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TECHNICAL PAPER NO. 29

Rainfall Intensity-Frequency Regime

Part 5—Great Lakes Region

(Rainfall intensity-duration-area-frequency regime, with other storm characteristics, for durations of 20 minutes to 24 hours, area from point to 400 square miles, frequencies for return periods from 1 to 100 years, for the region between longitude 80° and 90° W. and north of latitude 40° N.)

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Part 3—Great Lakes Region

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Rainfall Intensity - Frequency Regime
Part 5: Great Lakes Region

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INTRODUCTION

1. Authority. This report is the fifth of a series being prepared on a regional basis for the Soil Conservation Service, Department of Agriculture, to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention program (P. L. 566). Parts 1 and 2 [1, 2] covered the region between 80 ° and 90 °W longitude and south of 40 °N latitude, Parts 3 and 4 [3, 4] covered the region east of longitude 80 °W.

2. Scope. The point-rainfall analysis is based largely on routine application of the theory of extreme values, with empirical transformation to include consideration of the high values that are excluded from the annual series. Analysis of areal rainfall is a relatively new feature in frequency analysis and is based on the few dense networks that have several years of record and meet other important requirements. Consideration of additional storm characteristics includes portrayal of the seasonal variation in the intensity-frequency regime.

3. Separation of "Analysis" and "Applications". For convenience in practical application of the results of the work reported in this Technical Paper it is divided into two major sections. The first section, entitled "Analysis", describes what was done with the data, gives reasons for the way some things were done, and evaluates the results. The second section, entitled "Applications", gives step-by-step examples for use of the diagrams and maps in solving certain types of hydrologic problems.

4. Relation to Parts 1, 2, 3, and 4. The general techniques in this part are identical to those used in previous parts of the Technical Paper. Discussions of certain subjects have been abridged or omitted entirely, either because they are of secondary interest or because they have been covered adequately in previous parts of this paper. Brief discussions are presented of the analyses of the duration, frequency, and area-depth relationships which were given in Parts 1 and 2. Discussions of 'among storm' rainfall depth-duration-frequency curves and 'within storm' time distribution curves are given in Part 3, average mass curves are discussed in Part 4.

5. Acknowledgments. This investigation was directed by David M. Hershfield, project leader, in the Cooperative Studies Section (Walter T. Wilson, Chief) of Hydrologic Services Division (William E. Hiatt, Chief). Technical assistance was furnished by Leonard L. Weiss; collection and processing of data were performed under the supervision of William E. Miller and Normalee S. Foat by Margaret R. Caspar, Edward C. Harrigan, Jr., Elizabeth C. I'Anson, and Carlos E. Noboa; typing was by Normalee S. Foat, and drafting by Caroll W. Gardner. Coordination with the Soil Conservation Service, Department of Agriculture, was maintained through Harold O. Ogrosky, Chief, Hydrology Branch, Engineering Division. Max A. Kohler, Chief Research Hydrologist, and A. L. Shands, Assistant Chief, Hydrologic Services Division, acted as consultants. Lillian K. Rubin of the Hydrometeorological Section edited the text.

SECTION I. ANALYSIS

Climate

6. Precipitation in the Great Lakes Region is quite evenly distributed throughout the year with no pronounced wet and dry seasons. In general, precipitation decreases from east to west and from south to north, varying from an average of 40 inches annually in Ohio to less than 25 inches in northern Wisconsin with the largest proportion occurring in the summer months. The fall, winter, and spring precipitation tends to occur uniformly over large areas whereas the summer rainfall occurs principally as brief showers affecting relatively small areas. A number of stations have recorded more than 10 inches in 24 hours and/or 3 inches in one hour.

7. Most of the winter precipitation, particularly in Michigan and Wisconsin, is in the form of snow. The average annual snowfall ranges from a total of 160 inches in the mountain ranges of northern Michigan to about 15 inches at latitude 40° N. The Michigan snowfall is the greatest in the country east of the Rockies, except for a few points in the New England states. Where the snowfall is heavy, the ground remains covered most of the winter and the snow often accumulates to depths of 2 to 3 feet. Farther south where the snowfall is less, the ground is bare most of the winter because the snow is melted by warm or rainy weather.

Point Rainfall

Basic data

8. Station data. The sources of data used in this study are indicated in table 1-1. In order to generalize, and to insure proper relationships, it was necessary to examine data from 200 long-record Weather Bureau stations, 20 of which are in the region of interest. Long records were analyzed from 175 stations to define the frequency relationships, and relatively short portions of the record from 552 additional stations were analyzed to define the regional pattern.

Table 1-1

SOURCES OF POINT RAINFALL DATA

Duration	No. of Stations	Average Length of Record (yr.)	Source*
20 min-24 hr	20 recorder (WB first order)	51	5, 6, 7
hourly	211 recorder	13	8, 9, 10
6-hour	211 recorder	13	8, 9, 10
daily	211 recorder	13	8, 9, 10
daily	341 non-recorder	15	8
daily	155 non-recorder	56	8

*These numbers indicate references listed on page 13.

9. Period and length of record. The non-recording gage short-record data were compiled for the period 1939-1957 and long-record data from the earliest year available through 1957. The recording gage data covers the period 1940-1950, with selected stations processed through 1957. Data from long-record Weather Bureau stations were processed through 1957. No record of less than five years was used to estimate the 2-year values.

10. Station exposures. In refined analysis of mean annual and mean seasonal rainfall data it is necessary to evaluate station exposures by methods such as double-mass curve analysis [11]. Such methods do not apply to extreme values. Except for some subjective selection (particularly for longer records) of stations that have had consistent exposures, no attempt has been made to adjust rainfall values to a standard exposure. The effects of varying exposure are implicitly included in the areal sampling error and are averaged out, if not evaluated, in the process of smoothing the isopluvial lines.

11. Time increments. Some of the hourly data are clock-hour and some are maximum consecutive 60-minute data; correspondingly, some of the 24-hour data are for the maximum consecutive 1440-minute data, whereas others are for a calendar or observation day. Examination of sufficient data has resulted in reliable empirical conversion factors so that the results refer to maximum consecutive n-minute data for all durations.

12. Rain or snow. The term precipitation has been used in reference to the 24-hour data because snow as well as rain is included in some of the smaller 24-hour amounts. Comparison of arrays of all ranking precipitation events with those known to have only rain has shown trivial differences in the frequency relations for the several Michigan and Wisconsin stations tested. The heavier (rarer-frequency) 24-hour precipitation and all short-duration values of precipitation entering the analysis consist entirely of rain.

13. Duration interpolation diagrams. A generalized duration relationship is portrayed in the diagrams of figure 1-1 with which the rainfall rate or depth can be computed for any duration, from 20 minutes to 24 hours, provided the values for 1, 6, and 24 hours for a particular return period are given. This convenient generalization was obtained empirically from data from 200 first-order Weather Bureau stations and is the same relation presented in previous parts of Weather Bureau Technical Paper No. 29. For example, the 30-minute intensity or 3-hour rainfall depth may be obtained if the 1-hour and 6-hour depths are given, and the 10-hour or 12-hour depth is a simple function of the 6-hour and 24-hour depths. The values are obtained merely by laying a straightedge across the two given values (1 and 6, or 6 and 24 hours) and reading the value for the desired duration. No regional variation is evident in this duration-depth or duration-intensity relationship.

14. The 1-, 6-, and 24-hour values for use in figure 1-1 are obtained from isopluvial maps which will be described later. Two large working copies (fig. 2-1) containing diagrams and instructions with examples (table 2-1) for obtaining the desired depth-area-duration-frequency values are furnished in the pocket inside the back cover of this paper.

Frequency analysis

15. Return-period interpolation diagram. The return-period diagram of figure 1-2 is based on data from the long-record Weather Bureau stations and is identical with the return-period diagram in previous parts of Technical Paper No. 29. The derivation of the diagram—that is, the spacing of the ordinates—is partly empirical and partly theoretical. For return periods of 1 to 10 years it is entirely empirical, based on free-hand curves drawn through plottings of partial-duration series data. For the 20-year and longer return periods, reliance was placed on Gumbel [12] analysis of annual series data. The transition was smoothed subjectively between the 10- and 20-year return periods. If values between 2 and 100 years are taken from the return-period diagram of figure 1-2, then converted to annual-series values and plotted on either Gumbel or log-normal paper the points will very nearly define a straight line.

16. Partial-duration vs. annual series. The partial-duration series includes all the high values whereas the annual series consists of the highest value for each year. The highest value of record, of course, is the top value of each series, but at lower frequency levels (shorter return periods) the two series diverge (see fig. 1-4 in Part 1 of Technical Paper No. 29). The partial-duration series, having the highest values regardless of the year in which they occur, recognizes that the second highest of one year sometimes exceeds the highest of another year. The processing of partial-duration data is very laborious; furthermore, there is no theoretical basis for extrapolating this data beyond the length of record, nor is there a good basis for defining values for return periods approaching the length of record. Table 1-2, based on a sample of 50 widely scattered United States stations, gives the empirical factors

for converting the partial-duration series to the annual series. Tests with samples of record length from 10 to 50 years indicate that these factors are not a function of record length.

Table 1-2

EMPIRICAL FACTORS FOR CONVERTING
PARTIAL-DURATION SERIES TO ANNUAL SERIES

Return Period	Conversion Factor
2-year	0.88
5-year	0.96
10-year	0.99

For example, if the 2-, 5-, and 10-year partial-duration series values estimated from the return-period diagram are 3.00, 3.75, and 4.21 inches, respectively, the annual series values are 2.64, 3.60, and 4.17 inches after multiplying by the conversion factors in table 1-2.

RAINFALL INTENSITY (DEPTH) DURATION DIAGRAMS

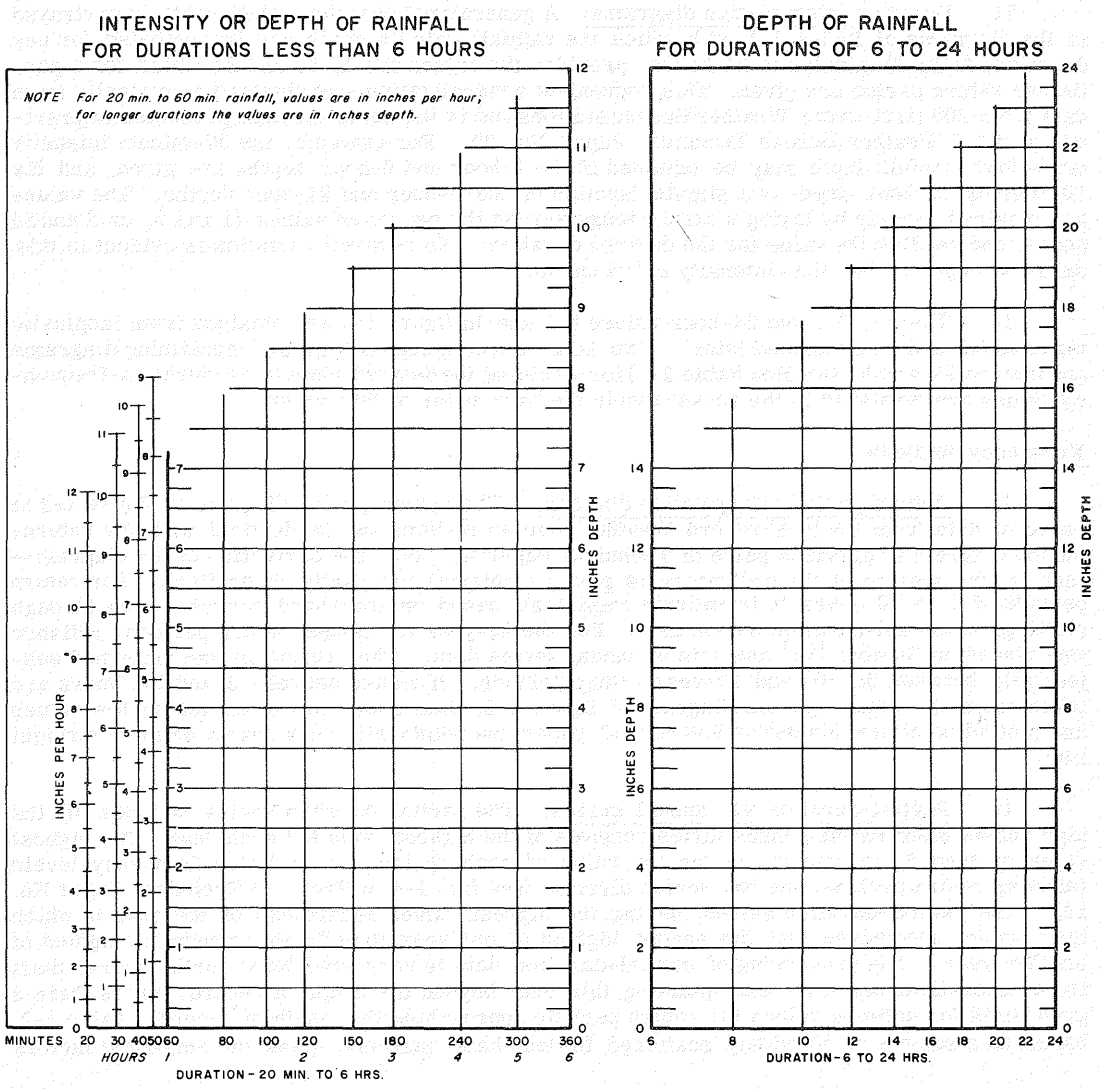

Figure 1-1

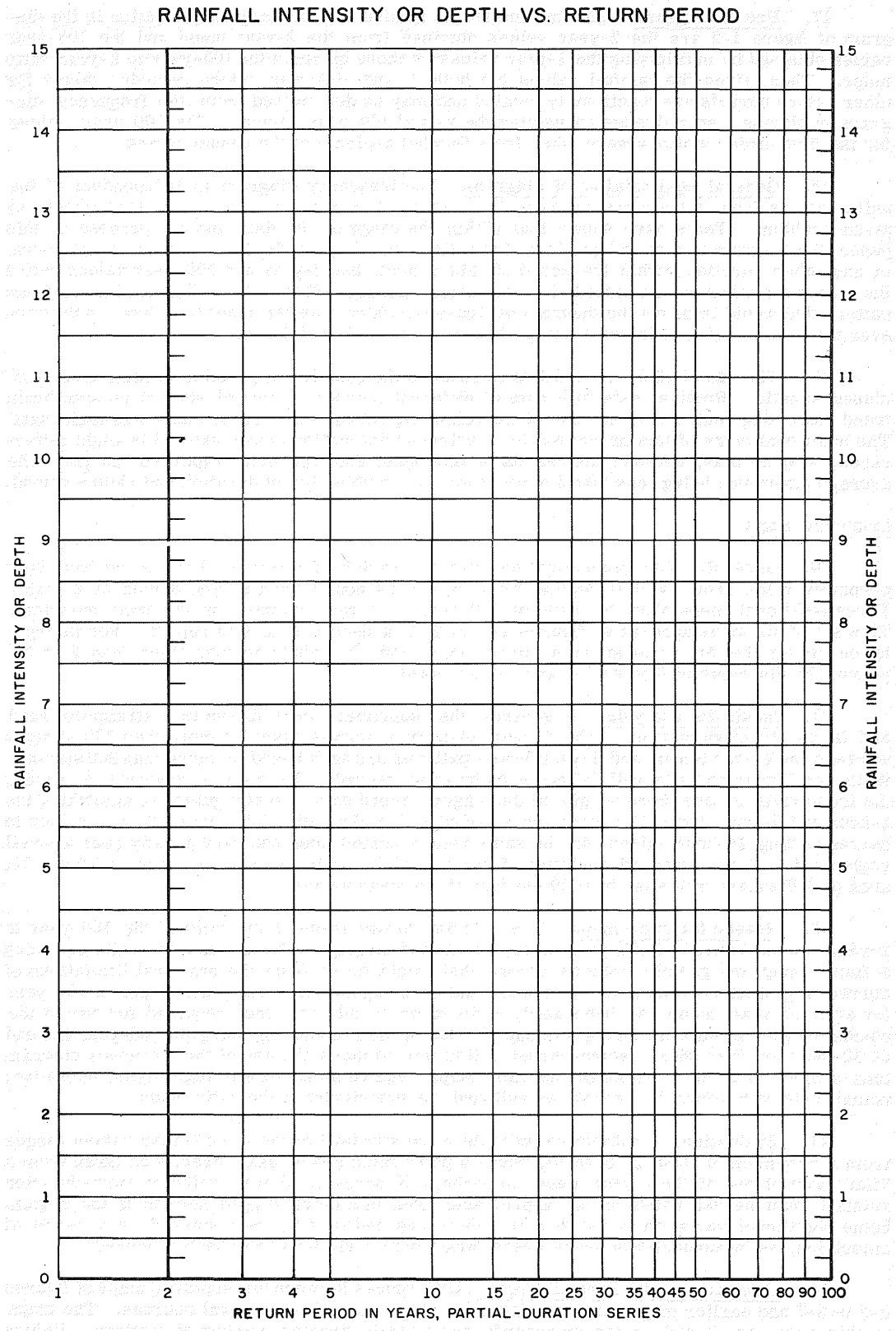

Figure 1-2

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17. Use of diagram. The two intercepts needed for the frequency relation in the diagram of figure 1-2 are the 2-year values obtained from the 2-year maps and the 100-year values obtained by multiplying the 2-year values by those given on the 100-year to 2-year ratio maps. Thus, given the rainfall values for both 2- and 100-year return periods, values for other return periods are functionally related and may be determined from the frequency diagram by placing a straightedge connecting the 2- and 100-year values. The 100-year values for the first-order stations were taken from Gumbel analysis of the annual series.

18. General applicability of diagram. The frequency diagram is independent of the units used as long as the same units (inches, tenths of inches, etc.) are used throughout any given problem. Tests have shown that within the range of the data and the purpose of this paper, the diagram is also independent of duration. In other words, for one hour, or 24 hours, or any other duration within the scope of this report, the 2-year and 100-year values define the values for other return periods in a consistent manner. Studies have disclosed no regional pattern that would improve the diagram of figure 1-2 which thus far appears to have application over the entire region of interest and perhaps the entire United States.

19. The use of short-record data introduces the question of possible secular trend and biased sample. Routine tests with data of different periods of record showed no significant trend indicating that the direct use of the relatively recent short-record data was legitimate. The additional years of data processed for the first-order stations have resulted in slight differences, with no bias, between the results of this paper and Technical Paper No. 25 [13]—the average difference being less than 5 percent for any combination of duration and return period.

Isopluvial maps

20. General. For generalization over the region of interest, three maps have been prepared which show rainfall depths for 1, 6, and 24 hours for a return period of 2 years. Three additional maps show the ratio of 100-year to 2-year rainfall for the same durations. This set of six maps appears as figures 2-2 to 2-7 in Section II of this report. For interpolation among the durations given on these maps, and for return periods other than 2 or 100 years, the diagrams of figures 1-1 and 1-2 are used.

21. Isopluvial analysis. In general, the isopluvials were drawn in a straightforward and fairly objective manner. The 2-year 24-hour pattern is based on more than 700 stations whereas the 2-year 1-hour and 2-year 6-hour patterns are each based on more than 200 stations. While the 2-year value is well defined even by short records, there was a tendency in drawing the isopluvials to give more weight to the longer-record data. Useful guides in smoothing the 1-hour and 6-hour isopluvials were the knowledge that the ratio of 1-hour or 6-hour values to corresponding 24-hour values for the same return period does not vary greatly over a small region and that the standard deviation of point rainfall for the 2-year return period for a flat area of 300 square miles is about 20 percent of the mean values.

22. Reason for ratio maps. The decision to use maps of the ratio of the 100-year to 2-year values, instead of 100-year maps, was based largely on the fact that the ratio produces a flatter map and greatly reduces errors that might arise from the practical limitations of correct registration in the printing process and of interpolation in using the maps. If 100-year (or even 10-year) maps had been used, ratio maps would have been required for one of the consistency tests while preparing this paper. One of the reasons for using the 100-year instead of 10-year or other short return-period ratios was to make the use of the frequency diagram less subject to error. Although the ratio maps require an additional multiplying operation, actual tests with alternate methods established the superiority of the ratio maps.

23. Evaluation. A subjective estimate of the standard error of the 2-year values ranges from a minumum of about 20 percent, where a point value can be used directly as taken from a "flat" part of one of the 2-year maps, to perhaps 40 percent, where a value of short-duration rainfall must be estimated for an appreciable area in a more rugged portion of the region. Some significant variation in the 2-year values has undoubtedly been masked as a result of smoothing, as in mountainous areas where large local variations have been obscured.

24. Comparison with Yarnell's maps. Differences between the isopluvial maps of figures 2-2 to 2-7 and earlier maps, such as Yarnell's [14], come from several sources. The maps in this paper are based on longer records and a vastly greater number of stations. Values

shown on the maps of this paper are adjusted to partial-duration series and are for maximum n-minutes—that is, the 24-hour values are the maximum for any successive 1440 minutes, not a calendar day. For example, rainfall values for the 2-year return period for partial-duration series and maximum 1440 minutes are about 30 percent greater than for annual series and calendar day.

25. Station data tables. In order to make unsmoothed data available to the user, all the observed 2-year 1-, 6-, and 24-hour values are given in table 2-2. The 100-year values for long-record data from first-order and cooperative stations are presented in table 2-3. The station names and locations shown in these two tables are those listed in climatological publications for the latest year of record used in this study.

Areal Rainfall

Area-depth relationships

26. Construction of area-depth diagram. The area-depth diagram of figure 1-3 is based on data from 20 dense networks of rain gages and is identical with the diagram in previous parts of this paper. The ordinate of the upper curve, for example, is conveniently expressed as a fraction whose numerator is the 2-year 24-hour rainfall over the area and whose denominator is the average of the 2-year 24-hour value for points in the area. The numerator is obtained from an annual series of values, each of which is the maximum average depth for a given area during the year—the times of beginning and ending of the 24-hour duration being the same for each station in the area covered by the dense network. The denominator is the mean of the individual station values, each being the 2-year 24-hour rainfall obtained from the annual series of point values without regard to when the 24-hour period occurs among the stations. The element of simultaneity in the numerator restricts the magnitude of the areal depths to values equal to or less than the average of the point rainfall depths.

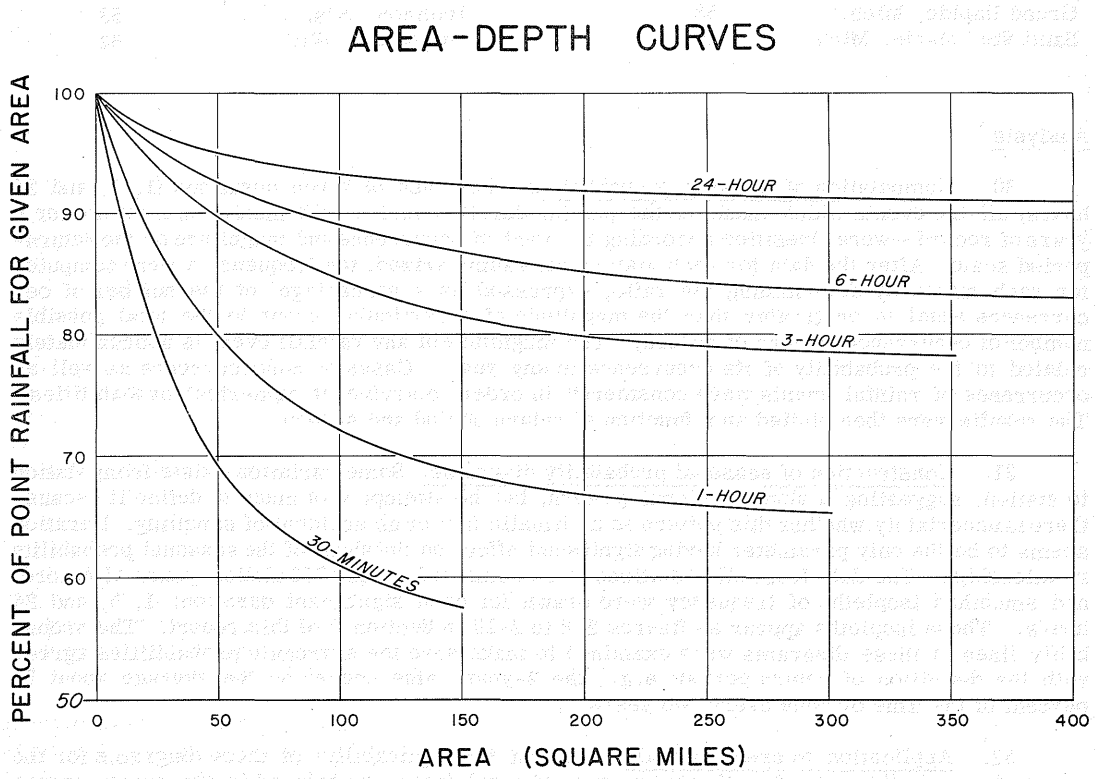

Figure 1-3

27. Generalization. The results from the limited number of widely scattered dense networks were studied in detail and it was found that (1) there was no systematic regional variation of the area-depth relation, (2) the relationship varies with duration as shown in figure 1-3, and (3) storm magnitude is not a parameter. A more complete discussion of the rationale and development of this relationship is given in Parts 1 and 2.

Seasonal Variation

28. Monthly vs. annual series. The frequency analysis so far discussed has followed the conventional procedures of using only the annual maxima or the n-maximum events for n-years of record. Obviously, some months contribute more events to these series than others and, in fact, some months might not contribute at all to these two series. The purpose of this analysis is to show how often these rainfall events occur during part of the year, or a specific calendar month.

29. Basic data. The seasonal variation relationship was developed from 14 first-order stations in the region of interest. The stations and length of record are shown in table 1-3.

Table 1-3

STATIONS USED TO DEVELOP SEASONAL VARIATION RELATIONSHIP

Station	Length of Record (yrs)	Station	Length of Record (yrs)
Chicago, Ill.	58	Cleveland, Ohio	67
Peoria, Ill.	53	Sandusky, Ohio	55
Fort Wayne, Ind.	47	Toledo, Ohio	50
Detroit, Mich.	62	Erie, Pa.	50
East Lansing, Mich.	48	Green Bay, Wis.	56
Grand Rapids, Mich.	53	Madison, Wis.	53
Sault Ste. Marie, Mich.	57	Milwaukee, Wis.	62

Analysis

30. Computation of monthly probabilities. For each of three durations (1, 6, and 24 hours) all the events which make up the partial-duration series—the maximum n events for n years of record—were classified according to month of occurrence and magnitude on the return-period scale. After the data for each station were summarized, the frequencies were computed for each month by determining the ratio, expressed as a percentage, of the number of occurrences equal to or greater than the magnitude of a particular event to the total possible number of occurrences (years of record). The magnitude of any rainfall event is approximately related to the probability of its occurrence in any year. Cases of nonoccurrence as well as occurrence of rainfal events were considered in order to arrive at numerical probabilities. The results were then plotted as a function of return period and season.

31. Construction of seasonal probability diagrams. Some variation exists from station to station, suggesting a slight regional pattern, but no attempt was made to define it because there is uncertainty whether this pattern is a climatic fact or an accident of sampling. Duration seems to be the only parameter having significant effect on the shape of the seasonal probability relationships. The data from all 14 stations were combined, giving 776 station-years of record, and smoothed isopleths of frequency were drawn for each significant duration: 1, 6, and 24 hours. These isopleths appear as figures 2-8 to 2-10 in Section II of this report. The probability lines in these diagrams were examined to make sure the aggregate probabilities agreed with the definition of return period; e.g., the 2-year value occurs on the average about 50 percent of the time or once every two years.

32. Application to areal rainfall. To test the applicability of these diagrams for the range of area in this report, a limited amount of areal data was analyzed in the same manner

as the point data. The results exhibited no substantial difference from those of the point data, which lends additional confidence for using these diagrams as a guide for small areas.

33. Comparison with monthly probabilities in Parts 1 to 4. The seasonal probability curves in this paper follow the same general pattern as those in Parts 1, 2, 3, and 4. They differ in that they are more peaked for all three durations than the curves of the preceding parts. This means that the larger amounts are relatively more likely to occur during the summer months. There is some regional discontinuity between the curves of the five papers which can be smoothed locally for all practical purposes.

SECTION II. APPLICATIONS

Introduction

34. This Technical Paper has the primary purpose of presenting rainfall data for hydrologic analysis and design criteria. The degree of detail presently available, and the introduction of areal and seasonal influences, have complicated the field engineer's work so that in many instances he must use a combination of maps and diagrams in a rather long series of operations. After having read how these aids were prepared he is ready to use them, and by having them together in one section of this paper he can easily find them for future use, without having to look through the entire paper each time he needs to refer to the maps or diagrams. Hypothetical examples of a few representative problems are included with the maps and diagrams in this section of the paper.

Use of Maps and Tables

Need for judgment

35. Site location. The tabulated data may be used in conjunction with the isopluvial maps in obtaining the best possible registration of the map with the stations and drainage areas themselves. Where there are steep gradients or complicated patterns in the isopluvials and in the contours of a region, the tabulated station data serve as identifying "bench marks". The station can be located on the ground and tied in with the station as shown on the map. If there are errors of printing registration, or of interpolation in the isopluvial pattern, adjustments can thus be made.

36. Average depth over an area. The three examples given in table 2-1 include reduction for area. If the particular area of interest is large enough and the isopluvial pattern is complicated enough, there may be a question as to what point in the area should be taken as representative. The point value to which the area-reduction factor should be applied is the average point value in the area. For practical purposes the average point value can be determined adequately by inspection of the isopluvial map or maps.

Table 2-1, with 3 examples, outlines the steps in the order they should be carried through in solving for the required rainfall intensities or depths.

Table 2-1

EXAMPLES OF RAINFALL INTENSITY (DEPTH) DURATION-FREQUENCY-AREA COMPUTATIONS

1.	Location	41° 00' N 82° 00' W	43° 00' N 89° 00' W	45° 00' N 84° 00' W
2.	Required Intensity (Depth) Duration-Frequency-Area	25-Year 3-Hour Rainfall (Inches) for 100 Square Miles	50-Year 12-Hour Rainfall (Inches) for 400 Square Miles	15-Year 30-Min Intensity (In/Hr) for 50 Square Miles
3.	2-Year 1-Hour Rainfall Figure 2-2	1.3 Inches	———	1.0 Inches
4.	2-Year 6-Hour Rainfall Figure 2-3	1.8 Inches	2.2 Inches	1.5 Inches
5.	2-Year 24-Hour Precip. Figure 2-4	———	2.8 Inches	———
6.	Straightedge connecting (3) and (4) or (4) and (5) intersects required duration. Figure 1-1	(2-Year 3-Hour) 1.6 Inches	(2-Year 12-Hour) 2.5 Inches	(2-Year 30-Min) 1.8 In/Hr
7.	100-Year 1-Hour Rainfall / 2-Year 1-Hour Rainfall Figure 2-5	2.1	———	2.2
8.	100-Year 6-Hour Rainfall / 2-Year 6-Hour Rainfall Figure 2-6	2.0	2.2	2.1
9.	100-Year 24-Hour Precip. / 2-Year 24-Hour Precip. Figure 2-7	———	2.2	———
10.	(7) x (3)	(100-Year 1-Hour) 2.7 Inches		(100-Year 1-Hour) 2.2 Inches
11.	(8) x (4)	(100-Year 6-Hour) 3.6 Inches	(100-Year 6-Hour) 4.8 Inches	(100-Year 6-Hour) 3.2 Inches
12.	(9) x (5)	———	(100-Year 24-Hour) 6.2 Inches	———
13.	Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Figure 1-1	(100-Year 3-Hour) 3.2 Inches	(100-Year 12-Hour) 5.5 Inches	(100-Year 30-Min) 3.5 In/Hr
14.	Straightedge connecting (6) and (13) intersects required return period. Figure 1-2	2.6 Inches	4.9 Inches	2.7 In/Hr
15.	Percent of Point Rainfall Figure 1-3	85	87	69
16.	(14) x (15) = (2)	2.2 Inches	4.3 Inches	1.9 In/Hr

37. Examples illustrating use of seasonal probability diagrams.

Example 1

Determine the probability of occurrence of a 10-year 1-hour rainfall for the months May through August. From figure 2-8, the probabilities for each month are interpolated to be 1, 2, 4, and 2 percent, respectively. In other words, the probability of occurrence of a 10-year 1-hour rainfall in May of any particular year is 1%; for June, 2%, etc.

Example 2

Determine the probability of occurrence in July of a 1-hour rainfall for Chicago within the range of magnitude of the 1- and 2-year values. The 1-year 1-hour value of 1.2 inches for Chicago is estimated from a combination of figures 1-2, 2-2, and 2-5. From figure 2-8, the empirical probability that the 1-year 1-hour rainfall will be equalled or exceeded in July of any one year is 25% or 25 chances out of 100. Similarly, the probability that Chicago's 2-year 1-hour value of 1.4 inches will be equalled or exceeded in any one July is 13% by interpolation. The difference (25% - 13% = 12%) is the probability of occurrence in any one July of a 1-hour rainfall within the range 1.2 - 1.4 inches, inclusive.

Example 3

Assume the growing season to be June through September and determine the probability of getting 1.5 inches or more in 6 hours during this season at a point near Detroit, Mich. For a first approximation, determine from the isopluvial map the 2-year 6-hour value near Detroit to be 1.8 inches. Referring to the seasonal probability chart for 6 hours for the 2-year return period, it may be seen that for June through September there is about a 40% chance of getting 1.8 inches or more for 6 hours (corresponding to the 2-year 6-hour return period) during the growing season. Since the chance of equalling or exceeding 1.5 is obviously greater than for 1.8 inches, use the return-period diagram for a second approximation to get a rainfall value for the 1-year return period. At the point of interest near Detroit, (referring to the map of fig. 2-6) we find that the ratio of 100-year to 2-year rainfall is about 2.3. Multiplying 1.8 inches by the ratio, 2.3, to get the 100-year value, we then enter the return-period diagram of figure 1-2 with the 2-year value, 1.8, and 100-year value, 4.1, and estimate 1.5 inches to be the 1.2-year value. Interpolating along the 1.2-year line of figure 2-9 gives 14, 17, 17, and 14 as the probabilities for June through September, respectively, or a total of 62%. In other words, the probability of 1.5 inches or more rain in 6 hours during the growing season is 62%; this depth of rainfall will be equalled or exceeded in six seasons out of ten.

Example 4

As an example where interpolation between durations is necessary, consider the first example of table 2-1 where the 25-year 3-hour rainfall is estimated to be 2.2 inches. If the probability of occurrence for July is required, 1.7 and 1.0% are estimated from the 1- and 6-hour seasonal probability charts, respectively. The 3-hour probability is then interpolated to be 1.3% or 13 chances in 1000 of equalling or exceeding a 3-hour rainfall of 2.2 inches in July of a particular year.

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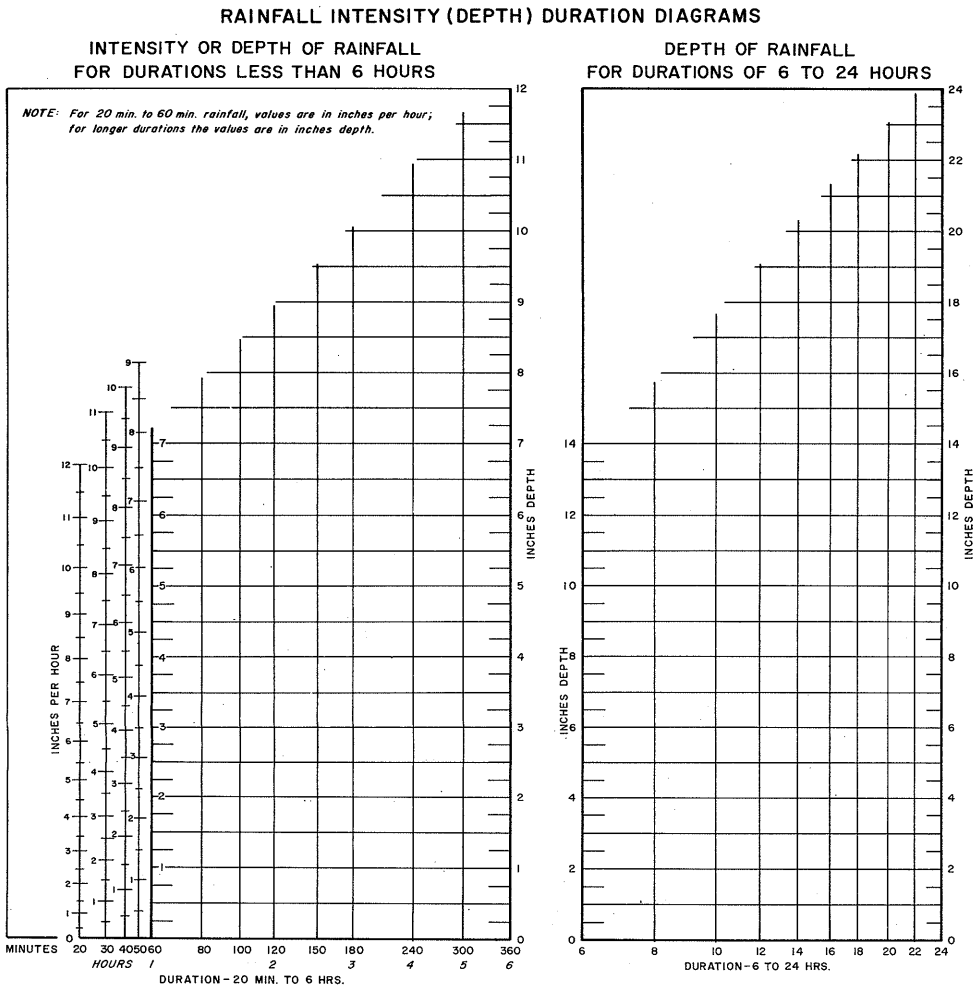


FIGURE 1-1

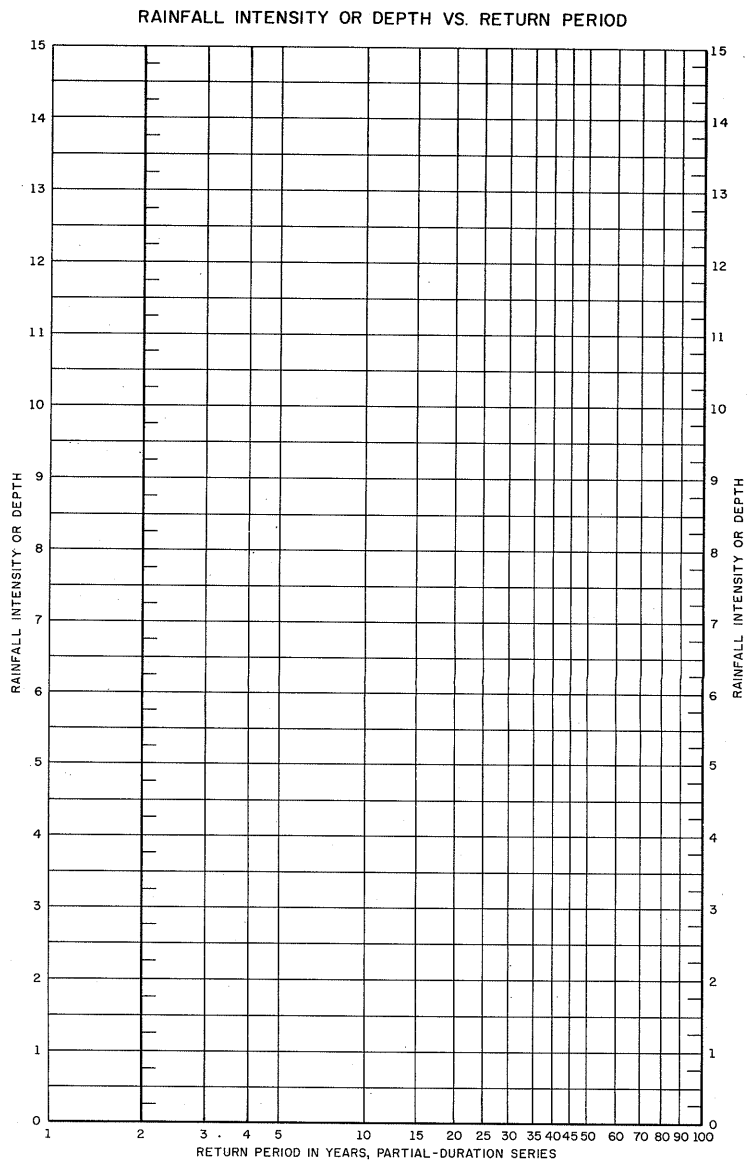


FIGURE 1-2

Table 2-1, with three examples, outlines the steps in the order they should be carried through in solving for the required rainfall intensities or depths.

TABLE 2-1

EXAMPLES OF RAINFALL INTENSITY (DEPTH) DURATION-FREQUENCY-AREA COMPUTATIONS

1.	Location	41° 00' N 82° 00' W	43° 00' N 89° 00' W	45° 00' N 84° 00' W
2.	Required Intensity (Depth) Duration-Frequency-Area	25-Year 3-Hour Rainfall (Inches) for 100 Square Miles	50-Year 12-Hour Rainfall (Inches) for 400 Square Miles	15-Year 30-Min Intensity (In/Hr) for 50 Square Miles
3.	2-Year 1-Hour Rainfall Figure 2-2	1.3 Inches	———	1.0 Inches
4.	2-Year 6-Hour Rainfall Figure 2-3	1.8 Inches	2.2 Inches	1.5 Inches
5.	2-Year 24-Hour Precip. Figure 2-4	———	2.8 Inches	———
6.	Straightedge connecting (3) and (4) or (4) and (5) intersects required duration. Figure 1-1	(2-Year 3-Hour) 1.6 Inches	(2-Year 12-Hour) 2.5 Inches	(2-Year 30-Min) 1.8 In/Hr
7.	100-Year 1-Hour Rainfall / 2-Year 1-Hour Rainfall Figure 2-5	2.1	———	2.2
8.	100-Year 6-Hour Rainfall / 2-Year 6-Hour Rainfall Figure 2-6	2.0	2.2	2.1
9.	100-Year 24-Hour Precip. / 2-Year 24-Hour Precip. Figure 2-7	———	2.2	———
10.	(7) x (3)	(100-Year 1-Hour) 2.7 Inches		(100-Year 1-Hour) 2.2 Inches
11.	(8) x (4)	(100-Year 6-Hour) 3.6 Inches	(100-Year 6-Hour) 4.8 Inches	(100-Year 6-Hour) 3.2 Inches
12.	(9) x (5)	———	(100-Year 24-Hour) 6.2 Inches	———
13.	Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Figure 1-1	(100-Year 3-Hour) 3.2 Inches	(100-Year 12-Hour) 5.5 Inches	(100-Year 30-Min) 3.5 In/Hr
14.	Straightedge connecting (6) and (13) intersects required return period. Figure 1-2	2.6 Inches	4.9 Inches	2.7 In/Hr
15.	Percent of Point Rainfall Figure 1-3	85	87	69
16.	(14) x (15) = (2)	2.2 Inches	4.3 Inches	1.9 In/Hr

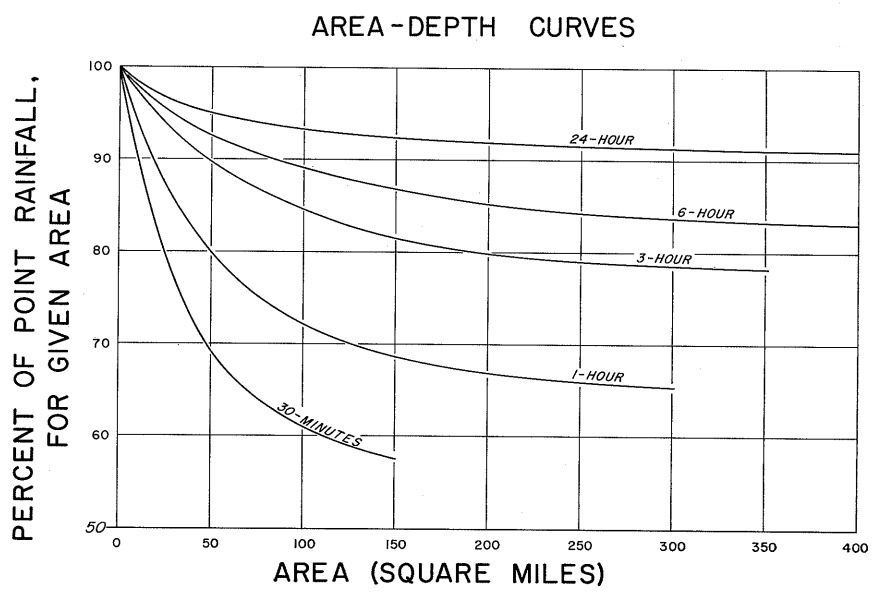


FIGURE 1-3

542480 O—60 (In pocket)

FIGURE 2-1. DURATION, FREQUENCY, AREA-DEPTH DIAGRAMS, AND EXAMPLES OF COMPUTATION FOR

WEATHER BUREAU TECHNICAL PAPER NO. 29, PART 5 (PREPARED JUNE, 1959)

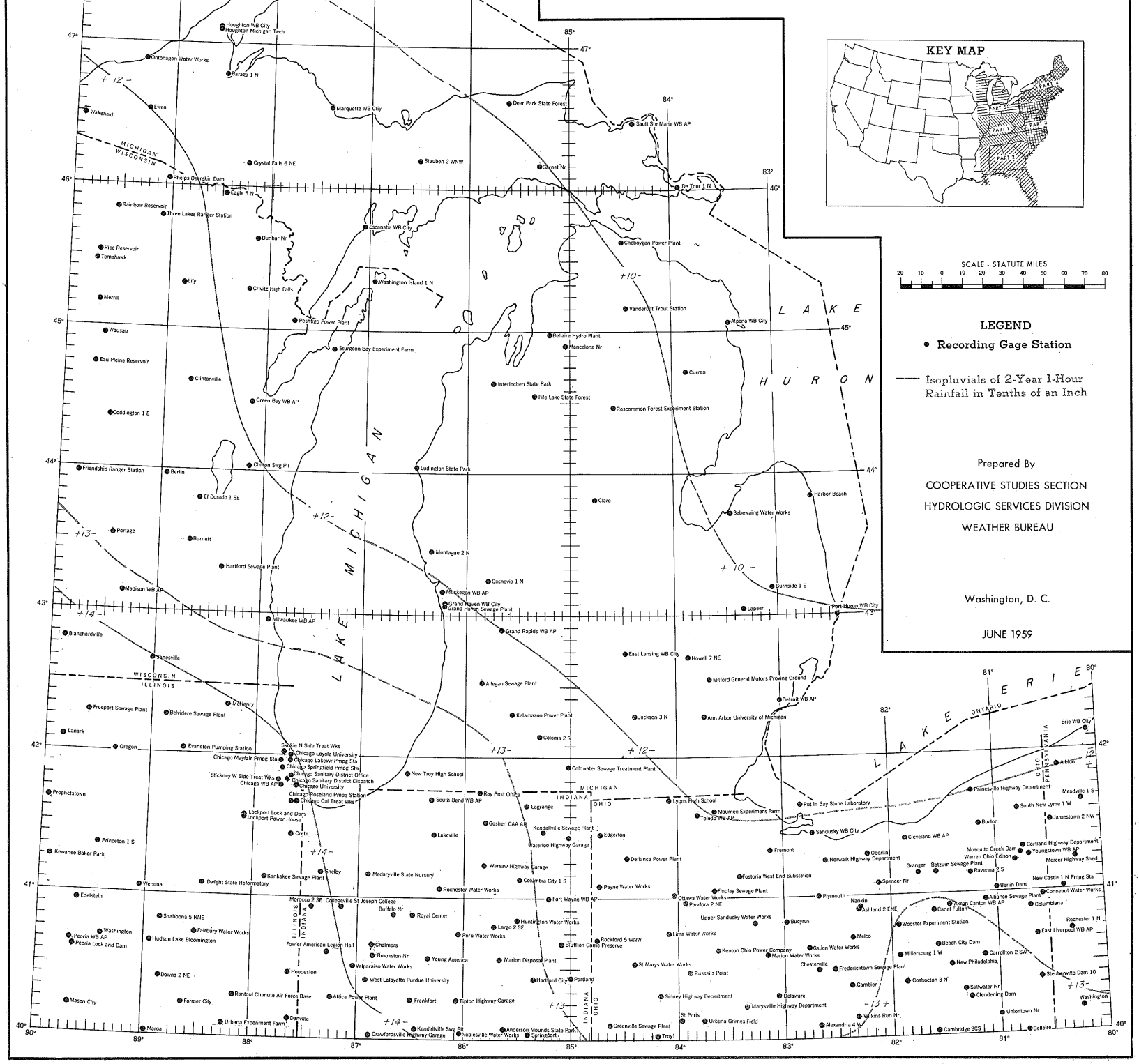


Figure 2-2

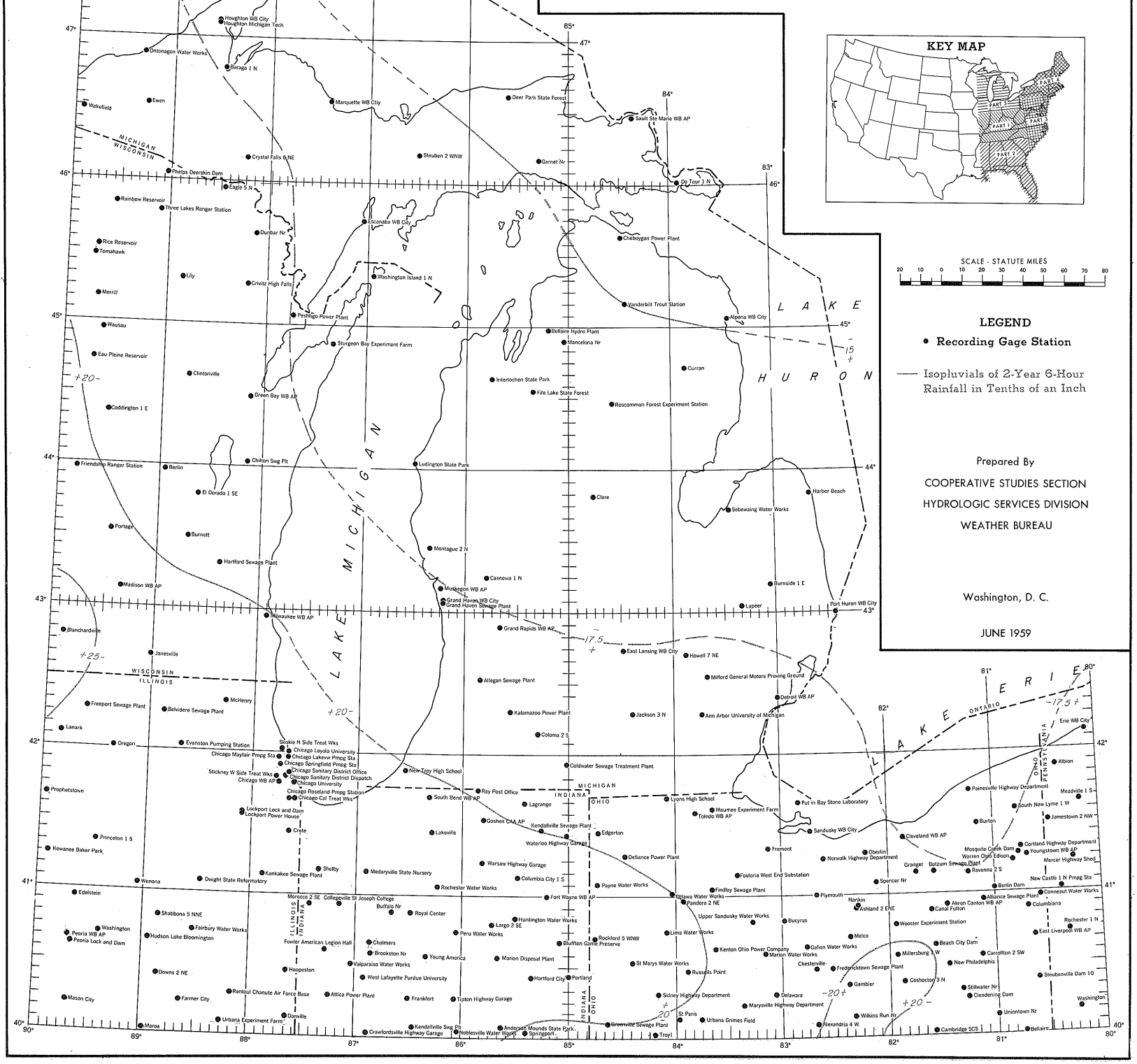
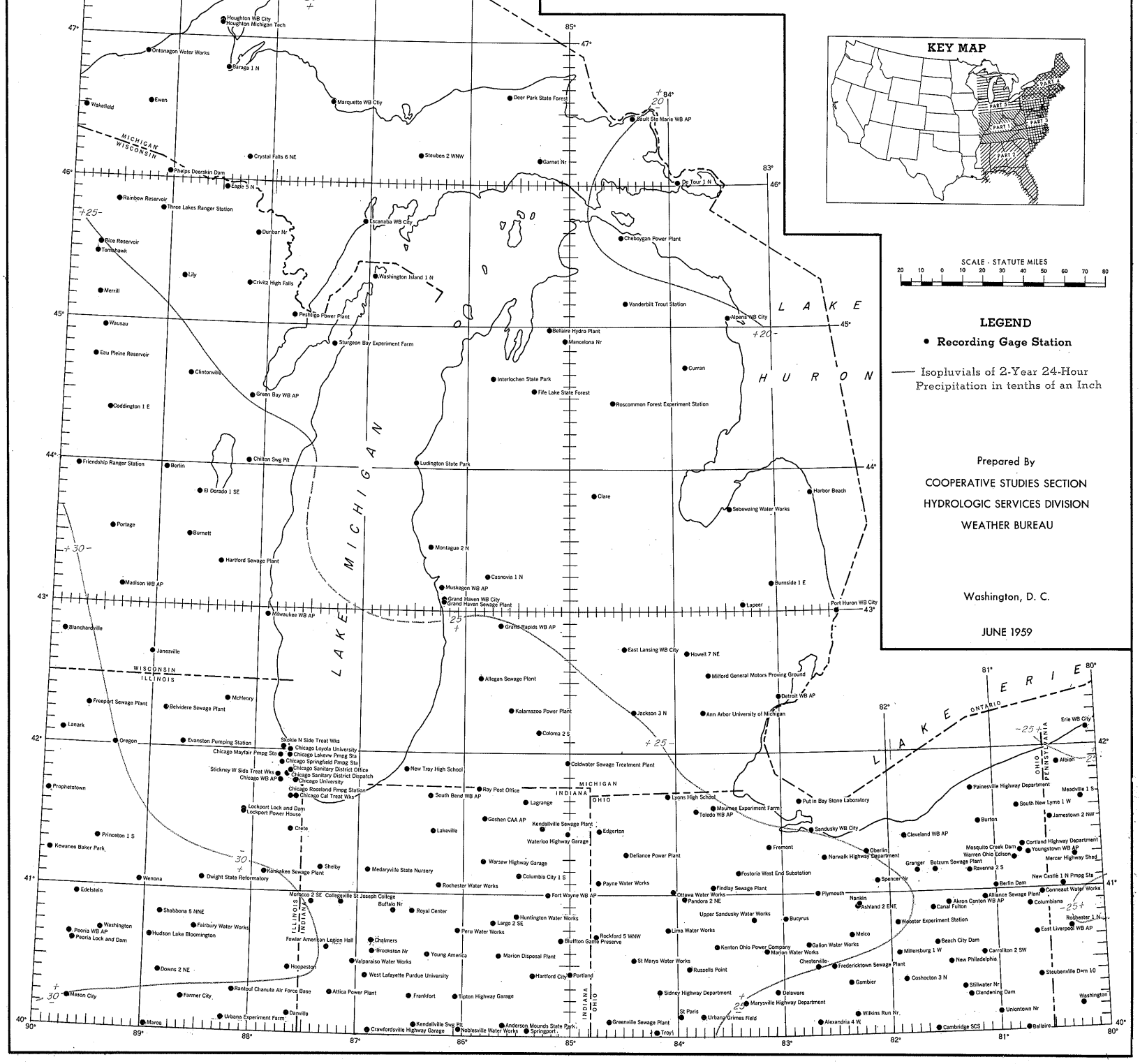
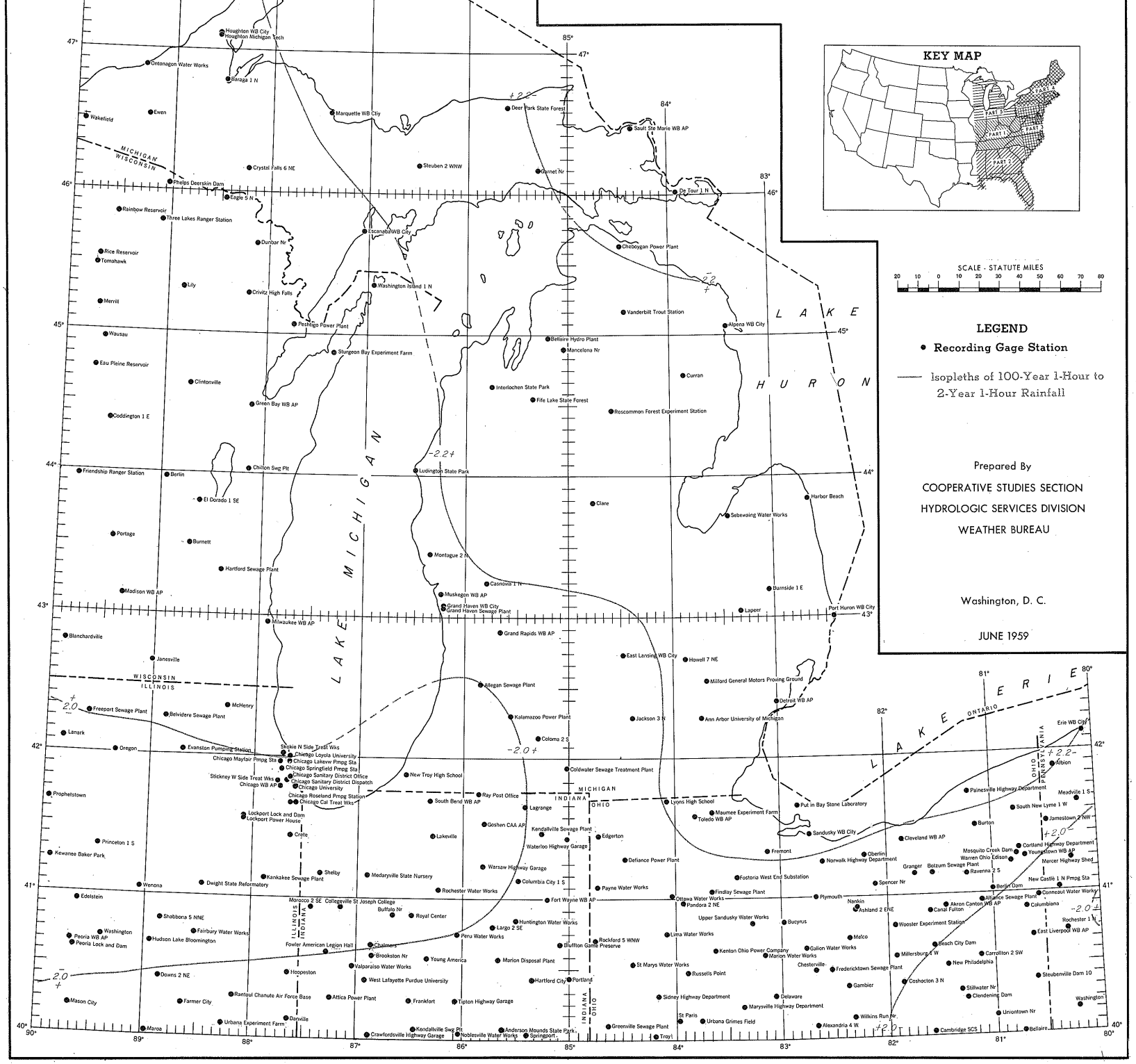


Figure 2-3



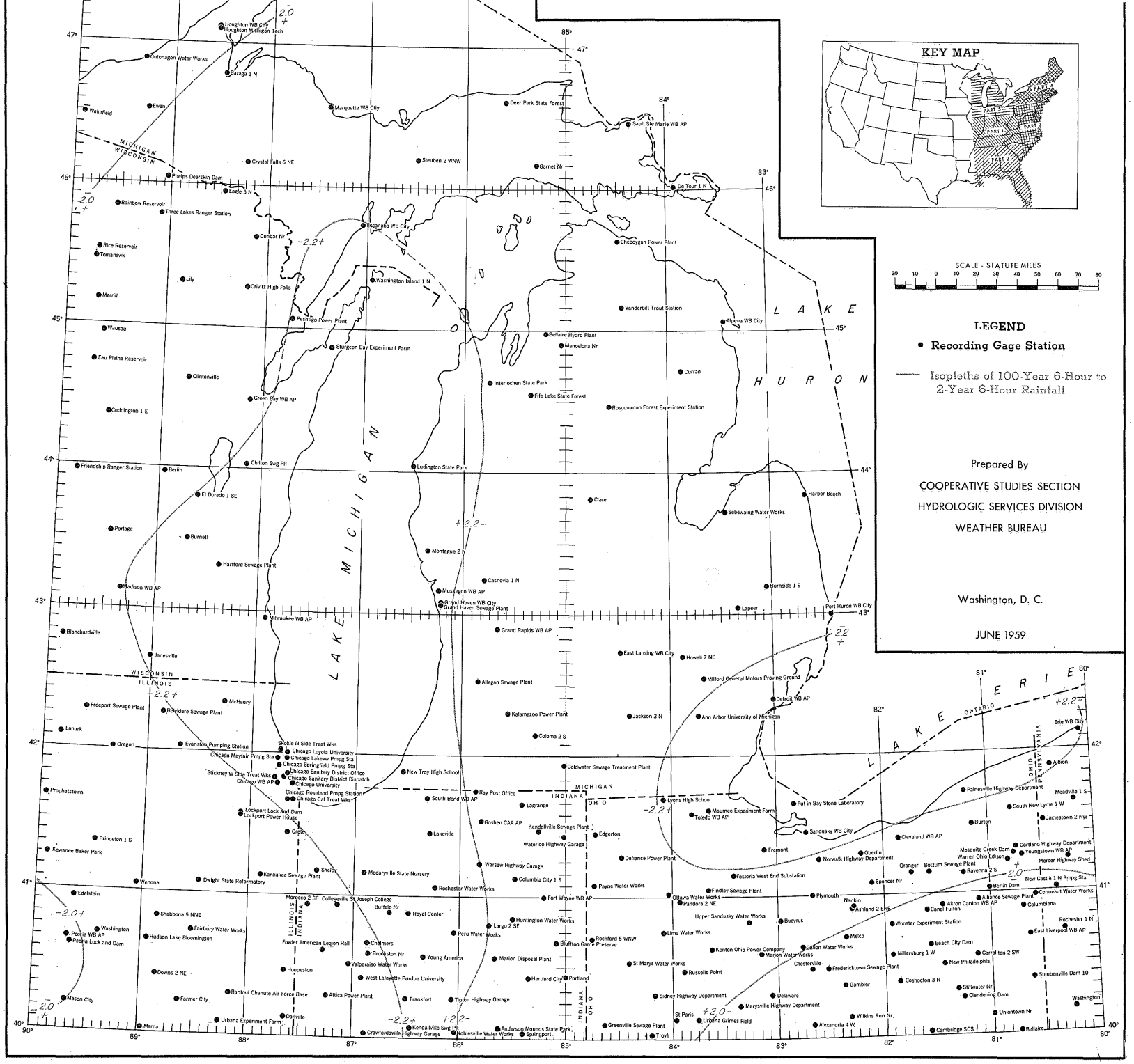
542480 O—60 (Face blank p. 14) No. 3

Figure 2-4



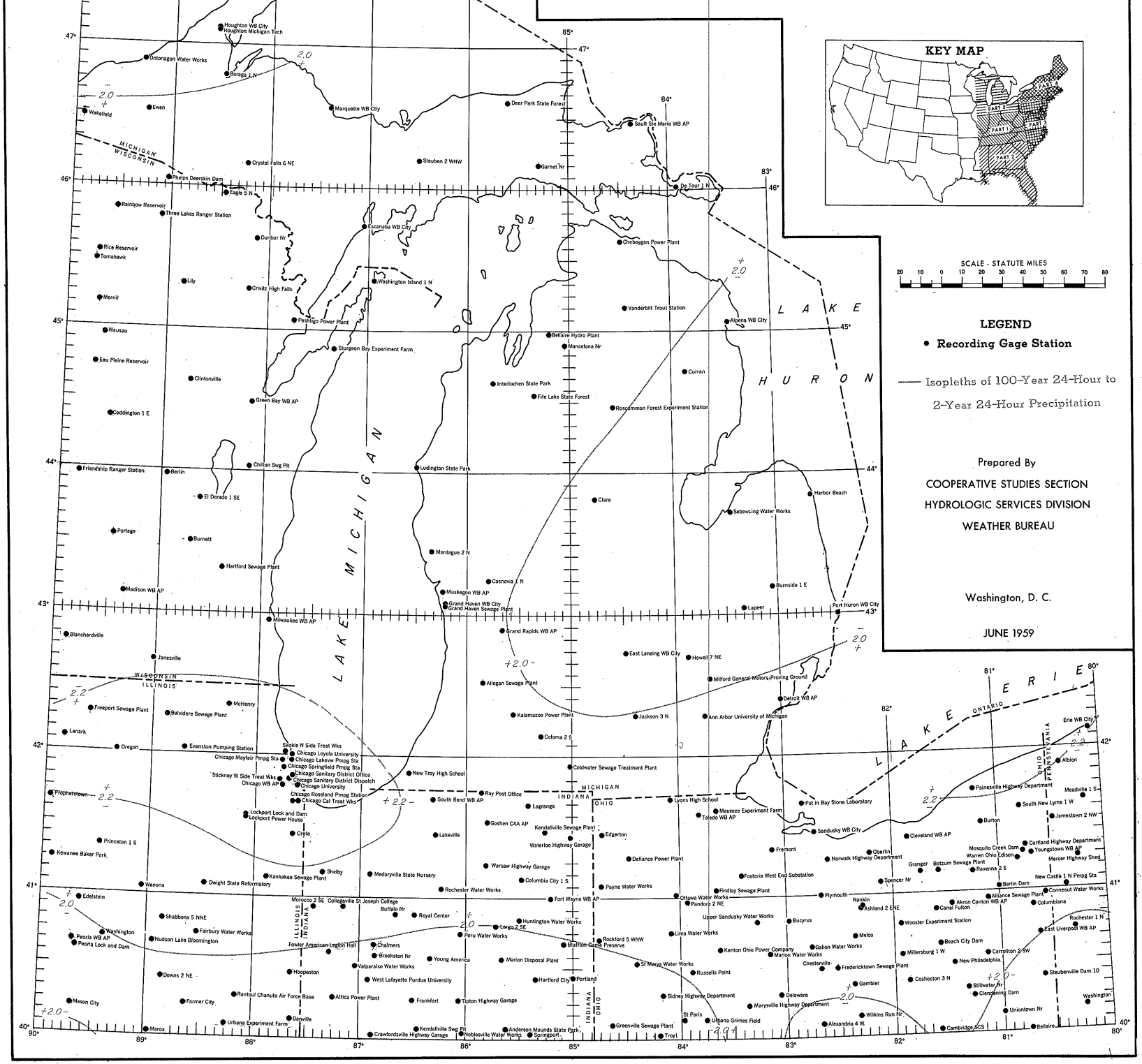
542480 O—60 (Face blank p. 14) No. 4

Figure 2-5



542480 O—60 (Face blank p. 14) No. 5

Figure 2-6



542480 O—60 (Face blank p. 14) No. 6

Figure 2-7

Table 2-2. Station Data 2-Year 1-, 6-, and 24-Hour

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
ILLINOIS							
Annawan	41 24	89 55	1941-57	17			3.13
Antioch	42 29	88 06	1941-57	17			2.48
Arlington Heights 4 SSE	42 02	87 58	1940-57*	16			3.12
Aurora College	41 45	88 20	1887-57*	65			2.86
Belvidere Sewage Plant	42 16	88 52	1940-57	18	1.51	2.36	3.17
Bloomington Normal	40 30	89 00	1895-57	63			3.04
Bloomington Water Works	40 30	89 01	1949-57*	8			2.95
Bradford CAA AP	41 13	89 37	1944-57	14			3.10
Channahon Dresden Island	41 24	88 17	1941-57	17			2.96
Chenoa	40 44	88 44	1944-57	14			3.36
Chicago Calumet Treatment Works	41 40	87 36	1941-50	10	1.32	2.29	3.10
Chicago Lakeview Pumping Station	41 58	87 40	1941-50	10	1.43	2.38	2.65
Chicago Loyola University	42 00	87 40	1941-50	10	1.32	2.46	3.18
Chicago Mayfair Pumping Station	41 58	87 45	1941-50	10	1.76	2.76	3.70
Chicago North Branch Pumping Station	41 58	87 42	1941-50	10	1.31	2.19	2.93
Chicago Roseland Pumping Station	41 42	87 38	1941-50	10	1.57	2.43	3.01
Chicago Sanitary District Dispatch	41 50	87 42	1941-50	10	1.32	2.08	2.67
Chicago Sanitary District Office	41 52	87 38	1941-50	10	1.26	2.07	2.78
Chicago Springfield Pumping Station	41 55	87 44	1941-50	10	1.43	2.52	3.34
Chicago University	41 47	87 36	1940-50	11	1.37	2.18	2.66
Chicago WB AP	41 47	87 45	1900-57	58	1.49	2.21	2.70
Chillicothe	40 55	89 29	1941-57	17			3.43
Cicero	41 51	87 46	1939-57	19			3.12
Clinton 1 SSW	40 08	88 58	1910-57	48			3.29
Crete	41 27	87 38	1943-57	15	1.52	2.51	3.38
Danville	40 08	87 38	1939-57	19			3.20
Danville	40 08	87 38	1940-57*	17	1.62	2.40	3.08
Danville Sewage Plant	40 06	87 36	1949-57	9			3.24
Dixon	41 51	89 29	1887-57*	64			3.03
Downs 2 NE	40 25	88 51	1940-57	18	1.38	2.19	3.03
Dwight	41 06	88 25	1939-50	12			3.41
Dwight State Reformatory	41 05	88 28	1940-56	17	1.68	2.59	3.15
Edelstein	40 57	89 38	1943-57	15	1.33	2.08	2.97
Elgin	42 02	88 17	1939-57	19			3.14
Evanston Pumping Station	42 02	87 41	1941-50	10	1.57	2.38	3.07
Fairbury Water Works	40 44	88 31	1941-57	17	1.72	2.52	3.49
Farmer City	40 14	88 38	1943-50	8	1.46	2.13	2.93
Freeport	42 18	89 37	1939-57	19			3.35
Freeport Sewage Plant	42 17	89 36	1941-57	17	1.66	2.73	3.28
Gibson City	40 28	88 23	1939-57	19			3.95
Gridley	40 45	88 53	1941-57	17			4.16
Hoopeston	40 28	87 40	1939-57	19			2.87
Hoopeston	40 28	87 40	1941-50	10	1.50	2.27	2.95
Hudson Lake Bloomington	40 40	88 56	1940-50	11	1.33	2.33	3.09
Joliet	41 32	88 05	1943-57	15			3.49
Joliet Brandon Road Dam	41 30	88 06	1939-57	19			3.34
Kankakee Sewage Plant	41 08	87 53	1941-57	17	1.59	2.35	3.26
Kankakee 3 SW	41 05	87 55	1939-57	19			3.40
Kankakee 4 NW	41 08	87 56	1941-57	17			3.23
Kewanee	41 14	89 56	1940-57	18			3.08
Kewanee Baker Park	41 15	89 54	1941-57	17	1.42	2.33	3.10
Lanark	42 06	89 50	1940-50	11	1.52	2.44	2.98
La Salle Peru	41 20	89 08	1939-57	19			2.76
La Salle 1 S	41 19	89 06	1950-57	8			2.70
LeRoy	40 21	88 46	1939-57	19			3.10
Lincoln	40 09	89 22	1906-57*	51			2.80
Lockport Lock and Dam	41 34	88 05	1940-50	11	1.66	2.70	3.35
Lockport Power House	41 34	88 05	1941-50	10	1.80	2.91	3.56
Mackinaw	40 32	89 22	1940-57	18			3.23
Marengo	42 15	88 36	1887-57*	65			2.80
Maroa	40 02	88 58	1941-57	17	1.47	2.10	2.75
Marseilles Lock	41 20	88 45	1941-57	17			3.23
Mason City	40 12	89 41	1941-57	17	1.36	2.33	3.10
McHenry	42 21	88 16	1940-57	18	1.20	1.90	2.74
McHenry 2 S	42 19	88 15	1941-57	17			2.80
Minonk	40 54	89 02	1887-57*	63			2.97
Monticello	40 02	88 34	1943-57	15			3.19
Morris	41 21	88 26	1949-57	9			3.32
Morris 3 NNE	41 24	88 24	1939-57	19			3.13
Morrison	41 49	89 58	1896-57	62			2.92
Mount Carroll	42 05	89 58	1887-57*	65			3.08
Mount Pulaski	40 01	89 17	1942-57	16			2.93
Newark 8 E	41 33	88 26	1941-57	17			3.10
Oregon	42 01	89 20	1940-50	11	1.86	2.50	2.83
Oregon Water Works	42 01	89 20	1939-55	17			3.17
Ottawa	41 22	88 50	1887-57*	63			2.79
Park Forest	41 30	87 41	1940-57	18			3.42
Paw Paw	41 41	88 59	1913-57	45			2.79
Peoria Lock and Dam	40 37	89 39	1940-50	11	1.27	2.32	3.30
Peoria WB AP	40 40	89 41	1905-57	53	1.55	2.47	3.24

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
ILLINOIS (continued)							
Peotone	41 20	87 48	1940-57	18			3.41
Petersburg 3 W	40 01	89 54	1941-57	17			2.93
Pontiac	40 53	88 37	1887-57*	57			2.87
Princeton 1 S	41 21	89 28	1940-50	11	1.68	2.42	2.94
Princeville	40 57	89 47	1939-57	19			3.04
Prophetstown	41 40	89 56	1940-57	18	1.43	2.18	2.80
Rantoul Chanute Air Force Base	40 18	88 09	1940-54	15			2.78
Rantoul Chanute Air Force Base	40 18	88 09	1941-57*	16	1.29	2.21	3.20
Roberts 3 N	40 40	88 11	1911-57	47			2.85
Rochelle 1 W	41 55	89 04	1939-57	19			2.98
Rockford	42 17	89 05	1895-56*	55			2.90
Rockford CAA AP	42 12	89 06	1943-57	15			3.17
Shabbona 5 NNE	41 50	88 51	1940-57	18	1.51	2.47	3.10
Skokie North Side Treatment Works	42 01	87 43	1941-50	10	1.70	2.59	3.45
Sparland	41 02	89 26	1939-53	15			3.16
Stickney West Side Treatment Works	41 49	87 46	1941-50	10	1.51	2.35	2.84
Stockton 1 N	42 21	90 00	1944-57	14			2.77
Streator 3 N	41 09	88 50	1939-57*	18			3.10
Sycamore	41 59	88 41	1887-57*	65			3.21
Tiskilwa	41 17	89 30	1939-57	19			3.06
Toulon	41 05	89 52	1942-57	16			2.78
Urbana	40 06	88 14	1939-57	19			2.81
Urbana Engineering Campus	40 07	88 14	1949-57	9			2.87
Urbana Experiment Farm	40 06	88 15	1940-50	11	1.48	2.05	2.76
Utica Starved Rock Dam	41 19	88 59	1941-57	17			2.83
Walnut	41 33	89 35	1895-57	63			2.89
Washington	40 42	89 24	1941-50	10	1.38	2.30	3.40
Watseka	40 46	87 41	1887-57*	59			3.09
Waukegan	42 22	87 52	1939-57	19			2.42
Wenona	41 03	89 03	1941-57*	16	1.65	2.57	3.35
Wheaton College	41 52	88 06	1939-57	19			3.34
INDIANA							
Albion	41 24	85 26	1917-57	41			2.58
Anderson Mounds State Park	40 05	85 37	1940-57	18	1.55	2.20	2.92
Anderson Sewage Plant	40 06	85 43	1897-57	61			2.83
Anderson Water Works	40 06	85 41	1945-57	13			2.88
Angola	41 38	85 00	1897-57*	49			2.86
Attica Power Plant	40 18	87 15	1942-57	16	1.68	2.50	3.34
Berne	40 40	84 57	1910-57	48			2.63
Bluffton	40 44	85 11	1897-57*	60			2.83
Bluffton Game Preserve	40 41	85 05	1941-50*	8	1.37	2.27	3.03
Bluffton Water Works	40 44	85 10	1949-57	9			2.96
Brookston (nr)	40 36	86 51	1940-46	7	1.21	1.69	1.92
Buffalo (nr)	40 53	86 39	1940-47	8	1.54	2.32	2.58
Chalmers	40 40	86 52	1946-50	5	1.39	2.47	2.88
Collegeville St. Joseph College	40 56	87 09	1900-57	58			2.90
Collegeville St. Joseph College	40 56	87 09	1945-50	6	1.45	2.18	2.59
Columbia City	41 09	85 29	1939-57	19			2.87
Columbia City 1 S	41 08	85 29	1940-57	18	1.60	2.37	2.88
Covington	40 08	87 24	1939-57	19			2.95
Crawfordsville Highway Garage	40 02	86 53	1940-50	11	1.54	2.64	3.15
Crawfordsville Power Plant	40 03	86 54	1898-57*	55			3.30
Decatur	40 51	84 56	1939-57*	16			3.05
Delphi	40 35	86 40	1897-57	61			2.84
Elkhart	41 41	85 58	1951-57	7			3.01
Elwood Water Works	40 16	85 51	1948-57	10			3.02
Fort Wayne Disposal Plant	41 06	85 07	1945-57	13			3.02
Fort Wayne WB AP	41 00	85 12	1911-57	47	1.27	2.04	2.68
Fowler	40 37	87 19	1939-57	19			3.07
Fowler American Legion Hall	40 37	87 19	1940-57	18	1.40	2.24	3.15
Frankfort	40 17	86 30	1941-57	17	1.47	2.41	3.04
Frankfort Disposal Plant	40 19	86 30	1914-57	44			2.86
Gary Disposal Plant	41 37	87 23	1939-57	19			3.05
Goshen CAA AP	41 32	85 48	1941-50	10	1.44	2.09	2.64
Goshen College	41 34	85 50	1916-57	42			2.51
Hartford City	40 26	85 22	1944-50	7	1.49	2.27	2.70
Hobart	41 32	87 15	1939-57	19			3.54
Howe	41 43	85 25	1906-52	47			2.70
Huntington	40 53	85 30	1897-57	61			2.73
Huntington Water Works	40 51	85 30	1940-50*	10	1.28	2.08	2.82
Kendallville	41 27	85 15	1949-57	9			2.83
Kendallville Sewage Plant	41 28	85 16	1946-50	5	1.72	2.50	2.92
Kentland	40 46	87 27	1940-57	18			3.35
Kokomo Post Office	40 29	86 08	1897-56	60			3.01
Kokomo Sewage Plant	40 28	86 09	1948-57	10			3.29
Lagrange	41 39	85 25	1940-57	18	1.22	1.80	2.43
Lagro 2 SE	40 48	85 43	1944-50	7	1.52	2.04	2.64
Lakeville	41 32	86 17	1940-57	18	1.37	2.26	2.98
La Porte	41 36	86 43	1897-57	61			3.07

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
INDIANA (continued)							
Lebanon Water Works	40 04	86 28	1940-57	18	1.58	2.39	3.08
Logansport Cicott Street Bridge	40 45	86 23	1897-57*	57			3.06
Marion Disposal Plant	40 34	85 40	1940-50	11	1.26	1.81	2.59
Marion 2 N	40 34	85 40	1897-57	61			2.92
Medaryville	41 10	86 54	1941-57	17	1.22	2.13	2.70
Monroeville 3 ENE	40 59	84 49	1941-57*	14			2.80
Monticello	40 45	86 46	1910-57*	46			3.02
Morocco 2 SE	40 56	87 26	1945-50	6	1.52	2.35	2.62
Muncie Sewage Plant	40 11	85 26	1948-57	10			3.38
Muncie 4 SE	40 08	85 21	1917-57*	38			2.88
Noblesville	40 02	86 01	1914-57	44			3.03
Noblesville	40 02	86 01	1942-50	9	1.46	2.07	2.88
Notre Dame Moreau Seminary	41 42	86 14	1912-53	42			2.46
Ogden Dunes	41 38	87 11	1952-57	6			3.68
Peru Water Works	40 45	86 03	1940-57*	17	1.34	2.29	3.06
Plymouth Power Substation	41 20	86 20	1906-57*	50			2.89
Portland	40 26	85 00	1950-57	8			2.78
Portland	40 26	85 00	1940-57*	17	1.18	2.01	2.66
Ray Post Office	41 45	84 52	1942-48*	6	1.06	1.65	2.17
Rochester	41 04	86 13	1904-57*	44			3.12
Rochester Water Works	41 04	86 13	1940-50	11	1.34	2.38	2.60
Royal Center	40 53	86 29	1918-31	14	1.49	2.09	2.59
Salamonia 7 W	40 23	85 00	1898-57	60			2.76
Shelby	41 11	87 21	1940-57*	17	1.35	2.11	2.75
South Bend WB AP	41 42	86 19	1941-57	17	1.43	2.12	2.67
Springport	40 02	85 24	1944-48	5	1.22	2.03	2.27
Tipton Highway Garage	40 17	86 04	1940-57	18	1.41	2.15	2.68
Valparaiso Water Works	41 31	87 02	1897-57*	52			2.76
Valparaiso Water Works	41 31	87 02	1940-50	11	1.56	2.55	3.22
Veedersburg	40 07	87 16	1900-52	53			3.03
Wabash	40 47	85 50	1939-57	19			3.08
Warsaw	41 14	85 52	1897-57*	52			2.69
Warsaw Highway Garage	41 14	85 49	1940-50	11	1.43	2.07	2.37
Waterloo	41 25	85 02	1940-57	18			2.68
Waterloo Highway Garage	41 26	85 01	1940-57	18	1.23	1.97	2.69
West Lafayette CAA AP	40 25	86 56	1897-57	61			2.87
West Lafayette Purdue University	40 25	86 55	1940-50	11	1.37	1.98	2.68
West Lafayette 6 NW	40 28	87 00	1950-57	8			3.32
Wheatfield	41 11	87 04	1917-57	41			2.87
Whitestown	40 00	86 20	1909-57	49			3.15
Whiting	41 40	87 29	1910-57	48			2.79
Winamac	41 03	86 36	1897-57*	49			2.89
Winchester AP	40 11	84 55	1942-57	16			2.92
Young America	40 34	86 20	1940-50*	9	1.37	2.33	2.79
MICHIGAN							
Adrian	41 54	84 02	1888-57*	69			2.61
Albion Rice Creek Station	42 17	84 46	1939-57	19			2.69
Allegan Sewage Plant	42 32	85 51	1910-57	48			2.36
Allegan Sewage Plant	42 32	85 51	1940-57	18	1.13	1.78	2.36
Alma	43 23	84 40	1888-57	70			2.43
Alpena AP	45 05	83 34	1939-57	19			2.02
Alpena WB City	45 04	83 26	1911-57	47	.99	1.51E	2.02
Ann Arbor University of Michigan	42 17	83 44	1939-57	19			2.33
Ann Arbor University of Michigan	42 17	83 44	1940-57*	17	1.18	1.86	2.30
Atlanta 3 ENE	45 01	84 06	1939-57	19			2.23
Bad Axe Radio Station	43 48	83 01	1939-57	19			1.99
Baldwin State Forest	43 54	85 51	1939-57	19			2.33
Baraga 1 N	46 47	88 29	1945-50	6	.90	1.43	2.34
Battle Creek AP	42 18	85 14	1939-57	19			2.80
Bay City Gas Plant	43 36	83 54	1896-57	62			2.55
Beechwood 7 WNW	46 11	88 53	1949-57	9			2.33
Bellaire Hydro Plant	44 59	85 12	1945-50	6	1.20	2.04	2.33
Benton Harbor AP	42 08	86 26	1898-57	60			2.57
Bergland Hydro Plant	46 35	89 33	1939-57*	18			3.17
Big Rapids Water Works	43 42	85 29	1888-57*	64			2.36
Bloomingdale	42 23	85 57	1939-57	19			2.62
Boyne Falls State Nursery	45 13	84 48	1949-57	9			2.14
Burnside 1 E	43 12	83 03	1941-57	17	1.00	1.60	2.13
Cadillac Water Works	44 15	85 24	1939-57	19			2.68
Calumet	47 15	88 27	1939-47	9			2.41
Caro State Hospital	43 27	83 24	1939-57	19			2.21
Casnovia 1 N	43 15	85 48	1945-50	6	.97	1.61	2.44
Champion Van Riper Park	46 31	87 59	1939-57*	18			2.53
Charlevoix	45 19	85 16	1939-57	19			2.04
Charlotte	42 32	84 50	1902-57*	54			2.41
Chatham Experiment Farm	46 21	86 56	1900-57*	57			2.23
Cheboygan Power Plant	45 38	84 29	1941-57	17	.82	1.30	1.85
Cheboygan River Range Light Station	45 39	84 28	1939-57	19			1.84
Clare	43 49	84 46	1940-45	6	1.19	2.22	2.83
Coldwater Sewage Treatment Plant	41 56	85 01	1942-57	16	1.36	2.00	2.58

*Breaks in Record
E = Estimated

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
MICHIGAN (continued)							
Coldwater State School	41 57	85 00	1939-57	19			2.51
Coloma 2 S	42 09	86 18	1944-50	7	1.31	2.30	3.28
Copper Harbor Fort Wilkins	47 28	87 52	1944-57*	13	1.03	1.54	1.95
Cornell 6 NW	45 59	87 16	1952-56	5			2.46
Crystal Falls 6 NE	46 10	88 14	1939-57	19			2.18
Crystal Falls 6 NE	46 10	88 14	1943-57	15	1.09	1.71	2.04
Curran	44 43	83 52	1940-47	8			2.51
Curran	44 43	83 52	1940-47	8	1.28	1.86	2.69
Deer Park State Forest	46 37	85 37	1939-53	15			2.15
Deer Park State Forest	46 37	85 37	1945-50	6	1.02	1.48	2.02
De Tour 1 N	46 01	83 55	1939-57*	18			2.06
De Tour 1 N	46 01	83 55	1943-57*	13	.98	1.54	2.12
Detroit WB AP	42 24	83 00	1896-57	62	1.25	1.85	2.37
Dowagiac 2 E	41 59	86 05	1939-51	13			3.54
Dunbar Forest Experiment Station	46 19	84 14	1945-57	13			2.04
Eagle Harbor Coast Guard	47 28	88 10	1899-57*	39			2.12
East Jordan	45 10	85 07	1939-57	19			2.11
East Lansing Experiment Farm	42 42	84 28	1949-57	9			2.42
East Lansing WB City	42 44	84 29	1910-57	48	1.12	1.76	2.25
East Tawas U. S. Forest	44 17	83 29	1897-57	61			2.29
Eaton Rapids	42 31	84 39	1942-57*	15			2.53
Eau Claire 4 NE	42 01	86 15	1939-57	19			3.00
Edmore	43 24	85 02	1939-57*	17			2.64
Elberta 4 SE	44 35	86 10	1900-57*	51			2.28
Escanaba WB City	45 45	87 03	1903-57	55	1.05	1.62E	2.17
Evart	43 54	85 16	1939-57*	16			2.59
Ewen	46 32	89 16	1943-57	15	1.06	1.91	2.51
Fayette Sack Bay	45 38	86 41	1921-57	37			2.41
Fife Lake State Forest	44 33	85 21	1945-50	6	1.14	2.14	2.70
Fife Lake 2 S	44 33	85 21	1939-57	19			2.68
Flint WB AP	42 58	83 44	1939-57	19			2.75
Garnet (nr)	46 10	85 18	1943-47	5	1.18	2.17	2.58
Gaylord Construction Department	45 02	84 41	1939-57	19			2.35
Germfask Wildlife Refuge	46 17	85 57	1944-57	14			2.70
Gladwin CAA AP	43 59	84 29	1939-57	19			2.60
Glen Arbor Leelanau School	44 55	85 58	1948-53	6			1.91
Grand Haven Fire Department	43 04	86 13	1939-57	19			2.53
Grand Haven Sewage Plant	43 04	86 13	1944-50	7	1.19	1.77	2.38
Grand Haven WB City	43 04	86 14	1906-32*	26	1.16	1.89	2.45
Grand Ledge	42 45	84 46	1942-57*	15			2.42
Grand Marais CAA AP	46 37	85 55	1939-57	19			2.16
Grand Rapids WB AP	42 54	85 40	1905-57	53	1.18	1.92	2.59
Grayling Military Reservation	44 38	84 47	1889-57*	68			2.38
Greenville	43 11	85 15	1939-57	19			2.52
Grosse Pointe Farms	42 23	82 54	1947-57	11			2.68
Gull Lake Experiment Farm	42 24	85 23	1939-57	19			2.93
Hale Five Channels Dam	44 28	83 41	1939-57	19			2.32
Harbor Beach	43 50	82 39	1940-57	18	1.28	1.76	2.16
Harbor Beach 3 NW	43 52	82 41	1939-57*	18			2.27
Harrison	44 01	84 48	1890-57*	51			2.36
Harrisville	44 40	83 18	1888-57	70			2.26
Hart	43 42	86 22	1888-57*	61			2.35
Hastings Fisheries	42 39	85 18	1888-57*	60			2.52
Hesperia	43 34	86 02	1939-57*	18			2.46
Higgins Lake	44 31	84 45	1939-57	19			2.66
Hillsdale	41 55	84 38	1897-57	61			2.59
Holland Hope College	42 47	86 07	1905-57	53			2.55
Houghton CAA AP	47 10	88 30	1948-57	10			2.48
Houghton Lake 3 NW	44 20	84 49	1910-57	48			2.25
Houghton Michigan College of Mining and Technology	47 07	88 34	1940-50	11	.95	1.59	2.12
Houghton WB City	47 07	88 34	1901-32	32	.90	1.64	2.28
Howell Sewage Plant	42 36	83 56	1939-57	19			2.36
Howell 7 NE	42 42	83 53	1940-57	18	1.25	1.98	2.59
Hulbert 2 S	46 20	85 09	1939-54	16			2.12
Huron Mountain	46 53	87 52	1950-57	8			2.82
Interlochen State Park	44 38	85 46	1945-50	6	1.44	2.41	2.81
Ionia Gas Plant	42 59	85 04	1940-57*	17			2.54
Iron Mountain Water Works	45 50	88 04	1939-57	19			2.47
Iron River	46 05	88 40	1896-35	40			2.34
Ironwood	46 27	90 10	1902-57*	51			2.49
Ishpeming	46 29	87 39	1899-57*	55			2.34
Jackson CAA AP	42 16	84 28	1939-57	19			2.28
Jackson 3 N	42 17	84 24	1940-57*	16	1.31	2.09	2.73
Kalamazoo Power Plant	42 18	85 34	1940-57	18	1.36	1.98	2.74
Kalamazoo State Hospital	42 17	85 36	1939-57	19			2.66
Kalkaska	44 44	85 10	1939-57	19			2.50
Kent City 2 SW	43 12	85 46	1939-57	19			2.62
Kenton U. S. Forest	46 29	88 53	1941-57	17			2.84
Kinross Air Force Base	46 15	84 28	1939-57	19			1.84
Lake City Experiment Farm	44 18	85 12	1939-57	19			2.90

*Breaks in Record
E = Estimated

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
MICHIGAN (continued)							
L'Anse 2 S	46 44	88 27	1939-57	19			2.44
Lapeer	43 03	83 20	1939-57	19			2.53
Lapeer	43 03	83 20	1946-50	5	1.46	2.63	2.97
Lapeer 2 SE	43 02	83 17	1939-49	11			2.53
Lowell 5 NW	42 59	85 25	1940-57	18			2.84
Ludington State Park	44 02	86 30	1940-55	16	1.14	1.86	2.33
Ludington 4 SE	43 55	86 25	1897-57*	60			2.33
Lupton 1 SW	44 25	84 02	1951-57	7			2.84
Mackinaw City	45 47	84 44	1896-57*	58			2.06
Mancelona	44 54	85 05	1939-53*	14			2.29
Mancelona (nr)	44 54	85 03	1940-44	5	1.13	1.90	2.60
Manistee Power Company	44 13	86 18	1939-57	19			2.26
Manistique Water Works	45 59	86 15	1939-57	19			2.09
Marquette WB City	46 34	87 24	1906-57*	51	1.16	1.74E	2.31
Mass	46 46	89 05	1941-53*	11			2.69
Midland Dow Chemical	43 37	84 15	1896-57*	58			2.23
Milford General Motors Proving Ground	42 33	83 41	1941-57	17	1.31	2.17	2.81
Millington 3 SW	43 14	83 34	1941-57	17			2.35
Mio Hydro Plant	44 40	84 08	1888-57*	49			1.98
Monroe Water Works	41 55	83 23	1917-57	41			2.37
Montague	43 25	86 22	1950-57	8			2.00
Montague 2 N	43 27	86 21	1946-50	5	1.07	1.66	2.10
Mott Island Isle Royale	48 06	88 33	1941-57*	14			2.34
Mount Clemens Air Force Base	42 36	82 49	1897-57*	58			2.17
Mount Pleasant College	43 36	84 47	1896-57*	58			2.35
Munising	46 24	86 39	1911-57	47			2.21
Muskegon WB AP	43 10	86 14	1941-57	17	1.06	1.81	2.37
Newaygo Croton Dam	43 27	85 40	1908-57	50			2.37
Newberry State Hospital	46 20	85 30	1897-57*	57			2.10
New Buffalo	41 47	86 42	1939-47	9			2.71
New Troy High School	41 53	86 33	1945-50	6	1.69	2.22	3.21
Niles	41 51	86 16	1943-57	15			2.69
Onaway Black Lake Forest	45 25	84 14	1939-57	19			1.91
Onaway 12 S	45 11	84 12	1939-54	16			2.23
Ontonagon	46 52	89 18	1939-57	19			2.28
Ontonagon Water Works	46 53	89 19	1943-50	8	1.09	1.40	1.92
Owosso Sewage Plant	43 01	84 11	1896-57*	61			2.26
Painesdale	47 02	88 40	1939-49	11			2.46
Paw Paw 2 E	42 13	85 51	1889-57*	31			2.60
Pellston CAA AP	45 34	84 48	1942-57	16			1.90
Petoskey	45 22	84 58	1896-57*	51			2.07
Pontiac State Hospital	42 39	83 18	1939-57	19			2.65
Port Huron Sewage Plant	42 59	82 25	1939-57*	18			2.59
Port Huron WB City	43 00	82 26	1904-32*	28	1.04	1.69	2.25
Rexton	46 10	85 15	1939-57*	18			2.10
Rock	46 04	87 10	1939-57*	18			2.33
Rogers City	45 25	83 49	1939-57*	17			1.98
Romeo 1 N	43 49	83 01	1941-57	17			2.58
Roscommon Forest Experiment Station	44 20	84 35	1945-50	6	.72	1.33	1.74
Saginaw CAA AP	43 32	84 05	1939-57	19			2.38
St. Charles	43 18	84 08	1941-57*	15			2.81
St. Ignace 2 N	45 52	84 45	1939-46	8			1.97
St. James Beaver Island	45 45	85 30	1953-57	5			1.84
St. Johns 5 NNW	43 04	84 35	1939-57	19			2.42
Sandusky	43 25	82 50	1909-57*	38			2.36
Sault Ste. Marie WB AP	46 28	84 22	1901-57	57	.88	1.44	2.02
Scottville 1 NE	43 58	86 16	1939-57	19			2.23
Sebewaing Water Works	43 43	83 27	1940-50	11	.97	1.32	1.77
Sebewaing 3 E	43 44	83 23	1941-57	17			1.96
South Haven Experiment Farm	42 24	86 17	1896-57*	61			2.44
Spalding	45 42	87 30	1939-57	19			2.34
Stambaugh	46 05	88 38	1939-57	19			2.50
Standish 2 S	43 57	83 58	1939-57	19			2.34
Stephenson 5 W	45 24	87 43	1939-57	19			2.58
Steuben 2 WNW	46 12	86 30	1939-52	14			2.23
Steuben 2 WNW	46 12	86 30	1943-57	15	.96	1.45	2.20
Suttons Bay 4 NW	45 01	85 42	1939-57	19			2.44
Thompsonville	44 31	85 56	1939-57	19			2.54
Three Rivers	41 56	85 38	1939-57	19			2.84
Traverse City CAA AP	44 44	85 35	1939-57	19			2.60
Vanderbilt Trout Station	45 10	84 27	1939-57	19			1.93
Vanderbilt Trout Station	45 10	84 27	1943-57	15	.94	1.42	1.96
Wakefield	46 29	89 55	1943-57	15	1.33	2.31	2.87
Watersmeet Fish Hatchery	46 18	89 05	1939-57	19			2.93
Wayne	42 16	83 23	1939-55	17			2.33
Wellston Tippey Dam	44 15	85 57	1939-57	19			2.40
West Branch State Forest	44 20	84 17	1900-57*	56			2.16
Whitefish Point	46 46	84 58	1939-57*	11			2.11
White Pine Mine	46 45	89 34	1947-53	7			2.53
Williamston 1 NE	43 41	84 16	1943-57	15			2.41

*Breaks in Record
E = Estimated

Table 2-2, cont

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
MICHIGAN (continued)							
Willis 5 SSW	42 05	83 35	1945-57	13			2.63
Wolverine State Forest	45 17	84 37	1939-49	11			1.98
Yale	43 08	82 48	1939-57*	18			2.39
MINNESOTA							
Grand Portage Ranger Station	47 58	89 41	1940-50	11	.96	1.86	2.78
OHIO							
Akron Canton WB AP	40 55	81 26	1941-57	17	1.39	2.20	2.70
Akron WB AP	41 02	81 27	1941-50	10			3.00
Alexandria 4 W	40 05	82 41	1950-57	8			2.30
Alexandria 4 W	40 05	82 41	1940-54*	14	1.24	1.69	2.24
Alliance Sewage Plant	40 57	81 07	1940-57	18	1.34	1.91	2.80
Apco Ravenna Arsenal	41 10	81 05	1948-57	10			2.52
Ashland 2 ENE	40 54	82 18	1889-57*	48			2.59
Ashland 3 NW	40 53	82 22	1939-57	19			2.47
Ashtabula	41 51	80 48	1951-57	7			1.98
Atwood Dam	40 32	81 17	1949-57	9			2.54
Beach City Dam	40 38	81 34	1951-57	7			2.68
Beach City Dam	40 38	81 34	1940-57	18	1.34	2.01	2.48
Bellaire	40 01	80 45	1945-50*	5	.92	1.49	2.20
Bellefontaine Sewage Plant	40 21	83 46	1897-57*	57			2.79
Berlin Dam	41 02	81 00	1944-57	14	1.19	2.11	2.61
Bolivar Dam	40 39	81 26	1950-57	8			2.48
Botzum Sewage Plant	41 09	81 34	1944-50	7	1.25	1.85	2.29
Bowling Green Sewage Plant	41 23	83 38	1893-57*	64			2.49
Brecksville 3 N	41 21	81 36	1939-47	9			2.68
Bucyrus Sewage Plant	40 48	82 58	1894-57*	58			2.64
Burton	41 29	81 09	1940-57*	14	1.04	1.56	2.28
Cadiz	40 16	81 00	1893-57*	51			2.66
Cambridge SCS	40 02	81 35	1940-56*	16	1.48	1.92	2.60
Cambridge State Hospital	40 05	81 35	1897-57	61			2.55
Canal Fulton	40 53	81 36	1940-45	6	1.27	1.79	2.15
Canfield 1 S	41 00	80 45	1939-57	19			2.33
Canton 5 N	40 52	81 24	1883-48*	65			2.57
Carrollton 2 SW	40 34	81 07	1943-57	15			2.63
Carrollton 2 SW	40 34	81 08	1941-54*	13	1.28	1.96	2.67
Catawba Island 1 SW	41 33	82 51	1939-57	19			2.56
Centerburg	40 18	82 42	1948-57	10			2.52
Centerburg 2	40 18	82 42	1953-57	5			2.86
Chardon	41 35	81 12	1945-57	13			2.78
Charles Mill Dam	40 44	82 22	1943-57	15			2.75
Chesterville	40 29	82 41	1940-45*	5	1.32	1.69	2.39
Chippewa Lake	41 05	81 54	1895-57*	62			2.46
Clendening Dam	40 16	81 17	1949-57	9			2.68
Clendening Dam	40 16	81 17	1946-50	5	1.27	1.93	2.60
Cleveland Shaker Heights	41 27	81 36	1948-52	5			2.46
Cleveland WB AP	41 24	81 51	1891-57	67	1.14	1.69	2.28
Columbiana	40 53	80 41	1940-57*	16	1.09	1.72	2.29
Conneaut Water Works	41 58	80 34	1940-57*	17	1.05	1.67	2.19
Cooperdale	40 13	82 04	1949-57	9			2.48
Cortland Highway Department	41 19	80 44	1940-55	16	1.09	1.62	2.26
Coshocton Sewage Plant	40 15	81 52	1910-57	48			2.78
Coshocton 2 N	40 18	81 52	1940-50	11	1.19	2.02	2.65
Defiance	41 17	84 23	1894-57*	48			2.47
Defiance Power Plant	41 17	84 28	1940-57	18	1.29	2.02	2.66
Delaware	40 18	83 04	1898-57	60			2.64
Delaware	40 18	83 04	1940-54	15	1.14	1.92	2.57
Delaware Dam	40 22	83 04	1950-57	8			2.24
Dennison	40 24	81 21	1939-57	19			2.53
Dover Dam	40 33	81 25	1949-57	9			2.47
East Liverpool WB AP	40 41	80 38	1941-48	8	1.54	2.06	2.55
Edgerton	41 27	84 44	1941-56	16	1.24	2.04	2.61
Ellsworth	41 01	80 51	1939-57	19			2.50
Elyria 3 E	41 23	82 04	1949-57	9			2.10
Findlay CAA AP	41 01	83 40	1949-57	9			2.57
Findlay Sewage Plant	41 03	83 40	1886-57*	66			2.47
Findlay Sewage Plant	41 03	83 40	1940-50	11	1.39	2.19	2.84
Fostoria West End Substation	41 09	83 25	1940-57	18	1.44	2.03	2.44
Fredericktown	40 29	82 32	1943-57*	13			2.62
Fremont	41 20	83 07	1908-57*	40			2.71
Fremont	41 20	83 07	1940-57	18	1.29	2.04	2.66
Galion Water Works	40 43	82 47	1946-50	5	2.30	2.90	3.14
Gambier	40 22	82 23	1940-57	18	1.27	2.01	2.54
Geneva 3 SW	41 46	81 00	1947-57	11			2.54
Granger	41 09	81 44	1940-45	6	1.43	2.05	2.51
Greenville Sewage Plant	40 06	84 38	1897-57	61			2.86
Greenville Sewage Plant	40 06	84 38	1940-57*	17	1.31	2.07	2.79
Greer	40 31	82 12	1948-57	10			2.32
Hiram	41 19	81 09	1885-57*	72			2.28

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
OHIO (continued)							
Holgate	41 15	84 08	1939-51	13			2.46
Hoytville 2 NE	41 12	83 47	1952-57	6			2.17
Huntsville 1 SW	40 26	83 49	1949-57	9			2.22
Irwin	40 08	83 29	1943-57	15			2.57
Jefferson	41 44	80 46	1939-47	9			2.77
Kenton Ohio Power Company	40 38	83 37	1941-57	17	1.15	1.94	2.34
Kenton 2 W	40 39	83 39	1890-57*	64			2.61
Lakeview 3 NE	40 32	83 54	1939-57	19			2.69
La Rue	40 34	83 23	1939-57	19			2.96
Leesville Dam	40 28	81 12	1949-57	9			2.65
Lima Sewage Plant	40 43	84 07	1883-57*	58			2.57
Lima Water Works	40 45	84 05	1941-57	17	1.14	1.76	2.40
Louisville	40 50	81 16	1948-57	10			2.78
Lyons High School	41 42	84 04	1941-57*	13	1.28	2.07	2.65
Mansfield CAA AP	40 49	82 31	1948-56	9			2.27
Mansfield 6 W	40 45	82 38	1939-57	19			2.82
Marion Water Works	40 36	83 10	1891-57*	65			2.59
Marion Water Works	40 36	83 10	1940-57*	16	1.19	1.74	2.38
Marshallville	40 54	81 43	1948-57	10			2.32
Marysville	40 14	83 22	1939-57	19			2.70
Marysville Highway Department	40 14	83 22	1940-57	18	1.14	1.94	2.56
Maumee Experiment Farm	41 37	83 39	1945-50	6	1.43	2.29	2.78
Melco	40 42	82 21	1940-47	8	1.28	1.96	2.66
Middlebourne	40 03	81 20	1948-57	10			2.20
Millersburg 1 W	40 34	81 56	1939-57	19			2.53
Millersburg 1 W	40 34	81 56	1940-57*	13	1.56	1.93	2.62
Millport 2 NW	40 43	80 54	1893-57*	55			2.38
Mineral Ridge Water Works	41 09	80 47	1939-57	19			2.23
Mohawk Dam	40 21	82 05	1949-57	9			2.46
Mohicanville Dam	40 44	82 09	1949-57	9			2.23
Montpelier	41 35	84 36	1891-57*	63			2.59
Mosquito Creek Dam	41 16	80 46	1949-57	9			2.60
Mosquito Creek Dam	41 16	80 46	1944-57	14	1.24	1.72	2.35
Mount Gilead Lakes Park	40 33	82 48	1949-57	9			2.75
Nankin	40 55	82 17	1946-50	5	1.58	1.81	2.34
Napoleon	41 23	84 07	1886-57*	66			2.69
Newark Water Works	40 05	82 25	1939-57	19			2.63
Newcomerstown	40 16	81 36	1939-57	19			2.40
New Philadelphia	40 30	81 27	1946-50	5	1.42	1.91	2.66
New Philadelphia 1 A	40 29	81 26	1950-57	8			2.47
Norwalk	41 15	82 37	1894-57*	63			2.53
Norwalk Highway Department	41 15	82 36	1940-50	11	1.39	1.85	2.49
Oberlin	41 17	82 13	1883-57*	74			2.64
Oberlin	41 17	82 13	1940-57	18	1.25	1.90	2.40
Ottawa	41 01	84 03	1889-49*	55			2.43
Painesville Highway Department	41 43	81 13	1940-57	18	1.33	1.92	2.50
Painesville 2 N	41 45	81 18	1950-57	8			2.59
Pandora 2 NE	40 58	83 57	1950-57	8			2.74
Pandora 2 NE	40 58	83 57	1940-57*	15	1.29	1.95	2.62
Paulding	41 08	84 35	1939-57	19			2.84
Payne Water Works	41 05	84 44	1940-50	11	1.16	2.02	2.58
Piedmont Dam	40 11	81 13	1949-57	9			2.45
Piqua Sewage Plant	40 08	84 14	1939-53	15			2.75
Pleasant Hill Dam	40 37	82 20	1950-57	8			2.28
Pleasant Hill 1 NW	40 03	84 21	1939-57*	14			2.63
Plymouth	41 00	82 40	1939-57	19			2.81
Plymouth	41 00	82 40	1940-50	11	1.39	2.25	2.69
Prospect 3 N	40 29	83 11	1939-57*	13			2.41
Put in Bay Stone Laboratory	41 39	82 50	1940-50	11	1.20	1.82	2.33
Ravenna 2 S	41 08	81 14	1953-57	5			3.12
Ravenna 2 S	41 08	81 14	1940-57*	17	1.10	1.76	2.31
Rockford 5 WNW	40 42	84 45	1940-57*	15	1.31	2.07	2.63
Russells Point	40 28	83 54	1944-50*	6	1.22	2.38	2.69
St. Marys Water Works	40 32	84 24	1940-57*	17	1.40	2.41	2.87
St. Marys 2 W	40 32	84 25	1939-57*	14			2.53
St. Paris	40 08	83 58	1940-50*	10	1.78	2.01	2.86
Sandusky WB City	41 27	82 43	1903-57	55	1.34	2.00	2.64
Sidney	40 17	84 09	1898-57*	59			2.80
Sidney Highway Department	40 18	84 10	1941-57	17	1.38	2.20	2.81
Sidney 2	40 17	84 09	1953-57	5			2.76
South New Lyme 1 W	41 35	80 46	1940-57*	16	1.04	1.73	2.39
Spencer (nr)	41 05	82 07	1940-45	6	1.39	2.26	2.58
Steubenville Dam 10	40 23	80 37	1940-57	18	1.36	2.24	2.78
Steubenville Water Works	40 23	80 38	1943-57	15			2.92
Stillwater (nr)	40 19	81 19	1940-45	6	1.21	1.71	2.34
Tappan Dam	40 21	81 14	1949-57	9			2.45
Tiffin	41 07	83 10	1890-57*	67			2.59
Toledo Blade	41 39	83 32	1952-57	6			2.62
Toledo Sewage Plant	41 41	83 29	1950-57	8			2.47
Toledo WB Express AP	41 36	83 48	1903-57	55	1.18	1.84	2.47

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
OHIO (continued)							
Troy	40 02	84 12	1940-47	8	1.63	2.04	2.56
Upper Arlington	40 00	83 04	1952-57	6			2.08
Upper Sandusky	40 50	83 17	1883-57*	73			2.62
Upper Sandusky Water Works	40 49	83 17	1940-57*	17	1.15	1.84	2.33
Urbana Grimes Field	40 08	83 45	1899-57	59			2.67
Urbana Grimes Field	40 08	83 45	1940-57*	16	1.22	1.87	2.54
Utica	40 15	82 27	1948-57	10			2.74
Van Wert	40 52	84 35	1939-57	19			2.75
Versailles	40 14	84 29	1914-57*	39			2.70
Vickery 2 NW	41 22	82 58	1893-52*	59			2.53
Warren	41 15	80 51	1883-57*	65			2.54
Warren Ohio Edison	41 13	80 48	1939-57*	14			2.46
Warren Ohio Edison	41 13	80 48	1938-57	20	1.20	1.64	2.21
Wauseon Sewage Plant	41 33	84 08	1883-57*	74			2.55
Westerville Water Plant	40 08	82 56	1952-57*	5			2.18
Wilkins Run (nr)	40 08	82 19	1940-47	7	1.14	1.77	2.37
Willoughby 4 N	41 41	81 24	1939-57	19			2.63
Wills Creek Dam	40 09	81 51	1949-57	9			2.52
Wooster Experiment Station	40 47	81 56	1883-57*	72			2.55
Wooster Experiment Station	40 47	81 56	1940-57	18	1.38	1.95	2.34
Wooster 2 SE	40 47	81 56	1939-57	19			2.71
Youngstown WB AP	41 16	80 40	1939-50	12			2.50
Youngstown WB AP	41 16	80 40	1941-57	17	1.18	1.77	2.42
PENNSYLVANIA							
Albion	41 54	80 22	1944-54*	10			2.69
Albion	41 53	80 22	1944-50	7	1.30	1.98	2.49
Beaver Falls	40 46	80 19	1939-57	19			2.57
Burgettstown 2 W	40 23	80 26	1948-57	10			2.74
Claysville 3 W	40 07	80 28	1904-56	53			2.52
Coraopolis Neville Island	40 30	80 05	1939-57*	17			2.48
Erie CAA AP	42 05	80 12	1948-57	10			2.70
Erie WB City	42 07	80 05	1939-53	15			3.17
Erie WB City	42 07	80 05	1903-52	50	1.19	1.99	2.55
Farrell-Sharon	41 14	80 30	1939-57	19			2.78
Glenwillard Dashields Dam	40 33	80 13	1948-57	10			2.35
Greenville	41 24	80 23	1888-56*	59			2.46
Jamestown 2 NW	41 30	80 28	1942-57	16			2.62
Jamestown 2 NW	41 30	80 28	1938-57	20	1.37	2.00	2.62
Linesville 5 WNW	41 41	80 31	1939-57	19			2.72
Meadville 1 S	41 38	80 10	1939-57	19			2.63
Meadville 1 S	41 38	80 10	1937-57	21	1.16	1.76	2.36
Mercer Highway Shed	41 14	80 15	1938-57	20	1.26	1.89	2.49
Midland Dam 7	40 38	80 28	1939-57	19			2.46
Mount Lebanon	40 23	80 03	1939-45	7			2.72
New Castle 1 N	41 01	80 22	1939-57	19			2.44
New Castle 1 N Pumping Station	41 01	80 22	1938-50	13	1.32	1.86	2.32
Rochester 1 N	40 43	80 18	1938-57	20	1.20	1.82	2.38
Sharpsville	41 16	80 28	1939-51*	7			2.56
Slippery Rock	41 04	80 03	1949-57	9			2.47
Washington	40 11	80 14	1938-57*	19	1.27	1.99	2.78
WEST VIRGINIA							
New Cumberland Dam 9	40 30	80 37	1939-57	19			2.89
Weirton	40 24	80 36	1950-57	8			2.99
Wellsburg 3 NE	40 18	80 35	1939-57	19			2.58
Wheeling Warwood Dam 12	40 06	80 42	1939-57	19			2.27
WISCONSIN							
Antigo	45 09	89 09	1894-57*	59			2.55
Appleton	44 15	88 23	1939-57	19			2.53
Arlington	43 20	89 22	1939-57	19			2.98
Baraboo	43 28	89 44	1949-57	9			2.90
Beaver Dam	43 27	88 54	1949-57*	8			2.48
Beloit	42 30	89 02	1893-57	65			2.77
Berlin	43 58	88 57	1941-57*	16	1.44	2.10	2.51
Big Saint Germain Dam	45 55	89 31	1939-57	19			3.08
Blanchardville	42 48	89 52	1941-57*	14	1.70	2.79	3.82
Bowler	44 52	88 59	1949-57	9			2.27
Breakwater	45 50	88 15	1940-57	18			2.29
Brillion	44 11	88 04	1939-57*	18			2.18
Brodhead 1 SW	42 37	89 23	1898-57*	59			2.83
Brule Island	45 57	88 13	1939-57	19			2.84
Buckatabon	46 01	89 19	1945-57	13			2.90
Burlington	42 40	88 16	1949-57	9			3.16
Burnett	43 30	88 42	1939-57*	18			2.77
Burnett	43 30	88 42	1940-57	18	1.16	1.99	2.79
Chilton Sewage Plant	44 02	88 09	1945-57	13			2.86
Chilton Sewage Plant	44 02	88 09	1940-57	18	1.47	2.50	3.00
Clinton 2 N	42 37	88 52	1950-57	8			2.63

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
WISCONSIN (continued)							
Clintonville	44 37	88 45	1940-57	18	1.39	2.02	2.34
Coddington 1 E	44 22	89 32	1939-57	19			2.94
Coddington 1 E	44 22	89 32	1941-57	17	1.27	2.18	2.76
Crivitz High Falls	45 17	88 12	1912-57	46			2.35
Dalton	43 39	89 12	1945-57	13			2.53
Dunbar (nr)	45 38	88 08	1940-46	7	1.08	1.81	2.70
Eagle 5 N	42 57	88 27	1940-57*	17	1.27	1.90	2.64
Eagle River 4 W	45 54	89 19	1947-57*	10			3.50
Eau Pleine Reservoir	44 44	89 45	1947-57	11			2.33
Eau Pleine Reservoir	44 44	89 45	1940-57	18	1.10	1.89	2.51
El Dorado 1 SE	43 48	88 37	1941-57	17			2.56
El Dorado 1 SE	43 48	88 37	1941-57*	16	1.25	2.00	2.62
Florence	45 54	88 16	1892-35*	43			2.58
Fond du Lac	43 47	88 27	1892-57*	65			2.47
Fort Atkinson	42 54	88 50	1941-57	17			2.98
Friendship Ranger Station	43 58	89 49	1940-57	18	1.40	1.98	2.52
Germantown 2 W	43 13	88 09	1945-57	13			2.76
Green Bay WB AP	44 29	88 08	1902-57	56	1.15	1.84	2.29
Hancock Experiment Farm	44 07	89 32	1903-57*	53			2.73
Hartford Sewage Plant	43 19	88 23	1940-49*	8	1.38	1.97	2.74
Janesville	42 40	89 01	1945-57	13			2.77
Janesville	42 40	89 01	1941-57	17	1.45	2.18	2.86
Kenosha	42 33	87 49	1944-57	14			2.58
Kewaunee	44 28	87 30	1909-57*	43			2.35
Lac Vieux Desert	46 08	89 08	1945-57	13			2.69
Lake Geneva	42 36	88 26	1946-57	12			2.48
Lake Mills	43 04	88 55	1892-57	66			2.77
Land O' Lakes	46 10	89 13	1942-54*	8			2.80
Laona 4 SSW	45 30	88 42	1939-57*	16			2.54
Lily	45 19	88 51	1942-57*	11	1.02	1.91	2.52
Long Lake Dam	45 54	89 08	1908-57	50			2.58
Madison WB AP	43 08	89 20	1905-57	53	1.36	2.08	2.78
Manitowoc	44 06	87 40	1892-57	66			2.57
Marinette	45 06	87 38	1919-57	39			2.13
Menasha	44 12	88 28	1896-56	61			2.55
Merrill	45 11	89 41	1939-57	19			2.62
Merrill	45 11	89 41	1941-57	17	1.43	2.03	2.53
Milwaukee Mount Mary College	43 04	88 02	1948-57	10			2.75
Milwaukee North Side	43 06	87 59	1952-57	6			3.42
Milwaukee WB AP	42 57	87 54	1896-57	62	1.28	1.98	2.54
Minocqua Dam	45 53	89 44	1939-57	19			2.75
Monroe 1 W	42 36	89 40	1949-57	9			3.19
Montello	43 48	89 19	1896-57	62			2.57
Mount Horeb 1 WSW	43 00	89 46	1952-57	6			3.19
New London	44 23	88 44	1896-57	62			2.67
North Pelican	45 38	89 15	1945-57	13			2.24
Oconomowoc 1 SW	43 06	88 31	1945-57	13			2.92
Oconto	44 53	87 53	1892-57	66			2.24
Oshkosh	44 03	88 32	1892-57*	63			2.59
Peshtigo Power Plant	45 04	87 44	1941-50	9	1.06	1.57	2.14
Phelps Deerskin Dam	46 03	89 02	1911-57	47			2.66
Phelps Deerskin Dam	46 03	89 02	1943-57*	12	1.27	1.92	2.64
Pine River 3 NE	44 11	89 02	1895-57*	60			2.54
Plymouth	43 45	87 59	1939-57	19			2.48
Portage	43 32	89 27	1939-57	19			2.53
Portage	43 32	89 27	1941-57*	16	1.25	1.89	2.62
Port Washington	43 23	87 52	1894-57*	63			2.53
Prairie du Sac 2 N	43 19	89 44	1911-57	47			2.64
Racine	42 43	87 49	1896-57	62			2.57
Rainbow Reservoir	45 50	89 33	1947-57	11			2.63
Rainbow Reservoir	45 50	89 32	1945-50	6	1.30	1.93	2.58
Reedsburg	43 31	90 00	1945-57	13			3.06
Rest Lake	46 08	89 53	1913-57	45			2.85
Rhinelander	45 38	89 25	1908-57	50			2.57
Rib Falls	44 58	89 54	1945-57	13			2.36
Rice Reservoir	45 32	89 45	1945-57	13			2.59
Ripon 5 NE	43 52	88 45	1948-57	10			2.28
Rosholt Collins Memorial Park	44 36	89 20	1941-57*	14			2.17
Shawano	44 47	88 37	1892-57*	45			2.44
Sheboygan	43 45	87 43	1900-57	58			2.59
South Pelican	45 32	89 12	1945-57	13			2.45
Spirit Falls	45 27	89 59	1945-57	13			2.72
Stevens Point	44 30	89 34	1893-57*	63			2.65
Stoughton	42 55	89 13	1939-57	19			2.51
Sturgeon Bay Experiment Farm	44 52	87 20	1905-57	53			2.30
Sturgeon Bay Experiment Farm	44 52	87 20	1941-50	10	1.07	1.66	2.18
Sugar Camp	45 52	89 24	1945-57	13			2.66
Summit Lake Ranger Station	45 23	89 12	1949-57	9			2.50
Three Lakes Ranger Station	45 47	89 05	1941-57*	16	1.18	1.90	2.58
Tomahawk	45 28	89 44	1945-49	5	1.22	2.32	2.86

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
WISCONSIN (continued)							
Tomahawk Spirit Reservoir	45 26	89 45	1903-57*	48			2.49
Townsend	45 20	88 35	1945-57*	12			2.63
Two Rivers	44 09	87 34	1952-57	6			2.82
Union Grove	42 42	88 03	1941-57	17			2.62
Washington Island	45 24	86 51	1946-50	5	1.10	1.49	2.21
Washington Island 1 N	45 21	86 57	1945-57	13			2.34
Watertown	43 12	88 43	1939-57	19			2.80
Waukesha	43 01	88 14	1939-57	19			2.22
Waupaca	44 22	89 05	1939-57	19			2.72
Wausau	44 57	89 37	1945-50	6	1.39	2.35	2.61
Wausau Old Post Office	44 57	89 38	1895-57*	61			2.72
Wausaukee	45 23	87 57	1945-57	13			2.16
West Allis	43 01	87 59	1952-57	6			2.51
West Bend	43 25	88 11	1939-57	19			2.84
Whitewater	42 50	88 44	1941-57	17			2.89
Williams Bay	42 35	88 32	1921-57	37			2.79
Willow Reservoir	45 43	89 51	1939-57	19			2.34
Wisconsin Dells	43 38	89 47	1922-57	36			2.63
Wisconsin Rapids	44 23	89 48	1892-57*	60			2.58
Wisconsin Rapids Grand Avenue Bridge	44 24	89 49	1940-57*	17			2.48

*Breaks in Record

Table 2-3. Station Data 100-Year 1-, 6-, and 24-Hour

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
ILLINOIS							
Aurora College	41 45	88 20	1887-57*	65			7.65
Belvidere Sewage Plant	42 16	88 52	1940-57	18	3.43	5.74	7.72
Bloomington Normal	40 30	89 00	1895-57	63			6.28
Chicago WB AP	41 47	87 45	1900-57	58	2.99	4.89	5.96
Clinton 1 SSW	40 08	88 58	1910-57	48			6.65
Crete	41 27	87 38	1943-57	15	3.65	5.61	9.57
Danville	40 08	87 38	1940-57*	17	3.08	5.17	6.27
Dixon	41 51	89 29	1887-57*	64			6.23
Downs 2 NE	40 25	88 51	1940-57	18	3.49	5.67	7.09
Dwight State Reformatory	41 05	88 28	1940-56	17	3.93	6.39	7.16
Edelstein	40 57	89 38	1943-57	15	3.39	5.04	6.31
Fairbury Water Works	40 44	88 31	1941-57	17	4.21	8.31	10.11
Freeport Sewage Plant	42 17	89 36	1941-57	17	3.81	5.83	6.89
Kankakee Sewage Plant	41 08	87 53	1941-57	17	4.30	6.20	10.21
Kewanee Baker Park	41 15	89 54	1941-57	17	2.71	5.13	6.73
Lincoln	40 09	89 22	1906-57*	51			6.04
Marengo	42 15	88 36	1887-57*	65			5.04
Maroa	40 02	88 58	1941-57	17	3.55	4.43	4.71
Mason City	40 12	89 41	1941-57	17	3.65	5.17	6.08
McHenry	42 21	88 16	1940-57	18	2.39	3.88	4.96
Minonk	40 54	89 02	1887-57*	63			6.23
Morrison	41 49	89 58	1896-57	62			6.00
Mount Carroll	42 05	89 58	1887-57*	65			6.41
Ottawa	41 22	88 50	1887-57*	63			5.63
Paw Paw	41 41	88 59	1913-57	45			5.55
Peoria WB AP	40 40	89 41	1905-57	53	2.81	4.87	6.02
Pontiac	40 53	88 37	1887-57*	57			6.17
Prophetstown	41 40	89 56	1940-57	18	3.00	5.30	6.81
Rantoul Chanute Air Force Base	40 18	88 09	1941-57*	16	2.66	4.68	7.32
Roberts 3 N	40 40	88 11	1911-57	47			5.92
Rockford	42 17	89 05	1895-56*	55			7.69
Shabbona 5 NNE	41 50	88 51	1940-57	18	3.65	5.66	8.61
Sycamore	41 59	88 41	1887-57*	65			6.02
Walnut	41 33	89 35	1895-57	63			5.65
Watseka	40 46	87 44	1887-57*	59			6.82
Wenona	41 03	89 03	1941-57*	16	3.24	5.17	7.45
INDIANA							
Albion	41 24	85 26	1917-57	41			5.33
Anderson Mounds State Park	40 05	85 37	1940-57	18	3.73	4.16	5.29
Anderson Sewage Plant	40 06	85 43	1897-57	61			5.27
Angola	41 38	85 00	1897-57*	49			6.49
Attica Power Plant	40 18	87 15	1942-57	16	3.87	5.65	6.46
Berne	40 40	84 57	1910-57	48			5.09
Bluffton	40 44	85 11	1897-57*	60			5.60
Collegeville St. Joseph College	40 56	87 09	1900-57	58			6.05
Columbia City 1 S	41 08	85 29	1940-57	18	3.45	4.42	5.23
Crawfordsville Power Plant	40 03	86 54	1898-57*	55			7.16
Delphi	40 35	86 40	1897-57	61			5.49
Fort Wayne WB AP	41 00	85 12	1911-57	47	2.58	4.35	5.38
Fowler American Legion Hall	40 37	87 19	1940-57	18	3.70	5.04	5.68
Frankfort	40 17	86 30	1941-57	17	3.29	5.69	8.26
Frankfort Disposal Plant	40 19	86 30	1914-57	44			6.28
Goshen College	41 34	85 50	1916-57	42			5.21
Howe	41 43	85 25	1906-52	47			6.05
Huntington	40 53	85 30	1897-57	61			5.62
Kokomo Post Office	40 29	86 08	1897-56	60			7.14
Lagrange	41 39	85 25	1940-57	18	2.58	4.12	5.71
Lakeville	41 32	86 17	1940-57	18	3.23	5.18	5.98
La Porte	41 36	86 43	1897-57	61			7.03
Lebanon Water Works	40 04	86 28	1940-57	18	3.68	6.46	7.89
Logansport Cicott Street Bridge	40 45	86 23	1897-57*	57			7.06
Marion 2 N	40 34	85 40	1897-57	61			5.93
Medaryville State Nursery	41 10	86 54	1941-57	17	3.39	4.44	5.10
Monticello	40 45	86 46	1910-57*	46			5.53
Muncie 4 SE	40 08	85 21	1917-57*	38			5.47
Noblesville	40 02	86 01	1914-57	44			6.27
Notre Dame Moreau Seminary	41 42	86 14	1912-53	42			4.98
Peru Water Works	40 45	86 03	1940-57*	17	2.38	4.82	5.98
Plymouth Power Substation	41 20	86 20	1906-57*	50			5.63
Portland	40 26	85 00	1940-57*	17	2.09	4.13	5.70
Rochester	41 04	86 13	1904-57*	44			6.17
Salamonia 7 W	40 23	85 00	1898-57	60			5.62
Shelby	41 11	87 21	1940-57*	17	2.94	3.39	4.93
South Bend WB AP	41 42	86 19	1941-57	17	3.04	3.73	4.61
Tipton Highway Garage	40 17	86 04	1940-57	18	3.69	5.36	5.83
Valparaiso Water Works	41 31	87 02	1897-57*	52			6.91
Veedersburg	40 07	87 16	1900-52	53			6.18
Warsaw	41 14	85 52	1897-57*	52			6.46
Waterloo Highway Garage	41 26	85 01	1940-57	18	2.47	3.98	5.51

*Breaks in Record

Table 2-3, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
INDIANA (continued)							
West Lafayette CAA AP	40 25	86 56	1897-57	61			5.85
Wheatfield	41 11	87 04	1917-57	41			5.70
Whitestown	40 00	86 20	1909-57	49			7.12
Whiting	41 40	87 29	1910-57	48			6.40
Winamac	41 03	86 36	1897-57*	49			6.19
MICHIGAN							
Adrian	41 54	84 02	1888-57*	69			5.14
Allegan Sewage Plant	42 32	85 51	1910-57	48			5.18
Allegan Sewage Plant	42 32	85 51	1940-57	18	2.35	4.17	4.72
Alma	43 23	84 40	1888-57	70			5.13
Alpena WB City	45 04	83 26	1911-57	47	2.30	3.15E	4.00
Ann Arbor University of Michigan	42 17	83 44	1940-57*	17	2.78	3.77	4.46
Bay City Gas Plant	43 36	83 54	1896-57	62			6.09
Benton Harbor AP	42 08	86 26	1898-57	60			6.29
Big Rapids Water Works	43 42	85 29	1888-57*	64			4.58
Burnside 1 E	43 12	83 03	1941-57	17	2.61	3.34	3.97
Charlotte	42 32	84 50	1902-57*	54			4.51
Chatham Experiment Farm	46 21	86 56	1900-57*	57			4.69
Cheboygan Power Plant	45 38	84 29	1941-57	17	1.85	2.47	3.32
Coldwater Sewage Treatment Plant	41 56	85 01	1942-57	16	3.19	4.40	5.19
Crystal Falls 6 NE	46 10	88 14	1943-57	15	2.10	3.34	3.83
Detroit WB AP	42 24	83 00	1896-57	62	2.99	4.46	5.01
Eagle Harbor Coast Guard	47 28	88 10	1899-57*	39			4.28
East Lansing WB City	42 44	84 29	1910-57	48	2.35	3.29	4.10
East Tawas U. S. Forest	44 17	83 29	1897-57	61			4.56
Elberta 4 SE	44 35	86 10	1900-57*	51			4.84
Escanaba WB City	45 45	87 03	1903-57	55	2.25	3.56E	4.86
Ewen	46 32	89 16	1943-57	15	3.07	4.66	6.34
Fayette Sack Bay	45 38	86 41	1921-57	37			4.77
Grand Haven WB City	43 04	86 14	1906-32*	26	2.53	4.38	5.07
Grand Rapids WB AP	42 54	85 40	1905-57	53	2.28	4.10	5.16
Grayling Military Reservation	44 38	84 47	1889-57*	68			4.54
Harbor Beach	43 50	82 39	1940-57	18	4.04	4.38	4.39
Harrison	44 01	84 48	1890-57*	51			5.14
Harrisville	44 40	83 18	1888-57	70			4.34
Hart	43 42	86 22	1888-57*	61			4.79
Hastings Fisheries	42 39	85 18	1888-57*	60			5.35
Hillsdale	41 55	84 38	1897-57	61			5.81
Holland Hope College	42 47	86 07	1905-57	53			4.78
Houghton Lake 3 NW	44 20	84 49	1910-57	48			5.08
Houghton WB City	47 07	88 34	1901-32	32	1.87	3.18	4.27
Howell 7 NE	42 42	83 53	1940-57	18	3.50	5.75	6.45
Iron River	46 05	88 40	1896-35	40			5.08
Ironwood	46 27	90 10	1902-57*	51			6.87
Ishpeming	46 29	87 39	1899-57*	55			5.34
Jackson 3 N	42 17	84 24	1940-57*	16	2.75	5.16	6.16
Kalamazoo Power Plant	42 18	85 34	1940-57	18	2.90	4.46	4.94
Ludington State Park	44 02	86 30	1940-55	16	2.99	5.17	6.02
Ludington 4 SE	43 55	86 25	1897-57*	60			5.26
Mackinaw City	45 47	84 44	1896-57*	58			4.17
Marquette WB City	46 34	87 24	1906-57*	51	2.58	3.72E	4.85
Midland Dow Chemical	43 37	84 15	1896-57*	58			5.19
Milford General Motors Proving Ground	42 33	83 41	1941-57	17	2.72	5.59	6.50
Mio Hydro Plant	44 40	84 08	1888-57*	49			3.62
Monroe Water Works	41 55	83 23	1917-57	41			4.38
Mount Clemens Air Force Base	42 36	82 49	1897-57*	58			4.54
Mount Pleasant College	43 36	84 47	1896-57*	58			5.15
Munising	46 24	86 39	1911-57	47			3.95
Muskegon WB AP	43 10	86 14	1941-57	17	2.16	3.31	4.60
Newaygo Croton Dam	43 27	85 40	1908-57	50			4.66
Newberry State Hospital	46 20	85 30	1897-57*	57			4.74
Owosso Sewage Plant	43 01	84 11	1896-57*	61			4.42
Paw Paw 2 E	42 13	85 51	1889-57*	31			6.19
Petoskey	45 22	84 58	1896-57*	51			5.05
Port Huron WB City	43 00	82 26	1904-32*	28	2.62	3.56	4.43
Sandusky	43 25	82 50	1909-57*	38			4.34
Sault Ste. Marie WB AP	46 28	84 22	1901-57	57	1.73	3.01	4.43
South Haven Experiment Farm	42 24	86 17	1896-57*	61			5.27
Steuben 2 WNW	46 12	86 30	1943-57	15	2.42	2.94	4.75
Vanderbilt Trout Station	45 10	84 27	1943-57	15	2.13	2.95	3.40
Wakefield	46 29	89 55	1943-57	15	3.80	5.74	7.27
West Branch State Forest	44 20	84 17	1900-57*	56			4.79
OHIO							
Akron Canton WB AP	40 55	81 26	1941-57	17	3.64	6.61	7.02
Alliance Sewage Plant	40 57	81 07	1940-57	18	2.96	3.60	5.66
Ashland 2 ENE	40 54	82 18	1889-57*	48			5.38
Beach City Dam	40 38	81 34	1940-57	18	3.56	4.21	4.41
Bellefontaine Sewage Plant	40 21	83 46	1897-57*	57			5.83

*Breaks in Record
E = Estimated

Table 2-3, cont.

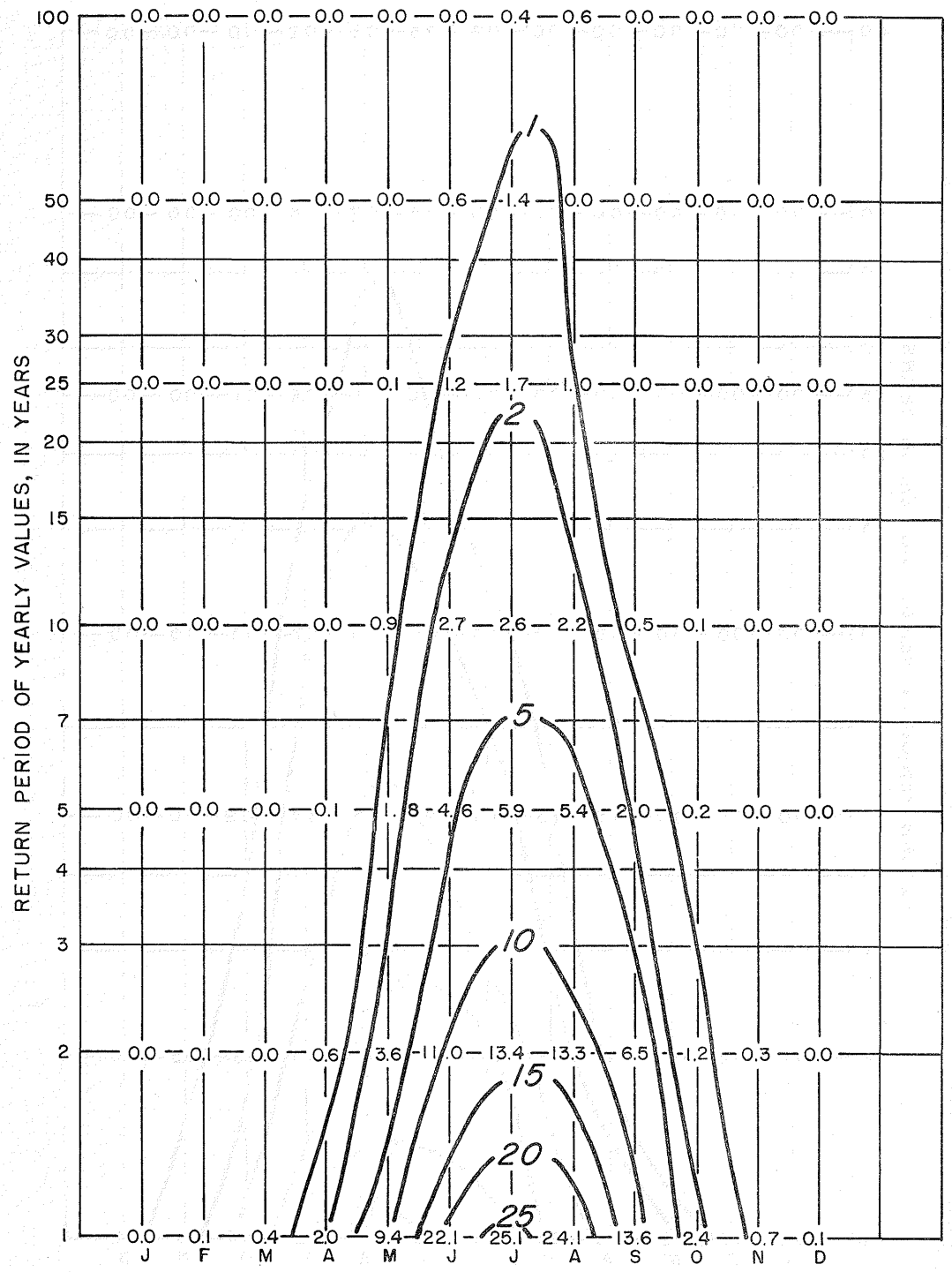
STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
OHIO (continued)							
Bowling Green Sewage Plant	41 23	83 38	1893-57*	64			4.84
Bucyrus Sewage Plant	40 48	82 58	1894-57*	58			5.94
Cadiz	40 16	81 00	1893-57*	51			4.82
Cambridge SCS	40 02	81 35	1940-56*	16	3.26	4.56	6.03
Cambridge State Hospital	40 05	81 35	1897-57	61			5.71
Canton 5 N	40 52	81 24	1883-48*	65			5.20
Chippewa Lake	41 05	81 54	1895-57*	62			4.56
Cleveland WB AP	41 24	81 51	1891-57	67	2.45	3.77	4.71
Columbiana	40 53	80 41	1940-57*	16	2.34	3.53	5.05
Conneaut Water Works	41 58	80 34	1940-57*	17	1.95	3.32	4.22
Cortland Highway Department	41 19	80 44	1940-55	16	2.51	3.63	4.80
Coshocton Sewage Plant	40 15	81 52	1910-57	48			6.70
Defiance	41 17	84 23	1894-57*	48			5.31
Defiance Power Plant	41 17	84 28	1940-57	18	3.19	4.05	4.94
Delaware	40 18	83 04	1898-57	60			5.70
Delaware	40 18	83 04	1940-54	15	1.82	3.38	5.39
Edgerton	41 27	84 44	1941-56	16	3.07	4.05	5.17
Findlay Sewage Plant	41 03	83 40	1886-57*	66			4.72
Fostoria West End Substation	41 09	83 25	1940-57	18	3.13	4.74	5.33
Fremont	41 20	83 07	1908-57*	40			6.04
Fremont	41 20	83 07	1940-57	18	2.66	3.83	4.91
Gambier	40 22	82 23	1940-57	18	2.54	3.92	4.13
Greenville Sewage Plant	40 06	84 38	1897-57	61			6.14
Greenville Sewage Plant	40 06	84 38	1940-57*	17	2.60	4.18	5.54
Hiram	41 19	81 09	1885-57*	72			4.26
Kenton Ohio Power Company	40 38	83 37	1941-57	17	2.59	4.50	4.86
Kenton 2 W	40 39	83 39	1890-57*	64			4.86
Lima Sewage Plant	40 43	84 07	1883-57*	58			5.41
Lima Water Works	40 45	84 05	1941-57	17	2.60	3.59	4.96
Marion Water Works	40 36	83 10	1891-57*	65			5.49
Marion Water Works	40 36	83 10	1940-57*	16	2.75	3.44	5.09
Marysville Highway Department	40 14	83 22	1940-57	18	2.35	4.34	5.01
Millport 2 NW	40 43	80 54	1893-57*	55			4.29
Montpelier	41 35	84 36	1891-57*	63			4.65
Napoleon	41 23	84 07	1886-57*	66			5.51
Norwalk	41 15	82 37	1894-57*	63			4.97
Oberlin	41 17	82 13	1883-57*	74			5.30
Oberlin	41 17	82 13	1940-57	18	2.87	4.50	4.79
Ottawa	41 01	84 03	1889-49*	55			4.83
Painesville Highway Department	41 43	81 13	1940-57	18	4.24	4.24	5.55
Pandora 2 NE	40 58	83 57	1940-57*	15	2.94	3.76	5.43
Ravenna 2 S	41 08	81 14	1940-57*	17	2.66	4.31	4.82
Rockford 5 WNW	40 42	84 45	1940-57*	15	3.16	3.65	4.93
St. Marys Water Works	40 32	84 24	1940-57*	17	3.22	5.28	6.26
Sandusky WB City	41 27	82 43	1903-57	55	3.13	4.88	5.67
Sidney	40 17	84 09	1898-57*	59			5.20
Sidney Highway Department	40 18	84 10	1941-57	17	2.85	4.97	5.01
South New Lyme 1 W	41 35	80 46	1940-57*	16	2.02	3.29	4.52
Steubenville Dam 10	40 23	80 37	1940-57	18	3.83	7.22	7.31
Tiffin	41 07	83 10	1890-57*	67			5.35
Toledo WB Express AP	41 36	83 48	1903-57	55	2.94	4.54	5.31
Upper Sandusky	40 50	83 17	1883-57*	73			5.20
Upper Sandusky Water Works	40 49	83 17	1940-57*	17	2.65	4.12	4.28
Urbana Grimes Field	40 08	83 45	1899-57	59			4.92
Urbana Grimes Field	40 08	83 45	1940-57*	16	2.15	3.13	4.87
Versailles	40 14	84 29	1914-57*	39			4.81
Vickery 2 NW	41 22	82 58	1893-52*	59			4.83
Warren	41 15	80 51	1883-57*	65			4.81
Warren Ohio Edison	41 13	80 48	1938-57	20	2.38	2.77	3.92
Wauseon Sewage Plant	41 33	84 08	1883-57*	74			4.54
Wooster Experiment Station	40 47	81 56	1883-57*	72			5.37
Wooster Experiment Station	40 47	81 56	1940-57	18	3.33	3.96	4.65
Youngstown WB AP	41 16	80 40	1941-57	17	2.34	3.97	5.38
PENNSYLVANIA							
Claysville 3 W	40 07	80 28	1904-56	53			4.86
Erie WB City	42 07	80 05	1903-52	50	2.89	6.71	7.44
Greenville	41 24	80 23	1888-56*	59			5.24
Jamestown 2 NW	41 30	80 28	1938-57	20	3.27	4.37	5.55
Meadville 1 S	41 38	80 10	1937-57	21	3.08	4.09	4.87
Mercer Highway Shed	41 14	80 15	1938-57	20	2.35	4.43	5.40
Rochester 1 N	40 43	80 18	1938-57	20	2.01	3.43	4.33
Washington	40 11	80 14	1938-57*	19	2.57	4.73	6.56
WISCONSIN							
Antigo	45 09	89 09	1894-57*	59			5.20
Beloit	42 30	89 02	1893-57	65			5.29
Berlin	43 58	88 57	1941-57*	16	4.80	5.36	6.16
Brodhead 1 SW	42 37	89 23	1898-57*	59			6.36
Burnett	43 30	88 42	1940-57	18	2.58	3.92	7.20

*Breaks in Record
E = Estimated

Table 2-3, cont.

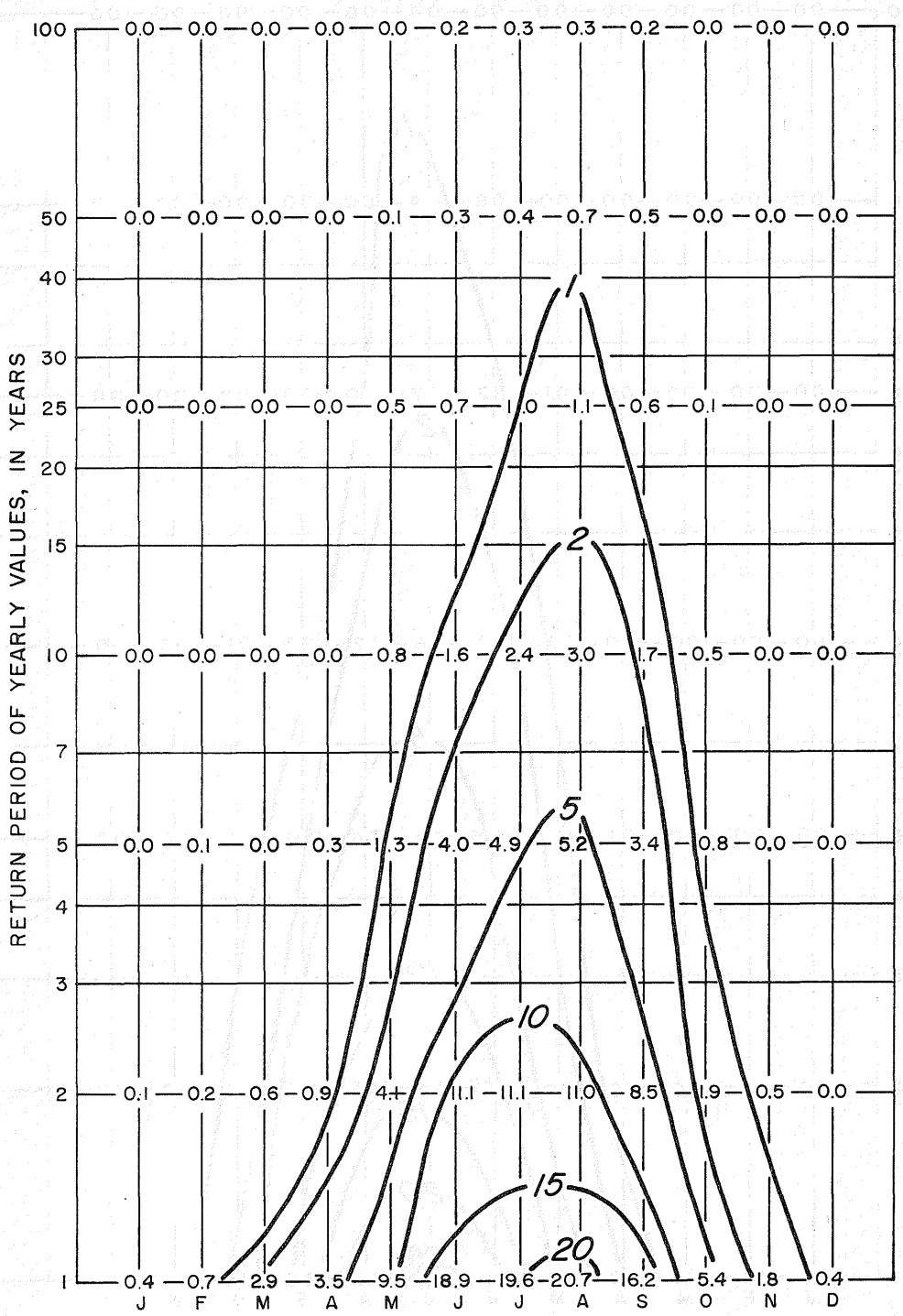
STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
WISCONSIN (continued)							
Chilton Sewage Plant	44 02	88 09	1940-57	18	4.14	7.42	8.57
Clintonville	44 37	88 45	1940-57	18	2.82	4.53	4.83
Coddington 1 E	44 22	89 32	1941-57	17	3.01	5.62	6.64
Crivitz High Falls	45 17	88 12	1912-57	46			4.34
Eagle 5 N	42 57	88 27	1940-57*	17	2.61	4.05	6.08
Eau Pleine Reservoir	44 44	89 45	1940-57	18	2.38	4.53	6.17
El Dorado 1 SE	43 48	88 37	1941-57*	16	2.24	4.40	5.65
Florence	45 54	88 16	1892-35*	43			5.00
Fond du Lac	43 47	88 27	1892-57*	65			5.06
Friendship Ranger Station	43 58	89 49	1940-57	18	2.62	4.13	5.50
Green Bay WB AP	44 29	88 08	1902-57	56	2.47	3.92	4.72
Hancock Experiment Farm	44 07	89 32	1903-57*	53			5.81
Janesville	42 40	89 01	1941-57	17	3.05	4.86	6.22
Kewaunee	44 28	87 30	1909-57*	43			5.29
Lake Mills	43 04	88 55	1892-57	66			5.78
Long Lake Dam	45 54	89 08	1908-57	50			6.48
Madison WB AP	43 08	89 20	1905-57	53	3.01	4.61	5.92
Manitowoc	44 06	87 40	1892-57	66			6.08
Marinette	45 06	87 38	1919-57	39			3.76
Menasha	44 12	88 28	1896-56	61			5.01
Merrill	45 11	89 41	1941-57	17	3.09	3.99	5.91
Milwaukee WB AP	42 57	87 54	1896-57	62	2.71	4.26	5.50
Montello	43 48	89 19	1896-57	62			5.41
New London	44 23	88 44	1896-57	62			5.49
Oconto	44 53	87 53	1892-57	66			4.52
Oshkosh	44 03	88 32	1892-57*	63			6.07
Phelps Deerskin Dam	46 03	89 02	1911-57	47			6.00
Pine River 3 NE	44 11	89 02	1895-57*	60			5.11
Portage	43 32	89 27	1941-57*	16	2.30	3.72	5.40
Port Washington	43 23	87 52	1894-57*	63			5.22
Prairie du Sac 2 N	43 19	89 44	1911-57	47			5.45
Racine	42 43	87 49	1896-57	62			5.04
Rest Lake	46 08	89 53	1913-57	45			7.20
Rhinelander	45 38	89 25	1908-57	50			5.04
Shawano	44 47	88 37	1892-57*	45			5.17
Sheboygan	43 45	87 43	1900-57	58			5.91
Stevens Point	44 30	89 34	1893-57*	63			5.61
Sturgeon Bay Experiment Farm	44 52	87 20	1905-57	53			4.57
Three Lakes Ranger Station	45 47	89 05	1941-57*	16	2.24	3.72	6.08
Tomahawk Spirit Reservoir	45 26	89 45	1903-57*	48			4.73
Wausau Old Post Office	44 57	89 38	1895-57*	61			6.44
Williams Bay	42 35	88 32	1921-57	37			5.61
Wisconsin Dells	43 38	89 47	1922-57	36			5.37
Wisconsin Rapids	44 23	89 48	1892-57*	60			5.28

*Breaks in Record



Probability in percent of obtaining a rainfall in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

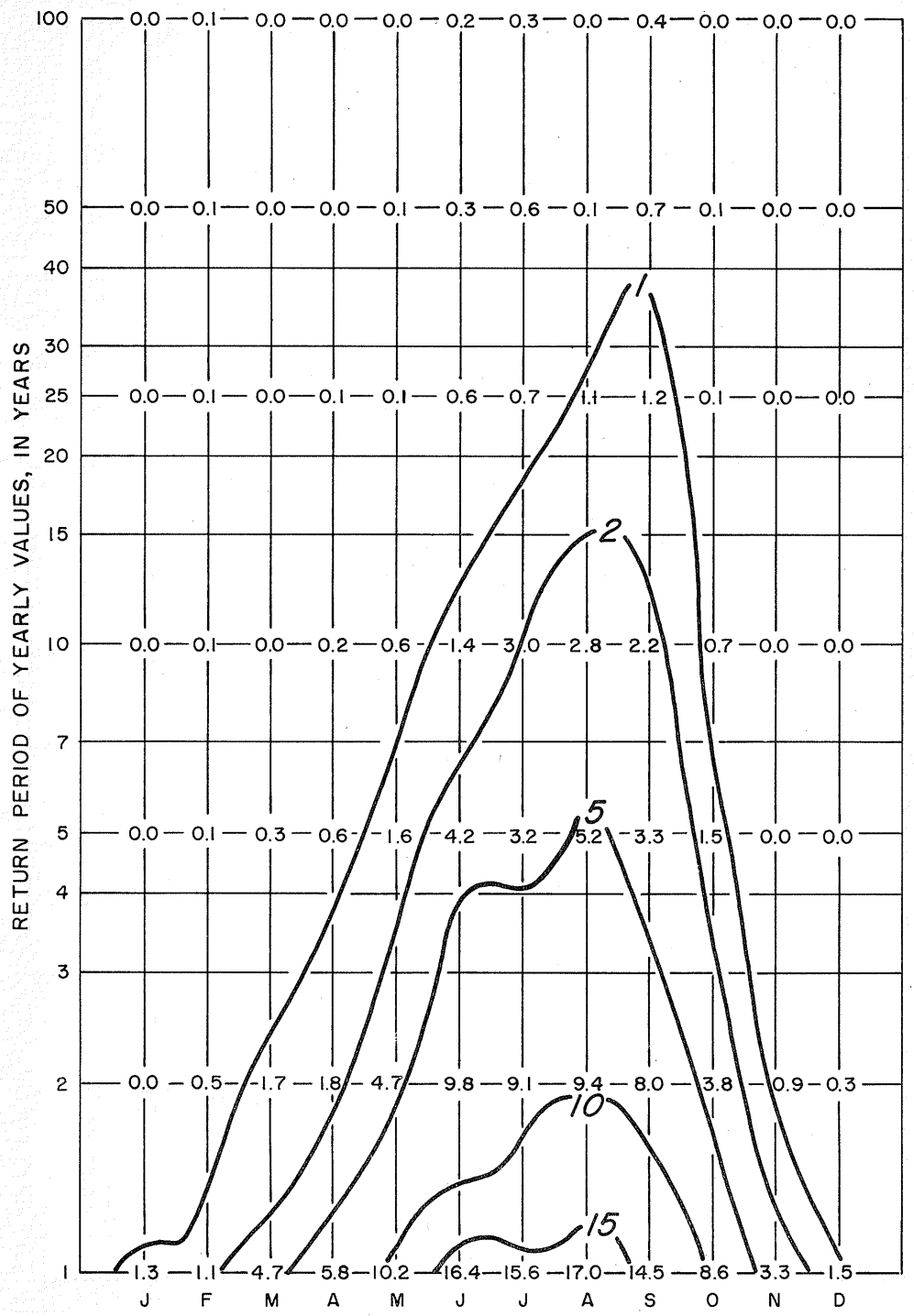
Figure 2-8



Probability in percent of obtaining a rainfall in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

Figure 2-9

SEASONAL PROBABILITY OF INTENSE PRECIPITATION
24-HOUR DURATION



Probability in percent of obtaining a precipitation in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

Figure 2-10

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