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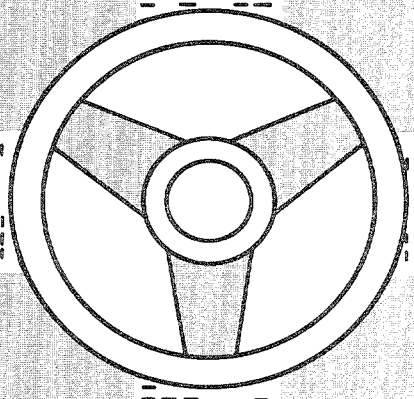
Electronic Computer Program For

FLOOD RECORD COMPILATION AND FREQUENCY PLOT

(BPR PROGRAM HY-5)

Developed by:

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
Bureau of Public Roads



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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
WASHINGTON, D. C.

FLOOD RECORD COMPILATION AND FREQUENCY PLOT

(BPR PROGRAM NO. HY-5)

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PREFACE

This booklet describes a method whereby annual maximum flood records can be stored, retrieved and displayed for use by engineers involved in the design of a stream crossing. The data is the annual flood data published by the U. S. Geological Survey in their water supply papers. The graphical display of the data is based on a Gumbel recurrence interval.

The computer system was developed in order to allow for as frequent as required updating of the frequency plots. The manual updating of the plot is time-consuming due to the need for recalculating the return period each time a new flood record is added. However, through the use of the computer, the flood record can be updated and the frequency plot generated automatically.

This revised edition is published in order to clear up some inconsistencies encountered in the frequency plot and gaging station index. The frequency plot has been revised to change the method of printing the vertical scale. The index has necessitated an increase in the size of tables used for creating the gaging station index. These changes are in the computer program entitled, "Flood Record Reports."

ACKNOWLEDGEMENTS

The authors greatly appreciate the initial concept of a computer system by Mr. Hugh Berger, Hydraulics Engineer, Bureau of Public Roads, Denver, Colorado; the revisions suggested by Mr. Sam Fox, Hydraulics Engineer, Texas Highway Department, Austin, Texas and the Hydraulics Section, Minnesota Department of Highways, St. Paul, Minnesota.

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STATEMENT OF PROBLEM

The U. S. Geological Survey and other agencies have measured and recorded peak or flood discharges for streams at gaging stations located throughout the United States. Most of these records are published in the Survey's Water Supply Papers, but complete and current records are seldom available in every highway design office. The purpose of this program is to present flood records and associated frequency curves for all gaging stations within any State in a form that can be used for immediate reference. (See Example Problem for sample print-out)

The compilation of records and frequency plots can be used in making a regional flood frequency analysis or a flood frequency study for the design of a proposed structure. In addition to furnishing information for making such analyses, the compilation provides a means of evaluating the magnitude and frequency of a recent flood if a gaging station exists upstream or downstream from a proposed site. In preparing the data for submission to the computer, all available publications and files are searched and flood records are copied onto a tabulation sheet. The flood data are then keypunched onto data cards.

The computer system is initiated by the submission of the data cards to the computer using the Flood Record Compilation Program. This first part of the system creates two tapes or tape files, one containing the identification and location of the gaging stations and the other containing associated flood records. These tape files are then used in the subsequent operations of updating or sorting the data, indexing, printing the flood discharges and plotting the frequency curves. The flow chart, Figure 1, of the system shows the interrelationship of the input, computer programs and output.

When additional flood data for either existing or new gaging stations are available, it is necessary to update the existing tape files. To accomplish this the additional data is keypunched and the Flood Record Update Program is used to create new tape files. The new tape files will contain all information from the previous tape files plus the new information. The new tape files are used in the subsequent operations of sorting, indexing, printing of data and plotting frequency curves.

To produce reports of the printed data and frequency curves, it is necessary to sort the tape file containing gaging stations identification and location. This sorting produces a tape file of the stream names in alphabetical order which is used in the Flood Record Reports Program.

The Flood Record Reports Program is the heart of the system and produces a flood record tabulation, frequency plot for each gaging station and an index of all the gaging stations. R. W. Powell's graphical adaptation of E. J. Gumbel's statistical theory of extreme values is used for plotting the frequency curves. Print-outs from selected gaging stations may be obtained from the program if desired.

SYSTEM DESCRIPTION

The computer system for Flood Record Compilation and Frequency Plot was developed to provide an orderly manner for storing flood records and for producing the necessary reports. The flow chart of the system, shown in Figure 1, depicts the interrelationships of the input, computer programs and output.

To initiate the system, flood data are keypunched into data cards which are used with the Flood Record Compilation program. The program creates two tape files, one containing the identification and location of the gaging stations and the other containing associated flood records. These output tapes are then used in the subsequent operations of updating or sorting and report producing.

When additional flood data for either existing or new locations are available, it is necessary to update the existing files. At this time the additional data is keypunched and used by the Flood Record Update program to create new tape files. The new tape files will contain all information from the previous data and identification files plus the new information. The new tape files are used in the subsequent operations of sorting and report producing.

Whenever the reports are to be produced, it is necessary to sort the file containing gaging station identification and location. This sort produces a tape file of the stream names in alphabetical order which is used in the next operation of report producing.

The Flood Record Reports program is the heart of the system and produces the desired reports. The reports consist of a flood record tabulation and frequency plot of each gaging station on the data tape file and an index of all the gaging stations. In place of the reports for all the gaging stations, it is possible to obtain the reports for any number of selected gaging stations.

To complete the system operation, the tape files used to produce the reports are retained until they are to be updated or used for producing the reports.

FLOOD RECORD COMPILATION AND FREQUENCY PLOT

SYSTEM FLOW CHART

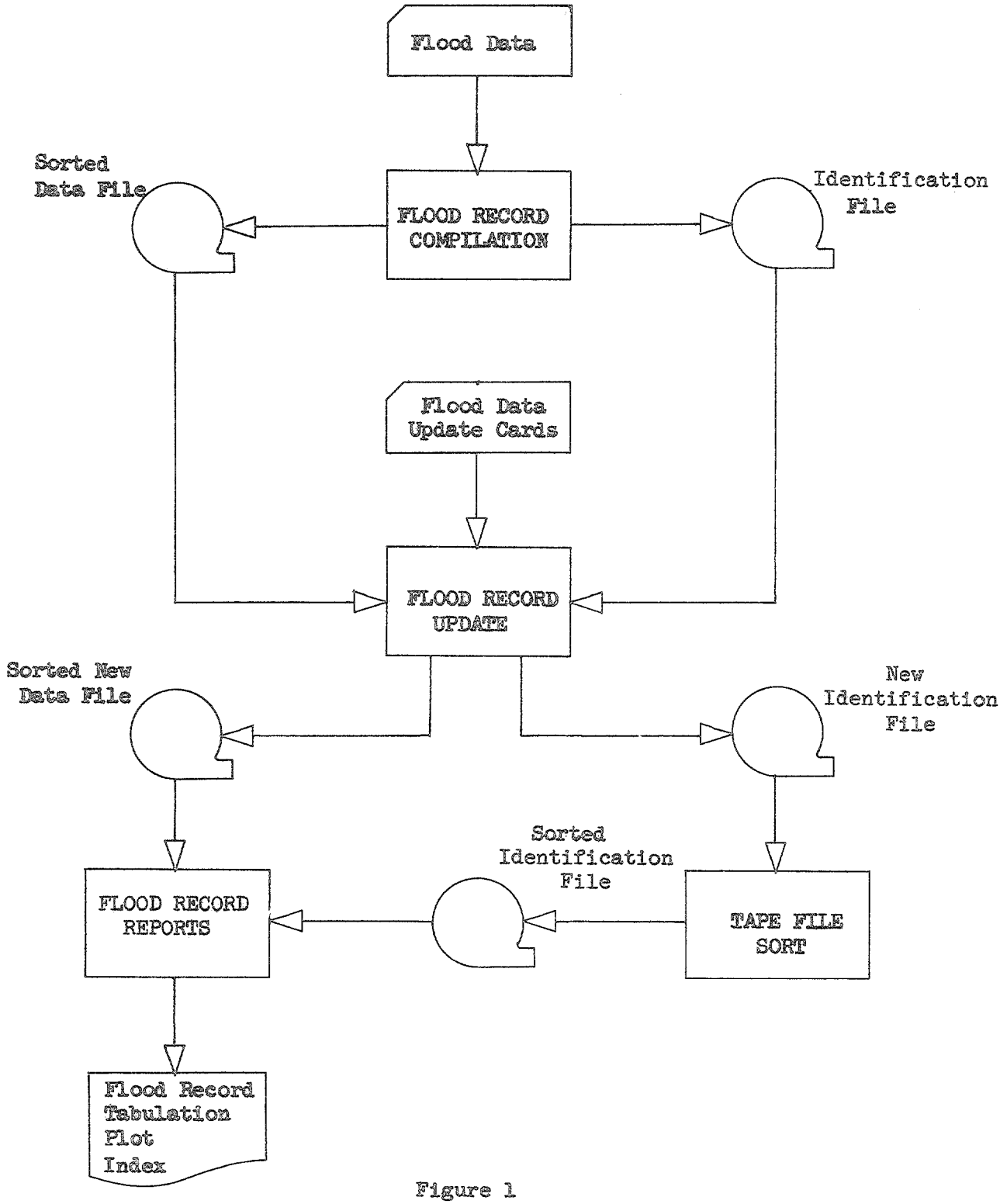


Figure 1

FLOOD RECORD COMPILATION PROGRAM

DESCRIPTION OF PROGRAM

The Flood Record Compilation Program is used to create the initial tape files which contain the flood records and gaging station identifications.

The program brings information from punched cards into the data processing system where it is stored and held until a complete flood record for one gaging station is compiled. At that time the complete flood record is transferred out of the system and is written onto magnetic tape for permanent storage and subsequent use. Within the computer, the information making up the flood record is stored or arranged in arrays. The program produces two such arrays or files, the first containing elements that collectively describe the gaging station and the second containing peak discharge and date of occurrence. A limitation of one hundred (100) years of record is used in the program. If the user desires to increase this limitation, the tape record array size can be expanded by changing the FORTRAN statements which refer to the tape record array.

Records are created consisting of gaging station identification and the flood data for that station as the information is read in from cards. When all data for a particular station has been read, the record is written onto magnetic tape for future use. These records are generated until all data for all stations has been read. Then an end of file record is written on each tape file for use by subsequent programs.

INPUT DATA

The data furnished the Flood Record Compilation Program are used in all subsequent operations. Therefore, it is necessary that care be used in obtaining the data. The discharge data collected by U. S. Geological Survey (USGS) and published in Water Supply Papers are the records from which flood data are gathered. Through the use of this computer system it is possible to retain the flood records for all the gaging stations in a geographical area, such as a State.

A flood record is composed of all identifying information and the annual flood data for an individual gaging station. An annual flood is defined as the highest momentary peak discharge occurring in a water year. A water year is defined as the period of time beginning October 1 and ending the next September 30.

In order to provide a convenient method for assembling data from the USGS Water Supply Papers, the form shown in Figure 2 is suggested. It has been designed to serve both as a record and a keypunching form. The top portion of the form is used for the gaging station identification information and the bottom portion is used for recording the annual flood data.

All identifying information for a gaging station is taken from the USGS Water Supply Papers. The part number required for the form is the geographical area number used by USGS. For example, Minnesota is in USGS area number 6. The recording of the Stream Name at Gaging Station Location on the form is done in a free-form manner and if necessary the recording can be continued from the first line to the second. The inverted V within "Station" and "Drainage Area" items on the form indicates the location of a decimal point. A decimal point should not be recorded on the form.

The annual flood data consists of the Date of Occurrence and the Peak Discharge. The annual flood data are listed in chronological order taking special care that the data are recorded on a water year basis. All data in the Water Supply Papers for the gaging stations under consideration should be used.

Special recording on the data form is necessary for those gaging stations where one or more breaks in the total annual flood record exist. Such a record is termed "discontinuous." A zero (0) is placed in the "Peak Discharge" portion of the form for every break in the flood record. In addition a code is placed in the "Day" portion of the "Date of Occurrence" for every such break in flood record to indicate the usable portion of a discontinuous flood record. The codes and their respective uses are as follows:

Code	Use
1	When flood data precedes the usable portion; the preceding data is disregarded.
2	When flood data follows the usable portion; the following data is disregarded.
0	When there is a break within the data that is to be disregarded.

Figure 3 shows how the flood data, as well as a special code for a particular gaging station, is recorded on the data form.

The following keypunch instructions should be furnished:

1. Keypunch a header card for each set of data cards from the information on top of the data form.

2. Keypunch data cards down the page from the information in the columns titled "Date of Occurrence" and "Peak Discharge."

    a. The Part No. and Station are to be duplicated from the header card into each data card.

    b. Punch the digit two (2) in card column 80 of each data card except the last card which has a digit nine (9) punched in card column 80.

3. Keypunch data cards starting with the first entry. If there is any entry in the left hand column, start keypunching down that column and continue with the right hand column.

When all flood records have been keypunched and it is desired to create the tape files, an additional step is necessary. The data cards must be arranged so that the gaging station numbers are in ascending order. For example, the data cards for gaging station number 286.00 would come before the data cards for gaging station number 1096.00.

An end-of-run-card with a field of 9's in card columns 1 through 8 and a field of Z's in card columns 21 through 25 is placed behind the data cards. At this time, the data are ready for use by the program. The arrangement of the data cards and program are shown in Figure 2.

OUTPUT DATA

The outputs from the Flood Record Compilation Program are the data file and identification file. The data file contains the gaging station number and up to 100 years of annual flood data. As the flood data is written onto one tape, the header card information is written onto another tape, the identification file.

The tape files are used in the subsequent operations of updating or report generating.

DEFINITION OF TERMS

IDENT(I) - An array for the storing of the gaging station identification which includes: gaging station part number; gaging station number; river basin; gaging station location; drainage area; latitude; longitude and years of record.

IDIS(I) - An array for the building of the flood record which includes for each occurrence: month, day, year, and peak discharge. The array is large enough to accommodate 100 years of record.

I - An index for defining elements in the arrays.

ICC80 - A variable for storing card type which is in card column 80.

N - The number of years of record.

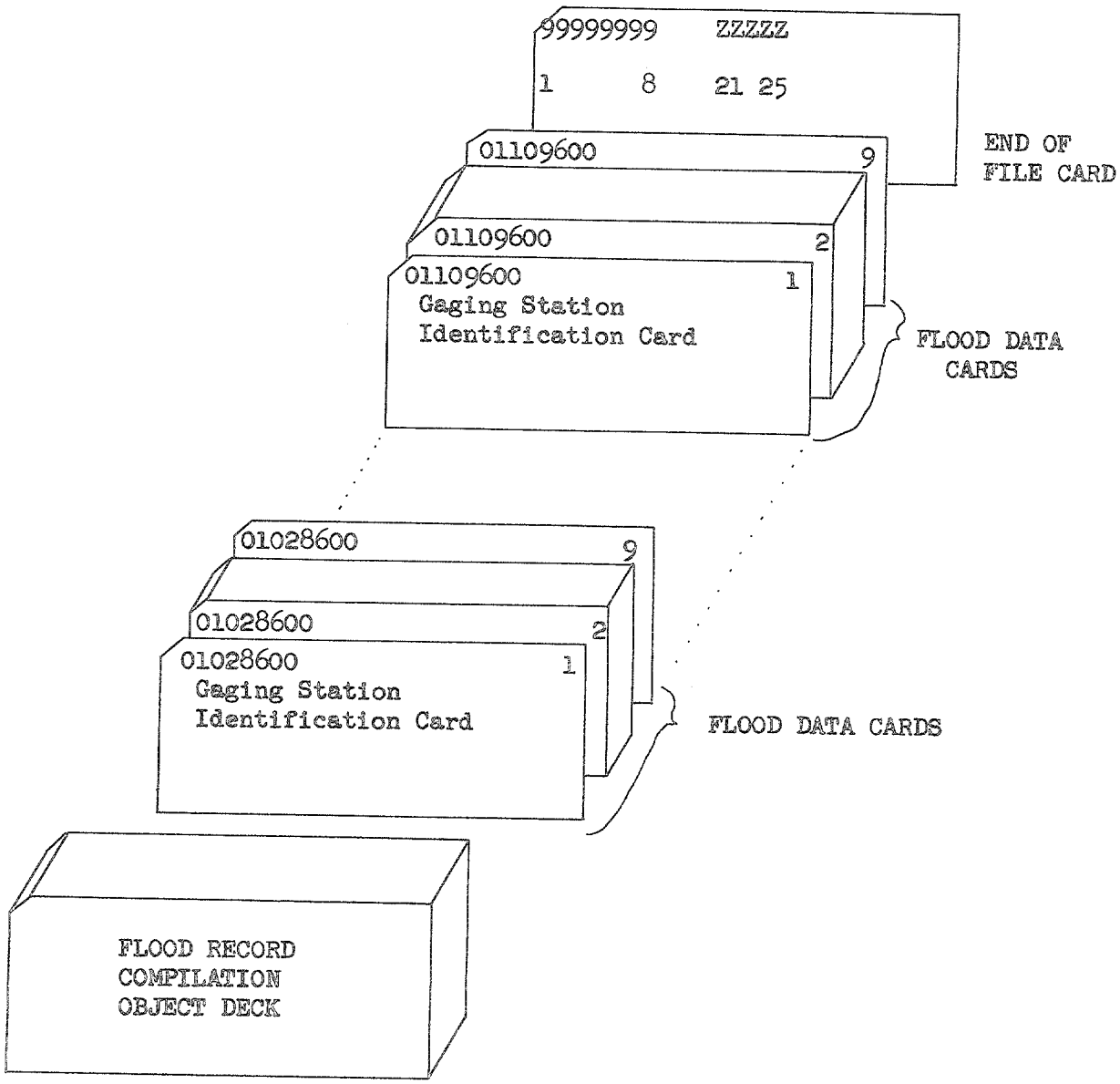

99999999 ZZZZZ
1 8 21 25
END OF FILE CARD
01109600 9
01109600 2
01109600 1
Gaging Station
Identification Card
FLOOD DATA CARDS
01028600 9
01028600 2
01028600 1
Gaging Station
Identification Card
FLOOD DATA CARDS
FLOOD RECORD
COMPILATION
OBJECT DECK

Figure 2

FORM PR-1308
(5-65)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

FLOOD RECORD COMPILATION

PART NO.	STATION	RIVER BASIN	STREAM NAME @ GAGING
1	1162500	CONNECTICUT	PRIEST NR WINCHENDON

STATION LOCATION	DRAINAGE AREA	LATITUDE	LONGITUDE
MASS	194	424057	721656 1

Water Year	Date of Occurrence Month	Day	Year	Peak Discharge (c.f.s.)
1901				
1902				
1903				
1904				
1905				
1906				
1907				
1908				
1909				
1910				
1911				
1912				
1913				
1914				
1915				
1916				
1917	MAR	18	1917	319
1918		1		0
1919	MAR	28	1919	608
1920	MAR	28	1920	732
1921	OCT	4	1920	457
1922	JUN	21	1922	648
1923	APR	29	1923	530
1924	APR	7	1924	569
1925	MAR	31	1925	148
1926	APR	12	1926	230
1927	MAR	17	1927	368
1928	NOV	4	1927	1000
1929	MAR	23	1929	319
1930	MAR	27	1930	136
1931	APR	11	1931	273
1932	APR	1	1932	457
1933	APR	18	1933	493
1934	APR	12	1934	368
1935	JAN	10	1935	352

Water Year	Date of Occurrence Month	Day	Year	Peak Discharge (c.f.s.)
1936	MAR	18	1936	1840
1937	APR	16	1937	210
1938	SEP	21	1938	3000
1939	DEC	6	1938	370
1940	APR	13	1940	685
1941	DEC	31	1940	104
1942	MAR	10	1942	550
1943	MAR	28	1943	169
1944	JUN	25	1944	532
1945	MAR	22	1945	280
1946	MAR	10	1946	413
1947	APR	8	1947	188
1948	MAR	23	1948	565
1949	JAN	7	1949	242
1950	MAR	30	1950	224
1951	NOV	27	1950	605
1952	APR	6	1952	389
1953	MAR	16	1953	479
1954	APR	18	1954	325
1955	APR	27	1955	286
1956	APR	30	1956	568
1957	JAN	24	1957	207
1958	APR	7	1958	276
1959	APR	3	1959	646
1960	APR	6	1960	744
1961	MAR	30	1961	159
1962	APR	2	1962	434
1963	APR	3	1963	305
1964				
1965				
1966				
1967				
1968				
1969				
1970				

Figure 3

```
C
C                FLOOD RECORD COMPILATION PROGRAM
C
C       THIS PROGRAM READS THE INFORMATION FROM CARDS AND CREATES TAPE
C       RECORDS FOR USE IN UPDATING AND THE TABULATION AND PLOT PROGRAMS
C
C       THIS PROGRAM IS DEVELOPED IN FORTRAN IV BY R.C. TENNENT,
C       ENGINEERING SYSTEMS DIVISION,OFFICE OF RESEARCH + DEVELOPMENT,
C       BUREAU OF PUBLIC ROADS, AUGUST 1965.
C
C       FIXED POINT VARIABLE WORD SIZE = 6
C
      DIMENSION IDENT(19),IDIS(400)
      EQUIVALENCE (N,IDENT(19))
C
    1 FORMAT ( I2,I6,8A6,A4,I6,3I2,I3,2I2,I3 )
    2 FORMAT ( 12X,A3,I2,I4,I6,52X,I1 )
    3 FORMAT(20H1  BEGIN FLOODCREAT )
    4 FORMAT(20H1 END OF FLOODCREAT )
      REWIND 6
      REWIND 7
C
C       THE ARRAY IDIS IS USED AS A TAPE AREA AND IS LARGE ENOUGH TO
C       STORE DATA FOR 100 YEARS OF RECORD. THE ARRAY IS BROKEN DOWN
C       INTO 100 SETS OF DATA, EACH SET CONSISTING OF THE MONTH,DAY,
C       + YEAR OF OCCURANCE AND THE PEAK DISCHARGE.
C
C       SET THE TAPE AREA TO SMALLEST NUMBER
C
      WRITE (3,3)
   10 DO 20 I = 1,400
   20 IDIS(I)  = -999999
C
C       READ IDENTIFICATION CARD FOR EACH GAGING STATION LOCATION
C
      READ(1,1) IDENT
C
C       CHECK FOR END OF RUN CARD
C
      IF ( IDENT(1) .NE. 99 ) GO TO 30
      WRITE(6) IDENT,IDIS
      WRITE(7,1) IDENT
```

```
      END FILE 6
      REWIND 6
      END FILE 7
      REWIND 7
      WRITE (3,4)
      STOP
   30 I      = 1
C
C       READ DATA CARD CONTAINING  MONTH,DAY,YEAR + DISCHARGE
C
   40 READ(1,2) IDIS(I),IDIS(I+1),IDIS(I+2),IDIS(I+3),ICC80
C
C       CHECK FOR LAST DATA CARD FOR A GAGING STATION
C
      IF ( ICC80 .EQ. 9 ) GO TO 50
      I      = I + 4
      GO TO 40
   50 N      = I / 4 + 1
C
C       WRITE TAPE RECORD CONTAINING ALL DATA FOR A GAGING STATION
C
      WRITE(6) IDENT,IDIS
C
C       WRITE TAPE RECORD CONTAINING STREAM NAME IDENTIFICATION
C
      WRITE(7,1) IDENT
      GO TO 10
      END
```

FLOOD RECORD UPDATE PROGRAM

DESCRIPTION OF PROGRAM

The Flood Record Update Program is used (1) to add new flood data to an existing data file, (2) to change existing header card information within the identification file and/or flood data within the existing data file and (3) to add records for new gaging stations to both files. Any one of these operations may be accomplished singly or in combination with the other operations.

The updating operation begins by reading the update information from cards and storing them on a work tape. As this is being accomplished, change codes (see Input Data of Flood Record Update Program) are stored in an update table. The update table enables the program to decide what type of data will be read from the work tape. The table for storing update codes has a maximum of 500 values, but this may be changed to accommodate the computer to be used.

After generating the work tape, the update table is searched to determine if any new gaging stations are to be added to the existing files. If there are new gaging stations, the old identification file is copied onto a new identification file. Otherwise, a message is printed indicating there is no change in the old identification file.

The basic operation of the update procedure is to read a record from the old data file and a record from the work tape. Based on a comparison of the gaging station numbers on the old data file with the work tape, the following operations take place to generate new data and identification files:

1. Whenever the work tape gaging station number is less than the old data file gaging station number, the update record is added to the new data file. Also, the gaging station identification of the new record is added to the new identification file. The old data file record is held for comparison with the next update record.

2. Whenever the work tape gaging station number and the old data file gaging station number are the same, a change is to be made to that flood record. The types of changes are: 1) the addition of new flood data, 2) a change in one or more flood readings and 3) a change in the header card information. The method of indicating these changes is covered in detail under Input Data, Flood Record Update Program. The information on the update work tape is combined with the old data file and added to the new

data file. When a change has been processed, the program returns to a point where the next update and old data file records are read.

3. Whenever the work tape gaging station number is greater than the old data file gaging station number,,the old data file record is added to the new data file. The update record is held for comparison with the next old data file record to be considered.

As either the work tape or the data file tape is read, a check is made for an end-of-file record. If an end-of-file record is detected on the work tape first, the remainder of the old data file is added to the new data file. If an end-of-file record is detected on the old data file first, and additional new gaging stations are to be considered, they are added to the new data and identification files; at which time the program pauses so that the old data and identification files can be removed by the operator. This may be necessary in order to have enough work tapes for the subsequent sorting operation.

INPUT DATA

The Flood Record Update Program adds data to or changes information on the existing tape files. Whenever records for a new gaging station are to be added, the data is recorded on the input form shown in Figure 2. The data is keypunched into cards according to the instructions given under Input Data Flood Record Compilation Program. As additional flood data becomes available for any gaging station already in the file, the information mentioned below should be recorded on the input data form shown in Figure 4.

The first recorded piece of information is the U.S.G.S. geographical part number and gaging station number. Because the old data file is arranged with the gaging station numbers in ascending order, the recording of updating information should be accomplished in this order. The dates of occurrence and associated peak discharges, the second item, are recorded on the form under the appropriate columns.

The third item is entered in the final two columns on Figure 4 to indicate the nature of the update operation. A number is recorded under "Entry" only when a change to an existing piece of flood data is necessary. The number is determined by counting the number of entrys, which consists of a date of occurrence and its associated discharge, up to and including the entry to be changed. This should be determined by using the latest tabulation produced by the Flood Record Reports Program, such as shown in Figure 5. Each addition or change recorded on the form must have a change code which is recorded under "Code." The change codes and their use are as follows:

Code	Use
3	When it is desired to add one (1) additional year of record to an existing gaging station record
5	When it is desired to change an existing piece of flood data, occurrence, or discharge, for an existing gaging station
6	When it is desired to change the identifying information for an existing gaging station

When it is desired to add two (2) or more additional years of record to the end of an existing gaging station record, the following codes are used:

Code	Use
4	The first entry for the additions
2	The entrys between the first and last additions
9	The last entry for the additions

Figure 4 shows examples of the way in which various changes would be recorded for a sample listing in the Example Problem.

After all the changes and additions have been recorded on the form, and cards are keypunched, it is necessary to check that the cards are in ascending order. At this time, a blank card should be added to the update data deck to indicate the end of data. The latest data and identification file are the only other necessary input data. The program is then run to perform the update operation.

OUTPUT DATA

The updating operation takes the additions and/or changes, and old data files and produces new files which are used in subsequent operations. The new files thus obtained contain the new flood data records for each gaging station and new gaging station identification.

The new flood data file is ready for use in the next operation which is the Flood Record Reports Program. However, the new gaging station identification file has to be sorted before the next operation can be accomplished.

FLOOD RECORD UPDATE DATA

USGS Gaging Sta. No.		Date of Occurrence Month	Day	Year	Peak Discharge (cfs)	Entry	Code
1	8	13 15	16 17	18 21	22 27	28	80
01	028600	MAR	7	1937	105400	22	5
01	104200	APR	18	1964	1190		4
01	104200	MAR	1	1965	1680		9
01	105800	FEB	26	1963	65		4
01	105800	APR	1	1964	43		2
01	105800	MAR	10	1965	59		9
01	109500	FEB	24	1964	300		3
01	162500	JUN	25	1944	582	28	5

USGS Gaging Sta. No.		Date of Occurrence Month	Day	Year	Peak Discharge (cfs)	Entry	Code
1	8	13 15	16 17	18 21	22 27	28	80

Figure 4

DEFINITION OF TERMS

IDENT(1) - An array for the storage of the gaging station identification which includes: gaging station part number; gaging station number; river basin; gaging station location; drainage area; latitude; longitude and years of record.

IDIS(1) - An array for the building of the flood record which includes for each occurrence: month, day, year, and peak discharge. The array is large enough to accommodate 100 years of record.

IUDTAB(J) - An array used for storage of the change codes of the update cards.

JDENT(1) - An array for the storage of the gaging station identification read from the update work tape.

I - An index for selecting elements of the arrays, IDENT, IDIS, and JDENT.

ICC80 - A variable for the storage card type, which is in card column eighty.

IDEOF - An indicator for the end of file condition of the old data file.

IUEOF - An indicator for the end of file condition of the update work tape.

J - An index for selecting elements of the update table, IUDTAB(J).

JUEOF - Indicates whether the update work tape contains any new gaging station records.

N - The number of years of record.

NSW0 - A switch for the control of the backspacing of the update work tape.

NSW1 - A switch for the control of the reading of data from the update work tape.

```
C
C                FLOOD RECORD UPDATE PROGRAM
C
C       THIS PROGRAM IS USED WHENEVER  THE DATA FILE OR STREAM NAME FILE
C       IS TO BE UPDATED.  IT WILL ADD NEW GAGING STATION LOCATIONS WITH
C       DATA AND/OR ADD ADDITIONAL FLOOD DATA TO AN EXISTING GAGING
C       STATION ON THE DATA FILE.
C
C       THIS PROGRAM DEVELOPED IN FORTRAN IV BY R.C. TENNENT,
C       ENGINEERING SYSTEMS DIVISION,OFFICE OF RESEARCH + DEVELOPMENT,
C       BUREAU OF PUBLIC ROADS, AUGUST 1965.
C
C       FIXED POINT VARIABLE WORD SIZE = 6
C
      DIMENSION JDENT(18),IDENT(19),IDIS(400),IUDTAB(501)
      EQUIVALENCE(N,IDENT(19))
C
    1 FORMAT(    79H
     1                                ,I1 )
    2 FORMAT(     I2,I6,8A6,A4,I6,3I2,I3,2I2,I3 )
    3 FORMAT ( 12X,A3,I2,I4,I6,52X,I1 )
    4 FORMAT ( 41H1 MAXIMUM NUMBER OF UPDATE CARDS EXCEEDED )
    5 FORMAT ( 52H1  REMAINING UPDATE RECORDS DO NOT START WITH TYPE 1,
     1          I2,I7,I3 )
    6 FORMAT ( 42H1  STREAM NAME MASTER FILE HAS NOT CHANGED )
    7 FORMAT(20H1  BEGIN FLOODUPDAT )
    8 FORMAT(20H1 END OF FLOODUPDAT )
C
      WRITE (3,7)
      REWIND 4
      REWIND 6
      REWIND 7
      REWIND 8
      REWIND 9
      DO 9 J = 1,501
    9 IUDTAB(J) = 0
      DO 10 J = 1,500
C
C       READ A FLOOD DATA UPDATE CARD
C
      READ(1,1) IUDTAB(J)
C
C       COPY UPDATE CARDS ONTO A WORK TAPE
C
      WRITE(4,1) IUDTAB(J)
      IF ( IUDTAB(J) .EQ. 0 ) GO TO 20
   10 CONTINUE
C
C         PROGRAM HAS A MAXIMUM OF 500 UPDATE CARDS
```

```
C
      WRITE(3,4)
   20 END FILE 4
      REWIND 4
      JUEOF = 1
C
C      SEARCH UPDATE TABLE TO DETERMINE IF ANY NEW GAGING STATIONS
C      ARE TO BE ADDED
C
      DO 25 J = 1,500
      IF ( IUDTAB(J) .EQ. 1 ) GO TO 26
   25 CONTINUE
      WRITE(3,6)
      JUEOF = 0
      GO TO 27
C
C      WHEN THERE ARE NEW GAGING STATIONS, COPY OLD STREAM NAME FILE
C      ONTO THE NEW STREAM NAME FILE
C
   26 READ(7,2) IDENT
      WRITE(9,2) IDENT
      IF ( IDENT(2) .EQ. 999999 ) GO TO 27
      GO TO 26
C
C      SET END OF FILE INDICATORS FOR THE WORK TAPE AND OLD DATA FILE
C
   27 IUEOF = 0
      IDEOF = 0
      J     = 1
C
C      ROUTINE FOR UPDATING THE OLD DATA FILE AND CREATE A NEW DATA FILE
C
   30 NSWO  = 0
      IF ( IUDTAB(J) .EQ. 0 ) GO TO 120
      IF ( IUDTAB(J) .GT. 1 ) NSWO = 1
C
C      READ A RECORD FROM THE UPDATE WORK TAPE
C
      READ(4,2) JDENT
      IF ( NSWO .EQ. 0 ) GO TO 31
      BACKSPACE 4
      GO TO 32
   31 J     = J + 1
   32 IF(IDEOF . EQ . 1)  GO TO 41
C
C      READ A RECORD FROM THE OLD DATA FILE
C
      READ(6) IDENT,IDIS
C
C      CHECK OLD DATA FILE FOR THE END OF FILE RECORD
```

```
C
      IF ( IDENT(2) .EQ. 999999 ) GO TO 150
C
C       CHECK GAGING STATION PART NO. FOR MERGING SEQENCE
C
      IF ( JDENT(1) - IDENT(1) )40,80,90
   40 BACKSPACE 6
C
C       MOVE GAGING STATION IDENTIFICATION FROM THE UPDATE TO DATA AREA
C
   41 DO 42 I = 1,18
   42 IDENT(I) = JDENT(I)
C
C       ADD NEW GAGING STATION IDENTIFICATION TO NEW STREAM NAME FILE
C
      WRITE(9,2) IDENT
      I      = 1
   43 NSW1   = 0
C
C       READ UPDATE WORK TAPE TO OBTAIN DATA FOR THE NEW GAGING STATION
C
   50 READ(4,3) IDIS(I),IDIS(I+1),IDIS(I+2),IDIS(I+3),ICC80
      J      = J + 1
C
C       CHECK FOR LAST PIECE OF DATA FOR A GAGING STATION
C
      IF ( ICC80 .EQ. 9 ) GO TO 60
      I      = I + 4
      GO TO 50
   60 N      = I/4 + 1
C
C       WRITE A RECORD ON THE NEW DATA FILE
C
   70 WRITE(8) IDENT,IDIS
C
C       SET THE TAPE AREA TO NINES
C
      DO 75 I = 1,400
   75 IDIS(I) = -999999
      IF ( NSW1 .EQ. 0 ) GO TO 30
      GO TO 32
C
C       CHECK GAGING STATION NO. FOR MERGING SEQUENCE
C
   80 IF ( JDENT(2) .LT. IDENT(2) ) GO TO 40
      IF ( JDENT(2) .EQ. IDENT(2) ) GO TO 100
   90 NSW1   = 1
      GO TO 70
C
C       CHECK FOR THE TYPE OF UPDATE DATA RECORD
```

```
C
  100 IF ( IUDTAB(J) .NE. 3 ) GO TO 110
      I      = N * 4
C
C       WHEN CHANGE CODE IS 3, ONLY ONE UPDATE RECORD IS TO BE ADDED
C
      N      = N + 1
  105 READ(4,3) IDIS(I+1),IDIS(I+2),IDIS(I+3),IDIS(I+4)
  106 J      = J + 1
      NSW1   = 0
      GO TO 70
  110 IF ( IUDTAB(J) .NE. 4 ) GO TO 115
C
C       WHEN CHANGE CODE IS 4, MORE THAN ONE UPDATE RECORD IS TO BE ADDED
C
      I      = N*4 + 1
      GO TO 43
  115 IF ( IUDTAB(J) .NE. 5 ) GO TO 116
C
C       WHEN CHANGE CODE IS 5, AN EXISTING RECORD IS TO BE CHANGED
C
      I      = ( JDENT(18) - 1 ) * 4
      GO TO 105
  116 IF ( IUDTAB(J) .NE. 6 ) GO TO 200
C
C       WHEN CHANGE CODE IS 6, AN EXISTING IDENTIFICATION IS TO CHANGE
C
      READ(4,2) JDENT
      DO 117 I = 1,18
  117 IDENT(I) = JDENT(I)
      GO TO 106
C
C       THE LAST UPDATE RECORD HAS BEEN PROCESSED,CHECK IF OLD DATA FILE
C       LAST RECORD HAS BEEN PROCESSED, IF NOT ADD REMAINING DATA FROM
C       THE OLD DATA FILE TO THE NEW DATA FILE
C
  120 IUEOF = 1
      IF ( IDEOF .NE. 0 ) GO TO 140
  130 READ(6) IDENT,IDIS
C
C       CHECK OLD DATA FILE FOR THE END OF FILE RECORD
C
      IF ( IDENT(2) .EQ. 999999 ) GO TO 140
      WRITE(8) IDENT,IDIS
      GO TO 130
C
C       WRITE END OF FILE RECORD ON NEW DATA FILE
C
  140 IDENT(2) = 999999
      WRITE(8) IDENT,IDIS
```

```
      END FILE 8
      REWIND 8
      IF ( JUEOF .EQ. 0 ) GO TO 145
      END FILE 9
      REWIND 9
  145 REWIND 4
      REWIND 6
      GO TO 200
C
C      THE LAST OLD DATA FILE HAS BEEN PROCESSED, CHECK IF UPDATE LAST
C      RECORD HAS BEEN PROCESSED. IF NOT ADD REMAINING DATA TO NEW
C      DATA FILE
C
  150 IDEOF = 1
      IF ( IUEOF .NE. 0 ) GO TO 140
C
C      CHECK REMAINING UPDATE RECORDS FOR AN IDENTIFICATION RECORD
C
      IF ( IUDTAB(J-1) .EQ. 1 ) GO TO 41
      WRITE(3,5) JDENT(1),JDENT(2),ICC80
      GO TO 140
  200 WRITE (3,8)
      CALL EXIT
      END
```

TAPE FILE SORT

DESCRIPTION

To produce an alphabetical index of the gaging stations, it is necessary to sort the identification file via stream name. The sorting of the identification file will have to be accomplished using the sort routines provided by the computer manufacturer. The sort routine must be capable of handling the type of tape record produced by the compilation and update programs. For example, the tape record length could be the same as the compilation and update program format which is 82 characters or some fixed length for tape output such as 133 characters.

Once the type and length of tape record have been determined, control cards, or whatever form is used for conveying the information to the sort routine, can be prepared. The control cards should indicate that an alphabetical sort is desired and that positions 21 through 25 of the tape record are to be the major sort field. The first five letters of the stream name which occupies tape record position 21 through 60, are sufficient for the alphabetical order.

The sort operation is performed using the latest identification file, the control cards and the manufacturer's sort program. The tape produced as output, which is in alphabetical order is now available for use with the Flood Record Reports Program.

FLOOD RECORD REPORTS PROGRAM

DESCRIPTION OF PROGRAM

This program begins by reading a card containing plotting constants and a request code. These two features are described in detail under Input Data, Flood Record and Reports Program. The request code is used for determining whether flood data for all the gaging stations or selected gaging stations are to be tabulated and plotted.

A tape record is read from the latest flood data file. If the selective method is used, the gaging station number just read from the file is compared with the requested gaging station number being considered. If these gaging station numbers do not match, the program reads the next tape record from the data file. This process continues until such time that a match is made or an end-of-file condition is encountered. An end-of-file condition indicates that either the requested gaging station number is out of sequence with previously requested gaging stations or that the requested gaging station is improperly defined. When a match is made, the flood data from the requested gaging station record are processed in the same way as in the non-selective method, which is as follows:

Initially it is necessary to establish the portion of the individual gaging station total flood record that will be used. If the total flood record for a gaging station is continuous, the entire record will be used. If a discontinuous record is encountered, it is necessary then to determine the portion of the total flood record that is to be used. Discontinuous records are detected by checking the peak discharge data for a zero value. In this case, the day portion of the date of occurrence is a code that indicates the portion of the total flood data or usable data to be used. A description of the codes is presented under Input Data Flood Record Compilation Program. Through examination of the peak discharge data, the upper and lower limits of the usable data are established and the years of continuous record are calculated. The sorting operation is performed after the upper and lower limits of the usable data have been determined. The peak discharge portion of the usable data is sorted into descending order along with their respective dates of occurrence.

Following completion of the sorting operation, the flood data is tabulated. This tabulation includes all identification information, the total flood data for a gaging station in chronological order, and the usable flood data with peak discharges in descending order except when there are less than 10 years of continuous record. When this exception exists for a gaging station, neither the tabulation of usable data nor the flood frequency plot are produced.

The next operation of the program creates a flood frequency plot from the usable data. Three steps make up the operation of plotting. They are: 1) calculation of the vertical scale, 2) calculation of the X and Y coordinates and 3) selection of the printing format. Steps 2) and 3) are repeated for each individual peak discharge of the usable data.

Calculation of the vertical scale consists of determining the range of plot and the vertical scale increment. When the years of record are less than 50, an approximate and arbitrary 50-year frequency peak discharge value is calculated and used as the maximum scale value. However, when the years of record exceed 50, the highest actual peak discharge is used as the maximum scale value. The range of the plot is the difference between the previously established maximum peak discharge and the lowest observed peak discharge. The increment of the vertical scale is then established by dividing the range by 56 units (7 inches at 8 lines per inch).

The second step of the frequency plot operation is the calculation of X and Y coordinates. The X value, or recurrence interval, is calculated by the following steps:

1. The value of y is determined from the following equation:

$$y = -\log_e \left[-\log_e \left(1 - \frac{1}{T}\right)\right]$$

where, y = a function of stream flow

$$T = \frac{n+1}{m},$$

where, n = number of continuous years of record

m = order number of the discharges being plotted.

For example, the highest peak discharge has an order number of 1 and each succeeding lower discharge has a higher order number.

2. The X coordinate is calculated by multiplying the sum of "y" and the positive value of the origin by a scale factor. For a detailed explanation of this procedure, the reader is referred to Ralph W. Powell's article "A Simple Method of Estimating Flood Frequency" that appeared in Civil Engineering, Vo. 13, No. 2, February 1943.

The scale factor is a mathematical device to convert the abscissa units used within the above noted reference to the total 9 inch abscissa used in the plots.

The Y ordinate is an individual peak discharge.

For use in the computer program, the X coordinate occurs at some position along a print line. The position of the previously calculated X is determined by translating the coordinate value to a position in the print line. The Y coordinate occurs at some position on the paper as it moves through the printer in a vertical direction. The paper is advanced until the Y coordinate is positioned within the tolerance of the vertical scale value.

The third step of the frequency plot operation is the determination of the type of line to be printed. In order to create a plot that is as usable as possible when obtained from the printer, it is necessary to have complete horizontal and vertical scales and descriptions.

Selection of the print format is accomplished by keeping various counts concerning which line of the plot is being printed. The counts are tested by the program to determine when the vertical scale description and/or the vertical scale value are to be printed. The computer program selects any combination of the descriptions, scale and X coordinate for each line. The X coordinate is printed only when the Y coordinate is properly positioned with respect to the vertical scale of the plot. This procedure of calculating the X and Y coordinates and selection of the print format is accomplished for each peak discharge of the usable data. When all points have been printed, a horizontal scale and description are printed to complete the frequency plot. At this time, the program stores the page number of the gaging station tabulation for subsequent use in the gaging station index.

At the completion of the frequency plot, the request code is checked to determine whether the program is to return and process the next requested gaging station or the next gaging station on the data file.

Following the flood frequency plots, the gaging station index is produced. This index furnishes an alphabetical listing of gaging station locations and the page number where the tabulation and frequency plot are located. The index is prepared by reading a gaging station location from the tape produced by the Tape File Sort and searching a table for the page number. Each gaging station, its identification and its corresponding page number are listed in the index. Upon completion of the index, the computer process is finished and the tape files are reserved for future use.

INPUT DATA

The input data for the Flood Record Reports Program consists of the information stored on magnetic tapes and the additional data necessary for the program to function.

The first card of input data to the program contains three plotting constants and a request code. The three constants in the order they occur on the card are as follows:

1. The symbol used in this program for plotting is the decimal point. The user may choose, however, any plotting symbol that is available on his computer system.

2. The next constant consists of an alphameric word of blanks. This is used to insure that only the desired plotting points will be printed.

3. The last constant consists of the vertical scale description, "D I S C H A R G E I N C F S." As the description is keypunched, a blank should be inserted between each letter of a word and two blanks between each word. Insertion of the blanks makes the vertical description more readable on the flood frequency plot.

The last piece of data on the first card is a request code which indicates whether the reports for all or selective gaging stations are to be produced. Whenever the request code is zero (0), the program will produce the reports for all gaging stations in the data file. No additional data is necessary for this condition. On the other hand, if reports for only certain gaging stations are desired, the request code is assigned the value of one (1). In this event additional data consisting of the selected gaging station numbers must be submitted. The program being reported herein is able to accommodate a maximum of 12 gaging station numbers at one time. When more than 12 numbers are requested, it will be necessary to use multiple cards. The last selected gaging station number should be followed by a zero (0). This enables the program to detect the end of run.

In addition to the above described cards, the program must have the most recent updated version of the flood data file and the most recent sorted updated identification file. The flood data file will contain the information for the tabulation and frequency plot reports and the sorted identification file will contain the information for the index report. It is not necessary to use the sorted identification file when reports for selected gaging stations are desired.

OUTPUT DATA

The Flood Record Reports Program can produce the following three reports: (1) a tabulation of the flood data for each gaging station, (2) a flood frequency plot for each gaging station, and (3) an index of all gaging stations. When selected gaging stations are processed, the index is not produced.

The tabulation for a gaging station consists of identification information and flood data. The identification information consists of: the river basin, stream name and location, drainage area, latitude, longitude, and years of record. This information is printed at the top of each page of the tabulation. The flood data is presented in tabular form and consists of: (1) a chronological listing of annual peak discharges with the associated dates of occurrence, and (2) a list of the annual peak discharges in descending order of magnitude with the associated dates of occurrence for each gaging station with ten or more years of record. An example of a tabulation is shown in Figure 5.

The chronological listing of annual peak discharges, as shown on the left side of Figure 5, will contain all the flood data for that gaging station. A discontinuous flood record is indicated when the peak discharge is noted as zero or blank on the form. The number under the day column is a code number which indicates the usable portion of the total flood record. An explanation of this code is discussed under Input Data, Flood Record Compilation Program.

The listing of annual peak discharges in descending order of magnitude, as shown on the right side of Figure 5, will contain only the usable portion of the total flood data.

Figure 6 is an example plot of the data shown on the right side of Figure 5. The plotting has been accomplished by taking advantage of the capabilities of the on-line printer of a computer. The Flood Record Reports Program was written for a computer system that can print eight lines to the inch in the vertical direction. Since the plotting is restricted to minimum distances of 1/10 inch along the abscissa and 1/8 inch along the ordinate, the plotted points may vary slightly from the actual positions. The accuracy of this plotting procedure is deemed compatible with the overall flood-frequency procedure used.

The horizontal scale is used for the recurrence interval and duplicates the scale of Bureau of Public Roads Form PR-1297, "Flood Data Plot," shown as Figure 7. Form PR-1297 is identical to U. S. Geological Survey form 9-179a entitled "Flood Data Plot." On the computer produced plot, the position of any desired recurrence interval is a vertical line passing through the center of the far right-hand digit of that recurrence interval.

The vertical scale is used for the discharge. On the computer produced plot, the position of any discharge is a horizontal line passing directly beneath the printed vertical scale value.

Due to the minimum vertical and horizontal plotting limitations of an on-line printer, the flood frequency plots will, in some cases, contain the following conditions:

1) Two successive discharges may plot as points at the same recurrence interval. In Figure 6 this occurs at a recurrence interval of 1.5.

2) More than two different discharges may plot as the same discharge for successive recurrence intervals. In Figure 8 this occurs at a discharge of 270 cfs.

3) Two different discharges may plot as the same discharge and the same recurrence interval. This may be verified by noting that although the number of years of record are 45, only 42 points are plotted, though only 41 appear due to page size limitation.

On each tabulation and flood frequency plot a page number is added to the top of the page. This is for use in finding the desired information from an index.

The index is the last item of possible output from the Flood Record Reports Program. The index contains gaging station numbers, associated stream names and locations, and page numbers where flood data for the respective gaging stations may be found. The index order is based upon an alphabetical listing by stream name as illustrated in Figure 8.

CONNECTICUT RIVER BASIN PAGE 1

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 1625.00 PRIEST NR WINCHENDON, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 45
19.4	42 40 57	72 6 56	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	18	1917	319
	1	0	0
MAR	28	1919	608
MAR	28	1920	732
OCT	4	1920	457
JUN	21	1922	648
APR	29	1923	530
APR	7	1924	569
MAR	31	1925	148
APR	12	1926	230
MAR	17	1927	368
NOV	4	1927	1000
MAR	23	1929	319
MAR	27	1930	136
APR	11	1931	273
APR	1	1932	457
APR	18	1933	493
APR	12	1934	368
JAN	10	1935	352
MAR	18	1936	1840
APR	16	1937	210
SEP	21	1938	3000
DEC	6	1938	370
APR	13	1940	685
DEC	31	1940	104
MAR	10	1942	550
MAR	28	1943	169
JUN	25	1944	532
MAR	22	1945	280
MAR	10	1946	413
APR	8	1947	188
MAR	23	1948	565
JAN	7	1949	242
MAR	30	1950	224
NOV	27	1950	605
APR	6	1952	389
MAR	16	1953	479
APR	18	1954	325
APR	27	1955	286
APR	30	1956	568
JAN	24	1957	207
APR	7	1958	276
APR	3	1959	646
APR	6	1960	744
MAR	30	1961	159
APR	2	1962	434
APR	3	1963	305

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
SEP	21	1938	3000
MAR	18	1936	1840
NOV	4	1927	1000
APR	6	1960	744
MAR	28	1920	732
APR	13	1940	685
JUN	21	1922	648
APR	3	1959	646
MAR	28	1919	608
NOV	27	1950	605
APR	7	1924	569
APR	30	1956	568
MAR	23	1948	565
MAR	10	1942	550
JUN	25	1944	532
APR	29	1923	530
APR	18	1933	493
MAR	16	1953	479
OCT	4	1920	457
APR	1	1932	457
APR	2	1962	434
MAR	10	1946	413
APR	6	1952	389
DEC	6	1938	370
APR	12	1934	368
MAR	17	1927	368
JAN	10	1935	352
APR	18	1954	325
MAR	23	1929	319
APR	3	1963	305
APR	27	1955	286
MAR	22	1945	280
APR	7	1958	276
APR	11	1931	273
JAN	7	1949	242
APR	12	1926	230
MAR	30	1950	224
APR	16	1937	210
JAN	24	1957	207
APR	8	1947	188
MAR	28	1943	169
MAR	30	1961	159
MAR	31	1925	148
MAR	27	1930	136
DEC	31	1940	104

Figure 5

FLOOD DATA PLOT FOR PRIL NR WINCHENDON, MASS

CONNECTICUT RIVER BASIN DRAINAGE AREA 19.4 SQ.MI. YEARS OF RECORD - 45

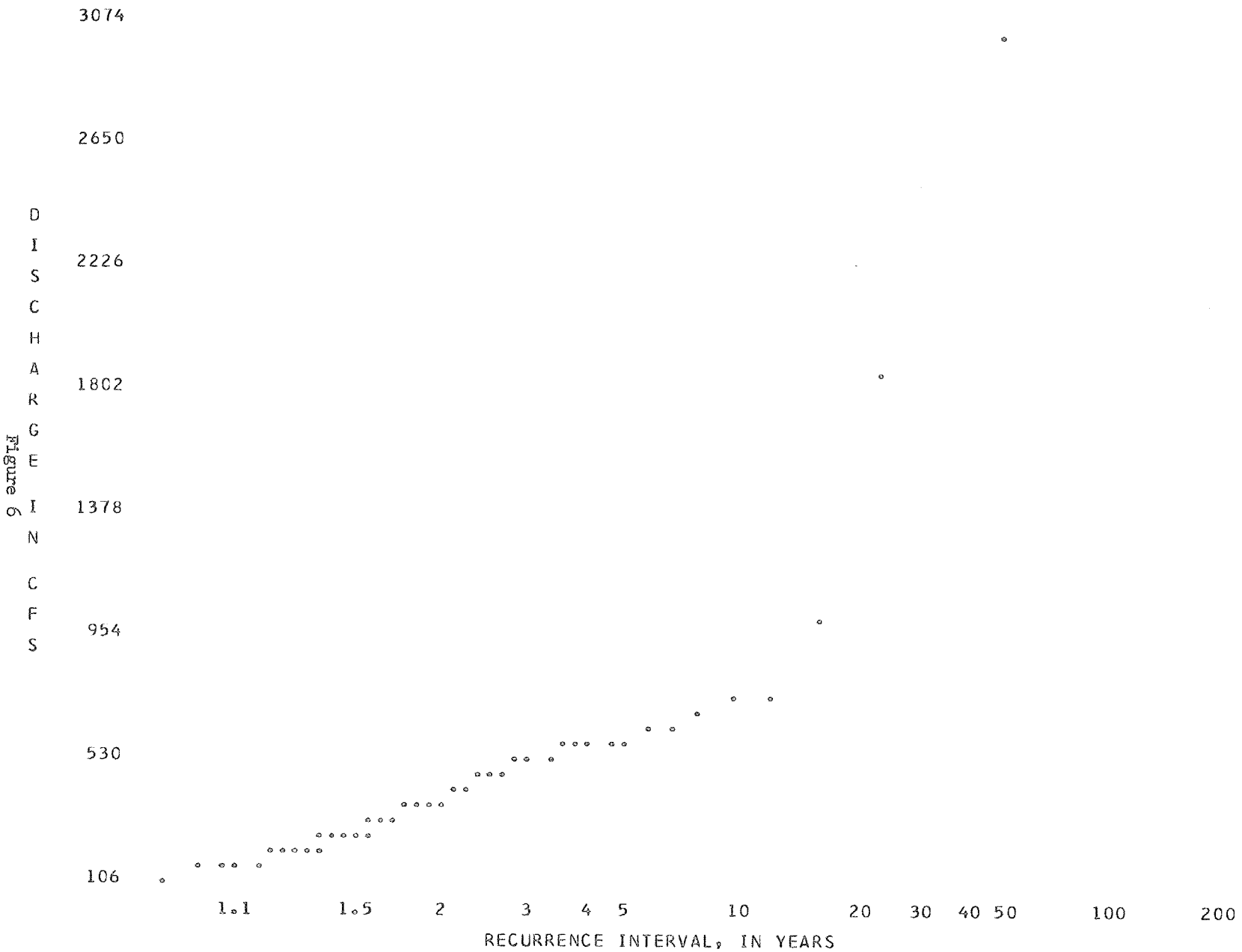


Figure 6

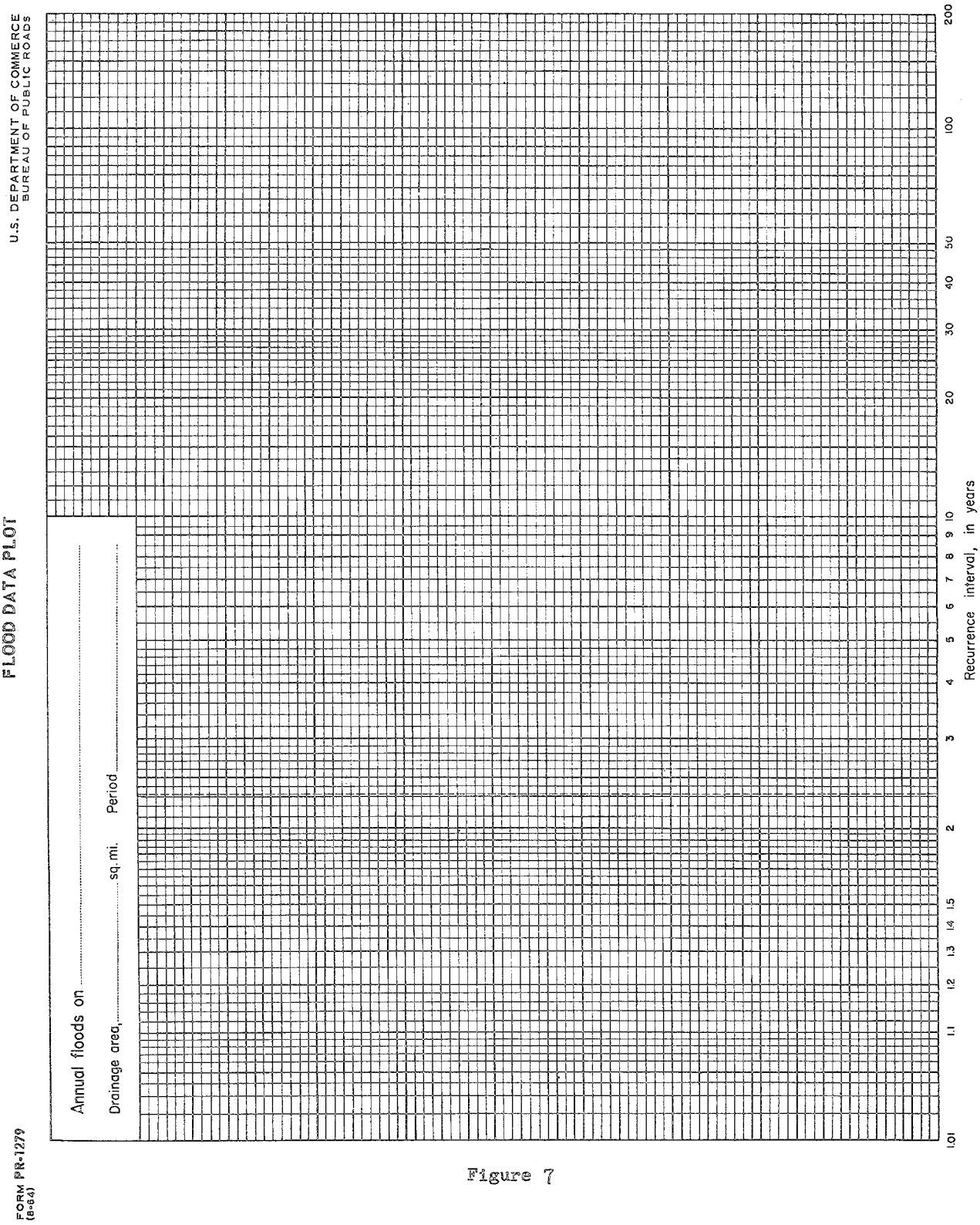

U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
FLOOD DATA PLOT
FORM PR-1279
(8-64)
Annual floods on
Drainage area, sq.mi. Period
1.01
1.1
1.2
1.3
1.4
1.5
2
3
4
5
6
7
8
9
10
20
30
40
50
100
200
Recurrence interval, in years

Figure 7

FLOOD DATA INDEX OF GAGING STATIONS

Figure 8

DEFINITION OF TERMS

IDENT(I)	-	An array for the storage of the gaging station identification which includes: gaging station part no.; gaging station number; river basin; gaging station location; drainage area; latitude; longitude and years of record.
IDIS(I)	-	An array containing the flood record which includes for each occurrence: month, day, year, and peak discharge. The array is large enough to accommodate 100 years of record.
IDIS1(I)	-	An array used for storing the usable portion of the flood record.
IPRINT(IXCOOR)	-	An array representing a line of print.
IPTAB(K)	-	An array of page numbers.
IREQNO(L)	-	An array of requested gaging station numbers.
ISTAB(K)	-	An array of gaging station numbers.
JHEAD(J)	-	An array containing the vertical scale heading.
AREA	-	The drainage area in square miles.
I	-	An index for selecting particular elements of an array.
IADD	-	The additional discharge added to the highest discharge in order to have an approximate 50 year discharge.
ICOUT	-	A counter for the line being printed during the frequency plot.
II	-	An index for selecting elements of the arrays IDIS and IDIS1.
INCVER	-	The increment of the vertical scale.
IPAGE	-	A counter for the page number.
IPRNT	-	An indicator as to whether or not the print array is to be printed.
IPRPA	-	The previous page.

IPRSW - A switch for controlling the print statements during the frequency plot.

IRKODE - The request or control code. The code indicates whether or not selected gaging station reports are desired.

ISKSW - A switch for indicating the skipping of a line.

ISORT - A limit for the sorting operation.

ISWO - A switch to indicate when the years of record are less than 10 and to control the print statements during the tabulation.

ISW1 - A switch to indicate the type of break in the total flood record.

ITEMP - A temporary storage for the month portion of a flood record.

IUPL - An index containing the upper limit of the usable data in the array IDIS1.

IXCOOR - The Y coordinate of the plot.

IYR - A counter used to indicate the number of years to be tabulated.

J - An index used for specifying a particular element in the heading array, JHEAD.

J1 - A counter used in the sorting of the usable flood data.

JJ - An index used for specifying a particular element in the arrays IDIS and IDIS1.

JTEMP - A temporary storage for the day portion of a flood record.

K - An index used for specifying a particular element in the arrays IPTAB and ISTAB.

KBLANK - An alphabetic word of blanks.

KON1 - The alphabetic symbol ".", which is used for plotting discharge.

KTEMP - A temporary storage for the year portion of a flood record.

L	-	An index used for specifying a particular element in the array IREQNO.
LINES	-	A counter to control the number of lines printed on a page.
LOWL	-	An index containing the lower limit of the usable date in the array IDIS1.
LTEMP	-	A temporary storage for the peak discharge portion of a flood record.
M	-	An index for specifying a particular element in the array IDIS1.
M1	-	The order number of the discharges to be plotted.
N	-	The number of continuous years of record.
STAIN	-	The USGS gaging station number.
T	-	The recurrence interval.
Y	-	A function of stream flow.

```
C
C                FLOOD RECORD REPORTS PROGRAM
C
C       THIS PROGRAM PRODUCES A TABULATION OF THE FLOOD DATA AND A
C       FREQUENCY PLOT OF THE USABLE PORTION OF THE FLOOD DATA FOR
C       EACH GAGING STATION ON THE DATA FILE.   AN INDEX IS PREPARED
C       FROM THE INFORMATION ON THE IDENTIFICATION FILE.
C       THIS PROGRAM DEVELOPED IN FORTRAN IV BY R.C. TENNENT,
C       ENGINEERING SYSTEMS DIVISION,OFFICE OF RESEARCH + DEVELOPMENT,
C       BUREAU OF PUBLIC ROADS, AUGUST 1965.
C
C       FLOATING POINT VARIABLE WORD SIZE = 10 + 2
C       FIXED POINT VARIABLE WORD SIZE = 6
C
      DIMENSION IDENT(19),IDIS(400),IDIS1(400),IPRINT(100),JHEAD(29),
     1           ISTAB(500),IPTAB(500),IREQN3(12)                          *
C
C                INPUT AND OUTPUT FORMATS
C
  901 FORMAT ( 2A6,29A1,I1 )
  902 FORMAT ( 12I6 )
  903 FORMAT ( 1H1,16X,2A6,13H  RIVER BASIN,16X,4HPAGE    ,I4 ////14H
     1STATION NO.,5X,38HSTREAM NAME ° GAGING STATION LOCATION // I4,
     2 F9.2,6X,6A6,A4 /// 10H   DR AREA,6X,8HLATITUDE,6X,9HLONGITUDE,6X,
     3          17HYEARS OF RECORD -,I3 // F9.1,6X,3I3,6X,3I3 //// 11X,
     4          4HDATE,10X,4HPEAK,16X,4HDATE,10X,4HPEAK//7X,8HMO. DAY ,
     5          16HYEAR   DISCHARGE,10X,24HMO. DAY YEAR   DISCHARGE / )
  904 FORMAT ( 7X,A3,I4,I5,I10,12X,A3,I4,I5,I10 )
  905 FORMAT ( 1H1 //      20X,21HFLOOD DATA PLOT FOR  ,6A6,A4,9X,4HPAGE
     1    ,I4// 11X,2A6,12HRIVER BASIN ,5X,13HDRAINAGE AREA,F7.1,7H SQ.M
     2I.,7X,   17HYEARS OF RECORD -,I3 )
  906 FORMAT ( 1X,A1,I7 )
  907 FORMAT ( 1X,A1,1X,A6,2X,100A1 )
  908 FORMAT ( 1X,A1,I7,2X,100A1 )
  909 FORMAT (  /  17X,3H1.1,7X,3H1.5,5X,1H2,6X,9H3     4  5,8X,2H10,8X,
     1          2H20, 12H   30  40 50,6X,3H100,6X,3H200 // 39X,
     2          29HRECURRENCE INTERVAL, IN YEARS )
  910 FORMAT ( 1H1,24HREQUESTED GAGING STATION,I8,16H  NOT ON FILE OR /
     1        35X,27HREQUEST WAS OUT OF SEQUENCE )
  911 FORMAT ( I2,I6,8A6,A4,I6,3I2,I3,2I2,I3 )
  912 FORMAT ( 1H1,15X,35HFLOOD DATA INDEX OF GAGING STATIONS //  3X,
     1          54HSTATION NO.      STREAM NAME AT GAGING STATION LOCATION
     2, 4X,8HPAGE NO. // )
  913 FORMAT ( I5,F8.2,5X,6A6,A4,I7 )
  914 FORMAT(24H1  END OF FLOOD REPORT      )
C
C       READ CONSTANTS AND CONTROL CODE
C
      REWIND 8
      REWIND 9
```

* Statements revised in May 1967 version.

```
      READ (1,901) KON1,KBLANK,JHEAD,IRKODE
      K     = 0
      IPAGE = 1
      IPRPA = 1
C
C      CHECK TO DETERMINE IF THE TABULATION AND PLOT ARE DESIRED
C      FOR SELECTED GAGING STATIONS
C
      IF ( IRKODE .EQ. 0 ) GO TO 10
C
C      READ THE GAGING STATION NUMBERS OF THE SELECTED STATIONS
C
    5 READ (1,902) IREQNO
      L     = 0
    6 L     = L + 1
      IF ( L .GT. 12 ) GO TO 5
      IF ( IREQNO(L) .EQ. 0 ) GO TO 725
C
C      READ DATA FILE CONTAINING DATA FOR A GAGING STATION
C
   10 READ(8) IDENT,IDIS
      IF ( IDENT(2) .NE. 999999 ) GO TO 15
      REWIND 8
      IF ( IRKODE .EQ. 0 ) GO TO 710
C
C      WHEN THE END OF FILE  CONDITION IS REACHED WHILE PROCESSING
C      SELECTIVE GAGING STATIONS THIS INDICATES THAT THE NUMBER WAS
C      NOT ON THE FILE OR THE REQUEST NUMBERS WERE OUT OF SEQUENCE
C
      WRITE(3,910) IREQNO(L)
      GO TO 6
   15 K     = K + 1
      IF ( IRKODE .EQ. 0 ) GO TO 19
C
C      SEARCH FOR THE SELECTED GAGING STATION DATA FROM THE DATA FILE
C
      IF ( IDENT(2) .NE. IREQNO(L) ) GO TO 10
C
C      TRANSFER DATA TO OTHER ARRAY FOR SORTING
C
   19 DO 20 I = 1,400
   20 IDIS1(I) = IDIS(I)
      ISWO  = 0
      N     = IDENT(19)
C
C      SET A SWITCH WHENEVER THE YEARS OF RECORD ARE LESS THAN 10
C
      IF ( N .LE. 10 ) ISWO = 1
      LOWL  = 1
      ISW1  = 0
```

```
      II     = 4
      JJ     = 2
C
C       WHENEVER DISCHARGE IS ZERO THIS INDICATES A BREAK IN THE DATA
C
   30 IF ( IDIS(II) .NE. 0 ) GO TO 60
C
C       INDICATION OF THE BREAK IN DATA OCCURS IS IN THE DAY FIELD
C
      IF ( IDIS(JJ) .GT. 1 ) GO TO 40
      ISW1   = 1
      GO TO 60
   40 ISW1   = 2
   60 II     = II + 4
      JJ     = JJ + 4
      IF ( II/4 .GT. N ) GO TO 80
      IF ( ISW1 .EQ. 0 ) GO TO 30
      IF ( ISW1 .EQ. 2 ) GO TO 70
      ISW1   = 0
      LOWL   = II/4
      GO TO 30
C
C       CALCULATE THE NUMBER OF YEARS OF CONTINOUS RECORD
C
   70 N      = II/4 - LOWL - 1
      IUPL   = II / 4 - 2
      GO TO 90
   80 N      = II/4 - LOWL
      IUPL   = II / 4 - 1
   90 ISORT = IUPL - 1
C
C       SORT DISCHARGES INTO DECENDING ORDER
C
      DO 100 I = LOWL,ISORT
      J1     = I + 1
      II     = I * 4
      DO 100 J = J1,IUPL
      JJ     = J * 4
      IF ( IDIS1(II) .GE. IDIS1(JJ) ) GO TO 100
      ITEMP = IDIS1(II-3)
      JTEMP = IDIS1(II-2)
      KTEMP = IDIS1(II-1)
      LTEMP = IDIS1(II)
      IDIS1(II-3) = IDIS1(JJ-3)
      IDIS1(II-2) = IDIS1(JJ-2)
      IDIS1(II-1) = IDIS1(JJ-1)
      IDIS1(II)   = IDIS1(JJ)
      IDIS1(JJ-3) = ITEMP
      IDIS1(JJ-2) = JTEMP
      IDIS1(JJ-1) = KTEMP
```

```
      IDIS1(JJ)    = LTEMP
  100 CONTINUE
C
C                 FLOOD RECORD TABULATION
C
C       DATA TABULATED WITH YEAR ASCENDING + DISCHARGE DESCENDING
C
      LINES = 61
      II    = LOWL * 4
      JJ    = 4
      IYR   = 1
      STATN = FLOAT(IDENT(2)) / 100.0
      AREA  = FLOAT(IDENT(12)) / 10.0
  120 IF ( LINES .LT. 60 ) GO TO 130
      WRITE(3,903) IDENT(3),IDENT(4),IPAGE,IDENT(1),STATN,(IDENT(I),I=5,
     1       11),N,AREA,(IDENT(I),I=13,18)
      IPAGE = IPAGE + 1
      LINES = 0
  130 IF ( ISW0 .EQ. 0 ) GO TO 140
      WRITE(3,904) IDIS(JJ-3),IDIS(JJ-2),IDIS(JJ-1),IDIS(JJ)
      GO TO 150
  140 WRITE(3,904) IDIS(JJ-3),IDIS(JJ-2),IDIS(JJ-1),IDIS(JJ),IDIS1(II-3)
     1             ,IDIS1(II-2),IDIS1(II-1),IDIS1(II)
  150 II    = II + 4
      JJ    = JJ + 4
      IYR   = IYR + 1
      IF ( IYR .GT. N ) ISW0 = 1
      IF ( IYR .GT. IDENT(19) ) GO TO 200
      LINES = LINES + 1
      GO TO 120
C
C                 FLOOD FREQUENCY PLOT
C
C       BASED ON METHOD PRESENTED IN CIVIL ENGINEER,FEB.1943,PAGE 105
C
  200 IF ( N .LE. 10 )GO TO 705                                          *
      WRITE(3,905) (IDENT(I),I=5,11),IPAGE,IDENT(3),IDENT(4),AREA,N
      IADD   = ( 50 - N ) * ((IDIS1(4*LOWL+4)-IDIS1(4*IUPL))/N/2)
      IF ( N .GT. 50 ) IADD = 0
C
C       CALCULATE APPROXIMATE Y COORDIATE FOR 50 YEAR RECURRENCE
C
      IYCOOR =   IDIS1(4*LOWL) + IADD
      JTEMP = 1000
      IF ( IYCOOR-IDIS1(4*IUPL) .LT. 56000 ) JTEMP = 100
      IF ( IYCOOR-IDIS1(4*IUPL) .LT. 5600 ) JTEMP= 10
      INCVER = ((IYCOOR-IDIS1(4*IUPL   ) )/56+JTEMP/20) / (JTEMP/10)     *
     1         * (JTEMP/10)                                              *
      IYCOOR = ( IYCOOR/INCVER + 1 ) * INCVER                            *
      IADD   = ( IYCOOR - IDIS1(4*IUPL) ) / INCVER                       *
```

* Statements revised in May 1967 version.

```
      ICOUT = MOD(IADD,8)                                                    *
      IF ( IADD - 56 )230,220,220                                            *
  220 IF ( IDIS1(4*IUPL) - (IYCOOR-(IADD+1)*INCVER+INCVER/2))225,225,230 *
  225 ICOUT = ICOUT + 1                                                      *
  230 CONTINUE                                                               *
      ISKSW = 0
      LINES = 0
      J     = 1
      M1    = 0
      DO 700 M = LOWL,IUPL
      M1    = M1 + 1
      T      =  FLOAT(N+1) / FLOAT(M1)
      Y    = -ALOG(-ALOG(1.0-1.0/T))
C
C      CALCULATE X COORDINATE FOR THE YEAR OF THE DATA BEING PLOTTED
C
      IXCOOR = ( 2.0143777 + Y * 1.319087 ) * 10.0 + 0.5
C
C      DETERMINE IF DISCHARGE IS NEAREST Y COORDINATE, WHICH
C      IS THE LINE TO BE PRINTED
C
  300 IF ( IDIS1(4*M) .GE. IYCOOR - INCVER/2 ) GO TO 400
      IF ( ISKSW .EQ. 1 ) GO TO 350
      IPRNT = 0
      GO TO 500
  350 ISKSW = 0
      IYCOOR = IYCOOR - INCVER
      GO TO 300
C
C      MOVE PLOTTING SYMBOL TO PRINT POSITION REPRESENTING X COORDINATE
C
  400 IPRINT(IXCOOR) = KON1
      IF ( IDIS1(4*M+4).GE.IYCOOR - INCVER/2 ) GO TO 700
      IPRNT = 1
C
C      SET PRINT SWITCH BASED UPON WHICH LINE IS BEING PRINTED
C
  500 IF ( LINES .EQ. ICOUT ) GO TO 530
      IF ( LINES .GE. 14 ) GO TO 520
  510 IPRSW = 1
      GO TO 560
  520 IF ( LINES .GT. 42 ) GO TO 510
      IPRSW = 2
      GO TO 560
  530 ICOUT = ICOUT + 8
      IF ( LINES .GE. 14 ) GO TO 550
  540 IPRSW = 3
      GO TO 560
  550 IF ( LINES .GT. 42 ) GO TO 540
      IPRSW = 4
```

* Statements revised in May 1967 version.

```
  560 IF ( IPRNT .EQ. 1 ) IPRSW=IPRSW+4
      GO TO ( 570,580,590,600,610,620,630,640),IPRSW
  570 WRITE(3,906)
      GO TO 660
  580 WRITE(3,906) JHEAD(J)
      GO TO 650
  590 WRITE(3,906) KBLANK,IYCOOR
      GO TO 660
  600 WRITE(3,906) JHEAD(J),IYCOOR
      GO TO 650
  610 WRITE(3,907) KBLANK,KBLANK,IPRINT
      GO TO 660
  620 WRITE(3,907) JHEAD(J),KBLANK,IPRINT
      GO TO 650
  630 WRITE(3,908) KBLANK,IYCOOR,IPRINT
      GO TO 660
  640 WRITE(3,908) JHEAD(J),IYCOOR,IPRINT
  650 J     = J + 1
  660 LINES = LINES + 1
      IF (IPRNT.EQ. 0 ) GO TO 350
      ISKSW = 1
C
C      MOVE BLANKS INTO THE PRINT ARRAY
C
      DO 690 I = 1,100
  690 IPRINT(I) = KBLANK
  700 CONTINUE
C
C      PRINT THE HORIZONTAL SCALE
C
      WRITE(3,909)
      IPAGE = IPAGE + 1
C
C      STORE PAGE NO. FOR CORRESPONDING GAGING STATION IN A TABLE
C
  705 ISTAB(K) = IDENT(2)
      IPTAB(K) = IPRPA
      IPRPA = IPAGE
      IF ( IRKODE .EQ. 0 ) GO TO 10
      GO TO 6
C
C               GAGING STATION INDEX
C
  710 LINES = 65
C
C      READ GAGING STATION NUMBER, IDENTIFICATION AND LOCATION
C
  720 READ(9,911) IDENT
      IF ( IDENT(2) .NE. 999999 ) GO TO 730
      WRITE(3,914)
```

```
      REWIND 9
  725 STOP
  730 IF ( LINES .LE. 64 ) GO TO 740
      WRITE(3,912)
      LINES = 0
C
C      SEARCH GAGING STATION TABLE TO DETERMINE SUBSCRIPT FOR PAGE TABLE
C
  740 DO 750 K = 1,500                                                    *
      IF ( IDENT(2) .EQ. ISTAB(K) ) GO TO 760
  750 CONTINUE
      GO TO 720
  760 STATN = FLOAT(IDENT(2)) / 100.0
      WRITE(3,913) IDENT(1),STATN,(IDENT(I),I=5,11),IPTAB(K)
      LINES = LINES + 1
      GO TO 720
      END
```

* Statements revised in May 1967 version.

CONNECTICUT RIVER BASIN PAGE 1

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 286.00 CONNECTICUT AT HOLYOKE, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 19
8309.0	42 12 50	72 36 10	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAY	18	1881	49000
DEC	30	1881	46800
APR	14	1883	68300
MAR	28	1884	71900
APR	24	1885	64000
APR	2	1886	80200
APR	12	1887	85500
MAY	1	1888	99800
DEC	19	1888	59300
MAY	8	1890	46800
APR	16	1891	67300
JAN	15	1892	63100
MAY	5	1893	94400
APR	25	1894	43300
APR	16	1895	115000
MAR	2	1896	112000
JUN	11	1897	75400
MAR	21	1898	76200
APR	26	1899	82500
	2	0	0
MAR	19	1936	226100
	0	0	0
SEP	22	1938	179000

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
APR	16	1895	115000
MAR	2	1896	112000
MAY	1	1888	99800
MAY	5	1893	94400
APR	12	1887	85500
APR	26	1899	82500
APR	2	1886	80200
MAR	21	1898	76200
JUN	11	1897	75400
MAR	28	1884	71900
APR	14	1883	68300
APR	16	1891	67300
APR	24	1885	64000
JAN	15	1892	63100
DEC	19	1888	59300
MAY	18	1881	49000
DEC	30	1881	46800
MAY	8	1890	46800
APR	25	1894	43300

Note:

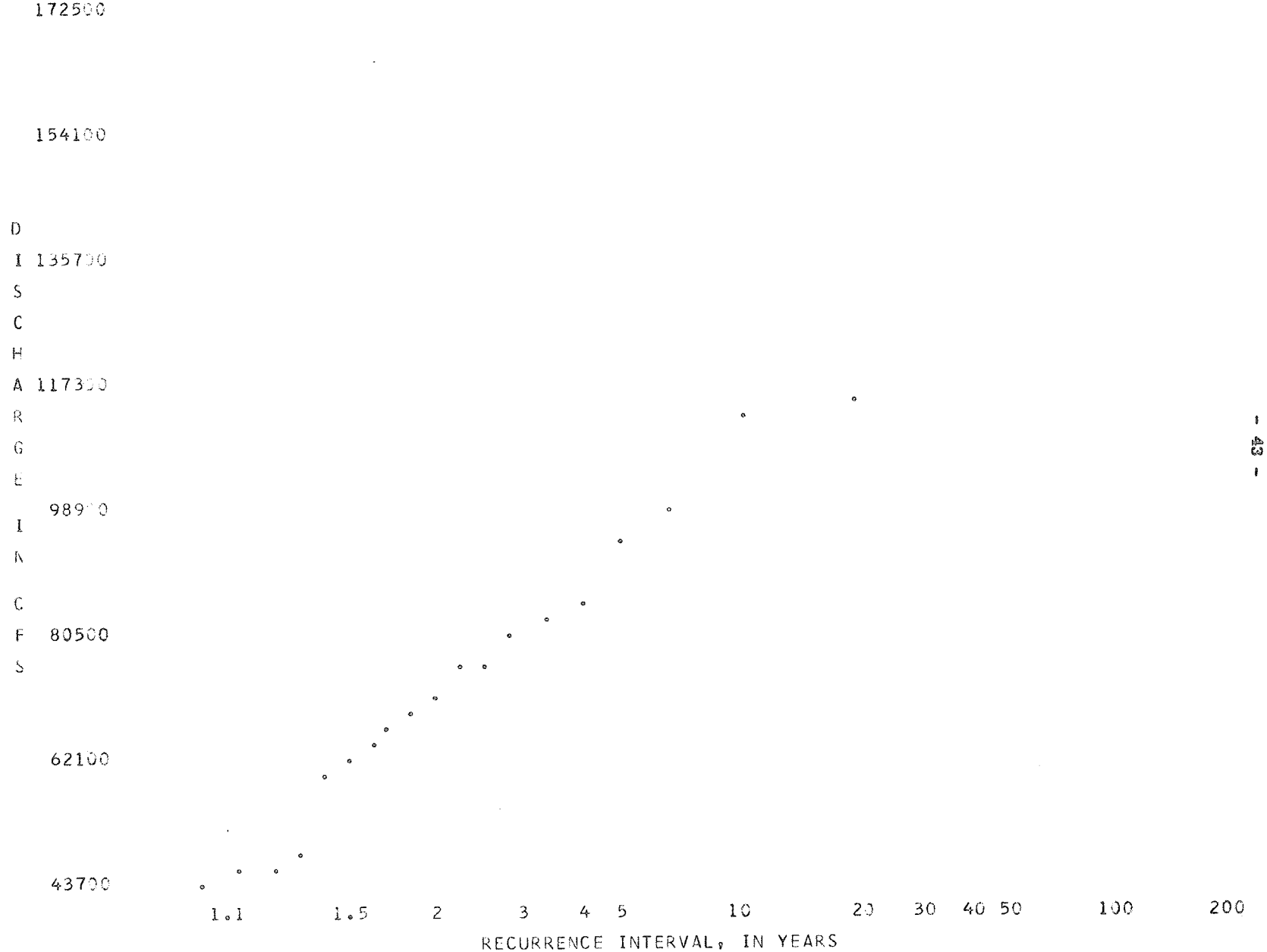
1. Zero (0) under "Peak Discharge" between years 1899 and 1936 indicates a discontinuous record. The accompanying two (2) under "Day" indicates that the preceding flood data makes up the usable portion.

2. Zero (0) under "Peak Discharge" between the years 1936 and 1938 signifies a discontinuity in the flood record while the accompanying zero (0) under "Day" specifies the break occurs within the nonusable portion of the record.

3. Figure 6 illustrates how the 1937 peak discharge, missing from this example, would be coded on the data form. The number 22 appearing under "Entry" is the number of entries, including the desired change. The 5 under "Code" specifies that this is a change within an existing record. Refer to Input Data in the Flood Record Update Program for a complete discussion of updating a flood record.

FLOOD DATA PLOT FOR CONNECTICUT AT HOLYOKE, MASS

CONNECTICUT RIVER BASIN DRAINAGE AREA 8309.0 SQ.MI. YEARS OF RECORD - 19



IPSWICH RIVER BASIN PAGE 3

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 1020.00 IPSWICH NR IPSWICH, MASS

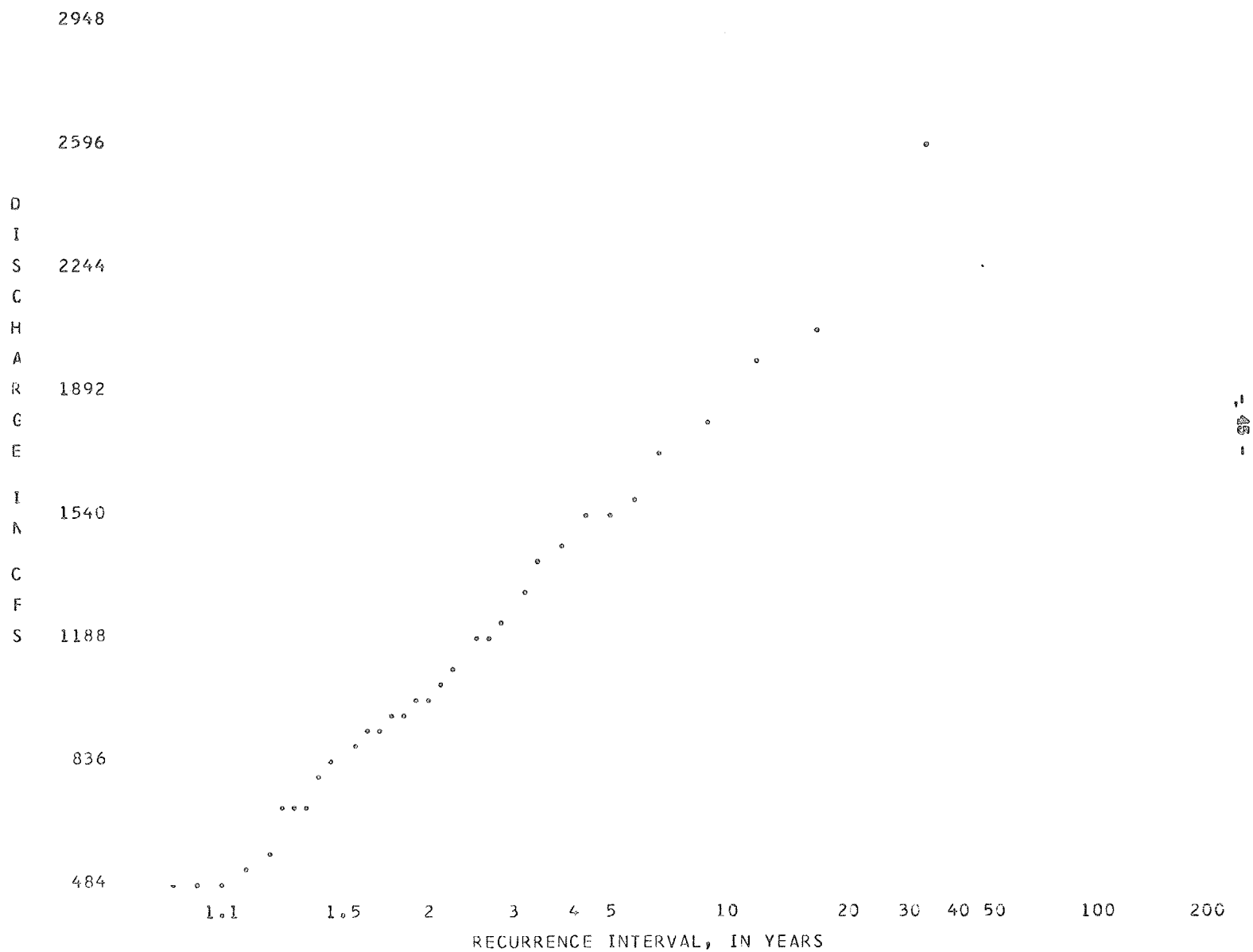
DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 33
124.0	42 39 35	70 53 39	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	31	1931	948
APR	1	1932	792
APR	20	1933	1540
MAR	7	1934	1580
APR	15	1935	1240
MAR	15	1936	2610
DEC	23	1936	590
JUL	26	1938	1700
APR	4	1939	1120
APR	2	1940	1180
MAR	28	1941	489
MAR	20	1942	877
MAR	21	1943	710
MAR	27	1944	506
MAR	8	1945	1020
MAR	10	1946	1430
MAY	6	1947	688
MAR	23	1948	1810
MAR	2	1949	500
MAR	26	1950	919
FEB	21	1951	835
MAR	14	1952	1070
APR	1	1953	1300
MAY	11	1954	1410
DEC	23	1954	682
JAN	13	1956	1530
JAN	26	1957	496
JAN	29	1958	1970
MAR	8	1959	934
APR	6	1960	953
APR	17	1961	1000
MAR	18	1962	1180
OCT	9	1962	2070

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	15	1936	2610
OCT	9	1962	2070
JAN	29	1958	1970
MAR	23	1948	1810
JUL	26	1938	1700
MAR	7	1934	1580
APR	20	1933	1540
JAN	13	1956	1530
MAR	10	1946	1430
MAY	11	1954	1410
APR	1	1953	1300
APR	15	1935	1240
MAR	18	1962	1180
APR	2	1940	1180
APR	4	1939	1120
MAR	14	1952	1070
MAR	8	1945	1020
APR	17	1961	1000
APR	6	1960	953
MAR	31	1931	948
MAR	8	1959	934
MAR	26	1950	919
MAR	20	1942	877
FEB	21	1951	835
APR	1	1932	792
MAR	21	1943	710
MAY	6	1947	688
DEC	23	1954	682
DEC	23	1936	590
MAR	27	1944	506
MAR	2	1949	500
JAN	26	1957	496
MAR	28	1941	489

FLOOD DATA PLOT FOR IPSWICH NR IPSWICH, MASS

IPSWICH RIVER BASIN DRAINAGE AREA 124.0 SQ.MI. YEARS OF RECORD - 33



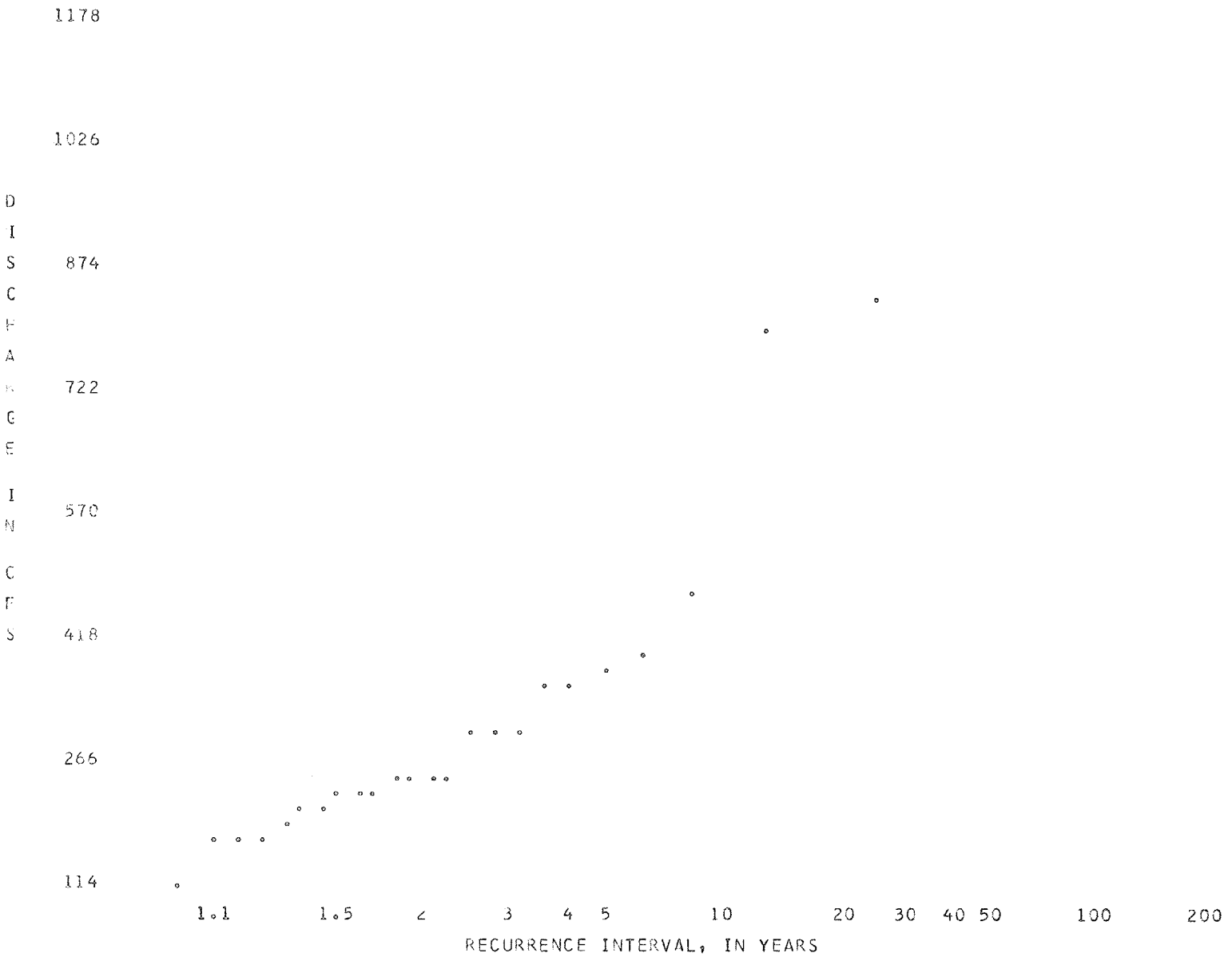
STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1025.00	ABERJONA AT WINCHESTER, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 24
23.3	42 26 50	71 8 22	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	15	1940	308
FEB	8	1941	202
MAR	17	1942	250
DEC	31	1942	233
SEP	15	1944	168
MAR	7	1945	215
DEC	7	1945	310
MAR	3	1947	306
MAR	20	1948	358
APR	6	1949	112
MAR	23	1950	246
FEB	19	1951	233
MAR	12	1952	221
MAR	31	1953	242
SEP	12	1954	482
AUG	19	1955	835
JAN	9	1956	378
JAN	24	1957	172
JAN	26	1958	390
MAR	6	1959	170
FEB	20	1960	194
APR	17	1961	238
MAR	13	1962	367
OCT	7	1962	790

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	19	1955	835
OCT	7	1962	790
SEP	12	1954	482
JAN	26	1958	390
JAN	9	1956	378
MAR	13	1962	367
MAR	20	1948	358
DEC	7	1945	310
MAR	15	1940	308
MAR	3	1947	306
MAR	17	1942	250
MAR	23	1950	246
MAR	31	1953	242
APR	17	1961	238
DEC	31	1942	233
FEB	19	1951	233
MAR	12	1952	221
MAR	7	1945	215
FEB	8	1941	202
FEB	20	1960	194
JAN	24	1957	172
MAR	6	1959	170
SEP	15	1944	168
APR	6	1949	112

MYSTIC RIVER BASIN DRAINAGE AREA 23.3 SQ.MI. YEARS OF RECORD - 24



CHARLES RIVER BASIN PAGE 7

STATION NO. STREAM NAME @ GAGING STATION LOCATION

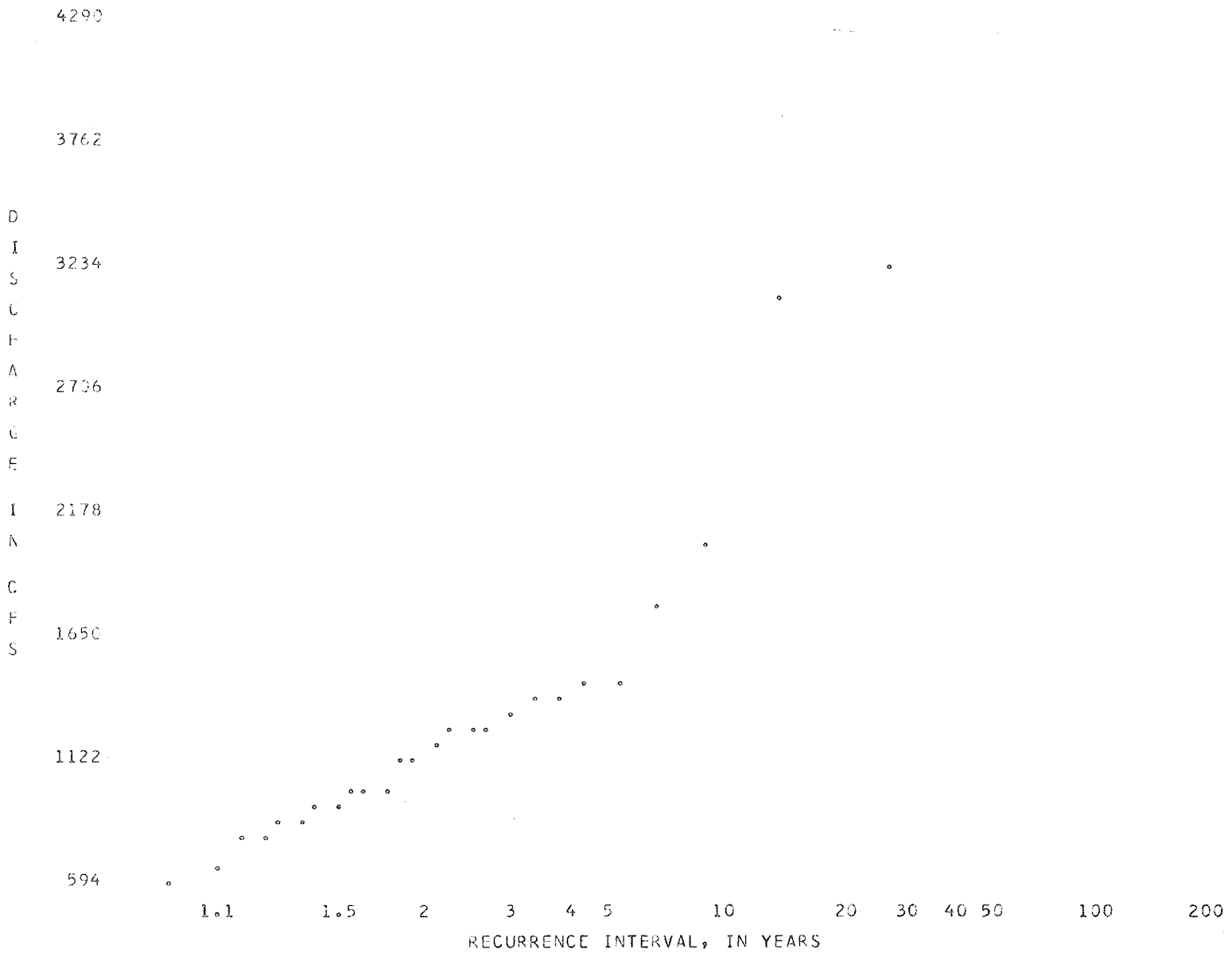
1 1035.00 CHARLES AT CHARLES RIVER VILLAGE, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 26
184.0	42 15 23	71 15 32	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
JUL	27	1938	3110
APR	7	1939	1000
APR	4	1940	1200
FEB	12	1941	685
MAR	22	1942	1140
MAR	11	1943	861
APR	29	1944	795
MAR	8	1945	1280
DEC	11	1945	1240
MAR	7	1947	765
MAR	22	1948	2060
FEB	23	1949	616
MAR	28	1950	857
APR	7	1951	980
MAR	15	1952	1310
APR	2	1953	1420
SEP	17	1954	1240
AUG	23	1955	3220
APR	11	1956	1480
APR	11	1957	924
JAN	30	1958	1770
MAR	9	1959	981
APR	8	1960	1100
MAR	1	1961	1370
MAR	19	1962	1390
MAR	18	1963	940

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	23	1955	3220
JUL	27	1938	3110
MAR	22	1948	2060
JAN	30	1958	1770
APR	11	1956	1480
APR	2	1953	1420
MAR	19	1962	1390
MAR	1	1961	1370
MAR	15	1952	1310
MAR	8	1945	1280
SEP	17	1954	1240
DEC	11	1945	1240
APR	4	1940	1200
MAR	22	1942	1140
APR	8	1960	1100
APR	7	1939	1000
MAR	9	1959	981
APR	7	1951	980
MAR	18	1963	940
APR	11	1957	924
MAR	11	1943	861
MAR	28	1950	857
APR	29	1944	795
MAR	7	1947	765
FEB	12	1941	685
FEB	23	1949	616

CHARLES RIVER BASIN DRAINAGE AREA 184.0 SQ.MI. YEARS OF RECORD - 26



CHARLES RIVER BASIN PAGE 9

STATION NO. STREAM NAME @ GAGING STATION LOCATION

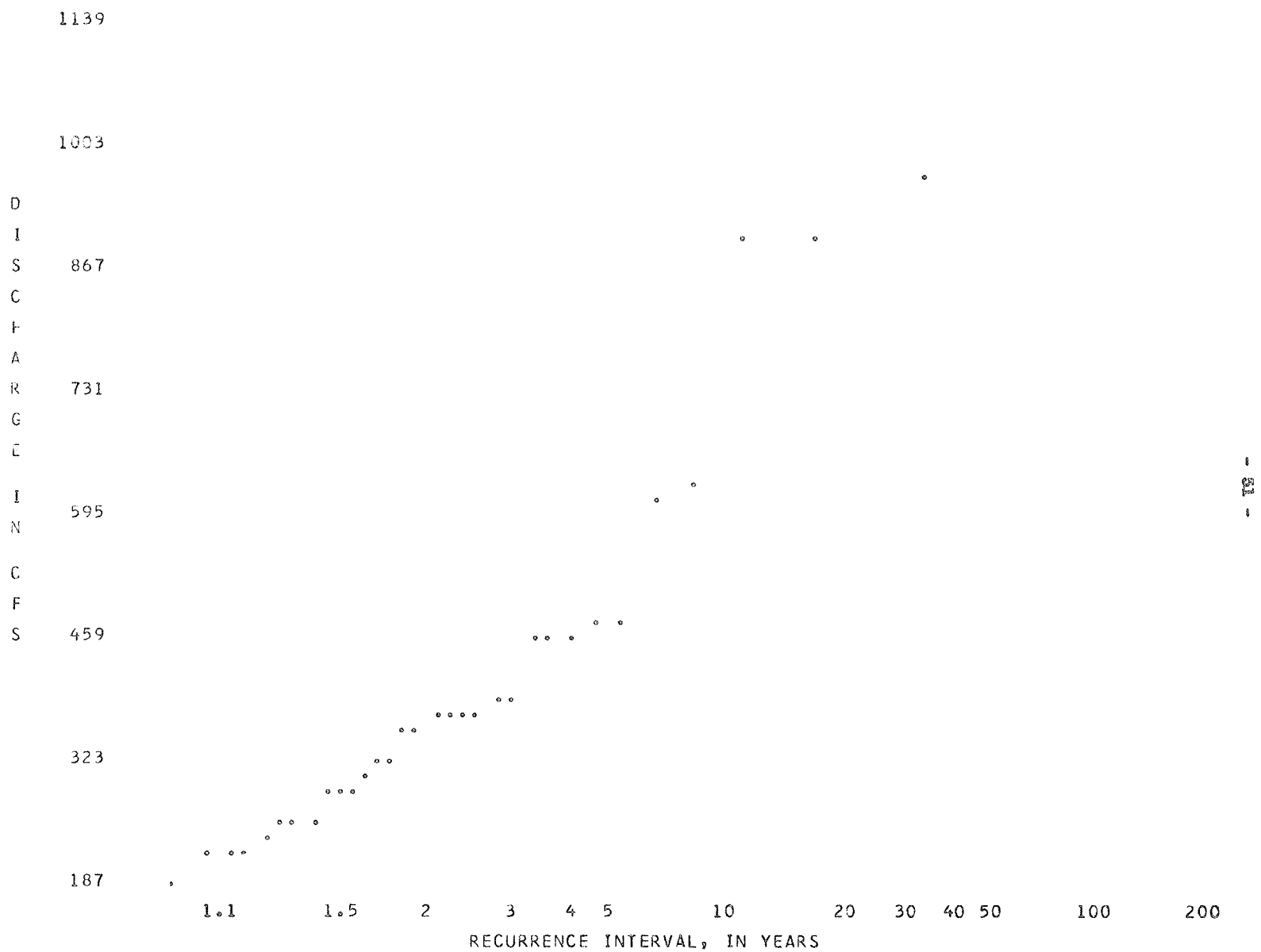
1 1040.00 MOTHER BROOK AT DEDHAM, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 32
.0	42 15 19	71 9 58	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
APR	3	1932	238
APR	19	1933	451
MAR	10	1934	385
APR	17	1935	467
MAR	19	1936	900
DEC	21	1936	388
JUL	28	1938	909
APR	7	1939	327
APR	25	1940	362
FEB	16	1941	222
MAR	23	1942	368
MAR	13	1943	247
APR	30	1944	229
MAR	9	1945	451
DEC	12	1945	376
MAR	10	1947	216
MAR	24	1948	626
MAR	1	1949	184
MAR	30	1950	257
APR	8	1951	247
MAR	17	1952	374
APR	20	1953	474
SEP	18	1954	354
AUG	24	1955	970
NOV	11	1955	480
APR	13	1957	285
JAN	30	1958	616
JUN	20	1959	290
FEB	16	1960	293
MAR	2	1961	376
MAR	18	1962	300
OCT	9	1962	315

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	24	1955	970
JUL	28	1938	909
MAR	19	1936	900
MAR	24	1948	626
JAN	30	1958	616
NOV	11	1955	480
APR	20	1953	474
APR	17	1935	467
MAR	9	1945	451
APR	19	1933	451
DEC	21	1936	388
MAR	10	1934	385
DEC	12	1945	376
MAR	2	1961	376
MAR	17	1952	374
MAR	23	1942	368
APR	25	1940	362
SEP	18	1954	354
APR	7	1939	327
OCT	9	1962	315
MAR	18	1962	300
FEB	16	1960	293
JUN	20	1959	290
APR	13	1957	285
MAR	30	1950	257
MAR	13	1943	247
APR	8	1951	247
APR	3	1932	238
APR	30	1944	229
FEB	16	1941	222
MAR	10	1947	216
MAR	1	1949	184

CHARLES RIVER BASIN DRAINAGE AREA .0 SQ.MI. YEARS OF RECORD - 32



CHARLES RIVER BASIN PAGE 11

STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1042.00	CHARLES AT WELLESLEY, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 4
211.0	42 18 59	71 13 42	

DATE			PEAK	DATE			PEAK
MO.	DAY	YEAR	DISCHARGE	MO.	DAY	YEAR	DISCHARGE
APR	5	1960	1470				
MAR	3	1961	1300				
MAR	19	1962	1230				
MAR	20	1963	813				

Note:

1. Neither a listing of discharges in descending order nor a frequency plot are shown because there are less than 10 years of record.

2. Figure 6 illustrates how the above record could be updated to include two additional years of record. The number 4 under "Code" indicates that this is the first entry of the additions. The number 9 used with the 1965 entry specifies that this is the last entry of the additions. Refer to "Input Data" in the Flood Record Update Program for a complete discussion of updating a flood record.

CHARLES RIVER BASIN PAGE 12

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 1045.00 CHARLES AT WALTHAM, MASS

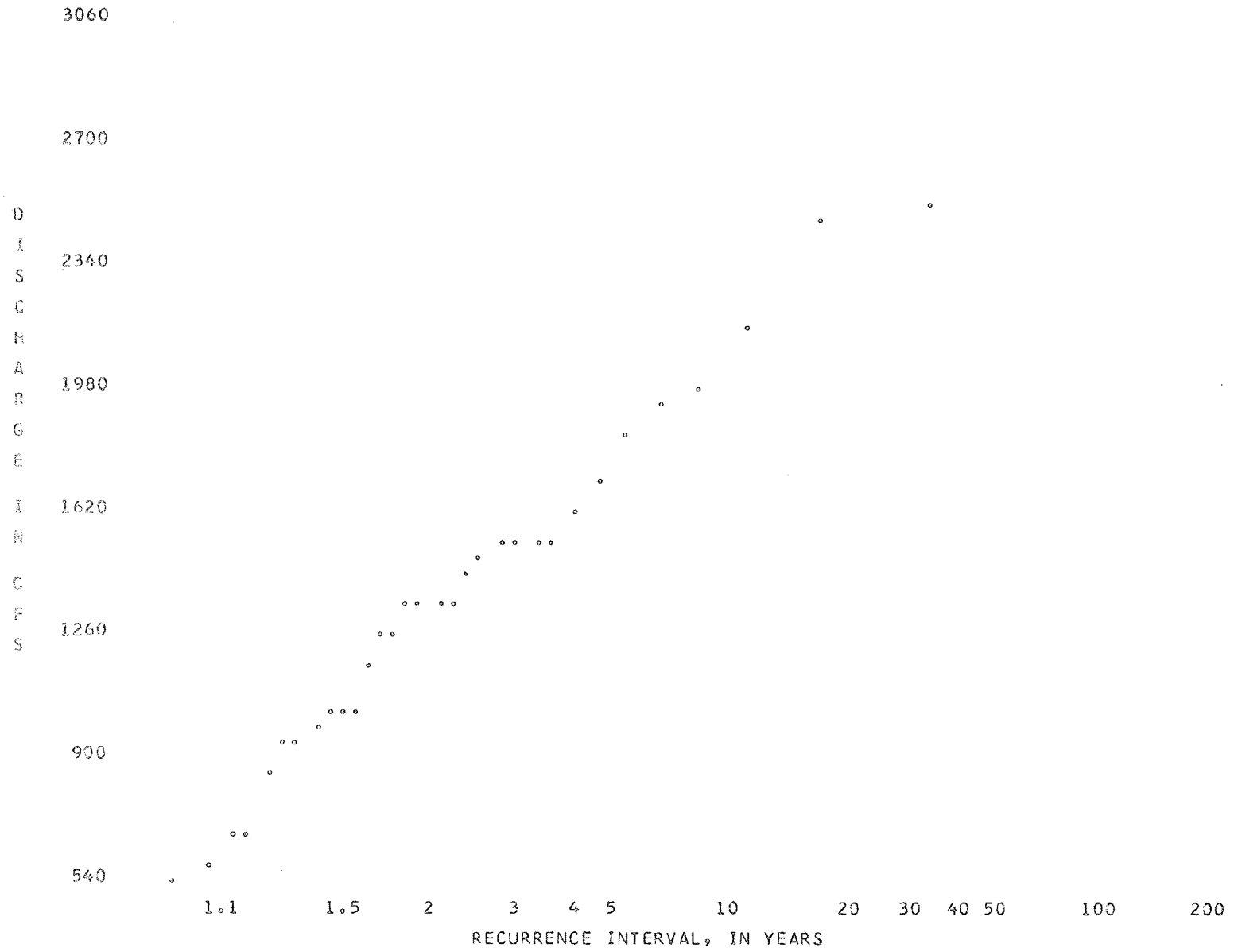
DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 32
227.0	42 22 20	71 14 3	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
APR	1	1932	690
APR	19	1933	1520
MAR	10	1934	1020
APR	14	1935	1370
MAR	19	1936	2540
DEC	20	1936	1020
JUL	26	1938	2180
APR	3	1939	1020
APR	22	1940	1600
FEB	15	1941	555
MAR	23	1942	1470
MAR	12	1943	1180
JAN	14	1944	1000
MAR	12	1945	1240
JAN	14	1946	1360
MAY	7	1947	692
MAR	22	1948	1730
FEB	20	1949	575
MAR	28	1950	869
APR	7	1951	933
MAR	17	1952	1250
APR	3	1953	1360
SEP	22	1954	1550
AUG	19	1955	2490
NOV	11	1955	1990
APR	11	1957	957
JAN	26	1958	1940
MAR	6	1959	1460
APR	6	1960	1510
FEB	27	1961	1850
APR	2	1962	1540
OCT	7	1962	1340

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	19	1936	2540
AUG	19	1955	2490
JUL	26	1938	2180
NOV	11	1955	1990
JAN	26	1958	1940
FEB	27	1961	1850
MAR	22	1948	1730
APR	22	1940	1600
SEP	22	1954	1550
APR	2	1962	1540
APR	19	1933	1520
APR	6	1960	1510
MAR	23	1942	1470
MAR	6	1959	1460
APR	14	1935	1370
JAN	14	1946	1360
APR	3	1953	1360
OCT	7	1962	1340
MAR	17	1952	1250
MAR	12	1945	1240
MAR	12	1943	1180
APR	3	1939	1020
DEC	20	1936	1020
MAR	10	1934	1020
JAN	14	1944	1000
APR	11	1957	957
APR	7	1951	933
MAR	28	1950	869
MAY	7	1947	692
APR	1	1932	690
FEB	20	1949	575
FEB	15	1941	555

FLOOD DATA PLOT FOR CHARLES AT WALTHAM, MASS

CHARLES RIVER BASIN DRAINAGE AREA 227.0 SQ.MI. YEARS OF RECORD - 32



NEPONSET RIVER BASIN PAGE 14

STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1050.00	NEPONSET AT NORWOOD, MASS

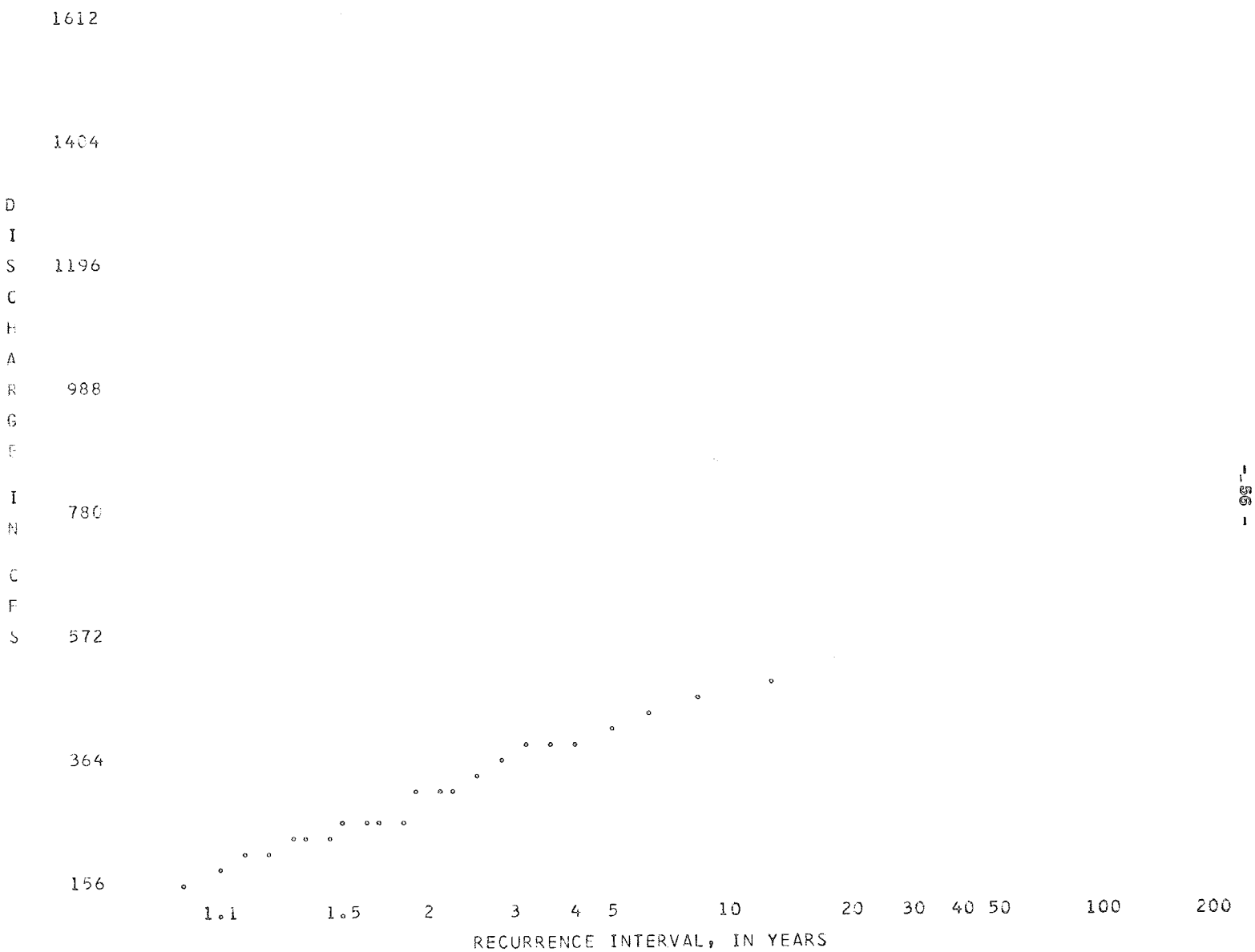
DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 24
35.2	42 10 39	71 12 5	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
APR	22	1940	226
FEB	8	1941	240
MAR	17	1942	304
MAY	15	1943	230
SEP	15	1944	200
MAR	7	1945	254
DEC	7	1945	414
MAR	3	1947	212
MAR	21	1948	398
APR	8	1949	165
MAR	23	1950	176
APR	3	1951	255
MAR	12	1952	336
MAR	30	1953	398
MAY	9	1954	430
AUG	19	1955	1490
NOV	5	1955	486
JAN	23	1957	247
JAN	27	1958	384
MAR	7	1959	321
FEB	20	1960	247
MAY	28	1961	318
APR	2	1962	368
OCT	7	1962	473

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	19	1955	1490
NOV	5	1955	486
OCT	7	1962	473
MAY	9	1954	430
DEC	7	1945	414
MAR	21	1948	398
MAR	30	1953	398
JAN	27	1958	384
APR	2	1962	368
MAR	12	1952	336
MAR	7	1959	321
MAY	28	1961	318
MAR	17	1942	304
APR	3	1951	255
MAR	7	1945	254
FEB	20	1960	247
JAN	23	1957	247
FEB	8	1941	240
MAY	15	1943	230
APR	22	1940	226
MAR	3	1947	212
SEP	15	1944	200
MAR	23	1950	176
APR	8	1949	165

FLOOD DATA PLOT FOR NEPONSET AT NORWOOD, MASS

NEPONSET RIVER BASIN DRAINAGE AREA 35.2 SQ.MI. YEARS OF RECORD - 24



STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1055.00	E BR NEPONSET AT CANTON, MASS

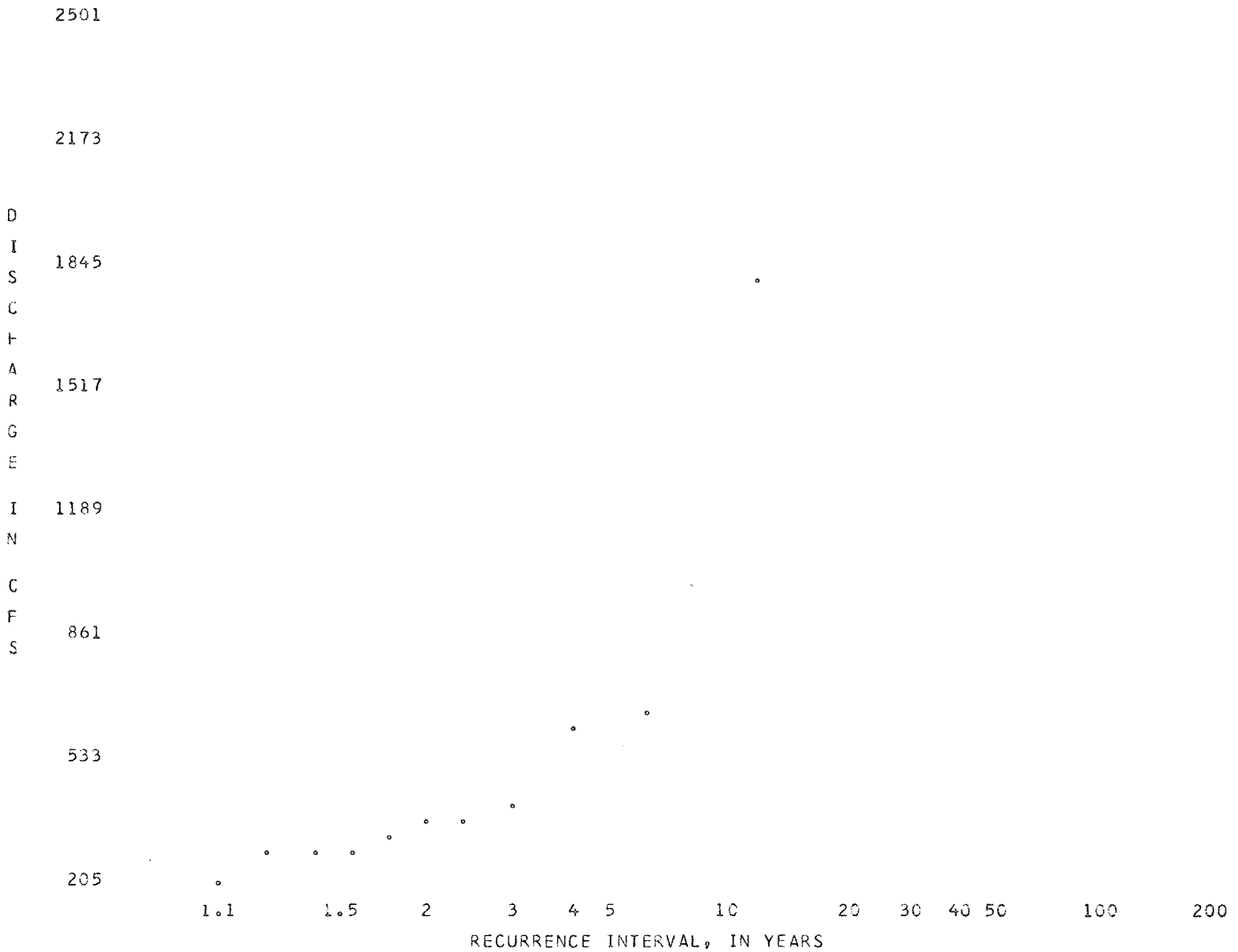
DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 11
26.7	42 9 16	71 8 47	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	31	1953	374
APR	18	1954	398
AUG	19	1955	1790
NOV	5	1955	598
JAN	23	1957	292
JAN	26	1958	360
MAR	7	1959	293
FEB	19	1960	221
FEB	26	1961	334
JAN	7	1962	281
OCT	6	1962	642

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	19	1955	1790
OCT	6	1962	642
NOV	5	1955	598
APR	18	1954	398
MAR	31	1953	374
JAN	26	1958	360
FEB	26	1961	334
MAR	7	1959	293
JAN	23	1957	292
JAN	7	1962	281
FEB	19	1960	221

FLOOD DATA PLOT FOR E BR NEPONSET AT CANTON, MASS

NEPONSET RIVER BASIN DRAINAGE AREA 26.7 SQ.MI. YEARS OF RECORD - 11



NORTH RIVER BASIN PAGE 18

STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1057.00	INDIAN HEAD BROOK NR HANSON, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 2
4.4	42 5 13	70 51 26	

DATE			PEAK	DATE			PEAK
MO.	DAY	YEAR	DISCHARGE	MO.	DAY	YEAR	DISCHARGE
APR	3	1959	24				
APR	5	1960	38				

NORTH RIVER BASIN PAGE 19

STATION NO.	STREAM NAME @ GAGING STATION LOCATION
1 1058.00	PUDDING BROOK AT EAST PEMBROKE, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 4
1.4	42 5 13	70 45 28	

DATE			PEAK	DATE			PEAK
MO.	DAY	YEAR	DISCHARGE	MO.	DAY	YEAR	DISCHARGE
MAR	15	1959	7				
SEP	20	1960	11				
APR	10	1961	28				
JAN	7	1962	25				

Note:

1. Neither a listing of the discharges in descending order nor a frequency plot are shown because there are less than 10 years of record.

2. Figure 6 illustrates how the above record could be updated to include three additional years of record. The numbers 4, 2 and 9 under "Code" specify, in this case, the first, second and third pieces of update data, respectively. Refer to Input Data in Flood Record Update Program for a complete discussion of updating a flood record.

BLACKSTONE RIVER BASIN PAGE 20

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 1095.00 KETTLE BROOK AT WORCESTER, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 36
31.3	42 13 55	71 50 7	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
APR	7	1924	740
FEB	12	1925	450
MAR	25	1926	400
NOV	8	1926	230
NOV	4	1927	790
APR	16	1929	473
MAR	9	1930	116
JUN	10	1931	935
SEP	17	1932	404
NOV	11	1932	586
APR	13	1934	570
JAN	10	1935	1020
MAR	18	1936	2520
DEC	9	1936	429
SEP	21	1938	1300
MAR	1	1939	337
APR	1	1940	500
FEB	8	1941	219
MAR	10	1942	540
MAY	22	1943	237
APR	25	1944	291
JAN	2	1945	312
MAR	8	1946	396
MAR	15	1947	213
MAR	22	1948	393
JAN	7	1949	162
MAR	24	1950	195
FEB	8	1951	596
JUN	2	1952	508
MAR	16	1953	584
SEP	12	1954	1530
AUG	19	1955	3970
OCT	16	1955	852
JAN	23	1957	246
APR	7	1958	687
APR	3	1959	747
	2	0	0
APR	17	1961	210
APR	1	1962	270
MAR	27	1963	400

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
AUG	19	1955	3970
MAR	18	1936	2520
SEP	12	1954	1530
SEP	21	1938	1300
JAN	10	1935	1020
JUN	10	1931	935
OCT	16	1955	852
NOV	4	1927	790
APR	3	1959	747
APR	7	1924	740
APR	7	1958	687
FEB	8	1951	596
NOV	11	1932	586
MAR	16	1953	584
APR	13	1934	570
MAR	10	1942	540
JUN	2	1952	508
APR	1	1940	500
APR	16	1929	473
FEB	12	1925	450
DEC	9	1936	429
SEP	17	1932	404
MAR	25	1926	400
MAR	8	1946	396
MAR	22	1948	393
MAR	1	1939	337
JAN	2	1945	312
APR	25	1944	291
JAN	23	1957	246
MAY	22	1943	237
NOV	8	1926	230
FEB	8	1941	219
MAR	15	1947	213
MAR	24	1950	195
JAN	7	1949	162
MAR	9	1930	116

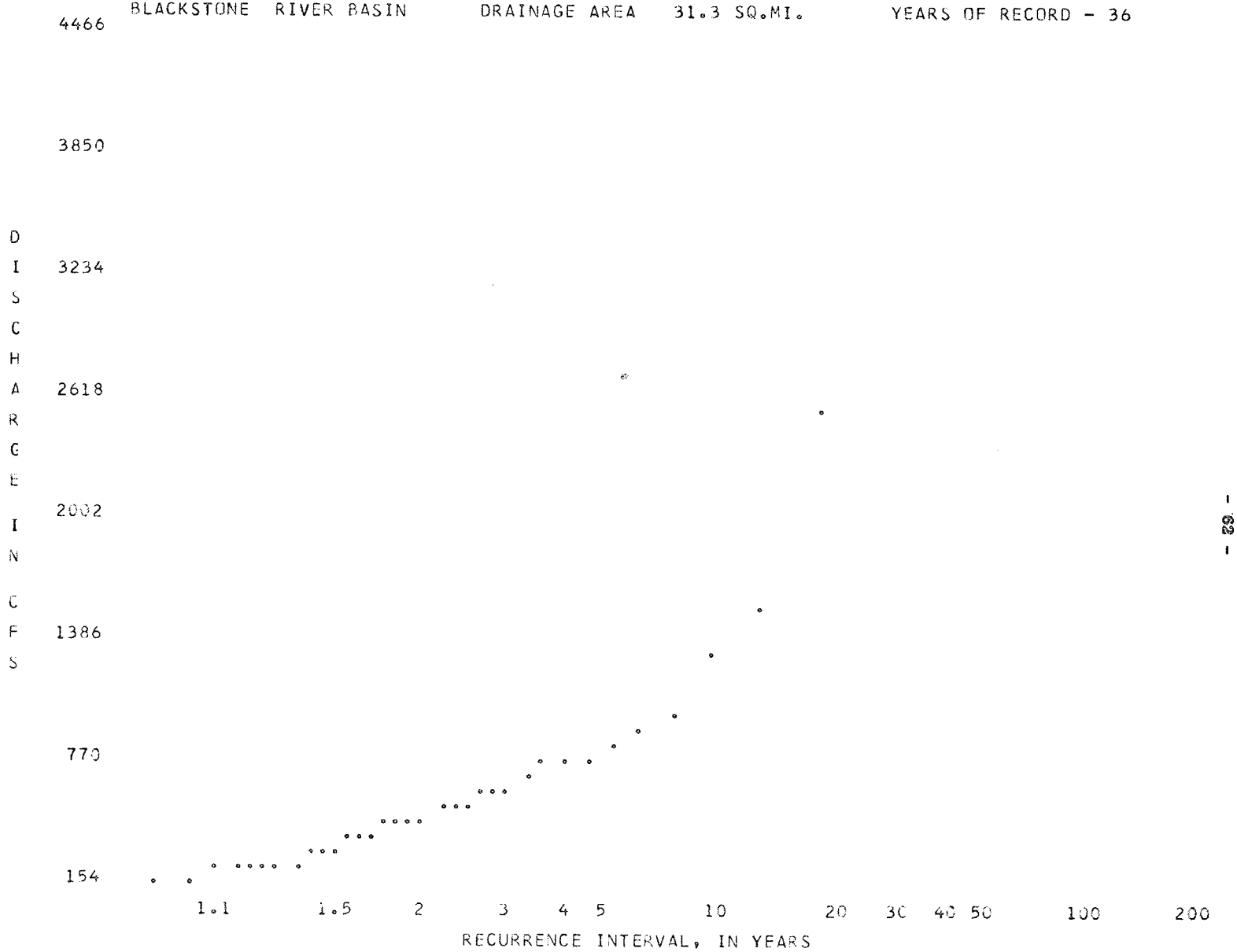
Note:

1. Zero (0) under "Peak Discharge" between 1959 and 1961 entries indicates a discontinuous record. The accompanying two (2) under "Day" specifies that the preceding flood data are the usable portion.

2. Figure 6 illustrates how the above record could be updated one year. A one year addition to an existing flood record is specified by the three digit under "Code".

FLOOD DATA PLOT FOR KETTLE BROOK AT WORCESTER, MASS

BLACKSTONE RIVER BASIN DRAINAGE AREA 31.3 SQ.MI. YEARS OF RECORD - 36



CONNECTICUT RIVER BASIN PAGE 22

STATION NO. STREAM NAME @ GAGING STATION LOCATION

1 1730.00 WARE AT COLDBROOK, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 9
96.8	42 23 30	72 3 40	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
MAR	16	1929	990
MAR	26	1930	425
APR	4	1931	1100
	1	0	0
APR	19	1933	1400
APR	13	1934	1180
JAN	11	1935	976
MAR	19	1936	5990
DEC	21	1936	1090
SEP	21	1938	14000
DEC	7	1938	961
APR	13	1940	1830
MAY	10	1941	897
	2	0	0
APR	17	1961	832
APR	1	1962	1470
APR	3	1963	1080

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
SEP	21	1938	14000
MAR	19	1936	5990
APR	13	1940	1830
APR	19	1933	1400
APR	13	1934	1180
DEC	21	1936	1090
JAN	11	1935	976
DEC	7	1938	961
MAY	10	1941	897

Note:

1. The Zeros(0) between 1931 and 1933 and between 1941 and 1961 in the "Peak Discharge" column indicates a discontinuous record. Under the "Day" column the one (1) after 1931 indicates that all prior data is not usable and the two (2) after 1941 indicates that the following data is not usable. This leaves the 1933 thru 1941 data usable and it has been sorted according to discharge in the right hand columns.

STATION NO. STREAM NAME @ GAGING STATION LOCATION

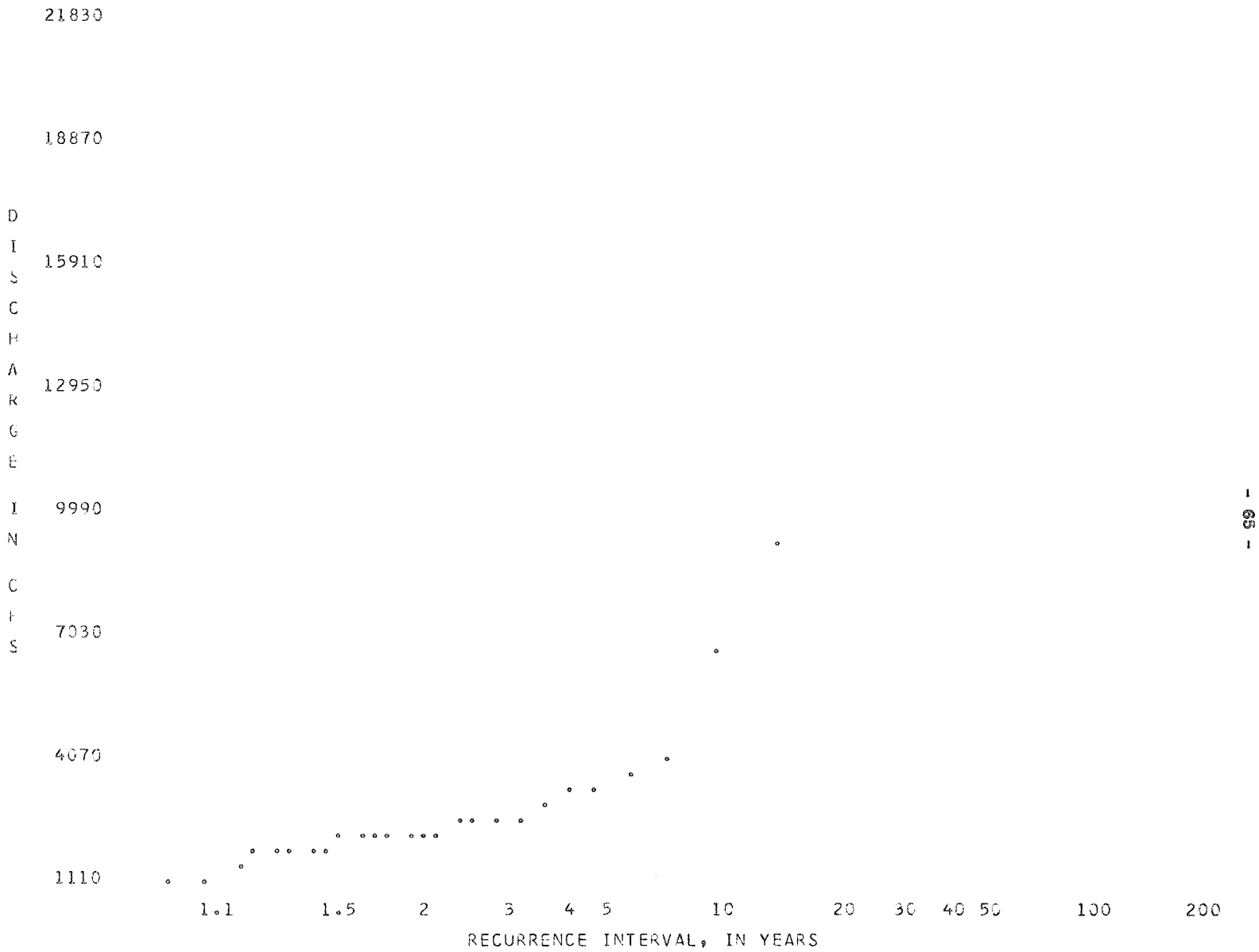
1 1855.00 W BR FARMINGTON NR NEW BOSTON, MASS

DR AREA	LATITUDE	LONGITUDE	YEARS OF RECORD - 27
92.0	42 4 45	73 4 24	

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
OCT	26	1913	3200
FEB	25	1915	2600
DEC	26	1915	2120
MAR	27	1917	1900
MAR	22	1918	1010
MAR	28	1919	2540
APR	13	1920	2390
MAR	9	1921	2520
MAR	29	1922	2200
APR	5	1923	1800
APR	7	1924	3960
FEB	12	1925	2050
APR	25	1926	1740
AUG	8	1927	1820
NOV	3	1928	6610
APR	21	1929	2590
MAR	8	1930	1100
JUN	10	1931	1450
APR	1	1932	1980
NOV	19	1933	3610
APR	12	1934	2250
JAN	10	1935	3060
MAR	18	1936	9080
MAY	15	1937	3280
SEP	21	1938	18500
APR	19	1939	2220
APR	12	1940	2280
	6	0	0
NOV	25	1942	1830
NOV	9	1943	2610
APR	25	1945	2450
	-0	0	0
MAR	22	1948	3180
DEC	31	1948	11700
APR	5	1950	1270
NOV	25	1950	10100
JUN	1	1952	4060
MAR	24	1953	3240
SEP	11	1954	4240
AUG	19	1955	34300
OCT	16	1955	7910
JAN	23	1957	1510
DEC	21	1958	2360
APR	2	1959	2440
APR	5	1960	3200
JUN	10	1961	2940
APR	1	1962	2510
APR	2	1963	1440

DATE			PEAK
MO.	DAY	YEAR	DISCHARGE
SEP	21	1938	18500
MAR	18	1936	9080
NOV	3	1928	6610
APR	7	1924	3960
NOV	19	1933	3610
MAY	15	1937	3280
OCT	26	1913	3200
JAN	10	1935	3060
FEB	25	1915	2600
APR	21	1929	2590
MAR	28	1919	2540
MAR	9	1921	2520
APR	13	1920	2390
APR	12	1940	2280
APR	12	1934	2250
APR	19	1939	2220
MAR	29	1922	2200
DEC	26	1915	2120
FEB	12	1925	2050
APR	1	1932	1980
MAR	27	1917	1900
AUG	8	1927	1820
APR	5	1923	1800
APR	25	1926	1740
JUN	10	1931	1450
MAR	8	1930	1100
MAR	22	1918	1010

CONNECTICUT RIVER BASIN DRAINAGE AREA 92.0 SQ.MI. YEARS OF RECORD - 27



FLOOD DATA INDEX OF GAGING STATIONS

GPO 924-315

Page 4, last para, line 2 - Figure 2 should be Figure 3