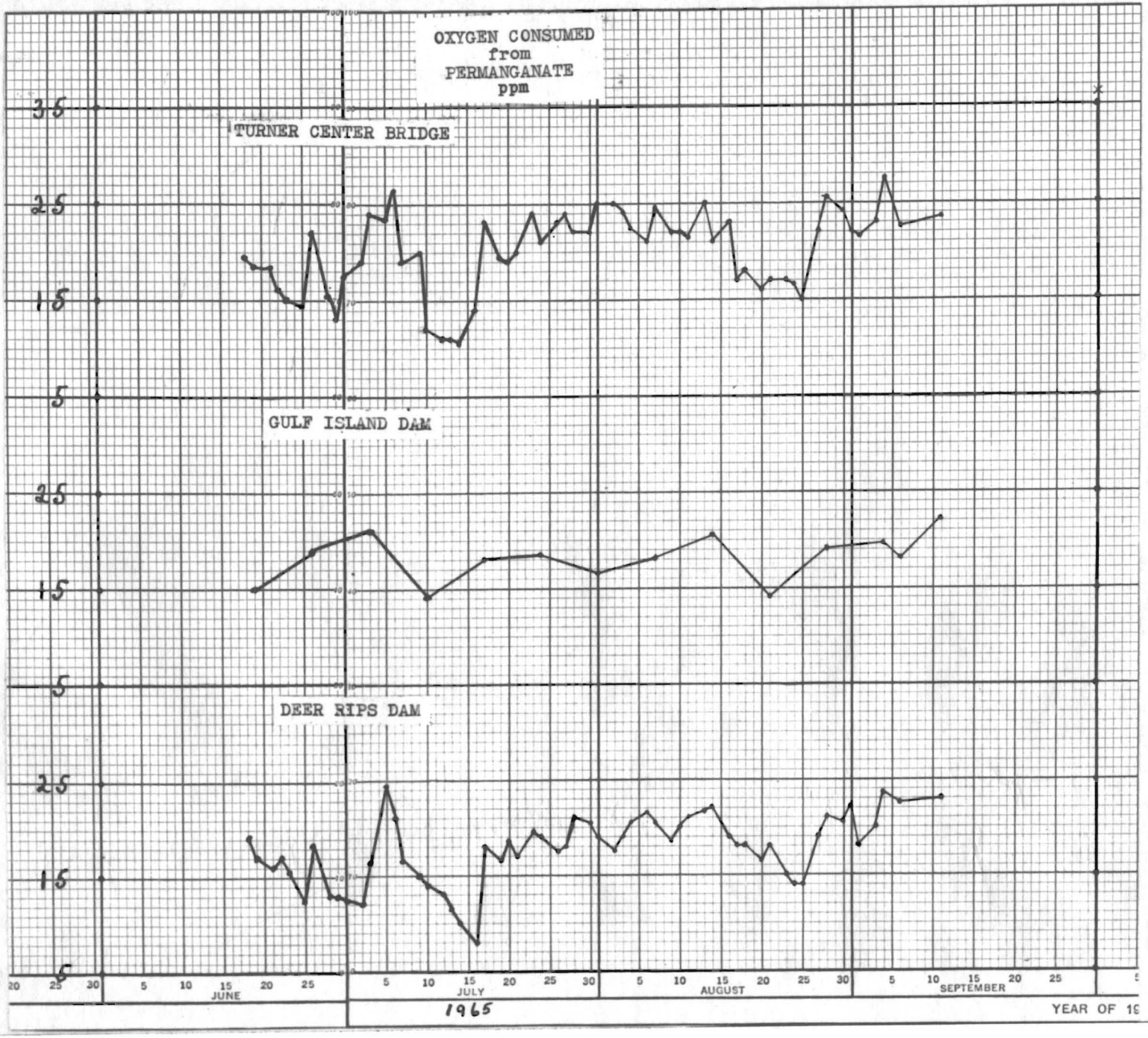
Cross-Section Tests. Early in the year, the question arose as to the validity of the samples taken at the regular stations below the mills at Rumford. Oxford Paper Company conducted nine five station cross-section tests at the Dixfield Bridge from May to mid-


OXYGEN CONSUMED
from
PERMANGANATE
ppm
GORHAM
(PUBLIC SERVICE)
RUMFORD POINT BRIDGE
DIXFIELD
35
25
15
5
25
15
5
30
20
10
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

A14


OXYGEN CONSUMED
from
PERMANGANATE
ppm
JAY, MAINE
CHISHOLM
NORTH TURNER BRIDGE
35
25
15
5
MAY
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

H13


OXYGEN CONSUMED
from
PERMANGANATE
ppm
TURNER CENTER BRIDGE
GULF ISLAND DAM
DEER RIPS DAM
35
25
15
5
JUNE
JULY
AUGUST
SEPTEMBER
1965
YEAR OF 19

H C

SPECIAL SAMPLING

DIXFIELD BRIDGE

Date	Temp. C	D.O. ppm	O.C.P. ppm	B.O.D. ppm	Location
May					
21	12.0	8.95	16.5	3.05	LEFT (MEXICO SIDE)
21	12.0	8.65	20.0	3.27	LEFT MIDDLE
21	12.5	8.40	20.5	3.45	MIDDLE
21	12.5	8.45	19.5	3.30	RIGHT MIDDLE
21	12.0	8.33	21.0	3.28	RIGHT (PERU SIDE)
June					
4	14.2	7.45	21.0	5.68	LEFT(MEXICO SIDE)
4	14.2	7.15	25.5	10.05	LEFT MIDDLE
4	14.0	7.15	23.5	11.05	MIDDLE
4	14.0	7.08	24.0	11.18	RIGHT MIDDLE
4	13.5	7.15	26.0	9.69	RIGHT (PERU SIDE)
June					
18	17.8	7.10	20.0	5.03	LEFT(MEXICO SIDE)
18	18.0	6.88	24.0	9.06	LEFT MIDDLE
18	18.0	6.72	24.0	8,90	MIDDLE
18	18.0	6.50	23.5	10.17	RIGHT MIDDLE
18	18.0	6.65	24.0	8.95	RIGHT (PERU SIDE)
July					
2	20.2	5.10	23.5	8.44	LEFT (MEXICO SIDE)
2	20.1	4.90	26.5	10.57	LEFT MIDDLE
2	20.0	4.80	26.5	8.64	MIDDLE
2	20.0	4.88	26.0	8.04	RIGHT MIDDLE
2	20.0	3.63	24.5	11.30	RIGHT (PERU SIDE)
July					
16	21.8	5.05	23.0	8.17	LEFT (MEXICO SIDE)
16	22.0	4.88	25.8	12.77	LEFT MIDDLE
16	22.0	4.85	27.0	11.30	MIDDLE
16	21.9	4.60	27.0	11.45	RIGHT MIDDLE
16	21.8	4.38	26.5	13.63	RIGHT (PERU SIDE)

SPECIAL SAMPLING

DIXFIELD BRIDGE

Date	Temp.	D.O.	O.C.P.	B.O.D.	LOCATION
July					LEFT
30	20.1	5.15	23.5	11.14	(MEXICO SIDE)
30	20.3	5.03	25.0	12.70	LEFT MIDDLE
30	20.3	4.92	26.0	12.07	MIDDLE
30	20.0	4.80	27.3	12.27	RIGHT MIDDLE
30	19.8	3.85	27.5	13.25	RIGHT (PERU SIDE)
August					LEFT
13	22.4	4.50	24.0	12.04	(MEXICO SIDE)
13	22.7	4.45	28.5	15.15	LEFT MIDDLE
13	22.5	4.15	29.0	12.85	MIDDLE
13	22.5	3.93	30.0	11.90	RIGHT MIDDLE
13	22.3	3.98	31.0	13.70	RIGHT (PERU SIDE)
August					LEFT
27	18.1	5.45	25.0	8.33	(MEXICO SIDE)
27	18.8	5.70	28.5	13.35	LEFT MIDDLE
27	18.7	5.23	28.5	9.55	MIDDLE
27	18.5	4.80	28.5	12.00	RIGHT MIDDLE
27	17.8	2.60	29.5	15.90	RIGHT (PERU SIDE)
September					LEFT
10	18.1	6.65	24.5	7.52	(MEXICO SIDE)
10	18.1	6.60	30.0	13.10	LEFT MIDDLE
10	18.0	6.15	29.0	11.50	MIDDLE
10	18.0	6.05	27.5	8.57	RIGHT MIDDLE
10	17.6	5.63	29.0	13.33	RIGHT (PERU SIDE)

September. The results are tabulated on the following pages. They indicate that although there are differences in concentration across the river from the south to the north shores, the sampling station chosen in 1941, and used since then, is representative of the average pollution load in the water.

Owing to the distance of the sampling station at Gorham from the Brown Company mills and the mixing which occurs in between, no differences were found when a test was conducted there.

Laboratory vs. Field Titration. On July first a series of tests were conducted by Mr. Wilbur Cote (Oxford) to determine the difference, if any, in the D.O. values when the samples were titrated in the Laboratory or in the Field. The results are tabulated below.

Sample Point	Analyzed in the Field	Analyzed in Laboratory	Difference
Rumford Point	5.80	5.90	+0.10
Rumford (V.B.)	5.15	5.03	-0.12
Dixfield	4.30	4.28	-0.02
Riley	0.30	0.25	-0.05
North Turner	2.40	2.40	0
Turner Center	0.78	0.68	-0.10
Gulf Island	3.20	3.10	-0.10
Deer Rips	2.68	2.70	+0.02
Lewiston	2.88	2.75	-0.13
Lisbon Falls	7.65	7.75	+0.10

"These data indicate that no significant differences exists in the two procedures." The Thursday dissolved oxygen titrations have always been made by Brown Company in the Field and by Oxford Paper Company in the Laboratory.

Comparison of Dissolved Oxygen Methods.

At the request of the Oxford Paper Company, Mr. J. J. McKeown, N.C.S.I. regional engineer at Tufts University conducted a series of D.O. tests on Androscoggin river water by three different methods. These tests were made in March 1965 at seven different concentrations of Dissolved Oxygen. The results and conclusions given below were received from Mr. McKeown.

Water Sampled above Rumford, Maine

Electrode Method A	B	Azide	Alkali Hypochloride	Difference Azide-Alkaline Hypochlorite
0.8	0.8	0.8	1.0	0.2
1.7	1.8	1.6	1.8	0.2
2.7	2.7	2.7	2.8	0.1
3.4	3.6	3.6	3.6	0
4.3	4.6	4.5	4.5	0
5.2	5.5	5.4	5.4	0
5.9	6.2	6.1	6.3	0.2

Water Sample at Dixfield Bridge

1.5	1.5	1.4	1.5	0.1
2.5	2.3	2.3	2.4	0.1
3.5	3.4	3.2	3.4	0.2
4.4	4.3	4.1	4.3	0.3
5.3	5.1	4.9	5.2	0.3
6.1	6.0	5.8	6.0	0.2
7.1	6.9	6.6	6.7	0.1
7.4	7.2	7.0	7.2	0.2

All values expressed as mg/liter (ppm)

Conclusions

1. Azide method gave 0.2 mg/liter lower on Dixfield water.
2. No significant difference between methods on river water above Rumford.

A conference was held on Friday May 7, 1965, by the Administrator with representatives of the three companies because Mr. Hinckley (W.I.D.) questioned the validity of

the alkaline hypochlorite method and favored the azide procedure which W.I.C. use. A decision was made to continue the alkaline hypochlorite method which the A.R.C. has used since 1941. Later Mr. Hinckley agreed to accept this decision and state in any report that the azide method yields slightly lower D.O. results.

In August 1965 Mr. R. H. Ramsey, Brown Company, conducted nine analyses on water sampled at Gorham, N.H. (Public Service) using the Winkler alkaline hypochlorite and azide modifications and compared them with the Polarograph** method.

The alkaline hypochlorite method gave averages significantly higher (0.43 ppm) values than the azide modification. The results obtained by the Polarograph lie between those determined by the other two methods.

The following tabulation contains the data.

Date	Winkler Modification		Polarograph	
	Hypochlorite	Azide	H.W.M.*	R.H.R.*
8/ 6/65	6.93	6.38	6.72	6.70 (1)
8/ 9/65	5.69	5.46	5.82	5.68 (1)
8/10/65	5.80	5.25	5.36 (1)	5.50
8/11/65	6.31	5.76	6.03 (1)	6.01
8/13/65	6.00	5.41	5.80	5.75 (1)
8/16/65	6.42	6.02	6.19 (1)	6.12
8/17/65	6.08	5.76	6.01	6.12 (1)
8/18/65	6.21	5.81	6.21 (1)	6.19
8/20/65	6.57	6.22	6.54 (1)	6.56
Averages	6.22	5.79	6.08	6.07

Average of three methods by regular operator 6.03

* Operator's initials
(1) Indicates the order of test (1) being first immediately followed by the other.
** Fisher Electropode, Model 65

In September 1965 the alkaline hypochlorite method was checked against the Polarograph in the determination of five day biochemical oxygen demand on water sampled at Gorham, N.H. (Public Service).

The results were,

Date	B.O.D. Winkler	B.O.D. Polarograph Duplicate	
9/ 8/65	4.9	4.7	4.5
9/10/65	5.1	5.1	5.0
9/15/65	1.3	1.6	1.7
9/17/65*	2.9	2.4	2.4

*Shelburne, N.H.

Note: The Polarograph used in all of the tests (D.O. and B.O.D.) was standardized by Water Pollution Commission, Concord, N.H.