BEACH EROSION BOARD
OFFICE OF THE CHIEF OF ENGINEERS

WAVE AND
LAKE LEVEL STATISTICS
FOR LAKE ONTARIO

TECHNICAL MEMORANDUM NO. 38

WAVE AND LAKE LEVEL STATISTICS FOR LAKE ONTARIO

TECHNICAL MEMORANDUM NO.38
BEACH EROSION BOARD
CORPS OF ENGINEERS

MARCH 1953

FOREWORD

This is the third of a series of reports to be issued by the Beach Erosion Board under its General Investigations program to provide wave statistics for selected regions. The need for such data is evident, and it is planned ultimately to supply it by actual wave measurement for sufficiently long periods to establish the wave climate at many locations. Suitable instruments for that purpose have not yet been developed and even after they become available much time must pass before the records can attain statistical value. The production of wave statistics by "hindcast" technique, admittedly of presently indeterminate quantitative accuracy, will nevertheless provide the engineer with better wave data than have heretofore been available.

Thorndike Saville, Jr., author of the report, is a Hydraulic Engineer in the Research Division of the Beach Erosion Board under the supervision of Joseph M. Caldwell, Chief of the Division. At the time this report was prepared, the technical staff of the Board was under the general supervision of Colonel E. E. Gesler, President of the Board and R. O. Eaton, Chief Technical Assistant.

The author was aided in the study by Robert F. Dearduff, Hydraulic Engineer; by John C. Fairchild, and Francis W. Kellum in computations and compilations; in map reduction by Philip A. Brown, Edward L. Hoeftman, Duane E. Nelson, Joseph W. Rom, and Lloyd W. Zwingelberg; and in drafting by Wendell E. Reece. The report was edited for publication by Albert C. Rayner. Views and conclusions stated in the report are not necessarily those of the Beach Erosion Board.

TABLE OF CONTENTS

	Page
Introduction	1
Wave Statistics	1
Lake Levels	8

APPENDICES

- A - Wave Statistics for Hamilton, Ontario
- B - Wave Statistics for Rochester, New York
- C - Wave Statistics for Stony Point, New York

FIG.1 LOCATION OF WAVE HINDCASTING STATIONS FOR LAKE ONTARIO

WAVE AND LAKE LEVEL STATISTICS FOR LAKE ONTARIO

by

Thorndike Saville, Jr.
Hydraulic Engineer, Research Division
Beach Erosion Board, Corps of Engineers

INTRODUCTION

The General Investigations program of the Beach Erosion Board comprises investigations, regional rather than local in scope, designed to improve, simplify, and expedite the solution of local problems, by giving a compilation of all existing data pertinent to shore processes in the particular region. As a first step in the compilation of these data, a study of wave and lake level conditions on the Great Lakes is being made. The results of such a study for Lake Ontario are presented herein.

WAVE STATISTICS

Three stations on Lake Ontario were selected for a comprehensive wave analysis, the locations (see Figure 1) being as follows:

<u>Station</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Vicinity</u>
A	43° 17' N	79° 46' W	Hamilton, Ontario
B	43° 15' N	77° 35' W	Rochester, New York
C	43° 49' N	76° 18' W	Stony Point, New York

These particular stations were selected since it was thought that they would give adequate coverage to the entire lake shore of the United States, and permit interpolation of values between stations, thus giving an accurate representation of wave action at any point along the United States shore line of Lake Ontario.

Wave characteristics were determined from synoptic weather charts for each station for the three-year period 1948-1950. The weather maps used were the North American Surface Synoptic Charts compiled at six-hour intervals by the U. S. Weather Bureau. Fetch areas, and the wind speeds and durations in these areas, were determined directly from the weather maps; these values were used with the curves derived by Sverdrup and Munk (1)* and revised by Arthur (2) and later by Bretschneider (3)

* Numbers in parentheses refer to References on page 15.

to obtain the hindcast wave characteristics. The only major variation from the usual methods of wave forecasting or hindcasting (4) (other than that the new Bretschneider revised curves were used) was that the surface wind was determined directly from reported observations rather than from a gradient wind determined from the isobar spacing. It was thought that with the lake area so small in comparison to the area of the pressure cell, the isobaric pattern on the surface would be influenced to a large extent by the surface topography, and gradient winds determined from the isobar spacing would not necessarily give true values of wind velocity over the lake surface. Hence reported values of the surface wind could be expected to give a more realistic figure of the wind velocity. Observations have shown (5) that the greater surface friction serves to reduce the wind over land from what it may be over water. Since the reported values were almost always obtained at land stations, the wind speeds used in the analysis may have been lower than those actually occurring over the lake in the generating area. Some compensation was made for this by selecting the top speed of the Beaufort range reported rather than the middle value.

The wave characteristics thus determined are for the significant wave -- that is, the period is that of the predominating waves, and the height is the average of the higher one-third of these predominant waves. These values are summarized for each station in Tables A-1 through C-1 (Appendices A through C). It should also be noted that the wave conditions in these tables are deep water conditions. They must be used in conjunction with refraction diagrams to obtain inshore values. The tables show, for each station, the number of hours' duration that deep water waves of any given height, period, and direction occurred during any month of the three-year period; and also for each month (as summations) the number of hours' occurrence of waves of any particular height and period exclusive of direction; the number of hours' occurrence of waves of any particular height and direction exclusive of period; and the total number of hours' occurrence of waves of any particular height.

As an example of the data presented, from Table B-1 (Table 1 for Station B) for the month of July, waves of 1 to 2-foot height and 3 to 4-second period from the west-northwest occurred for 12 hours during 1948, 12 hours during 1949, and 36 hours during 1950. Thus, waves of this category occurred for a duration of 60 hours during the three-year period and hence can be expected to occur for about 20 hours (on the average) during July of any year in the future. Waves of 1 to 2-foot height and 3 to 4-second period (from all directions) occurred for 156 hours over the three-year period, or an average of 52 hours per year. Waves of 1 to 2-foot height from the west-northwest (all periods) occurred for 66 hours over the three-year period, or an average of 22 hours per year. Waves of 1 to 2-foot height (all periods and all directions) occurred for 252 hours over the three-year period, or an average of 84 hours per year. Tables A-2 through C-2 show the summation of the values in Tables A-1 through C-1 for the entire year and are read similarly to those tables.

During much of the winter season, portions of the lake are covered with ice, and fetch areas are limited considerably. In addition, for a somewhat greater portion of the winter season, the coast area of the lake is covered with ice, and, even though waves are generated in offshore areas, they never reach the shore, being interrupted by the ice around the rim of the lake. No account of this effect of the ice was taken in the actual hindcasting of the waves, and the durations given for the various winter months are computed as though there were no ice on the lake, a fact that should be remembered in using these data.

From yearly records of lake and air temperatures, and the dates of opening and closing of the lake for navigation, an average ice-free period was determined. For Lake Ontario this appeared to run, on the average, from April through November, and the average ice-free period was determined as 1 April - 1 December for all three stations. A summation of the wave data for this ice-free period is shown in Tables A-3 through C-3. These tables are similar to Tables 1 and 2 and represent a summation of the values in Tables 1 for all months from April through November. The durations of waves of particular height and direction have also been tabulated as percentages of time for the three-year period and are shown graphically in the wave roses for the full year and also for the ice-free period in Figures A-1 through C-1. In these roses, as in all other curves contained herein, the durations are percentages of 365 days, for the ice-free period as well as the full year data.

Figures A-2 through C-2 show the total percentages of time that the wave height may be expected to be greater than any particular height throughout the year. They thus show the (average) total duration time of specific waves over the year. Two curves are shown, one based on the data gathered for the entire year, and the other on just the average ice-free period (April through November). For example, at Station B, the total duration of waves in excess of 10 feet in height during the ice-free period is expected to be 0.09 percent of the time; and 0.20 percent of the time during the full year. Hence waves 10 feet or higher can be expected to occur for a total duration of 18 hours ($0.002 \times 365 \times 24$) over the course of each year, and, of this, 8 hours ($0.0009 \times 365 \times 24$) will be during the ice-free portion of the year when the waves will be certain to reach the shore.

Figures A-3 through C-3 show the frequency with which storms resulting in waves higher than a given height can be expected to occur. For example, at Station B, on 0.64 percent of the days each year the waves may be expected to be ten feet or greater in height, and on 0.29 percent of the days they may be expected to reach this height during the ice-free portion of the year. Thus waves ten feet or higher may be expected to occur (on the average) $2\frac{1}{3}$ times each year (0.0064×365), or seven times every three years; of these occurrences, only one (0.0029×365) will be expected to occur during the ice-free portion of the year.

Combining the data obtained from graphs on Figures B-2 and B-3, waves ten feet and higher may be expected to occur at Station B slightly more frequently than twice each year, and the average duration of each storm will be about 8 hours. During the ice-free portion of the year, waves of ten feet and higher may be expected to occur only once, and the duration of this storm is also expected to be about 8 hours.

There are, in general, two methods of plotting points to obtain frequency curves such as those shown in Figures A-3 through C-3. One, based on the so-called theory of sampling, involves the assumption that the known period of record (three years) is a fair average sample of all similar three-year periods over an infinite number of years, and that therefore the largest storm of this three-year period is the median of all storms of the same class in all other three-year periods. This results in a frequency given by the following equation:

$$F = \frac{2N - 1}{2T} \times 100$$

where F = frequency (in percent) of the occurrence of storms equalling or exceeding the given storm

T = number of days of record

N = number of occurrences of a storm equal to or greater than the given storm

The second method essentially considers only the period of record, in which case the frequency becomes

$$F = \frac{N}{T} \times 100$$

Values of F are the abscissa of points on the frequency curve. Using the second equation above, the largest storm which occurred in the known three-year period would have an abscissa of .0914 percent and would represent the storm which would most probably occur once in three years, i.e., would be the "three-year storm", etc. But this would be contrary to the theory of sampling, where (above) the assumption is made that the largest storm in the known three-year period was the median of the largest storms in a long succession of three-year periods. Therefore, over a long period such as 300 years, it will be exceeded not 100 times, but 50 times; i.e., it is by definition not a "3-year storm", but a "6-year storm".

Either of the above two equations could be, and have been used to prepare frequency curves. Although the former is the one most generally used for hydrologic data, the latter method has been used in this case. The use of this formula ($F = 100N/T$) will result in a somewhat more conservative interpretation of the data, and was thought justified in view of the extremely short period of record (3 years).

The points plotted may be represented fairly closely by a continuous curve which frequently approximates a straight line, as may be seen from the figures. The curves shown have, in general, been drawn as lines of visual best fit; occasionally, however, more weight has been placed on the higher values. This tends to give a somewhat more conservative interpretation, which is thought warranted in some cases. The user is free to make his own interpretation of the plotted points. It is thought, also, that the very high waves occurring at Station A (Hamilton) may well represent storm waves of lesser frequency (particularly as there is a very sharp break and steepening of slope in the curve for the higher values), but due to the shortness of the period of observation this could not be determined.

In view of the shortness of the period of record some doubt arose as to the validity of extrapolation from these curves, and as to whether the three years chosen were representative (i.e., that they represent average conditions, and not three years of abnormally high, or low, waves). In a similar report, on Lake Michigan (6), hindcasts were made for one station for a period of 12 years (1939-1950) for all storms which were expected to give waves greater than 8 feet. The points determined were compared to those determined from the three-year data. These points fitted a straight line curve very closely and, though the points mostly lay slightly above those determined from the three-year data, the curve was not greatly different from that which had been drawn from the three-year data. Observations of the "average maximum" wave were obtained at this same station by the Milwaukee lightship over the period 10 April 1931 to 28 September 1932 (7) and these points were also compared to those hindcast. Although the exact correspondence between the significant waves hindcast and the "average maximum" waves observed is not known, values should be closely comparable -- and although the observed points lay somewhat higher for the lower waves, agreement was good for the higher waves. The comparison of these various points is shown in Figure 2.

Although comparisons were made for a station on Lake Michigan rather than on Lake Ontario, it is thought that the same degree of accuracy should be observed on Lake Ontario, and that therefore reasonable confidence can be put in the curves shown, at least for values of the waves occurring with frequencies less than about once in 10 years (with the possible exception of Station A).

Although for structural design purposes the important factor is the size of the maximum probable wave (within a certain time period), for computations involving sand movement and littoral drift, a more desirable parameter would be some averaged factor including within it the effect of both height and period, the variation of these parameters, and the duration that waves of each particular category exist. Present day knowledge indicates that sand movement by wave action is best correlated with the amount of energy transmitted forward (and eventually on to the beach) by the waves. The total energy per unit width in each wave is,

FIG. 2

in deep water

$$E_o = \frac{wLH^2}{8} \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right] = \frac{wg}{16\pi} H^2 T^2 \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right]$$

where w = unit weight of water = 62.4 lbs./cu. ft.

g = acceleration due to gravity = 32.2 ft./sec./sec.

H = wave height (ft.)

T = wave period (sec.)

L = wave length (ft.)

One-half of this energy is transmitted forward from deep water toward the shore, and it is this amount of energy that eventually reaches the shore line. The total energy transmitted forward in any given period of time (E_T) is then $E_o/2$ times the number of waves occurring in that period of time,

$$\text{and } E_T = \frac{E_o}{2} \frac{(3600t)}{T} = 7.195 \times 10^4 H^2 T t \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right]$$

where t is the duration of the waves in hours. If some particular time interval (say one month) is considered during which waves of varying height and period pass a given point toward shore, then the heights and associated periods may be tabulated (as in Tables A-1 through C-1) and there will be n groups. If the height of the i th group is represented by its class mark $\bar{H}_i$, and the wave period in that group denoted by T_i , and the duration of the group by t_i , then the total amount of energy transmitted forward during the entire time interval is

$$E_T = E_{T1} + E_{T2} + E_{T3} + \dots + E_{Ti} + \dots + E_{Tn}$$

and

$$E_T = 7.195 \times 10^4 \sum_{i=1}^{i=n} \bar{H}_i^2 T_i t_i \left[1 - 4.93 \left(\frac{\bar{H}_i}{L_i} \right)^2 \right]$$

Tables A -4 through C-4 show a tabulation of the average energy transmitted forward from deep water toward the shore during the average ice-free period in each category of height, period, and direction. Thus for Station B, waves of 1 to 2-foot height and 3 to 4-second period from the west-northwest may be expected to transmit forward toward the shore 6214×10^4 foot-pounds per foot of wave crest during the ice-free period of each year. Waves of 1 to 2-foot height and 3 to 4-second period (all directions) would be expected to send forward $31,295 \times 10^4$ foot-pounds per foot of wave crest each ice-free period; waves of 1 to 2-foot height from the west-northwest (all periods) would be expected to send forward 7225×10^4 foot-pounds of energy per foot of wave crest; and waves of 1 to 2-foot height (all periods and directions) would be expected to

transmit toward the shore $37,214 \times 10^4$ foot-pounds of energy per foot of wave crest each ice-free period. Tables A-5 through C-5 show a similar tabulation for the average full year. Since the values in Tables A-1 through C-1 represent significant wave height and period, these energy values are those obtained if the wave system is uniform, and consists only of waves of significant height and period. Wave trains in nature are, however, exceedingly irregular, and have less energy than that determined by the significant wave concept. The relationship between the actual energy contained in any given wave train and that computed from the significant wave has been examined somewhat at Scripps Institution of Oceanography (8) and more recently by Barber (9) and Darbyshire (10), and has been found to be very nearly a constant ratio (on the order of 0.58). The energies given, therefore, may be considered to be the true value of the energy multiplied by some nearly constant value, and hence can be used to determine quite accurately ratios of energies from different directions. These latter represent very closely the ratios of the drift-producing forces. Summations of these energies for each direction and period grouping are shown in Figures A-4 through C-4.

All the wave data given in the tables refer to deep water conditions-- that is, depths greater than one-half the wave length. As such, interpolation between stations to obtain values for other points along the shore is quite valid, and it is felt that adequate deep water hindcast values may be thus obtained for all points on the United States shores of Lake Ontario.

Although the deep water data are useful for many types of design work, particularly for preliminary considerations, it is usually the inshore, shallow water data which are of the most interest. These data may be readily obtained from the deep water data through the use of refraction diagrams. A partial example for Ludington Harbor on Lake Michigan has been worked out and presented in the publication dealing with wave statistics on that lake (6), to which the reader may refer if unacquainted with the techniques involved.

LAKE LEVELS*

The levels of the Great Lakes fluctuate from year to year and from month to month during each year, depending upon the volume of water in the lakes. Continuous records of lake levels have been kept by the Corps of Engineers since 1860. A summary of these records for Lake Ontario is shown in Figure 3 which is a hydrograph of the monthly average levels from 1860 to date. The monthly average was chosen to eliminate the effects of short period barometric or wind-induced changes in stage. For Lake Ontario, the average level during the period of record (1860-1952) was 246.00 feet (above mean tide at New York, 1935 Datum) the highest one-month average of 248.97 occurring in May 1870 and July 1947 and the lowest of 242.68 occurring in November 1934. The difference between the highest and lowest monthly average levels is thus 6.29 feet, although the seasonal variation usually ranges between one and two feet

*Much of the following data on lake levels is taken almost verbatim from an unpublished report by the Great Lakes Div., Corps of Engrs., entitled "Preliminary Examination Report on Property Damage on the Great Lakes" issued in June 1952 (11).

MONTHLY MEAN WATER LEVELS OF LAKE ONTARIO
 DATA COMPILED BY U.S. LAKE SURVEY, CORPS OF ENGINEERS
 FIG. 3

(having an average range of 1.8 feet). The greatest range in level in a single season between the high and low month was 3.5 feet, and the lowest was 0.3 feet. The usual pattern of seasonal variation shows high levels in the summer and low levels in late winter (Figure 4). The highest monthly average level is usually reached in June and the lowest in January, though occasionally seasonal fluctuations have departed greatly from this usual pattern.

Figure 5 shows the percentage of time that the seasonal high average monthly level reaches various elevations on Lake Ontario for single, two, three, four, and five consecutive years. For example, it shows that the high monthly average each year reached elevation 245 feet or higher 97 percent of the time, reached elevation 246 feet or higher 80 percent of the time, reached elevation 248 feet or higher 20 percent of the time, and so on. It also shows that while the high monthly average level reached 246 feet or higher 80 percent of the time in single years, it reached this elevation only 70 percent of the time in two consecutive years, only 62 percent of the time in three consecutive years, only 51 percent of the time in four consecutive years, and only 46 percent of the time in five consecutive years.

Superimposed on the long range and seasonal fluctuations resulting from the actual quantities of water present in the lake, are daily and even hourly fluctuations resulting from an unbalance or tilting of the lake surface. These are induced primarily by winds, though some have attempted to ascribe them to differential barometric pressures. Figure 6 is derived from data given in a report by the Great Lake Division Engineer (11) and shows the frequency of occurrence of short-period fluctuations at various gage sites on Lake Ontario during the period of record. Short-period rises at intermediate points between gage sites depend upon local conditions, but reference to the figures for points in the vicinity will provide an indication of the rises to be expected.

It has been found (12)(13) that, at least for shallow water areas, the rise in level due to wind stress may be predicted quite accurately by the formula

$$S = 1.165 \times 10^{-3} \frac{V^2 F}{D} N \cos \alpha$$

where S is the total set-up (difference in water surface elevations at the windward and leeward sides of the lake) in feet, F is the fetch length in statute miles, V is the average wind velocity over the fetch in miles per hour, D is the average depth in feet of that portion of the lake that is more or less contiguous to the fetch, α is the angle between the wind and the fetch, and N is a shape coefficient dependent on the planform and nearshore hydrography of the particular area. Though methods of computing N are available, unless the area is a very marked convergent bay, it is usually sufficient to assume values of $N = 1$. The actual rise in water surface elevation above still water level will

AVERAGE SEASONAL FLUCTUATION
LAKE ONTARIO

1860-1951

FIG. 4

FROM REPORT BY GREAT LAKES
DIVISION ENGINEER JUNE 1952

Interval in Months Expected Between Recurrence Of Given Rise
 FREQUENCY OF OCCURRENCE - SHORT PERIOD FLUCTUATIONS
 TIBBETTS POINT & OSWEGO — LAKE ONTARIO
 FIG. 6

be slightly greater than $S/2$ depending on the nearshore hydrography; an average value of 0.57 has been in general use, and is quite adequate. Although this formula has been checked quite adequately for shallow areas (experimental tanks, the Zuider-Zee, and Lake Okeechobee) extension to deeper waters, as Lake Ontario, may be unwarranted, and it should be used with some caution.

REFERENCES

1. Sverdrup, H. U. and W. H. Munk - Wind Sea and Swell: Theory of Relations for Forecasting, H. O. Pub. 601, 1947.
2. Arthur, R. S. - Revised Wave Forecasting Graphs and Procedures, Scripps Inst. of Oceanog, Wave Report No. 73, 1947 (unpub.)
3. Bretschneider, C. L. - Revised Wave Forecasting Relationships, Proceedings of the 2nd Conf. on Coastal Engineering, 1951.
4. Hydrographic Office - Techniques for Forecasting Wind Waves and Swell, H. O. Pub. 604, 1951.
5. Hydrometeorological Section, U. S. Weather Bureau - Analysis of Winds over Lake Okeechobee During Tropical Storm of August 26-27, 1949, Hydromet. Report 26, 1951.
6. Saville, T., Jr. - Wave and Lake Level Statistics for Lake Michigan, Beach Erosion Board Tech. Memo. 36, 1953.
7. Milwaukee District, Corps of Engineers - Lake Michigan Wave Measurements at Milwaukee, Wisconsin, Misc. rpt. 20/203-1, 1933 (unpub.)
8. Scripps Institution of Oceanography - A Statistical Study of Wave Conditions at Five Open Sea Localities Along the California Coast, Wave Report 68, 1947 (unpub.)
9. Barber, N. F. - Ocean Waves and Swell, London Institution of Civil Engineers, Maritime and Waterways Division, 1950.
10. Darbyshire, J. - The Generation of Waves by Wind, Proceedings of the Royal Society, Series A, Vol. 215, No. 1122, 1952.
11. Great Lakes Division, Corps of Engineers - Preliminary Examination Report on Property Damage on the Great Lakes Resulting from Changes in Lake Level, June 1952 (unpub.).
12. Keulegan, G. H. - Wind Tides in Small Closed Channels, Jour. Res. Nat'l. Bur. Stds., RP 2207, v. 46, n. 5, 1951.
13. Saville, T. Jr. - Wind Set-up and Waves in Shallow Water, Beach Erosion Board Tech. Memo 27, 1952.

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ONTARIO

APPENDIX A

WAVE STATISTICS

FOR

STATION A

HAMILTON, ONTARIO

TABLE A-1

JANUARY

[illegible]

FEBRUARY

[illegible]

MARCH

PERIOD	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds					
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
5-1	ENE	18		6	24												18		6	24		
	NE							6	6											6		
1-2	ENE	12		12	18	18	30	48	18		18						30	36	30	96		
	E	6		6	12	6	18										18	6	24			
	Total	18		18	30	18	48	70	18		18						48	36	42	126		
	NE				6		6	12											6	12		
2-3	ENE				6		6	12											6	12		
	E				6		6	12											6	12		
	Total				18		6	24									18		6	24		
	NE							6				6							6	6		
	NE							12			12								12	12		
3-4	ENE						6	6			12						6	6	12	12		
	E										18	12							12	12		
	Total						6	24			12	42					6	24	12	42		
	NE																		12	12		
4-5	ENE																6	6	6	6		
	E																	6	6	6		
	Total																18	6	24	18		
	NE																		6	12		
5-6	ENE							6			6	6					6	6	6	6		
	Total							6			6	12					12	18	18	18		
TOTAL		36		6	42	48	18	48	114	12	42	12	64	12	18	6	36	108	78	72	234	
CALM																			636	666	672	1974
TOTAL HOURS																			744	744	744	2232

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION A, HAMILTON, ONTARIO

Period	APRIL					MAY					JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER					NOVEMBER					DECEMBER				
	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total	1948	1949	1950	1951	Total										
5-1	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-2	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-3	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-4	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-5	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-6	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-7	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
5-8	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										
TOTAL	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	1.0	1.0	4.0										

DATE	1948					1949					1950					1951					TOTAL
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
1/1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1/12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
 				

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION A, HAMILTON, ONTARIO
Duration given in hours. Height and period groupings include lower value but not the upper.

HEIGHT/FEET	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				2-6 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NNE	6			6													6			6
	NE	6			6													6			6
	ENE	12	24		36													12	24		36
	E	6			6													6			6
	ESE	6			6													6			6
1-2	TOTAL	24	24		48													24	24		48
	N	6			6													6			6
	NNE	6			6													6			6
	NE	6			6													6			6
	E	6			6													6			6
2-3	TOTAL	18	18		36													18	18		36
	NNE	6			6													6			6
	NE	6			6													6			6
	E	6			6													6			6
	TOTAL	18	18		36													18	18		36
3-4	NNE	6			6													6			6
	NE	6			6													6			6
	E	6			6													6			6
	TOTAL	18	18		36													18	18		36
	NNE	6			6													6			6
4-5	NE	6			6													6			6
	TOTAL	42	54	18	114	30	18	6	54	18	6	6	30	6	6	12	6	648	666	708	2022
	CALM																	744	744	744	2232
	TOTAL HOURS																				

AUGUST

HEIGHT/FEET	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				2-5 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
1-2	N				6				3					6			6	
	NNE	6			12	6	18	3						18	24		42	
	NE	6	12	6	24	12	18	18	48					6	24	18	48	
	E	6		6	12	18	6	24					6	6	18	30	54	
	TOTAL	18	18	12	48	24	42	36	108					6	42	36	126	
2-3	NNE						6		6						6		6	
	NE					6			12				12		18		30	
	E						6	6							6	6	12	
	TOTAL					6	6	12	12				12	18	6	24	30	
	NNE												12	12		12	24	
3-4	NE													6	6		12	
	E													6	6		12	
	TOTAL																	
	NNE																	
	NE																	
CALM	TOTAL	18	18	12	48	30	42	30	102				30	42	60	84	72	216
	TOTAL HOURS																	604,660,672 2016
																		704,744,759,2232

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION A, HAMILTON, ONTARIO
Duration given in hours Height and period groupings include lower value but not the upper.

OCTOBER												
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds			
HEIGHT (FEET)	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	12			12								
NE	6			6								
ESE	6	6	18	24								
E	6	6	12	18								
ESE	6	6	6	12								
TOTAL	24	12	30	66								
1-2	12			12	6	6		12				
NE	6			6	18			12				
ESE								34	34	12	12	
E								6				
ESE	12	12	12	36	6	6		12	12			
TOTAL	18	18	24	60	24	12	30	66	12	12		
2-3												
NE					12			12	18			
ESE								12	12			
TOTAL					12			24	30			
4-5												
ESE												
TOTAL												
TOTAL	42	36	30	108	48	12	30	90	6	36	42	
CALM										102	48	102
TOTAL HOURS										642	676	642
										744	744	744

NOVEMBER												
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds			
HEIGHT (FEET)	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	12			12								
NE	6			6								
TOTAL	12			12								
1-2	6	6		12	18	12		30				
ESE	6	6		12	18	12		30				
E	12	12		24	6	6		12				
TOTAL	18	24		42	24	18		42				
2-3												
NE					6	6		12				
ESE					6	6		12				
TOTAL					12	12		24				
3-4									12	18		
ESE									6	6		
TOTAL									12	18		
4-5												
ESE												
TOTAL												
6-7												
ESE												
TOTAL												
TOTAL	24	34		58	42	36		78	6	36		
CALM										6	6	
TOTAL HOURS										648	654	678
										720	720	720

DECEMBER												
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds			
HEIGHT (FEET)	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	6			6								
NE	6			6								
ESE					18			18				
E					18			18				
ESE	6	6	6	18	12	12		24				
TOTAL	6	6	6	18	30	24		54				
1-2												
NE									6	6		
ESE									12	12		
TOTAL									18	18		
3-4												
NE												
ESE												
TOTAL												
4-5												
ESE												
TOTAL												
5-6												
ESE												
TOTAL												
6-7												
ESE												
TOTAL												
TOTAL	12	6	18	36	30	24		54	30	18	12	
CALM										6	6	
TOTAL HOURS										490	478	740
										744	744	744

Duration given in hours. Height and period groupings include lower value but not the upper

CALM
TOTAL HOURS

Duration given in hours. Height and period groupings include lower value but not the upper.

CALM
TOTAL HOURS

TABLE A-4
STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION A, HAMILTON, ONTARIO
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year $\times 10^{-6}$. Height and period groupings include lower value but not the upper.

Height (feet)	Period (Secs)	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	8-10 Seconds	11-12 Seconds	13-14 Seconds
5-1	N	38.0								4.0
	NNE	12.1								12.1
	NE	182								182
	E	404								404
	ESE	182		36						218
1-2	N	61								61
	NNE	240	119							1026
	NE	721	3054							353
	E	881	2034	1164						1545
	ESE	401	452	291		210				3771
2-3	N	3845	10507	1455		210				6279
	NNE		625							3616
	NE		1562							853
	E		1249	1614						16017
	ESE		807							625
3-4	N		625							937
	NNE		6247	2421						625
	NE		1829	6311						8668
	E		408	9664						8134
	ESE		5522							10074
4-5	N		608	7099	1739					3522
	NNE		608	1578						9641
	E		3647	27376	1234					2186
	ESE			1299	9585					35557
	ESE			2578	7988					10884
5-6	N			1299	4799					2186
	NNE				2379					2379
	NE				2379					2379
	E				2379					2379
	ESE				7127					7127
6-7	N					2334				3230
	NNE					5230				3230
	NE						14172			14172
	E							37010		37010
	ESE								86913	86913
TOTAL		4835	20401	36486	36437	9374	14172	37010	86913	249628

TABLE A-5
STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION A, HAMILTON, ONTARIO
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^{-6}$. Height and period groupings include lower value but not the upper.

Height (feet)	Period (Secs)	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	8-10 Seconds	11-12 Seconds	13-14 Seconds
5-1	N	40								20
	NNE	191								191
	NE	282								282
	E	562								562
	ESE	282		36						318
1-2	N	101								101
	NNE	1210								1210
	NE	320	113							433
	E	801	1193							2186
	ESE	961	9519							5580
2-3	N	1282	6317	7088						9647
	NNE	1282	3236	437		210				5025
	E	641	1817							1658
	ESE	5267	16235	8435		210				24527
	ESE		625							625
3-4	N		2186							2186
	NNE		3113	3738						6351
	NE		1562	1211						2723
	E		1562	407						1746
	ESE		625							625
4-5	N		809	2862						12676
	NNE		1823	3499						4282
	NE		600	12421	967					18196
	E		600	10155	967					14122
	ESE		1215	3185	1738					15163
5-6	N		4254	95751	1862					4370
	NNE			2578	15776					53473
	E			5176	15776	1872				18574
	ESE			1279	11183					17068
	ESE			2073	28135	1872				16377
6-7	N			1932	9752					1277
	NNE				3138					54120
	E				2379					6491
	ESE				1222					2188
	ESE				16276					16200
7-8	N					2334				2334
	NNE					11803				15118
	E					1934				3934
	ESE					19671				22706
	ESE					5230				23372
8-9	N					5230				11284
	NNE					10162				21676
	E					6054				15520
	ESE					24316				1424
	ESE					15340				14172
9-10	N									14172
	NNE									24684
	E									24684
	ESE									24684
	ESE									24684
TOTAL		6777	30740	64130	65591	32233	64754	106702	86913	452565

FIG. A-1

AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY.

FIG. A-4

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ONTARIO

APPENDIX B

WAVE STATISTICS

FOR

ROCHESTER, NEW YORK

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper.

FEBRUARY																												
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				8-9 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	W			12	12																							
	NW	6	6	18	30																							
	N		6	6																								
	NNE	18		12	30																							
	NE		12	6	18																							
	TOTAL	24	24	48	96																							
1-2	W				6																							
	NW				18	6	18	42																				
	N																											
	NNE																											
	NE	6	12		18	18	12	36	60																			
	E		6		6	12		12																				
	E	6			6																							
	TOTAL	12	30		42	66	60	66	192																			
	W					12				12	6		18															
	NW						6	6																				
2-3	N									6			6															
	NNE					6		6																				
	NE					6		6																				
	E								12			12																
	TOTAL					12	18	6	36	30	6	36																
3-4	W								12		6	18																
	NW								12		6	18																
	N								6		6	12																
	NNE									6	6	12																
	TOTAL									30	18	18	66															
4-5	W								6		6	12	18															
	E									6	6			12	18													
	TOTAL								6		6	12	18															
5-6	W										6	12																
	NW										6	12																
	TOTAL										6	12																
6-7	W											6	12															
	E											6	12															
	TOTAL											6	12															
7-8	W												6	12														
	E												6	12														
	TOTAL												6	12														
8-9	W													6	12													
	E													6	12													
	TOTAL													6	12													
9-10	W														6	12												
	E														6	12												
	TOTAL														6	12												
10-11	W																12											
	E																	12										
	TOTAL																		12									
11-12	W																			6	12							
	E																			6	12							
	TOTAL																			6	12							
TOTAL	36	54	48	138	78	78	72	228	66	24	30	120	24	24	48	24	36	60	12	12	24	240	156	222	618			
CALM HOURS																												
TOTAL HOURS																												
456 516 450 1422 696 678 672 2040																												

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper

HEIGHT (FEET)	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				2-3 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	WNW			12	12																					12	12	12	12
	NW		12		12																					6	12	12	12
	N	6			12																					6	12	12	12
	NNE	6	6	6	18																					6	6	6	18
	NW		6		6																					6	6	6	18
TOTAL		12	30	30	72																					12	30	30	72
1-2	WNW				6	36	24	66																		6	36	24	66
	NW		6		6	18	18	36																		6	36	24	66
	NW		6		6	18	18	36																		6	36	24	66
	N				6	18	18	36																		6	36	24	66
	NNE	6			6	18	18	36																		6	36	24	66
TOTAL		6	12		18	66	90	180																		6	12		18
2-3	W					6	6	6																		12	12	12	12
	WNW					6	6	6																		12	12	12	12
	NW					6	6	6																		12	12	12	12
	N					6	6	6																		12	12	12	12
	TOTAL					6	12	18																		24	24	24	24
3-4	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
4-5	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
5-6	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
6-7	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
7-8	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
10-11	W					6	6	6																		6	6	6	6
	WNW					6	6	6																		6	6	6	6
	NW					6	6	6																		6	6	6	6
	N					6	6	6																		6	6	6	6
	TOTAL					6	12	18																		6	12	18	18
TOTAL		18	42	30	90	78	90	66	234	96	90	36	222	24	42	54	120	30	18	42	6	6	6	6	18	222	300	204	726
CALM																													
TOTAL HOURS																										582	444	540	1566
																										744	744	744	2232

APRIL

CALM
TOTAL HOURS

TABLE B-1
 STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
 Duration given in hours. Height and period groupings include lower value but not the upper.
 MAY

Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	WNW	18		6	24																18		6	24
	NW	6		6	12																6		6	12
	NNW	6		6	12																6		6	12
	N	24		24	48																24		24	48
	NNE	24		12	36																24		12	36
	NE			18	18																		18	18
	ENE	24		6	30																24		6	30
TOTAL	102		66	168																102		66	168	
1-2	W				12			12																
	WNW	6		6	18			36													18		6	24
	NW	6		6	12			18													12		6	18
	NNW				6			6													6		6	12
	N	6		12	18	12		24	36	6											24		36	60
	NNE	6		6	12	6		12	24	12											24		6	30
	NE	6		6	18	18		36	54	6											24		18	42
ENE			6	6	6		12	18	6											12		6	18	
E							6	12	6											6		6	12	
TOTAL	30		12	24	66	24	66	78	228	24										30		24	78	
2-3	W				6			6																
	WNW								18			18												
	NW				6			12	6			6									6		12	18
	NNW				6			6	6			6									6		6	12
	N				12			12	18			18									30		30	60
	NNE				6			6	6			6									6		6	12
	NE				6			6	6			6									6		6	12
ENE				6			6	6			6									6		6	12	
TOTAL				18			36	48	42			42								18		36	72	
3-4	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
4-5	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
5-6	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
6-7	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
7-8	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
8-9	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
9-10	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE								18		6	24									18		6	24	
E										12	12													
TOTAL									36	36	60	132								36		36	60	
10-11	N								6	6		12												
	WNW										12	12												
	NW								6	6	12	12												
	NNW								6	6	6	6												
	N								24	6	30	6									24		6	30
	NNE								6	6	12	12									6		6	12
	NE										12	12												
ENE																								

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper
JUNE

Height Feet	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	WNW				6																	6			6
	NW	6			12																	6			12
	NNW	24			6				30													24			6
	N	6	6		12																	6	6		12
	NE				6																				6
	ESE				6																				6
1-2	TOTAL	36	18	24	78																	36	18	24	78
	WNW	12			6	18			12	18	24	54										24	18	30	72
	NW	6	6		12	12	6		6	24												12	12	12	36
	NNW									6															6
	N		6	6	12	18	6		6	30												18	12	12	42
	NE					6				6												6			6
2-3	ESE				6																				6
	TOTAL	12	18	18	48	48	30	42	120													60	48	60	168
	W									6			6												6
	WNW									6			6												6
	NW					6			6				6									6			12
	N					6			6				6									6			6
3-4	NE					6			6				6									6			6
	TOTAL					18	6	24	48	6	12	18	36									24	18	30	72
	WNW									12	12	18	42									12	12	18	42
	NW									12	6	6	24									12	6	6	24
	NNW											6	6												6
	TOTAL									24	18	30	72									24	18	30	72
4-5	WNW															12	12								12
	NW									6		6	6	6	6		12					6	6	6	18
	NNW									6		6										6			6
	N									6		6										6			6
	NE											6	6	6	6	12	24					18	6	18	42
	TOTAL									12	6	18	36	36	36	36	60					42	24	36	102
5-6	WNW															6	6								6
	NW															6	6								6
	NNW																								
	N																								
	NE																								
	TOTAL																								
6-7	W																								
	WNW																								
	NW																								
	NNW																								
	N																								
	TOTAL																								
TOTAL		48	36	42	126	66	36	42	144	42	30	36	108	6	6	18	30					6	6	18	30
CALM																									
TOTAL HOURS																									

JULY

Height Feet	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	WNW	6			6																				
	NW				6																				
	NNW		12		12																				
	N				6				6																
	NE	6	6		12																				
	ESE	6	18		24																				
1-2	TOTAL	18	36	12	66																				
	W	12			12																				
	WNW				6	12	12	36	60																
	NW	6	12		6	24	6	18	24																
	NNW				6	6			30																
	N		18	6	24	6			6																
2-3	NE				6	6																			
	ESE	6	6		12	6	6	6	18																
	TOTAL	24	42	30	96	42	72	42	156																
	W					6			6																
	WNW									6	12	18													
	NW					6			6																
3-4	NNW																								
	N									12	6	18													
	NE																								
	ESE																								
	TOTAL					6	6	12	30	30	30	60													
	W									6		6													
4-5	WNW																								
	NW																								
	NNW																								
	N																								
	NE																								
	TOTAL																								
TOTAL		42	78	42	162	54	78	48	180	60	36	24	120	24											
CALM																									
TOTAL HOURS																									

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper
AUGUST

HEIGHT (FEET)	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				2-6 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	W	6			6													6			6
	WNW			6	6														6		6
	NW			6	6														6		6
	NNW	12	12		24													12	12		24
	N			12	12														12	12	
	NNE			6	6														6	6	
	ENE			6	6														6	6	
TOTAL	18	12	24	54														18	12	24	54
1-2	WNW	6			6	12	12	12	36									24	12	12	48
	NW			6	6	24	6		30									24	6	6	36
	NNW	6	6		12	12	24	12	48									18	30	12	60
	N		6		6	24	18	18	60									24	24	18	66
	NNE					6	24	12	42									6	24	12	42
	NE	6	6		12	12	36	18	66									18	36	18	72
	ENE	6			6		18	12	30									6	18	12	36
TOTAL	24	18	6	48	96	120	84	300									120	156	90	366	
2-3	WNW					12		12	24	18			18					30			30
	NW					12		12	24				12					12			12
	NNW						12	12	24	6	6		12					6	18		24
	N					12	24	36	72				6					12	30		42
	NNE					12	6	18	36				6					12	6		18
	NE						6	6	12				6						6	6	12
	ENE							6	6				6						6	6	12
TOTAL					48	48	66	162	24	12		42					72	66	6	144	
3-4	WNW									6	6		12								18
	NNW									6	6		12								18
	N									6	6		12					6	6		12
	NNE									6	6		12								12
	NE									12			12					12			12
	ENE									12			12					12			12
	TOTAL									18	6	24	48					18	6	24	48
4-5	WNW												6				6	6			6
	NW												6	6			6	6			12
	NNE												6	6				6	6		12
	NE												12				12				12
	ENE												12				12				12
	TOTAL												12	12			12	12			24
	TOTAL	42	30	48	120	144	186	90	420	42	24	36	102	12				12	240	240	174
CALM																		504			
TOTAL HOURS																		798			

SEPTEMBER

HEIGHT (FEET)	Period	2 - 3 Seconds				3 - 4 Seconds				4 - 5 Seconds				5 - 6 Seconds				2 - 6 Seconds																
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total													
.5 - 1	WNW			6	6															6	6	18	24											
	NW			6	6														6	6	6	18												
	N			12	12														12			12												
	NNE			18	18														18			18												
	NE			12	12														12		6	24												
	ENE																		12		12	24												
	TOTAL			48	48														48		12	48	108											
1 - 2	WNW							12	6	18									12		6	18												
	NW			6	6			6	12	18								6	30	18	54													
	NNW							12	6	18								12	6	18														
	N			6	6			36	24	36								36	24	30	90													
	NNE			12	12			18		18								30	6	36														
	NE			6	6			18		30	18							24		36	60													
	ENE								24	24										24	24													
TOTAL			18	6	24	48	72	102	252								72	78	126	300														
2 - 3	W							6		6									6															
	WNW							12		12									12			12												
	NW							18		18									18			18												
	TOTAL							6	30	36								6	30		36													
	WNW									6	12	18							6	12	18													
	NW							6		6								6		6														
	N									6									6		6													
3 - 4	NNE									6	18	24						6		18	24													
	ENE																																	
	TOTAL							6	6	6	48	60						6	12	48	66													
	WNW																	12		12														
	NW							6		6								6		6														
	N									6										6														
	TOTAL																																	
4 - 5	WNW																	12	12															
	NW																	6	6															
	N																																	
	NNE																																	
	ENE																																	
	TOTAL																																	
	WNW																	12	12															
NW																	6	6																
N																																		
5 - 6	WNW																																	
	NW																	6	6															
	TOTAL																	18	18															
	WNW																																	
	NW																	6	6															
	TOTAL																	24	24															
	TOTAL	66	18	72	156	84	118	102	292	6	6	54	66					24	24	156	132	252	540											
CALM																			564				580				648				1620			
TOTAL HOURS																			720				720				720				2160			

OCTOBER

NOVEMBERB-8

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper.

		DECEMBER																							
HEIGHT FEET	Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				8-7 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NNW	6			6																	6			6
	NW		6		6																		6		6
	NNW		6	6	12																		6	6	12
	N			18	18																		18	18	18
	NNE	6			6																	6			6
	NE	6	6		12																	6	6		12
1-2	ENE			6	6																	6		6	6
	Total	18	18	30	66																	18	18	30	66
	NNW					18	6	12	36													18	6	12	36
	NW					18	6	12	36													18	6	12	36
	NNW	12			12																	12			12
	N					6	18	6	30														6	18	6
2-3	NNE							6	6																6
	NE					6			6													6			6
	ENE					6			6													6			6
	Total	12			12	54	30	54	138													66	30	54	150
	NNW					6			6													6			6
	N						6	6	12														6	6	6
3-4	Total					6	6	6	18													6	6	6	18
	NNW									6	12	12	30		6		6					6	6	6	18
	NW									12		12										12	12	12	36
	NNW											18	18									18	18	18	54
	N									6	6	12										6	6	12	30
	NNE									6	6	12										6	6	12	30
4-5	E									6		6										6		6	12
	Total									36	18	30	84		6		6					42	18	30	90
	NNW														6	6	12					6	6	12	30
	NW														12		12					12		12	36
	NNW														18	6	24					18	6	24	60
	N									6	6	12										6	6	12	30
5-6	NNE									6		6										6		6	12
	Total									6		6										6		6	12
	NNW														6	6	12					6	6	12	30
	NW														6		6					6		6	12
	NNW														12	6	6	24				12	6	6	24
	Total														12	6	6	24				12	6	6	24
6-7	NNW																	6	6			6	6		6
	NNE																	6	6			6	6		6
	NE														6		6					6		6	12
	Total														6		6					6		6	12
	NNW																								
	Total																								
7-8	NNW																								
	NW																								
	NNE																								
	NE														6		6					6		6	12
	Total														6		6					6		6	12
	Total	30	18	30	78	60	36	60	156	36	18	30	84	24	24	12	60		12	12		150	96	144	390
CALM																									
TOTAL HOURS																									

Duration given in hours. Height and period groupings include lower value but not the upper

B-10

TABLE B-4

STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.

ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Height (ft)	Period		3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	8-9 Seconds
	Dir.	2-3 Seconds						
.5-1	W	40						40
	WNW	262						262
	WN	423						423
	NNW	383						383
	N	625						625
	NNE	423						423
	NE	262						262
	ENE	363						363
	E	81						81
	Total	2862						2862
1-2	W	240	565					805
	WNW	801	6212			210		7225
	WN	961	4745					5706
	NNW	320	3728					4048
	N	961	5197	146				6304
	NNE	721	2825	291				3837
	NE	641	4519					5160
	ENE	481	2937	146				3564
	E		565					565
	Total	5126	31295	583		210		37214
2-3	W		937	404				1341
	WNW		1874	4939				6313
	WN		2811	2421				5232
	NNW		3123	2421				5544
	N		4372	3228				7600
	NNE		1874	404				2278
	NE		937	1211				2148
	ENE		937					937
	Total		16865	14528				31393
3-4	W			2366				2366
	WNW			24453	967			25420
	WN		1215	13410				14625
	NNW		608	5521				6129
	N		608	11093				11651
	NNE			11093				11093
	NE			4733	1934			6667
	ENE			8677	967			9649
	E		608	1578				2186
	Total		3039	82824	3868			89731
4-5	W			2578	4793			7371
	WNW			1299	23963			25262
	WN			5196	15776			21172
	NNW			3897				3897
	N			5196	3175			8371
	NNE			1279	1598			2897
	NE			1279	7988			9287
	ENE			1279				1299
	Total			22083	57517			79596
5-6	W				21717			21714
	WNW				7138			7138
	WN				2379			2379
	NNW				4759	2820		4759
	N				2379			2379
	NNE				4759			4759
	Total				42828	2820		45648
	W				19672			19672
	WNW				11803			11803
	WN				15738			15738
6-7	NNW				3315			3315
	Total				3315	47212		50528
7-8	W					10460		10460
	WNW					5230		5230
	Total					15690		15690
8-9	ENE					6707		6707
	W						9694	9694
	ENE							16723
	Total					16723	9694	26417
9-10	W							14172
	WNW							14172
	Total							28344
11-12	W							14172
	WNW							14172
	Total							28344
	W							14172
	WNW							14172
	Total							28344
	W							14172
	WNW							14172
	Total							28344
	W							14172
	WNW							14172
	Total							28344
TOTAL		7788	51199	120018	107524	89363	38038	414130

TABLE B-5
STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION B, ROCHESTER, N.Y.
FULL YEAR

Energy given in foot-pounds per foot of crest per year x 10⁶. Height and period groupings include lower value but not the upper

Height (feet)	Period							
	Dir.	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	2-8 Seconds
5-1	W	40						40
	NNW	403						403
	NW	585						585
	NNW	444						444
	N	847						847
	NNE	645						645
	NE	464						464
	E	81						81
1-2	Total	3253						3253
	W	240	678					918
	NNW	801	8490			210		19501
	NW	1202	7457					8659
	NNW	721	5710					6031
	N	1041	6892	146				8079
	NNE	881	3854	291				5126
	NE	961	6101					7062
2-3	E	641	4180	146				4967
	Total	80	791					871
	W	6568	44853	583		210		52214
	NNW		1562	404				1766
	NW		4060	6456				10516
	NNW		4060	3632				7672
	N		3435	3632				7067
	NNE		1497	3632				3629
3-4	NE		2488	1614				4112
	NE		1874	2825				4699
	E		1249	807				2056
	Total		23733	23002				46735
	W			5522				5522
	NNW			35497	2901			38398
	NW		1823	22876				24699
	NNW		608	11832				12440
4-5	N			18143				18751
	NNE			16565				16565
	NE			7888	2901			10789
	E			9466	1934			11400
	Total		608	3944				4552
	W		3647	131233	7736			143116
	NNW			2598	6390			8988
	NW			7795	49524			57319
5-6	NNW			10393	21159			32552
	N			7795				7795
	NNE			6496	3195			9691
	NE			1299	1598			2897
	E			2598	11183			13781
	E			2598	4795			7391
	Total			1598	1598			1598
	Total			41572	105440			147012
5-6	W			1932	2379			4311
	NNW			1932	30931			32863
	NW				23793			23793
	NNW			1932	7138			9070
	N				4759	2820		1579
	NNE				4759			4759
	NE				7138			7138
	Total			5796	80897	2820		89519
6-7	W					18672		18672
	NNW				13259	31476		44735
	NW					23606		23606
	NNW					3315		3315
	NE					3315		3315
	E					18672		18672
	Total				19889	93426		113315
	NNW					36612		36612
7-8	N					5230		5230
	NNE					5230		5230
	NE				4401			4401
	Total				4401	47072		51473
	NNW					13413		13413
	E					6707		6707
	Total					20120		20120
	NNW					8361	19388	27749
9-10	N					8361		8361
	E					16723		16723
	Total					33445		33445
	W						19388	19388
	NNW							23654
	Total							11828
	W							35484
	NNW							14172
11-12	E							14172
	Total							14172
	W							42516
	NNW							42516
	E							16042
	Total							16042
	W							16042
	NNW							16042
12-13	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042
	Total							16042
	W							16042
	NNW							16042
TOTAL	E							16042
	Total							16042
	W							16042
	NNW							16042
	E							16042

FIG. B-1

AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY

FIG. B-4

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ONTARIO

APPENDIX C

WAVE STATISTICS

FOR

STONY POINT, NEW YORK

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper
JANUARY

Drain	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	Total
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NE	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
NW	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SW	12	12	12													

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.

Period	FEBRUARY										TOTAL	TOTAL HOURS
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949		
2-9 Seconds	6	6	6	18	6	6	6	18	6	6	6	18
2-9	6	6	6	18	6	6	6	18	6	6	6	18
3-4	6	6	6	18	6	6	6	18	6	6	6	18
4-5	6	6	6	18	6	6	6	18	6	6	6	18
5-6	6	6	6	18	6	6	6	18	6	6	6	18
6-7	6	6	6	18	6	6	6	18	6	6	6	18
7-8	6	6	6	18	6	6	6	18	6	6	6	18
8-9	6	6	6	18	6	6	6	18	6	6	6	18
9-10	6	6	6	18	6	6	6	18	6	6	6	18
10-11	6	6	6	18	6	6	6	18	6	6	6	18
11-12	6	6	6	18	6	6	6	18	6	6	6	18
TOTAL	6	6	6	18	6	6	6	18	6	6	6	18

MARCH

CALM

TABLE C-1

MAY

CALM.	
TOTAL HOURS	

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.

Duration given in hours. Height and period groupings include lower value but not the upper

JUNE																																																		
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				8-9 Seconds																									
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total																						
5-1	SSW	12	6	18																	12	6	18																											
	SW	24	18	24	66																24	18	24	66																										
	WSW	42		24	66																42		24	66																										
	W		6	6	12																	6		6	12																									
	WSW			12	12																		12		12	24																								
	WSW		6		6																		6		6	12																								
	TOTAL	76	30	66	172																	76	30	66	172																									
1-2	SSW		6	6																					12	12	30																							
	SW		6	12	18	42	42	102					6	6											12	42	114																							
	WSW		6	12	18	30	34	102					6	6											12	42	114																							
	W		6	6	12	12	18	36	18				18	36											12	42	114																							
	WSW		6	6	12	12	30	54																	12	36	60																							
	WSW		6	6	12	12	6	18																	12	12	30																							
	TOTAL	12	30	32	72	78	102	150	336	18			24	42											12	138	224	450																						
2-3	SW					6	6	6					6	6											12	12	24																							
	WSW					12	6	18					6	6											12	12	24																							
	W						6	6					12												12	6	18																							
	WSW						6	6					6												6		12																							
	WSW						6	12					6												6	6	12																							
	WSW						6	6					6												6	6	12																							
	TOTAL					18	30	6	24				24	24											18	54	6	78																						
3-4	SSW					6	6	12					6	6											12	6	18																							
	SW						12	18	36				6	6	12									6	12	18	36																							
	WSW						18	24	54				12	6	18									18	18	30	66																							
	W						18	12	42															18	24	18	60																							
	WSW						6	6	30															6	24	30																								
	WSW						6	6	12	30														12	12	12	36																							
	TOTAL					6	6	12	54	54	96	204	18	12	30									60	72	120	264																							
4-5	SW												6	6											6	42	48																							
	WSW												12	6	18									12	6	18																								
	W												18	6	48	72								18	6	48	72																							
	WSW												6	6										6	6																									
	WSW												6	6	12	30								12	12	12	36																							
	TOTAL												6	6	12	30								60	72	120	264																							
	5-6	SW												6	6											6	42	48																						
WSW													12	6	18									12	6	18																								
W													6	6										6	6																									
WSW													6	6										6	6																									
WSW													6	6	12	30								12	12	12	36																							
TOTAL													6	6	12	30								6	6	12	36																							
6-7		SW												6	6											6	42	48																						
	WSW												12	6	18									12	6	18																								
	W												6	6										6	6																									
	WSW												6	6										6	6																									
	WSW												6	6	12	30								12	12	12	36																							
	TOTAL												6	6	12	30								6	6	12	36																							
	7-8	SW												6	6											6	42	48																						
WSW													12	6	18									12	6	18																								
W													6	6										6	6																									
WSW													6	6										6	6																									
WSW													6	6	12	30								12	12	12	36																							
TOTAL													6	6	12	30								6	6	12	36																							
8-9		SW												6	6											6	42	48																						
	WSW												12	6	18									12	6	18																								
	W												6	6										6	6																									
	WSW												6	6										6	6																									
	WSW												6	6	12	30								12	12	12	36																							
	TOTAL												6	6	12	30								6	6	12	36																							
	9-10	SW												6	6											6	42	48																						
WSW													12	6	18									12	6	18																								
W													6	6										6	6																									
WSW													6	6										6	6																									
WSW													6	6	12	30								12	12	12	36																							
TOTAL													6	6	12	30								6	6	12	36																							
10-11		SW												6	6											6	42	48																						
	WSW												12	6	18									12	6	18																								
	W												6	6										6	6																									
	WSW												6	6										6	6																									
	WSW												6	6	12	30								12	12	12	36																							
	TOTAL												6	6	12	30								6	6	12	36																							
	TOTAL	108	60	96	264	102	144	156	402	72	78	120	270	24	24	72	120	18				6	24	6		12	24	330	444																					
CALM																																																		
TOTAL HOURS																																																		

JULY

Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				8-9 Seconds				9-10 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total				
5-1	SSW	24	6	30																					24	6	30					
	SW	36	18	54																					36	18	54					
	WSW	48	6	54																					48	6	54					
	W	12		12	24																					12		12	24			
	WSW		6	6	12																						6	6	12			
TOTAL	120	30	150																						120	30	150					
1-2	SSW	6	6	12	6	12	18	36	18	18	54	90	18	6	6	30	6									12	6	18	36			
	SW	18	12	6	36	18	18	30	66	18	6	6	30	6											36	30	60	126				
	WSW		12	6	18	72	30	42	150	18	6	6	30	6											102	48	54	204				
	W	18			18	30		36	66	6			36	72												54	72	126				
	WSW	6			6	12	18	30	66																	6	12	18	36			
TOTAL	54	30	12	96	132	72	126	378	24	6	6	72	6												216	114	240	570				
2-3	SSW				6																											
	SW				24	24	24	72	24																							
	WSW				12	6	18	36	6	6			12													18	6	24				
	W				6	18	24	48																		6	18	24				
	WSW				6	6	6	18																		6	6	12				
TOTAL				30	72	6	72	150	6	30		36													36	72	6	114				
3-4	SSW								6	6																						
	SW								6	12	18																					
	WSW								18	24	12	54																				
	W								12	12	6	30																				
	WSW								12		18	30																				
TOTAL								12	12	42	96															42	72	54				
4-5	SSW								6	12	18																					
	SW								6	12	18																					
	WSW								6	6																						
	W								6	6																						
	WSW								6	6																						
TOTAL								6	6	12	36															12	18	36				
5-6	SSW																															
6-7	SSW																															
7-8	SSW																															
8-9	SSW																															
9-10	SSW																															
10-11	SSW																															
TOTAL	126	60	48	234	142	114	204	460	78	72	96	246	30			42	72	6			12	18			12	12	450	246	414			
CALM																																
TOTAL HOURS																																

274 478 330 112
744 744 744 222

Period		2 - 3 Seconds												3 - 4 Seconds												4 - 5 Seconds												5 - 6 Seconds												6 - 7 Seconds												7 - 8 Seconds												8 - 9 Seconds												9 - 10 Seconds												10 - 11 Seconds												11 - 12 Seconds												12 - 13 Seconds												13 - 14 Seconds												14 - 15 Seconds												15 - 16 Seconds												16 - 17 Seconds												17 - 18 Seconds												18 - 19 Seconds												19 - 20 Seconds												20 - 21 Seconds												21 - 22 Seconds												22 - 23 Seconds												23 - 24 Seconds												24 - 25 Seconds												25 - 26 Seconds												26 - 27 Seconds												27 - 28 Seconds												28 - 29 Seconds												29 - 30 Seconds												30 - 31 Seconds												31 - 32 Seconds												32 - 33 Seconds												33 - 34 Seconds												34 - 35 Seconds												35 - 36 Seconds												36 - 37 Seconds												37 - 38 Seconds												38 - 39 Seconds												39 - 40 Seconds												40 - 41 Seconds												41 - 42 Seconds												42 - 43 Seconds												43 - 44 Seconds												44 - 45 Seconds												45 - 46 Seconds												46 - 47 Seconds												47 - 48 Seconds												48 - 49 Seconds												49 - 50 Seconds												50 - 51 Seconds												51 - 52 Seconds												52 - 53 Seconds												53 - 54 Seconds												54 - 55 Seconds												55 - 56 Seconds												56 - 57 Seconds												57 - 58 Seconds												58 - 59 Seconds												59 - 60 Seconds												60 - 61 Seconds												61 - 62 Seconds												62 - 63 Seconds												63 - 64 Seconds												64 - 65 Seconds												65 - 66 Seconds												66 - 67 Seconds												67 - 68 Seconds												68 - 69 Seconds												69 - 70 Seconds												70 - 71 Seconds												71 - 72 Seconds												72 - 73 Seconds												73 - 74 Seconds												74 - 75 Seconds												75 - 76 Seconds												76 - 77 Seconds												77 - 78 Seconds												78 - 79 Seconds												79 - 80 Seconds												80 - 81 Seconds												81 - 82 Seconds												82 - 83 Seconds												83 - 84 Seconds												84 - 85 Seconds												85 - 86 Seconds												86 - 87 Seconds												87 - 88 Seconds												88 - 89 Seconds												89 - 90 Seconds												90 - 91 Seconds												91 - 92 Seconds												92 - 93 Seconds												93 - 94 Seconds												94 - 95 Seconds												95 - 96 Seconds												96 - 97 Seconds												97 - 98 Seconds												98 - 99 Seconds												99 - 100 Seconds												100 - 101 Seconds												101 - 102 Seconds												102 - 103 Seconds												103 - 104 Seconds												104 - 105 Seconds												105 - 106 Seconds												106 - 107 Seconds												107 - 108 Seconds												108 - 109 Seconds												109 - 110 Seconds												110 - 111 Seconds												111 - 112 Seconds												112 - 113 Seconds												113 - 114 Seconds												114 - 115 Seconds												115 - 116 Seconds												116 - 117 Seconds												117 - 118 Seconds												118 - 119 Seconds												119 - 120 Seconds												120 - 121 Seconds												121 - 122 Seconds												122 - 123 Seconds												123 - 124 Seconds												124 - 125 Seconds												125 - 126 Seconds												126 - 127 Seconds												127 - 128 Seconds												128 - 129 Seconds												129 - 130 Seconds												130 - 131 Seconds												131 - 132 Seconds												132 - 133 Seconds												133 - 134 Seconds												134 - 135 Seconds												135 - 136 Seconds												136 - 137 Seconds												137 - 138 Seconds												138 - 139 Seconds												139 - 140 Seconds												140 - 141 Seconds												141 - 142 Seconds												142 - 143 Seconds												143 - 144 Seconds												144 - 145 Seconds												145 - 146 Seconds												146 - 147 Seconds												147 - 148 Seconds												148 - 149 Seconds												149 - 150 Seconds												150 - 151 Seconds												151 - 152 Seconds												152 - 153 Seconds												153 - 154 Seconds												154 - 155 Seconds												155 - 156 Seconds												156 - 157 Seconds												157 - 158 Seconds												158 - 159 Seconds												159 - 160 Seconds												160 - 161 Seconds												161 - 162 Seconds												162 - 163 Seconds												163 - 164 Seconds												164 - 165 Seconds												165 - 166 Seconds												166 - 167 Seconds												167 - 168 Seconds												168 - 169 Seconds												169 - 170 Seconds												170 - 171 Seconds												171 - 172 Seconds												172 - 173 Seconds												173 - 174 Seconds												174 - 175 Seconds												175 - 176 Seconds												176 - 177 Seconds												177 - 178 Seconds												178 - 179 Seconds												179 - 180 Seconds												180 - 181 Seconds												181 - 182 Seconds												182 - 183 Seconds												183 - 184 Seconds												184 - 185 Seconds												185 - 186 Seconds												186 - 187 Seconds												187 - 188 Seconds												188 - 189 Seconds												189 - 190 Seconds												190 - 191 Seconds												191 - 192 Seconds												192 - 193 Seconds												193 - 194 Seconds												194 - 195 Seconds												195 - 196 Seconds												196 - 197 Seconds												197 - 198 Seconds												198 - 199 Seconds												199 - 200 Seconds												200 - 201 Seconds												201 - 202 Seconds												202 - 203 Seconds												203 - 204 Seconds												204 - 205 Seconds												205 - 206 Seconds												206 - 207 Seconds												207 - 208 Seconds												208 - 209 Seconds												209 - 210 Seconds												210 - 211 Seconds												211 - 212 Seconds												212 - 213 Seconds												213 - 214 Seconds												214 - 215 Seconds												215 - 216 Seconds												216 - 217 Seconds												217 - 218 Seconds												218 - 219 Seconds												219 - 220 Seconds												220 - 221 Seconds												221 - 222 Seconds												222 - 223 Seconds												223 - 224 Seconds												224 - 225 Seconds												225 - 226 Seconds												226 - 227 Seconds												227 - 228 Seconds												228 - 229 Seconds												229 - 230 Seconds												230 - 231 Seconds												231 - 232 Seconds												232 - 233 Seconds												233 - 234 Seconds												234 - 235 Seconds												235 - 236 Seconds												236 - 237 Seconds												237 - 238 Seconds												238 - 239 Seconds												239 - 240 Seconds												240 - 241 Seconds												241 - 242 Seconds												242 - 243 Seconds												243 - 244 Seconds												244 - 245 Seconds												245 - 246 Seconds												246 - 247 Seconds												247 - 248 Seconds												248 - 249 Seconds												249 - 250 Seconds												250 - 251 Seconds												251 - 252 Seconds												252 - 253 Seconds												253 - 254 Seconds												254 - 255 Seconds												255 - 256 Seconds												256 - 257 Seconds												257 - 258 Seconds												258 - 259 Seconds												259 - 260 Seconds												260 - 261 Seconds												261 - 262 Seconds												262 - 263 Seconds												263 - 264 Seconds												264 - 265 Seconds												265 - 266 Seconds												266 - 267 Seconds												267 - 268 Seconds												268 - 269 Seconds												269 - 270 Seconds												270 - 271 Seconds												271 - 272 Seconds												272 - 273 Seconds												273 - 274 Seconds												274 - 275 Seconds												275 - 276 Seconds												276 - 277 Seconds												277 - 278 Seconds												278 - 279 Seconds												279 - 280 Seconds												280 - 281 Seconds												281 - 282 Seconds												282 - 283 Seconds												283 - 284 Seconds												284 - 285 Seconds												285 - 286 Seconds												286 - 287 Seconds												287 - 288 Seconds												288 - 289 Seconds												289 - 290 Seconds												290 - 291 Seconds												291 - 292 Seconds												292 - 293 Seconds												293 - 294 Seconds												294 - 295 Seconds												295 - 296 Seconds												296 - 297 Seconds												297 - 298 Seconds												298 - 299 Seconds												299 - 300 Seconds												300 - 301 Seconds												301 - 302 Seconds												302 - 303 Seconds												303 - 304 Seconds												304 - 305 Seconds												305 - 306 Seconds												306 - 307 Seconds												307 - 308 Seconds												308 - 309 Seconds												309 - 310 Seconds												310 - 311 Seconds												311 - 312 Seconds												312 - 313 Seconds												313 - 314 Seconds												314 - 315 Seconds												315 - 316 Seconds												316 - 317 Seconds												317 - 318 Seconds												318 - 319 Seconds												319 - 320 Seconds												320 - 321 Seconds												321 - 322 Seconds												322 - 323 Seconds												323 - 324 Seconds												324 - 325 Seconds												325 - 326 Seconds												326 - 327 Seconds												327 - 328 Seconds												328 - 329 Seconds												329 - 330 Seconds												330 - 331 Seconds												331 - 332 Seconds												332 - 333 Seconds												333 - 334 Seconds												334 - 335 Seconds												335 - 336 Seconds												336 - 337 Seconds												337 - 338 Seconds												338 - 339 Seconds												339 - 340 Seconds												340 - 341 Seconds												341 - 342 Seconds												342 - 343 Seconds												343 - 344 Seconds												344 - 345 Seconds												345 - 346 Seconds												346 - 347 Seconds												347 - 348 Seconds												348 - 349 Seconds												349 - 350 Seconds												350 - 351 Seconds												351 - 352 Seconds												352 - 353 Seconds												353 - 354 Seconds												354 - 355 Seconds												355 - 356 Seconds												356 - 357 Seconds												357 - 358 Seconds												358 - 359 Seconds												359 - 360 Seconds												360 - 361 Seconds												361 - 362 Seconds												362 - 363 Seconds												363 - 364 Seconds												364 - 365 Seconds												365 - 366 Seconds												366 - 367 Seconds												367 - 368 Seconds												368 - 369 Seconds												369 - 370 Seconds												370 - 371 Seconds												371 - 372 Seconds												372 - 373 Seconds												373 - 374 Seconds												374 - 375 Seconds												375 - 376 Seconds												376 - 377 Seconds												377 - 378 Seconds												378 - 379 Seconds												379 - 380 Seconds												380 - 381 Seconds												381 - 382 Seconds												382 - 383 Seconds												383 - 384 Seconds												384 - 385 Seconds												385 - 386 Seconds												386 - 387 Seconds												387 - 388 Seconds												388 - 389 Seconds												389 - 390 Seconds												390 - 391 Seconds												391 - 392 Seconds												392 - 393 Seconds												393 - 394 Seconds												394 - 395 Seconds												395 - 396 Seconds												396 - 397 Seconds												397 - 398 Seconds												398 - 399 Seconds												399 - 400 Seconds												400 - 401 Seconds												401 - 402 Seconds												402 - 403 Seconds												403 - 404 Seconds												404 - 405 Seconds												405 - 406 Seconds												406 - 407 Seconds												407 - 408 Seconds												408 - 409 Seconds												409 - 410 Seconds												410 - 411 Seconds												411 - 412 Seconds												412 - 413 Seconds												413 - 414 Seconds												414 - 415 Seconds												415 - 416 Seconds												416 - 417 Seconds												417 - 418 Seconds												418 - 419 Seconds												419 - 420 Seconds												420 - 421 Seconds												421 - 422 Seconds												422 - 423 Seconds												423 - 424 Seconds												424 - 425 Seconds												425 - 426 Seconds												426 - 427 Seconds												427 - 428 Seconds												428 - 429 Seconds												429 - 430 Seconds												430 - 431 Seconds												431 - 432 Seconds												432 - 433 Seconds												433 - 434 Seconds												434 - 435 Seconds												435 - 436 Seconds												436 - 437 Seconds												437 - 438 Seconds												438 - 439 Seconds												439 - 440 Seconds												440 - 441 Seconds												441 - 442 Seconds												442 - 443 Seconds												443 - 444 Seconds												444 - 445 Seconds												445 - 446 Seconds												446 - 447 Seconds												447 - 448 Seconds												448 - 449 Seconds												449 - 450 Seconds												450 - 451 Seconds												451 - 452 Seconds												452 - 453 Seconds												453 - 454 Seconds												454 - 455 Seconds												455 - 456 Seconds												456 - 457 Seconds												457 - 458 Seconds												458 - 459 Seconds												459 - 460 Seconds												460 - 461 Seconds												461 - 462 Seconds												462 - 463 Seconds												463 - 464 Seconds												464 - 465 Seconds												465 - 466 Seconds												466 - 467 Seconds												467 - 468 Seconds												468 - 469 Seconds												469 - 470 Seconds												470 - 471 Seconds												471 - 472 Seconds												472 - 473 Seconds												473 - 474 Seconds												474 - 475 Seconds												475 - 476 Seconds												476 - 477 Seconds												477 - 478 Seconds												478 - 479 Seconds												479 - 480 Seconds												480 - 481 Seconds												481 - 482 Seconds												482 - 483 Seconds												483 - 484 Seconds												484 - 485 Seconds												485 - 486 Seconds												486 - 487 Seconds												487 - 488 Seconds												488 - 489 Seconds												489 - 490 Seconds												490 - 491 Seconds												491 - 492 Seconds												492 - 493 Seconds												493 - 494 Seconds												494 - 495 Seconds												495 - 496 Seconds												496 - 497 Seconds												497 - 498 Seconds												498 - 499 Seconds												499 - 500 Seconds												500 - 501 Seconds												501 - 502 Seconds												502 - 503 Seconds												503 - 504 Seconds												504 - 505 Seconds												505 - 506 Seconds												506 - 507 Seconds												507 - 508 Seconds												508 - 509 Seconds												509 - 510 Seconds												510 - 511 Seconds												511 - 512 Seconds												512 - 513 Seconds												513 - 514 Seconds												514 - 515 Seconds												515 - 516 Seconds												516 - 517 Seconds												517 - 518 Seconds												518 - 519 Seconds												519 - 520 Seconds												520 - 521 Seconds												521 - 522 Seconds												522 - 523 Seconds												523 - 524 Seconds												524 - 525 Seconds												525 - 526 Seconds												526 - 527 Seconds												527 - 528 Seconds												528 - 529 Seconds												529 - 530 Seconds												530 - 531 Seconds												531 - 532 Seconds												532 - 533 Seconds												533 - 534 Seconds												534 - 535 Seconds												535 - 536 Seconds												536 - 537 Seconds												537 - 538 Seconds												538 - 539 Seconds												539 - 540 Seconds												540 - 541 Seconds												541 - 542 Seconds												542 - 543 Seconds												543 - 544 Seconds												544 - 545 Seconds												545 - 546 Seconds												546 - 547 Seconds												547 - 548 Seconds												548 - 549 Seconds												549 - 550 Seconds												550 - 551 Seconds												551 - 552 Seconds												552 - 553 Seconds												553 - 554 Seconds												554 - 555 Seconds												555 - 556 Seconds												556 - 557 Seconds												557 - 558 Seconds												558 - 559 Seconds												559 - 560 Seconds												560 - 561 Seconds												561 - 562 Seconds												562 - 563 Seconds												563 - 564 Seconds												564 - 565 Seconds												565 - 566 Seconds												566 - 567 Seconds												567 - 568 Seconds												568 - 569 Seconds												569 - 570 Seconds												570 - 571 Seconds												571 - 572 Seconds												572 - 573 Seconds												573 - 574 Seconds												574 - 575 Seconds												575 - 576 Seconds												576 - 577 Seconds												577 - 578 Seconds												578 - 579 Seconds												579 - 580 Seconds												580 - 581 Seconds												581 - 582 Seconds												582 - 583 Seconds												583 - 584 Seconds												584 - 585 Seconds												585 - 586 Seconds												586 - 587 Seconds												587 - 588 Seconds												588 - 589 Seconds												589 - 590 Seconds												590 - 591 Seconds												591 - 592 Seconds												592 - 593 Seconds												593 - 594 Seconds												594 - 595 Seconds												595 - 596 Seconds												596 - 597 Seconds												597 - 598 Seconds												598 - 599 Seconds												599 - 600 Seconds												600 - 601 Seconds												601 - 602 Seconds												602 - 603 Seconds												603 - 604 Seconds												604 - 605 Seconds												605 - 606 Seconds												606 - 607 Seconds												607 - 608 Seconds												608 - 609 Seconds												609 - 610 Seconds												610 - 611 Seconds												611 - 612 Seconds												612 - 613 Seconds												613 - 614 Seconds												614 - 615 Seconds												615 - 616 Seconds												616 - 617 Seconds												617 - 618 Seconds												618 - 619 Seconds												619 - 620 Seconds												620 - 621 Seconds												621 - 622 Seconds												622 - 623 Seconds												623 - 624 Seconds												624 - 625 Seconds												625 - 626 Seconds												626 - 627 Seconds												627 - 628 Seconds												628 - 629 Seconds												629 - 630 Seconds												630 - 631 Seconds												631 - 632 Seconds												632 - 633 Seconds												633 - 634 Seconds												634 - 635 Seconds												635 - 636 Seconds												636 - 637 Seconds												637 - 638 Seconds												638 - 639 Seconds												639 - 640 Seconds												640 - 641 Seconds												641 - 642 Seconds												642 - 643 Seconds												643 - 644 Seconds												644 - 645 Seconds												645 - 646 Seconds												646 - 647 Seconds												647 - 648 Seconds												648 - 649 Seconds												649 - 650 Seconds												650 - 651 Seconds												651 - 652 Seconds												652 - 653 Seconds												653 - 654 Seconds												654 - 655 Seconds												655 - 656 Seconds												656 - 657 Seconds												657 - 658 Seconds												658 - 659 Seconds												659 - 660 Seconds												660 - 661 Seconds												661 - 662 Seconds												662 - 663 Seconds												663 - 664 Seconds												664 - 665 Seconds												665 - 666 Seconds												666 - 667 Seconds												667 - 668 Seconds												668 - 669 Seconds												669 - 670 Seconds												670 - 671 Seconds												671 - 672 Seconds												672 - 673 Seconds												673 - 674 Seconds												674 - 675 Seconds												675 - 676 Seconds												676 - 677 Seconds												677 - 678 Seconds												678 - 679 Seconds												679 - 680 Seconds												680 - 681 Seconds												681 - 682 Seconds												682 - 683 Seconds												683 - 684 Seconds												684 - 685 Seconds												685 - 686 Seconds												686 - 687 Seconds												687 - 688 Seconds												688 - 689 Seconds												689 - 690 Seconds												690 - 691 Seconds												691 - 692 Seconds												692 - 693 Seconds												693 - 694 Seconds												694 - 695 Seconds												695 - 696 Seconds												696 - 697 Seconds												697 - 698 Seconds												698 - 699 Seconds												699 - 700 Seconds												700 - 701 Seconds											
--------	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	---------------	--	--	--	--	--	--	--	--	--	--	--	----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	-----------------	--	--	--	--	--	--	--	--	--	--	--	------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.
Duration given in hours. Height and period groupings include lower value but not the upper.

OCTOBER																																
Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				8-9 Seconds				2+9 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	SW	6			6																											
	SW	6	18	12	36																											
	WSW	12		12	24																											
	W			18	18																											
	WNW	6			6																											
	Total	30	30	30	90																											
1-2	SW	6	12	6	24	12	30	6	48																							
	SW		6	6	12			18	6	24																						
	WSW					30	42	12	84				6	6																		
	W			6	6			6	48				6	6																		
	WNW		6		6			6	18	6	30																					
	Total	12			12	18	12	6	18				12	12																		
2-3	SW					12			12	12																						
	WSW						6	6	12																							
	W												6																			
	WNW													6																		
	Total					18	6	6	30	24				24	6																	
3-4	SW									6	12																					
	SW									12	6																					
	WSW										6																					
	W										6																					
	WNW											6																				
	Total									6	18	12	36																			
4-5	SW										6																					
	WSW											6																				
	W												6																			
	WNW													6																		
	Total												6																			
5-6	SW											6	12																			
	SW											6	12																			
	WSW												18																			
	W													12	30																	
	WNW														12	18																
	Total												24	6	48	78																
6-7	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
7-8	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
8-9	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
9-10	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
10-11	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
11-12	SW																															
	SW																															
	WSW																															
	W																															
	WNW																															
	Total																															
TOTAL	54	60	42	156	78	132	78	388	42	48	60	150	42	48	54	144	6	6	30	42	6	6	6	18								
CALM TOTAL HOURS																																
576 448 424 1428 744 264 264 2472																																

STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.

Duration given in figure. Height and period groupings include lower value but not the upper.

NOVEMBER

CALM.	
TOTAL HOURS	

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.
Duration given in hours Height and period groupings include lower value but not the upper
DECEMBER

Period	2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				8-9 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	SSW	6	6	12	24																							
	SW	6	6	12																								
	NW	18	18	6	42																							
	W	6	6		12																							
	WSW	18		12	30																							
	W	6			6																							
	Total	60	36	30	126																							
5-2	SSW					18	6		24																			
	SW	6			6	18	66	12	96																			
	NW	6	6	18	30	30	24	42	96	12	12		24															
	W					18		36		6	36	12	54															
	WSW					24	24	12	60																			
	W					18	6	12	36																			
	Total	12	6	18	36	126	126	96	348	18	48	12	78															
5-3	SSW					12	6		18																			
	SW					6			6																			
	NW					6	6		12																			
	Total					24	12		36																			
5-4	SSW									12	12																	
	SW								6	18	18	18	54															
	NW					6		6	18	18	30	48																
	W								18	24	18	42																
	Total					12	12	42	42	96	96	180																
5-5	SSW									6	6	6																
	SW								6				12	12	4	36												
	NW								6		6		24	36	18	78	12	6	6	24								
	W								12	6	18		42	60	24	126	12	12	6	30								
	Total								12	6	18		42	60	24	126	12	12	6	30								
5-6	SSW												6	6														
	SW												12	12														
	NW												18	18														
	Total												30	30														
6-7	SSW																											
	SW												6	30	30													
	NW												6	18	24													
	W												6	6	6													
	Total												6	36	42													
7-8	SSW																											
8-9	SSW																											
9-10	SSW																											
11-12	SSW																											
TOTAL	72	42	48	162	150	150	96	396	60	102	114	276	42	66	78	186	36	54	36	126	12	6	18	360	436	378	1164	
CALM																												
TOTAL HOURS																												

Question given in figure. Height and period groupings include lower value but not the upper

Duration given in hours. Height and period groupings include lower value but not the upper

CALM.
TOTAL HOURS

TABLE C-3

ICE-FREE PERIOD (1 APRIL - 30 NOV)

Duration given in hours. Height and period groupings include lower value but not the upper.

[illegible]

TABLE C-4
STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.

ICE-FREE PERIOD (1 APRIL - 30 NOV.)
Energy given in foot-pounds per foot of crest per year $\times 10^3$. Height and period groupings include lower values but not the upper.

Height (feet)	Period	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	8-9 Seconds	9-10 Seconds	10-12 Seconds
5-1	SW	585								585
	SEW	1058								1058
	W	902	28							1016
	N	504								504
	NW	282								282
	NNW	222								222
1-2	TOTAL	2629	28							2657
	SW	961	2728							3689
	SEW	1722	11,911	196						13,979
	W	6121	10,123	2,030	178					17,960
	N	761	6,950	3,057						10,768
	NW	761	6,927							7,688
2-3	NNW	160	2,577							2,737
	TOTAL	7857	45,080	5,241	178					57,556
	SW		635							635
	SEW		1,684	3,220						5,529
	W		5,421	15,702	979					22,122
	N		9,460	9,072	980					20,572
3-4	NW		9,685	807						10,492
	NNW		3,935	817						4,752
	TOTAL		24,099	21,720	1,959					47,820
	SW		608	9,966						10,574
	SEW			21,270	1,939					23,209
	W			33,130	12,579	11,79				57,508
4-5	N		1,823	22,007	2,701		1,322			28,133
	NW			28,398						28,398
	NNW		1,215	22,007						23,222
	TOTAL		9,646	108,049	17,909	11,79	1,322			146,566
	SW			1,277						1,277
	SEW			2,578	4,773					7,351
5-6	W			9,074	6,7078	3,784				19,566
	N			2,578	3,6777	2,568				8,823
	NW			3,077	3,175					6,252
	NNW			3,077						3,077
	TOTAL			23,753	11,830	11,852				47,435
	SW				7,138					7,138
6-7	SEW				16,615					16,615
	W				38,067	3,820				41,887
	N				38,310	8,461				46,771
	NW				17,114					17,114
	NNW				7,118					7,118
	TOTAL				121,349	11,281				132,630
7-8	SW					15,788				15,788
	SEW					31,474				31,474
	W					3,734	7,557			11,291
	N					3,315				3,315
	NW					6,630	5,178			11,808
	TOTAL					51,195	12,735			63,930
8-9	SW									
	SEW									
	W									
	N									
	NW									
	NNW									
9-10	TOTAL									
	SW									
	SEW									
	W									
	N									
	NW									
10-11	NNW									
	TOTAL									
	SW									
	SEW									
	W									
	N									
11-12	NW									
	NNW									
	TOTAL									
	SW									
	SEW									
	W									
12-13	N									
	NW									
	NNW									
	TOTAL									
	SW									
	SEW									
13-14	W									
	N									
	NW									
	NNW									
	TOTAL									
	SW									
14-15	SEW									
	W									
	N									
	NW									
	NNW									
	TOTAL									
TOTAL		10,676	72,002	108,958	288,774	205,254	166,652	157,170	7686	1,079,644

TABLE C-5
STATISTICAL ENERGY DATA FOR LAKE ONTARIO STATION C, STONY POINT, N.Y.
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Ways	Period (feet)	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	7-8 Seconds	8-9 Seconds	9-10 Seconds	10-12 Seconds
5-1	SSW	706								706
	SW	1230								1230
	WSW	1831	28							1859
	W	887		45						892
	WSW	568								564
	SW	363								363
1-2	SSW	20								20
	SW	5161	28	45						5234
	WSW	261	1406							3967
	W	2403	15252	126						17801
	WSW	1602	19320	3348	178					24448
	W	1121	2038	5677						15826
2-3	SSW	1202	9264							10266
	SW	1081	4519							5560
	WSW	240	452							622
	W	8570	62251	9171	178					80170
	WSW		222							237
	SW		6226	3228						9274
3-4	WSW		7808	16544	494					24826
	W		6284	6860	1402					16588
	WSW		6821	1211						8082
	W		3107	1614						6723
	WSW		237	464						1341
	W		35354	23861	1976					46171
3-4	SSW		408	13410						14018
	SW		609	26081	1934					20572
	WSW		2430	48118	19343	1144				71035
	W		2430	41019	7797		1322			52508
	WSW			51223						51223
	W		1823	35497						37320
4-5	SSW			1578						4578
	SW			7899	216926	29014	1144	1322		256305
	WSW			2578						2578
	W			7795	12780	1892				22467
	WSW			12291	107037	5676	2184			127888
	W			6494	70273	20812				97601
5-6	SSW			9094	3195					12289
	SW			3897	1598					5495
	WSW			42871	194903	28380	2184			268338
	W				14276					14276
	WSW				26172					26172
	W				64241	31024				95265
6-7	SSW			57103	37485					96588
	SW			45207						45207
	WSW			26172						26172
	W			233171	70509					303680
	WSW			3315						3315
	W			12574	23607					40181
7-8	SSW			13257	66885					80144
	SW			9744	31476	9114				50534
	WSW			13257	3734					17193
	W			56351	115282	9114				191367
	WSW				5230					5230
	W			4901	41843	6054	7686			53784
8-9	SSW			17603	5230	36324				62476
	SW			4901						22833
	WSW			26405	78455	42378	7686			4401
	W				20120					20120
	WSW			5634	53452	23310				82596
	W				33533	31080				68413
9-10	SSW			5634	13413					18047
	SW				5634					5634
	WSW				16302	120718	54380			192010
	W									9694
	WSW				25084	87248				112332
	W				41807	58165				106783
10-11	SSW					8361				8361
	SW					8361				8361
	WSW					7011				245731
	W									23656
	WSW									35493
	W									11441
11-12	SSW									13441
	SW									40323
	WSW									16110
	W									16110
	WSW									14172
	W									14172
12-13	SSW									48370
	SW									57160
	WSW									95100
	W									152160
	WSW									64472
	W									46429
13-14	SSW									132958
	SW									25590
	WSW									25590
	W									28420
	WSW									51080
	W									28420
14-15	SSW									32684
	SW									32684
	WSW									32684
	W									32684
	WSW									32684
	W									32684
15-16	SSW									32684
	SW									32684
	WSW									32684
	W									32684
	WSW									32684
	W									32684
 
	W

FIG. C-1

AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY

FIG. C-4

9593 052

C-16

D71.01