ANNIE

An Interactive Processor for Hydrologic Modeling

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AN INTERACTIVE PROCESSOR FOR HYDROLOGIC MODELING

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 83-

Prepared in cooperation with the

U.S. ENVIRONMENTAL PROTECTION AGENCY

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By Alan M. Lumb and John L. Kittle, Jr.

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ANNIE - AN INTERACTIVE PROCESSOR FOR HYDROLOGIC MODELING

PART A - USER'S GUIDE

By Alan M. Lumb and John L. Kittle, Jr.

ABSTRACT

ANNIE is a Fortran program designed for mini- and microcomputers to help the user interactively create, check, and update input to hydrologic models. For models that require time-series data, ANNIE can be used to reformat, store, list, update, and plot those data. Each hydrologic model has an information file that is used by ANNIE to display questions and check the responses. When all the input has been prepared for one of the hydrologic models, the job is then submitted for processing. After processing, ANNIE helps the user conduct statistical analysis on the output files from the hydrologic models and to print and plot data from those files.

PURPOSE

ANNIE was developed to reduce the time and effort required to calibrate, verify, and apply watershed models that continuously simulate water quantity and quality. Figure 1 illustrates the role ANNIE plays in processing data for a watershed modeling system. Watershed models have two categories of input: watershed parameters and time-series data. Watershed parameters include physical dimensions of the watershed and channels, and parameters for the hydrologic processes such as interception and infiltration. Time-series data include meteorological data such as precipitation, temperature, potential evapotranspiration, and solar radiation that are used as input, and data such as flow diversions, observed streamflow, and water equivalent of snowpack which might be used as input or for comparisons with the simulated values. ANNIE was developed to help with both categories of input.

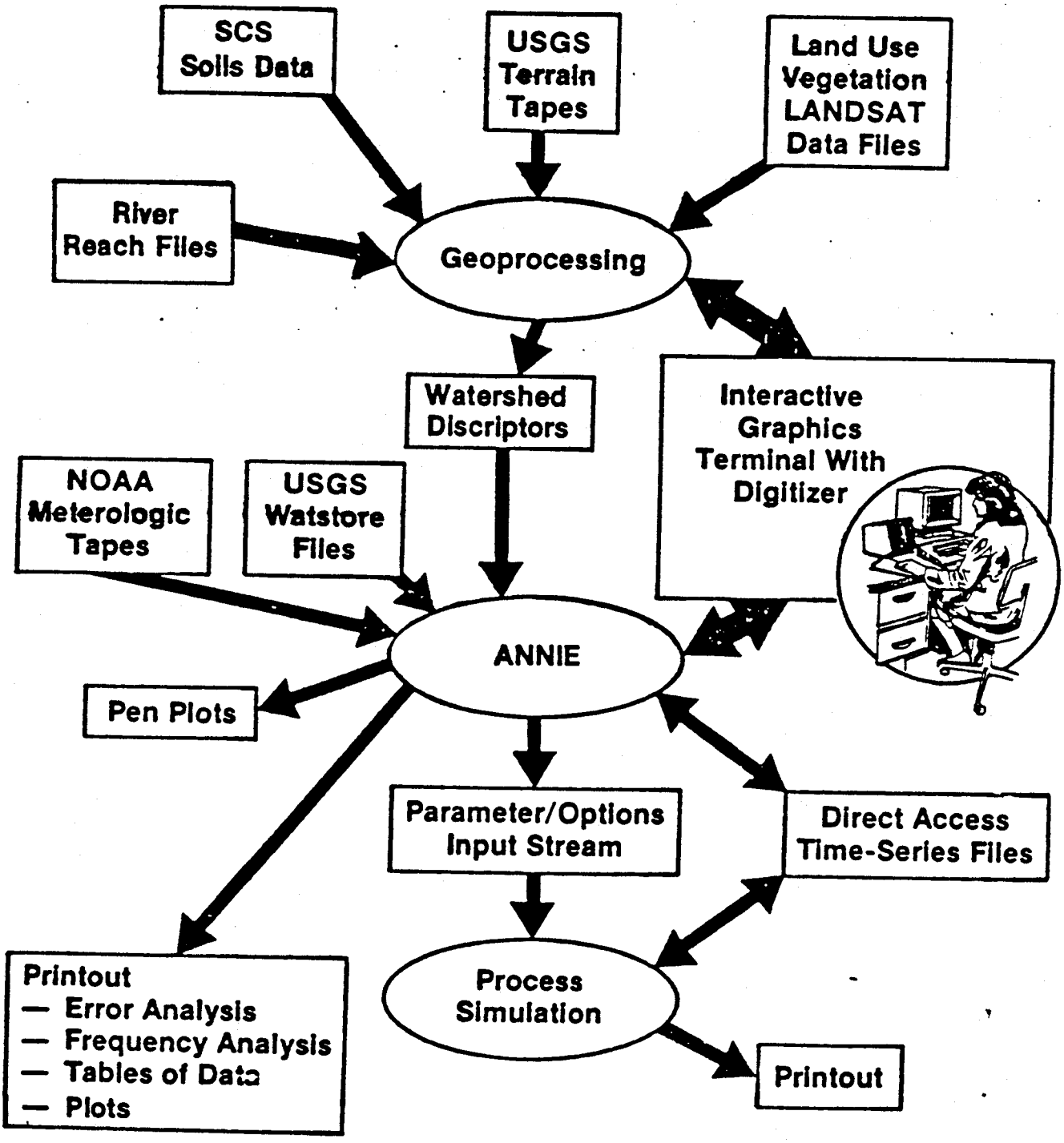


Figure 1.--Data transfers in a watershed modeling system.

For watershed parameters, ANNIE helps the user create an input file for the model. To create that file, ANNIE prompts the user for parameters and options, provides default values, and checks the user's entry against an acceptable range. Once the input file is created, ANNIE can be used to modify the file. Some changes will affect other input and ANNIE also checks for those cases. This is especially important if a new option is added to the input file, in which case the user is prompted for more input. A major reduction in the time and effort for the modeling portion of a study results from these checks. Often a change will be made and the following simulation run will abort because that change required another change which was overlooked. ANNIE would force the other change so that the simulation would not abort. Experience has shown this can save substantial time.

For time-series data, ANNIE uses a direct access file that has a label for each time-series. The label is used to identify and retrieve the time-series. ANNIE can be used to add, replace, list, plot, and display the labels and time-series data in an interactive mode. Since time-series data management often takes more than 50 percent of the effort in a hydrologic simulation study, any software to help reduce the effort is very useful.

DESIGN GOALS FOR THE SOFTWARE

As stated in the purpose, ANNIE is designed to help develop, check, and update input to hydrologic models. Additional goals for ANNIE include the development of software that is easily implemented on minicomputers and some microcomputers and software that has no special requirements for interactive display terminals. Another goal is for the user interaction to be based on the experience of the user so that ANNIE is helpful to the inexperienced user and yet efficient and brief for the experienced user. Finally, the code should be designed so that additional hydrologic models can easily be added to ANNIE.

DESIGN SPECIFICATIONS FOR THE SOFTWARE

The design goals lead to the following specifications. All code is written in ANSI Fortran. Coding conventions are established and concepts of structured programing are used. A set of utility subroutines are developed and another set of subroutines contain the control and logic of the program. For terminal compatibility, all terminal inputs are by line and not full screen. Also, all terminal inputs and outputs will be placed in one or a very small group of subroutines so that full screen interaction can more easily be added. All questions are placed on a direct access file and not in format statements. All questions are less than 60 characters but have associated help information, default values, and acceptable values which are also on the direct access file. All inputs are read as character data with one character per word for easy manipulation by the utility routines. For alphanumeric responses that are used to select options, only sufficient characters are needed to distinguish that option from the other options. For example, questions that require a "yes" or "no" can be answered with a "y," "ye," "yes," "n," or "no." Questions that require a "list" or "line" response can be answered with a "lin," "line," "lis," or "list." For time-series data base management, the file structure of the HSPF time-series store (TSS) (Johanson, 1981) is used.

For interactive processing, five methods of communication can be identified. The first method is a sequence of questions and responses that always follows a given order. The second method is a variation of the first in which the question is a "fill-in-the-blank" form. This method has screen input as opposed to line input. The form fills the entire screen with several places on the form for input. Many display terminals have special features to create the forms. Fill-in-the-blank forms are often used by data entry clerks for various kinds of applications. Thirdly, the sequence of questions and responses can follow an "option tree" or a menu in which the response

to a question determines what question will be displayed next. The fourth method is similar to the third method but uses the full screen to display the menu. Lastly, and unfriendly to the inexperienced user, is a large menu that is not displayed but is known to the user. In this case, the user enters a sequence of commands in most any order desired. This last method is similar to text editors and some command languages.

The third method is used by ANNIE. Methods one and two do not provide the needed options to the user. The last method could not be used because the various commands or responses in ANNIE are not sufficiently independent. The fourth method requires special full-screen features on the terminals which are not standardized, and, thus, the software would not be as portable between the various computer systems and terminals.

Research in the social sciences has shown that people prefer information in no more than seven elements at a time. That is, a speech should have no more than seven points to be made, a manager should supervise no more than seven people, or a menu should have no more than seven options. With few exceptions, menus for ANNIE have been kept to seven choices or less. Most often a menu of 24 options can be broken into four to six groups of four to seven options per group. The user first selects the group and then the option. This is particularly useful when help information is available for each menu. Appropriate help information for 24 options would more than fill the display screen.

The method used by ANNIE treats the menus like a tree structure or system of branches. A branch is selected with the use of a menu. Each response moves the user further out on a branch. On any particular branch, ANNIE may use a simple series of questions and responses as in the first method. On another branch, ANNIE may use a line format in which a heading

is written across the screen and the user makes a set of entries at locations beneath the line. In an update mode, ANNIE may display the heading and the previous or default values and the user only enters items in the set that need to be changed. With the tree structure, ANNIE is able to guide the user and at no time is the user required to choose among more than seven options. Although there are hundreds of options (menus) in ANNIE, the user never searches a long list. A partial tree structure of some of the menus is shown in figure 2.

When one climbs a tree and is out on a branch, one either falls out or climbs back down. In most cases, the user of ANNIE will climb back down, although in a few cases, it may be appropriate to fall out. To climb back down, the user enters "DONE." If the user is at a fifth level and wants to be at level three, two options are possible. One option is to climb back by entering DONE twice and the other is to fall out and start climbing again. The option to climb back was included in ANNIE under the assumption that the user, once on a branch, may want to do further tasks related to that branch. This is especially important when files have been opened for processing that is related to a specific branch. To fall out, system break or abort key is used. A system command must then be used to close the files that are left open from the abort. ANNIE has not allowed the user to jump from one branch to another because the complexity in the software, and potential confusion to to the inexperienced user would not be compensated by the small gain to the experienced user.

A constant addition of new features is anticipated for ANNIE. Such features will include the creation of input streams for additional models and additional analyses of time-series data such as statistical comparisons, error analyses, and adjustments for periods of missing records. The modular

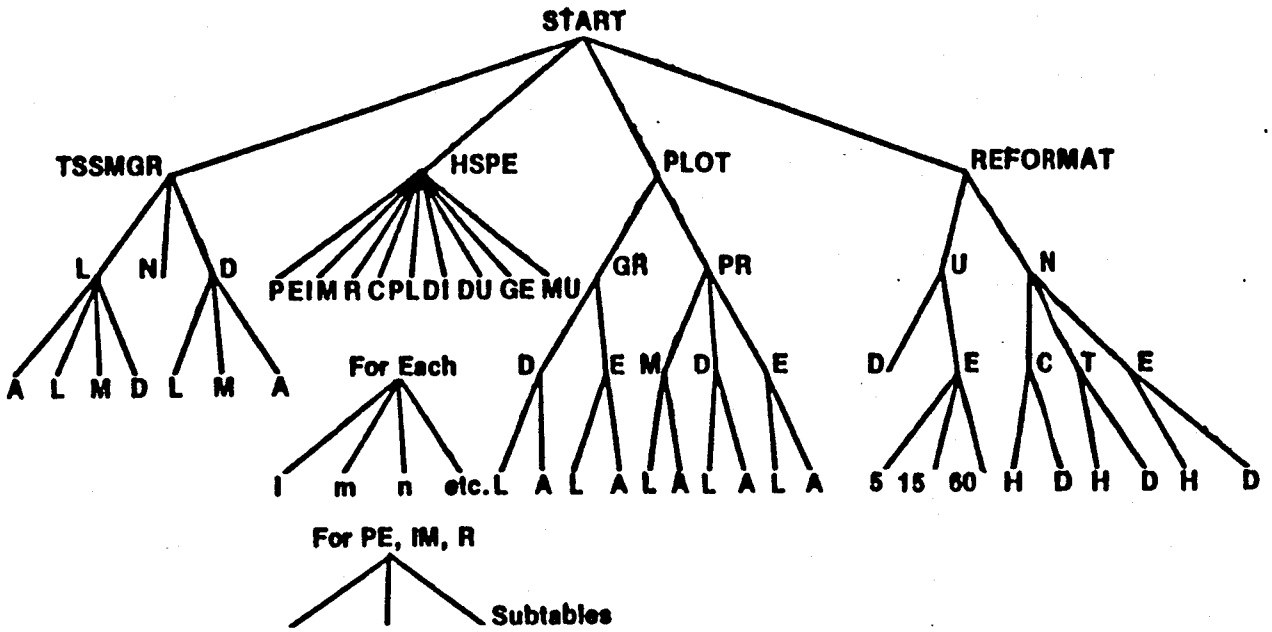


Figure 2.--ANNIE option tree (selected branches).

design of ANNIE and use of utility subroutines makes the programing task much easier. These features are discussed in Part C, Programer's Guide.

Is ANNIE any better than a good text editor? In some applications it is not. If an input file has already been developed and only the roughness factor for the right flood plain of the third channel section is to be changed, then the text editor could be as efficient or more efficient than ANNIE. However, if the decimal place for the changed value was off two spaces, ANNIE would have caught it, but the editor would not. Often a change is made that may impact other input, ANNIE can check that while the editor cannot. ANNIE is always easier to use in developing and checking a new input file. Also, the text editor is always there and can be used when it is easier than ANNIE. ANNIE is an additional tool, not a replacement for a text editor.

OVERVIEW

As illustrated in figure 3, ANNIE reads and creates several types of files. The central purpose of ANNIE is to create the input stream and time-series store (TSS) for hydrologic models and then from files created by the models, analyze the output using tables, plots, and statistics.

ANNIE does not include any software that comes under the heading of expert systems. Such systems contain knowledge abstracted from an expert that could be used to select the appropriate hydrologic model, to calibrate the model, or to segment the watershed into a set of subwatersheds and channels. Thus, the user must know what model to use, what types of data are required, the files and formats of all the data, and the desired analyses of the output. When these decisions have been made, ANNIE helps get the tasks accomplished.

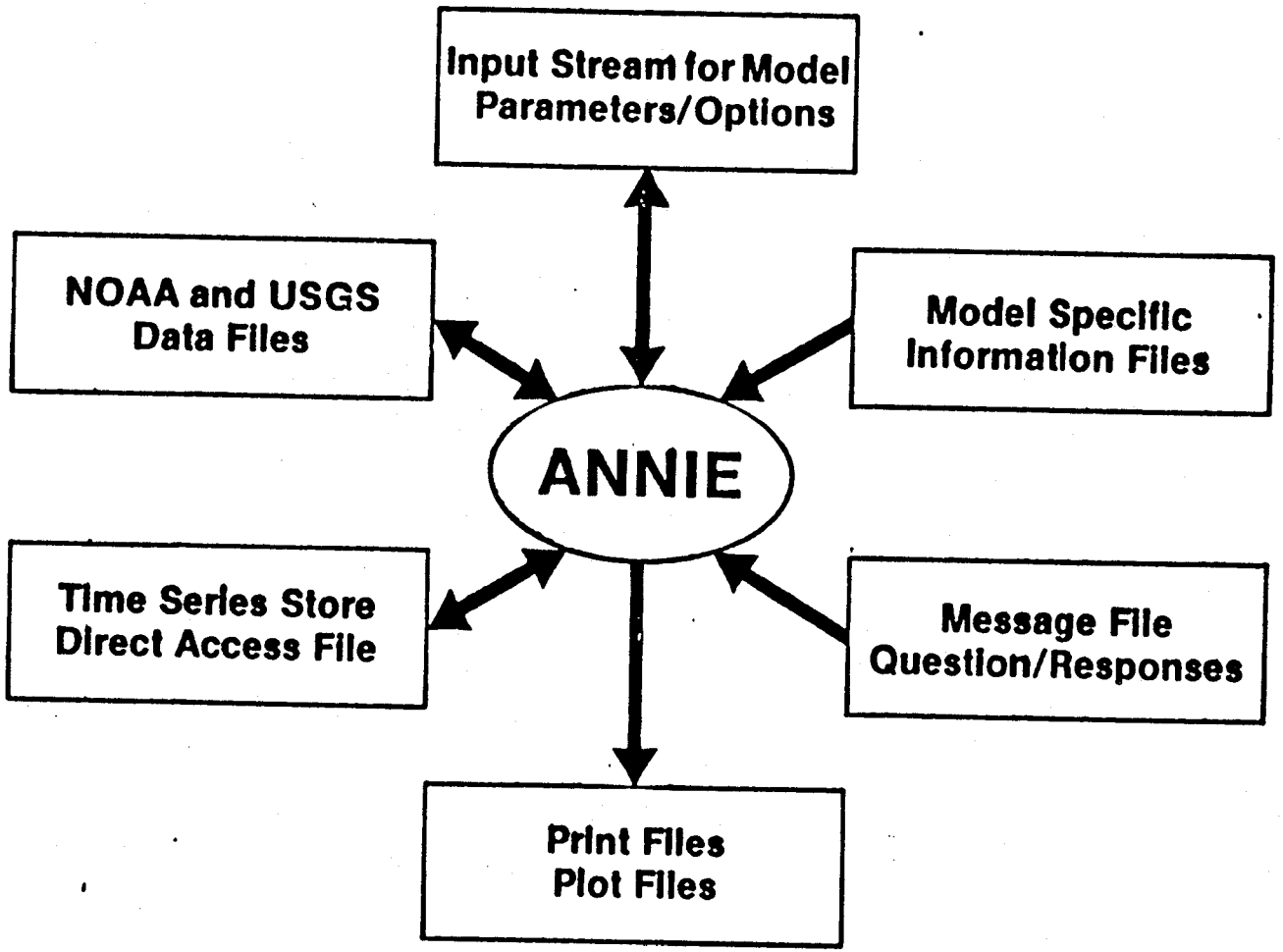


Figure 3.--Files used by ANNIE.

PART B

APPLICATIONS

Part B. Applications

INTRODUCTION

Generally, three major tasks are needed for hydrologic modeling. First the input stream for the model must be developed. Second, the time-series data must be placed on a file that can be read by the model. Some storm-event models may include the required time-series in the input stream and not require a separate file. It is advantageous in most hydrologic models to separate the time-series input from the other input. Steady-state models have no time-series input. Third, the hydrologic model is run and produces various output files which are plotted, listed, or further analyzed. ANNIE helps with all three steps and samples of those activities with ANNIE are illustrated in the following sessions. These are:

Session 1: Create space on a disk for the Time-Series Store (TSS) file.

Session 2: Add labels to the TSS file for each time-series that is needed.

Session 3: Add data to the TSS file from a formatted sequential file.

Session 4: Create an input sequence for batch processing to simulate rainfall-runoff.

Session 5: Plot data from the simulation run on the line printer.

Session 6: Make a statistical analysis of the data from the simulation run.

Session 1

The TSS file was designed to manage time-series data. Given an index number for a time-series and the calendar year, ANNIE and the models that use the TSS file go directly to the location on the disk for that dataset for that year. For the TSS file to work properly, the total size of the file must be known at the beginning so that the total space may be allocated and "blanked" out. Table 1 should be completed before ANNIE is used. The HSPF User's Manual, Appendix III, Program NEWTSS, should be consulted for additional information on the structure of the TSS file.

Time-series data such as rainfall have lots of zero values and can be stored on the TSS file in a compressed format. Basically, instead of storing a series of zeros, the number of zeros in the series is stored. Since less space is required for compressed data, a compression ratio (number of non-zero values/total number of possible values) is used to compute the space needed for compressed data. For example, if daily rainfall is to be stored and during the wettest year 63 days had rain, the compression ratio would be 0.173 (63/365). A value of 0.2 should provide plenty of space.

Space is computed as records. One record is required for dataset index numbers between 1 and 85, and another record is needed for dataset index numbers between 86-170, and so forth. Thus, storage space is saved if the dataset index numbers are in the 1-85 range. A dataset index number can be as large as 9999 but would require 118 records when only 1 or 2 records would be needed if small dataset index numbers were used.

Consideration also should be given to the allocation of space on the TSS file for simulated data. Several of the hydrologic models can write time-series data on the TSS file. Simulated data on the TSS file can be used as input to other hydrologic models or as input to the REFORMAT, PLOT, or

STATISTICS options in ANNIE.

Following is an example of the interaction using ANNIE to create a TSS file.

Table 1.--Estimating size of TSS file

Dataset index number on TSS file	Data type on TSS file	Total number of years	Time step of data (minutes)	Compression ratio	Required records on TSS file*

*Will be computed by ANNIE or see Appendix III, HSPF User's Manual.

```
**********************************************************
******              WELCOME TO "ANNIE"                  ******
******       VERSION DATED OCTOBER 31, 1984             ******
**********************************************************
DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
> N
  ANNIE helps prepare or update input to models.

  Also, ANNIE helps create and fix the data for the time-series
       file (TSS file) that is used by some of the models.

  Don't be concerned about bad entries,
       ANNIE guides you to acceptable responses.

  When a question isn't clear, enter a question mark (?).

  Many of the options are part of loops.  When you have finished
       all activities within a set of options, enter done to
       exit from the loop.

  MORE?
> Y

  Many options require word responses, but only enough
       characters are required to make the response unique.
       For a question that requires a 'YES' or 'NO' response,
       responses could be Y, YE, YES, N, or NO.
       For a question that requires a 'LINE' or 'LIST' response
       the responses could be LIN, LINE, LIS, or LIST.

  Definitions:
       UCI file - User Control Input,
                  is simply the input for one of the models.

  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> ?
  HSPF        Simulation of hydrology using HSPF.
  TSSMGR      Interactively create/add/modify/list TSS file.
  STAT        Statistical analysis of time-series data.
  PRMS        Simulation with Precip./Runoff Model System.
  DR3M        Distributed Routing Rainfall/Runoff program. **
  CREAMS      US ARS rainfall/runoff model. **
  REFORMAT    Reformats USGS, NOAA, HSPF sequential files
              and adds data to TSS file from sequential files.
  PLOT        Plots data from various sources to plotters.
              ** not yet available.
  Valid responses are:
  HSPF      , TSSMGR    , STAT      , PRMS      , DR3M      , CREAMS    ,
  REFORMAT  , PLOT
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> T
  The Time-Series Store is a storage and retrieval system
     for time-series data such as streamflow or rainfall.
     Each time series must have a unique index number and
     several labels such as station number, location,
     name and units.

  FIRST, space for the TSS file must be created by using
       the NEW-TSS option.
  SECOND, the unique index numbers and labels of the
       time series must be provided.
  THIRD, the data is added.
  After the data is added, it may be updated, listed, plotted
  or used by one of the hydrologic models.
```

```
  ENTER NEW-TSS, LABELS, DATA, OR DONE.
> ?
   If you wish to create space on disk for a new TSS file,
     enter NEW-TSS.
   If you wish to add a new time-series or change any label on
     an existing time-series, enter LABELS.
   If you wish to list, add, or change data on an existing
     time-series, enter DATA.
   If you wish to do none of the above, enter DONE.

   Valid responses are:
   LABELS     , DATA      , NEW-TSS   , DONE
  ENTER NEW-TSS, LABELS, DATA, OR DONE.
> NEW
  ENTER THE LARGEST DATASET INDEX NUMBER YOU PLAN TO USE.
  (Hit return for 170)
> ?
   Each dataset has a unique index number from 3 to 9999.
   Smaller numbers make more efficient use of disk space.
   Min acceptable value is 85,  Max acceptable value is 9999
  ENTER THE LARGEST DATASET INDEX NUMBER YOU PLAN TO USE.
  (Hit return for 170)
> 85
  WANT HELP ESTIMATING NUMBER OF RECORDS FOR THIS FILE?
> ?
   If you know the number enter 'NO', otherwise enter 'YES'.
   Valid responses are:
   NO   ,        YES
  WANT HELP ESTIMATING NUMBER OF RECORDS FOR THIS FILE?
> Y
  PROVIDE INFORMATION FOR ALL ANTICIPATED DATASETS.

   Space required for a dataset depends on the
    time step, length of record, and compression ratio.

  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> ?
   1 day= 24 hours= 1440 minutes, 6 hours= 360 minutes
   Valid responses are:
      60,          1,          2,          3,          4,          5,
       6,         10,         12,         15,         20,         30,
     120,        180,        240,        360,        480,        720,
    1440
  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> 5
  ENTER YEARS OF RECORD ANTICIPATED FOR THIS DATASET.
  (Hit return for 1)
> ?
   This must be the number full and partial calendar years that
     will be needed for this dataset.
   (e.g., 2 water years requires 3 calendar years)
   Min acceptable value is 1,  Max acceptable value is 99
  ENTER YEARS OF RECORD ANTICIPATED FOR THIS DATASET.
  (Hit return for 1)
> 2
```

```
  COMPRESSION RATIO?
  (Hit return for 1.)
> ?
   # of non-zero values divided by # of possible values.
     Precipitation usually ranges from 0.05 to 0.30.
   Min acceptable value is 0.,  Max acceptable value is 1.
  COMPRESSION RATIO?
  (Hit return for 1.)
> 0.1
  ENTER NUMBER OF DATASETS LIKE THIS ONE?
  (Hit return for 1)
> ?
   Number datasets with the same time step, same # years,
     and the same compression ratio.
   Min acceptable value is 1,  Max acceptable value is 1000
  ENTER NUMBER OF DATASETS LIKE THIS ONE?
  (Hit return for 1)
> 2
    Records needed:
                   92
  ANY MORE DIFFERENT TYPES OF DATASETS FOR THIS FILE?
> Y
  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> 1440
  ENTER YEARS OF RECORD ANTICIPATED FOR THIS DATASET.
  (Hit return for 1)
> 3
  COMPRESSION RATIO?
  (Hit return for 1.)
> 1
  ENTER NUMBER OF DATASETS LIKE THIS ONE?
  (Hit return for 1)
> 3
    Records needed:
                   92
                   12
                  ----
        TOTAL     104
  ANY MORE DIFFERENT TYPES OF DATASETS FOR THIS FILE?
> N
   The number of records should be at least:
                  111
  HOW MANY RECORDS DO YOU WANT IN YOUR TSS FILE?
  (Hit return for 111)
> ?
   See Appendix III of your Users Manual for more information.
   Min acceptable value is 4,  Max acceptable value is 90000
  HOW MANY RECORDS DO YOU WANT IN YOUR TSS FILE?
  (Hit return for 48)
> 125
  NAME FOR YOUR TSS FILE?
> SESSION.TSS
   STILL PROCESSING, SPACE MADE FOR   50 OF  125 RECORDS.
   STILL PROCESSING, SPACE MADE FOR  100 OF  125 RECORDS.
  ENTER NEW-TSS, LABELS, DATA, OR DONE.
> DO
  ARE YOU FINISHED?
> Y
  **** STOP
```

Session 2

If the TSS file is perceived as a library, then each book is a dataset, and each entry in the card catalog is a set of labels for a dataset. The labels for a dataset include:

1. Dataset index number (3-9999).*
2. Space required for the data (records @ 512 words/record).*
3. Write protect flag.
4. First year of data.
5. Data type (6 characters).*
6. English or metric units indicator.*
7. Compressed or uncompressed indicator.*
8. Station number (16 characters).*
9. Station description (40 characters).*
10. Time step (minutes).*
11. Point (instantaneous) or mean value indicator.
12. Format code for printouts.
13. Observation time if daily data.

Only items with an asterisk are required, the other items use the default. The defaults can be changed with the modify option.

Labels are similar to parameters in the header file of the WATSTORE system. Use the process TSSMGR in ANNIE to create the labels. A set of labels must be created before the associated time-series data can be added to the file. Most of the labels can be modified after the labels have been added but before time-series data are added. A few of the labels can be modified after time-series data have been added. If a change is needed for one of the labels that cannot be modified, the entire dataset, labels, and time-series data must be deleted then added again with the correct labels.

Table 2 is a form that is useful to gather all the additional information needed by the labels option of the process TSSMGR in ANNIE. Some of the information for the form is already listed on the form in table 1. The TSSMGR process will prompt for all the necessary input. Following is an example of the interaction using ANNIE to add all the dataset labels.

Table 2.--Information for labels for datasets

Data-set index number	Space (from table 1)	Name of data type (6 char)	Time Step (min)	Station Number or Name (16 char)	Description title or location (limit 40 characters)	English or metric	Compress or Uncompress

```
  ************************************************************
  ******              WELCOME TO "ANNIE"                ******
  ******       VERSION DATED OCTOBER 31, 1984           ******
  ************************************************************
  DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
> L
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> T
  ENTER NEW-TSS, LABELS, DATA, OR DONE.
> L
  NAME OF YOUR TSS FILE?
> SESSION.TSS
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> ?
   To add a new label (dataset description), enter ADD.
   To delete label ((and associated data)), enter DELETE.
   To list the current labels on the file, enter LIST.
   To modify one of the labels for a dataset, enter MODIFY.
   Valid responses are:
   ADD     ,    DELETE  ,    MODIFY  ,    LIST    ,    DONE
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> AD
  DATASET NUMBER?
> ?
   Each dataset must have a unique index number from 3
   to the largest that was specified for your TSS file.
   Min acceptable value is 3,  Max acceptable value is -999
  DATASET NUMBER?
> 10
  HAVE YOU ESTIMATED THE SPACE NEEDED FOR THIS DATASET?
> N
   Space required for a dataset depends on the
    time step, length of record, and compression ratio.

  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> ?
   1 day= 24 hours= 1440 minutes, 6 hours= 360 minutes
   Valid responses are:
      60,           1,           2,           3,           4,           5,
       6,          10,          12,          15,          20,          30,
     120,         180,         240,         360,         480,         720,
    1440
  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> 1440
  ENTER YEARS OF RECORD ANTICIPATED FOR THIS DATASET.
  (Hit return for 1)
> 3
  COMPRESSION RATIO?
  (Hit return for 1.)
> 1
   The space should be at least:
             4
  NUMBER OF RECORDS FOR THIS DATASET?
  (Hit return for 4)
> 4
  ENTER DATA TYPE (DATASET NAME) (6 CHARACTERS).
    IE. PRECIP, STFLOW, TEMPMX, POTEVP, SOLRAD, DISOXY, ETC.
> ?
   Any 6 letter name characterizing the data.
  ENTER DATA TYPE (DATASET NAME) (6 CHARACTERS).
    IE. PRECIP, STFLOW, TEMPMX, POTEVP, SOLRAD, DISOXY, ETC.
> PRECIP
```

```
  ENTER TIME STEP FOR DATASET IN MINUTES.
  (Hit return for 1440)
> 1440
  ENTER STATION IDENTIFICATION NUMBER (16 CHARACTERS).
> ?
   Any alphanumeric characters.
  ENTER STATION IDENTIFICATION NUMBER (16 CHARACTERS).
> NWS 07_4855
  ENGLISH OR METRIC UNITS?
> ?
   Has to be one or the other.
   Valid responses are:
   ENGLISH    ,  METRIC
  ENGLISH OR METRIC UNITS?
> E
  ENTER COMPRESSION CODE.
> ?
   If data is correct and has lots of zeros, enter COMPR.
   If data will be updated or has no zeros, enter UNCOMP.
   Valid responses are:
   UNCOMP     ,  COMPR
  ENTER COMPRESSION CODE.
> U
  LOCATION OF SITE. (40 CHARACTERS)
> ?
   Enter up to 40 alphanumeric characters.
  LOCATION OF SITE. (40 CHARACTERS)
> RAINGAGE @ CAMP CREEK, IN TUG FORK BASIN
  WILL DATASET CONTAIN POINT OR MEAN DATA?
> ?
   Enter POINT if data is instantaneous recordings.
   Enter MEAN if data is sum or average over the time step.
   Valid responses are:
   POINT ,      MEAN
  WILL DATASET CONTAIN POINT OR MEAN DATA?
> M
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> AD
  DATASET NUMBER?
> 11
  HAVE YOU ESTIMATED THE SPACE NEEDED FOR THIS DATASET?
> Y
  NUMBER OF RECORDS FOR THIS DATASET?
> 4
  ENTER DATA TYPE (DATASET NAME) (6 CHARACTERS).
    IE. PRECIP, STFLOW, TEMPMX, POTEVP, SOLRAD, DISOXY, ETC.
> STFLOW
  ENTER TIME STEP FOR DATASET IN MINUTES.
  (Hit return for 1440)
> 1440
  ENTER STATION IDENTIFICATION NUMBER (16 CHARACTERS).
> NWS 07-2715
  ENGLISH OR METRIC UNITS?
> E
  ENTER COMPRESSION CODE.
> U
  LOCATION OF SITE. (40 CHARACTERS)
> DAILY STREAMFLOW -- CAMP CREEK
  WILL DATASET CONTAIN POINT OR MEAN DATA?
> M
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> AD
```

```
  DATASET NUMBER?
> 20
  HAVE YOU ESTIMATED THE SPACE NEEDED FOR THIS DATASET?
> N
   Space required for a dataset depends on the
    time step, length of record, and compression ratio.

  ENTER TIME STEP FOR DATASET IN MINUTES?
  (Hit return for 60)
> 5
  ENTER YEARS OF RECORD ANTICIPATED FOR THIS DATASET.
  (Hit return for 1)
> 2
  COMPRESSION RATIO?
  (Hit return for 1.)
> .1
   The space should be at least:
              46
  NUMBER OF RECORDS FOR THIS DATASET?
  (Hit return for 46)
> 45
  ENTER DATA TYPE (DATASET NAME) (6 CHARACTERS).
    IE. PRECIP, STFLOW, TEMPMX, POTEVP, SOLRAD, DISOXY, ETC.
> URAIN
  ENTER TIME STEP FOR DATASET IN MINUTES.
  (Hit return for 1440)
> 5
  ENTER STATION IDENTIFICATION NUMBER (16 CHARACTERS).
> 21394
  ENGLISH OR METRIC UNITS?
> E
  ENTER COMPRESSION CODE.
> C
  LOCATION OF SITE. (40 CHARACTERS)
> CAMP CREEK UNIT PRECIPITATION STATION
  WILL DATASET CONTAIN POINT OR MEAN DATA?
> M
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> AD
  DATASET NUMBER?
> 21
  HAVE YOU ESTIMATED THE SPACE NEEDED FOR THIS DATASET?
> Y
  NUMBER OF RECORDS FOR THIS DATASET?
> 45
  ENTER DATA TYPE (DATASET NAME) (6 CHARACTERS).
    IE. PRECIP, STFLOW, TEMPMX, POTEVP, SOLRAD, DISOXY, ETC.
> UDISCH
  ENTER TIME STEP FOR DATASET IN MINUTES.
  (Hit return for 1440)
> 5
  ENTER STATION IDENTIFICATION NUMBER (16 CHARACTERS).
> 213594
  ENGLISH OR METRIC UNITS?
> E
  ENTER COMPRESSION CODE.
> U
  LOCATION OF SITE. (40 CHARACTERS)
> CAMP CREEK -- STORM DISCHARGES
  WILL DATASET CONTAIN POINT OR MEAN DATA?
> M
```

```
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> L
  LIST BY DATASET NUMBER, TYPE, OR STATION, OR LIST ALL?
> ?
   Valid responses are:
   NUMBER  ,    TYPE    ,    STATION ,    ALL
  LIST BY DATASET NUMBER, TYPE, OR STATION, OR LIST ALL?
> ALL
  WHICH ATTRIBUTE?
> ?
   To list attributes, enter LIST.
   If finished listing, enter DONE.
   If want years of available data, enter YEARS.
   If want listing of attributes for all datasets, enter ALL.
   Valid responses are:
   DATASE,      SPACE ,      NAME  ,      TIMEST,      NMEMS ,      STATIO,
   SECURI,      UNITS ,      COMPRE,      OBS TI,      FILLER,      GAP CO,
   YEAROR,      BASEYR,      LOCATI,      MEMBER,      NCOMPS,      KIND  ,
   FORMAT,      ALL   ,      LIST  ,      DONE  ,      YEARS
  WHICH ATTRIBUTE?
> STAT
  DATASET NUMBER  10        STATION=          NWS 07_4855
  DATASET NUMBER  11        STATION=          NWS 07-2715
  DATASET NUMBER  20        STATION=          21394
  DATASET NUMBER  21        STATION=          213594
  NO MORE DATASETS BY THAT NAME OR NUMBER.
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> LIST
  LIST BY DATASET NUMBER, TYPE, OR STATION, OR LIST ALL?
> ALL
  WHICH ATTRIBUTE?
> ALL
    DATASET NO=             10
      SPACE=                 4
      NAME=              PRECIP
      TIMESTEP=            1440
      NMEMS=                 1
      STATION=          NWS 07_4855
      SECURITY=          WRITE
      UNITS=            ENGLISH
      COMPRESSION=       UNCOMP
      OBS TIME=              24
      FILLER CODE=         ZERO
      GAP CODE=              UU
      YEAROR=               YES
      BASEYR=              1900
      LOCATION=       RAINGAGE @ CAMP CREEK, IN TUG FORK BASIN
      MEMBER NAME=       PRECIP
        NCOMPS=                1
        KIND=               MEAN
        FORMAT=                1
```

```
  MORE?
> YES
    DATASET NO=              11
      SPACE=                  4
      NAME=               STFLOW
      TIMESTEP=             1440
      NMEMS=                   1
      STATION=           NWS 07-2715
      SECURITY=            WRITE
      UNITS=             ENGLISH
      COMPRESSION=        UNCOMP
      OBS TIME=               24
      FILLER CODE=          ZERO
      GAP CODE=               UU
      YEAROR=                YES
      BASEYR=               1900
      LOCATION=        DAILY STREAMFLOW -- CAMP CREEK
      MEMBER NAME=        STFLOW
        NCOMPS=                1
        KIND=                MEAN
        FORMAT=                1
  MORE?
> YES
    DATASET NO=              20
      SPACE=                 45
      NAME=               URAIN
      TIMESTEP=               5
      NMEMS=                  1
      STATION=            21394
      SECURITY=            WRITE
      UNITS=             ENGLISH
      COMPRESSION=         COMPR
      OBS TIME=              24
      FILLER CODE=          ZERO
      GAP CODE=               CC
      YEAROR=                YES
      BASEYR=               1900
      LOCATION=        CAMP CREEK UNIT PRECIPITATION STATION
      MEMBER NAME=        URAIN
        NCOMPS=                1
        KIND=                MEAN
        FORMAT=                1
  MORE?
> NO
  ENTER ADD, DELETE, MODIFY, LIST, OR DONE.
> DO
  ENTER NEW-TSS, LABELS, DATA, OR DONE.
  DO
  ARE YOU FINISHED?
> Y
  **** STOP
```

Session 3

Processing time-series data is a major portion of any hydrologic modeling effort; many files are created and corrections often need to be made. Table 1 can be used to help manage the time-series data. All time-series data are first loaded on the computer system as sequential files. It may be loaded from magnetic tapes, cards, or as a remote job entry from another computer. The data may then be put on the TSS file or reformatted to another format using the ANNIE process called REFORMAT. This process accepts the following input formats:

1. WATSTORE daily values, punch card format.
2. WATSTORE unit values, punch card format.
3. National Oceanic and Atmospheric Administration (NOAA) State tapes, Office of Hydrology monthly format.
4. NOAA standard card format for daily and hourly data.
5. NOAA tapes with element formats.
6. HSPF PLTGEN format.
7. HSPF punch card format.

Other formats will be added as needed. For current capabilities, enter "?" when ANNIE asks for format type. Table 3 is a suggested form to help keep track of the various files. Data also can be added to the TSS file by direct entry from terminal using the ANNIE process called TSSMGR. Following is an example of the interaction using ANNIE.

Table 3.--Time-series data files

Station number	Station name	Time step of data (minutes) 1 day=1440	Starting date	Ending date	Sequential file name	Sequential file format	Dataset index number on TSS file	Name of data type on TSS file (6 char.)

```
  ************************************************************
  ******              WELCOME TO "ANNIE"                ******
  ******       VERSION DATED OCTOBER 31, 1984           ******
  ************************************************************
  DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
> L
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> REF
  *** NOTE: ALL OPTIONS HAVE NOT BEEN TESTED.
  REPORT PROBLEMS TO ALAN LUMB, USGS-SWB, FTS 8-928-6838.
  FORMAT OF INPUT DATA?
> ?
   USGS-DAILY :  Watstore Users Guide, Volume 1
   USGS-UNIT  :  Watstore Users Guide, Volume 4
   NOAA-CARD  :  TD-9657 hourly precipitation - Deck 488
   NOAA-TAPE  :  Tape Deck 9655 - Office of Hydrology Format
   HSPF-CARD  :  See Formats Section, HSPF Users Manual
   PLTGEN     :  See PLTGEN Section, HSPF Users Manual
   NOAA-ELEM  :  NCDC Element archives
   TSSFILE    :  See HSPF Users Manual
   Valid responses are:
   USGS-DAILY,  USGS-UNIT ,  NOAA-ELEM ,  NOAA-CARD ,  NOAA-TAPE ,  HSPF-CARD ,
   PLTGEN    ,  TSSFILE   ,  DONE
  FORMAT OF INPUT DATA?
> USGS-U
  FORMAT OF OUTPUT DATA?
> ?
   USGS-DAILY :  Watstore Users Guide, Volume 1
   USGS-UNIT  :  Watstore Users Guide, Volume 4
   HSPF-CARD  :  Formats Section, HSPF Users Manual
   TSS-FILE   :  See NEWTSS Section of HSPF Users Manual
   Valid responses are:
   USGS-DAILY,  USGS-UNIT ,  HSPF-CARD ,  TSS-FILE
  FORMAT OF OUTPUT DATA?
> HSPF
  TIME INTERVAL OF INPUT DATA (MINUTES)?
  (Hit return for 1440)
> 5
  NAME OF INPUT FILE?
> SESSION.PRECIP.USGSU
  NAME OF OUTPUT FILE?
> SESSION.PRECIP.HYD5
  DO YOU WANT A TRACE OF THE REFORMATTING PROCESS?
> ?
   A trace message just lets you know
   how the reformatting is progressing.
   Valid responses are:
   YES ,        NO
  DO YOU WANT A TRACE OF THE REFORMATTING PROCESS?
> Y
  HOW MANY I/O'S BETWEEN EACH TRACE MESSAGE?
  (Hit return for 100)
>
  STANDARD OR EXPANDED FORMAT?
> ?
   Standard format has only 2 columns for each value, which is
   only good for precipitation.
   Expanded format has 6 columns for each value, but the HSPF
   FORMAT Block will be needed for an HSPF COPY operation.
   Valid responses are:
   STANDARD  ,  EXPANDED
  STANDARD OR EXPANDED FORMAT?
> S
```

```
    100th RECORD READ AND IS DATED 1982 APR. 14 20:35
    200th RECORD READ AND IS DATED 1982 MAY. 4 13:5
    300th RECORD READ AND IS DATED 1982 MAY. 11 5:35
  346 RECORDS READ ENDING 1982/5/15
  FINISHED REFORMATTING DATA.
  DO YOU WANT TO REFORMAT ANOTHER DATASET?
> Y
  FORMAT OF INPUT DATA?
> USGS-U
  FORMAT OF OUTPUT DATA?
> HSPF
  TIME INTERVAL OF INPUT DATA (MINUTES)?
  (Hit return for 1440)
> 5
  NAME OF INPUT FILE?
> SESSION.DISCH.USGSU
  NAME OF OUTPUT FILE?
> SESSION.DISCH.HYDS
  DO YOU WANT A TRACE OF THE REFORMATTING PROCESS?
> Y
  HOW MANY I/O'S BETWEEN EACH TRACE MESSAGE?
  (Hit return for 100)
>
  STANDARD OR EXPANDED FORMAT?
> E
  NUMBER OF DECIMAL PLACES ON OUTPUT?
  (Hit return for 0)
> 2
    100th RECORD READ AND IS DATED 1982 APR. 3 1:35
    200th RECORD READ AND IS DATED 1982 APR. 5 3:35
    300th RECORD READ AND IS DATED 1982 APR. 7 5:35
    400th RECORD READ AND IS DATED 1982 APR. 9 7:35
    500th RECORD READ AND IS DATED 1982 APR. 11 9:35
    600th RECORD READ AND IS DATED 1982 APR. 13 11:35
    700th RECORD READ AND IS DATED 1982 APR. 15 13:35
    800th RECORD READ AND IS DATED 1982 APR. 17 15:35
    900th RECORD READ AND IS DATED 1982 APR. 19 17:35
    1000th RECORD READ AND IS DATED 1982 APR. 21 19:35
    1100th RECORD READ AND IS DATED 1982 APR. 23 21:35
    1200th RECORD READ AND IS DATED 1982 APR. 25 23:35
    1300th RECORD READ AND IS DATED 1982 APR. 28 1:35
    1400th RECORD READ AND IS DATED 1982 APR. 30 3:35
    1500th RECORD READ AND IS DATED 1982 MAY. 2 5:35
    1600th RECORD READ AND IS DATED 1982 MAY. 4 7:35
    1700th RECORD READ AND IS DATED 1982 MAY. 6 9:35
    1800th RECORD READ AND IS DATED 1982 MAY. 8 11:35
    1900th RECORD READ AND IS DATED 1982 MAY. 10 13:35
    2000th RECORD READ AND IS DATED 1982 MAY. 12 15:35
    2100th RECORD READ AND IS DATED 1982 MAY. 14 17:35
    2200th RECORD READ AND IS DATED 1982 MAY. 16 19:35
  2207 RECORDS READ ENDING 1982/5/16
  FINISHED REFORMATTING DATA.
  DO YOU WANT TO REFORMAT ANOTHER DATASET?
> Y
  FORMAT OF INPUT DATA?
> USGS-D
  FORMAT OF OUTPUT DATA?
> HSPF
  TIME INTERVAL OF INPUT DATA (MINUTES)?
  (Hit return for 1440)
>
```

```
  NAME OF INPUT FILE?
> SESSION.DISCH.USGSD
  FILE NOT FOUND. DO YOU WANT TO TRY ANOTHER NAME?
> Y
  NAME OF INPUT FILE?
> SESSION.PRECIP.USGSD
  NAME OF OUTPUT FILE?
> SESSION.PRECIP.HYD24
  DO YOU WANT A TRACE OF THE REFORMATTING PROCESS?
> Y
  HOW MANY I/O'S BETWEEN EACH TRACE MESSAGE?
  (Hit return for 100)
> .
  NUMBER OF DECIMAL PLACES ON OUTPUT?
  (Hit return for 0)
> 2
    Read error on record # 70.  It will be skipped.
    Records missing or out of order around record # 71 approx date 1981/6
    100th RECORD READ AND IS DATED 1982 JAN. 25 24:0
  144 RECORDS READ ENDING 1982/12
  FINISHED REFORMATTING DATA.
  DO YOU WANT TO REFORMAT ANOTHER DATASET?
> NO
  ARE YOU FINISHED?
> Y
  **** STOP
```

Session 4

Once the data have been loaded on the TSS file with the previous steps, various kinds of simulation runs and data analyses can be done. The types of simulations and analyses that can be done through ANNIE will expand as needs arise and resources become available. The latest list can be obtained by entering a question mark in response to the second prompt that asks for a model or process. For an illustration, input for an HSPF simulation of the rainfall-runoff process is developed with ANNIE.

ANNIE assumes the user has a general knowledge of the model or process, even when the user gives a "no experience" response to ANNIE. Thus, most model parameters must be determined and listed before a session with ANNIE begins. However, input items like print options, start and end dates, and titles do not need to be written down. Although ANNIE has a definition or help information for almost every input requested, that information is to be used more as a reminder than a learning process. As user experience is accumulated and evaluated, enhancements will be directed toward making ANNIE a training tool. Until then, the user should prepare many of the input parameters before the interactive session begins.

For the following example, a few basic concepts on the organization of HSPF input are discussed. HSPF can do a wide range of processing from simply reading data from the TSS file and printing them in tables to the simulation of phytoplankton in a reservoir. For any processing with HSPF, five blocks of input are possible and the first four required.

1. Global block--specifies general information.
2. Operation sequence block--specifies which operations are to be done and in what order.
3. Operations block--parameters and options required by each operation.

4. External sources, network, and external targets block--specifies where each time-series comes from and where it goes.

5. Other blocks--for formats, rating curves for spillways, etc.

Operations available are:

PERLND -- rainfall-runoff on pervious soil

IMPLND -- rainfall-runoff on impervious surfaces

RCHRES -- channel and reservoir routing

COPY -- move time-series data from one file to another

PLTGEN -- creates output file for plotting programs

MUTSIN -- reads data from PLTGEN format to TSS file

DISPLY -- prints tables of data

DURANL -- makes frequency-duration analysis

GENER -- transforms one or two time-series to another time-series with a selected set of functions

The first three operations listed above simulate hydrologic processes including sediment and water quality. The last six operations are utilities. Part F of the HSPF User's Manual describes the detailed input for each input block of each operation. Since an operation can be used many times in an HSPF run, each operation is given a unique number, usually sequentially from 1.

For the PERLND operation, the model option HSPF in ANNIE is used. The user first will be prompted for information for the GLOBAL block; such as run title, beginning and ending dates, and a few other questions for which the default should be used. Next, the user is prompted for a list of all operations in this run. A PERLND response with a number should be given for each

rainfall-runoff segment in the watershed. Input for the PERLND operations is a set of tables (lines) that provides the parameters and options. The final blocks, external sources, network, and external targets, transfer time-series data from the TSS file to an operation, between operations, and from an operation to the TSS file. Information on the time-series names in the operations is found in the time-series catalog, Section 4.7, Part F, of the HSPF user's manual. Below is an example of the interaction using ANNIE to prepare the HSPF input for batch processing.

```
  ************************************************************
  ******              WELCOME TO "ANNIE"                ******
  ******       VERSION DATED OCTOBER 31, 1984           ******
  ************************************************************
  DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
> L
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> ?
   HSPF        Simulation of hydrology using HSPF.
   TSSMGR      Interactively create/add/modify/list TSS file.
   STAT        Statistical analysis of time-series data.
   PRMS        Simulation with Precip./Runoff Model System.
   DR3M        Distributed Routing Rainfall/Runoff program. **
   CREAMS      US ARS rainfall/runoff model. **
   REFORMAT    Reformats USGS, NOAA, HSPF sequential files
               and adds data to TSS file from sequential files.
   PLOT        Plots data from various sources to plotters.
               ** not yet available.
   Valid responses are:
   HSPF       ,  TSSMGR     ,  STAT       ,  PRMS       ,  DR3M       ,  CREAMS     ,
   REFORMAT   ,  PLOT
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> HSP
  ARE YOU WORKING FROM AN OLD UCI FILE?
> N
  NAME OF YOUR TSS FILE?
> ELKFOOT.TSS
  PROCESSING GLOBAL

  ENTER THE RUN TITLE (78 CHARACTERS)
> SAMPLE TEST RUN FOR RAINFALL-RUNOFF
  ENTER STARTING DATE.
> 1980/10/1
  ENTER ENDING DATE.
> 1979/13/44
  MONTH INVALID.
               13
  DAY INVALID.
               44
   CURRENT  END  DATE 1979/13/44          (?-INSTRUCTIONS, X-DELETE, D-DONE)
> ?
   To make corrections move curser below the appropriate column,
    then enter replacement number or slash(/)
    or enter X to delete the value in the column.
    When finished enter D or DONE beginning in column 1.
   CURRENT  END  DATE 1979/13/44          (?-INSTRUCTIONS, X-DELETE, D-DONE)
>                          09 30
   CURRENT  END  DATE 1979/09/30          (?-INSTRUCTIONS, X-DELETE, D-DONE)
> D
  END DATE IS BEFORE START DATE! TRY AGAIN.
   CURRENT START DATE 1980 10 1           (?-INSTRUCTIONS, X-DELETE, D-DONE)
> D
   CURRENT  END  DATE 1979 9 30           (?-INSTRUCTIONS, X-DELETE, D-DONE)
>                        81
   CURRENT  END  DATE 1981 9 30           (?-INSTRUCTIONS, X-DELETE, D-DONE)
> D
  ENTER DESIRED VALUE OF RUN INTERPRETER OUTPUT LEVEL.
  (Hit return for 3)
> 3
```

```
  SHOULD THIS RUN EXECUTE OR JUST INTERPRET INPUT?
> I
  ENTER THE FORTRAN UNIT NUMBER OF THE TSS FILE.
  (Hit return for 15)
>
  PROCESSING OPN SEQUENCE

  ENTER THE TIME STEP (INDELT) FOR THE RUN IN MINUTES.
  (Hit return for 1440)
> ?
   See Part F Section 4.3 of Users Manual for details.
   Valid responses are:
    1440,          4,          60,          5,          15,          2,
       6,         10,          12,          1,          20,         30,
     120,        180,         240,        360,         480,        720,
       3
  ENTER THE TIME STEP (INDELT) FOR THE RUN IN MINUTES.
  (Hit return for 1440)
> 5
  WHAT OPTION FOR THE NEXT OPERATION IN THIS RUN?
> ?
   First complete the list of all operations in the run,
     then develop the data for each operation.
   Valid responses are:
   LIST    ,     ADD     ,     MODIFY ,     DELETE ,     DONE
  WHAT OPTION FOR THE NEXT OPERATION IN THIS RUN?
> AD
  ENTER THE OPERATION NAME.
> ?
   These are names of the operating modules.
   See Part F Section 4.3 of the HSPF Users Manual.
   Valid responses are:
           ,    PERLND  ,    IMPLND  ,    RCHRES  ,    COPY    ,    PLTGEN  ,
   DISPLY  ,    DURANL  ,    GENER   ,    MUTSIN
  ENTER THE OPERATION NAME.
> PERLND
  ENTER THE OPERATION NUMBER.
> 3
  WHAT OPTION FOR THE NEXT OPERATION IN THIS RUN?
> LIST
       INGRP               INDELT  0: 5
         PERLND        3
  WHAT OPTION FOR THE NEXT OPERATION IN THIS RUN?
> DONE
  PROCESSING PERLND

  ------------------------------------------------------------------------------
   OPERATION #  3              TABLE:  ACTIVITY                    OCCURRENCE #  1
  ------------------------------------------------------------------------------
      <PLS >                  Active Sections                              ***
      # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC***
  MIN           0    0    0    0    0    0    0    0    0    0   -0    0
  MAX           1    1    1    1    1    1    1    1    1    1    1    1
  CURRENT       0    0    0    0    0    0    0    0    0    0    0    0
>                  ?    ?
  value  of 1 indicates section SNOW is active

  value  of 1 indicates section PWATER is active
```

```
  COMBINED VALUE FOR PARAMETERS IN THIS TABLE IS INCORRECT.
  PROBABLY NUMBERS NEED TO SUM TO ONE OR NON-ZERO.
  SEE HSPF USERS MANUAL FOR MORE DETAIL.
  CURRENT        0    0    0    0    0    0    0    0    0    0    0    0
>                                  1
  CURRENT        0    0    1    0    0    0    0    0    0    0    0    0
> D
-------------------------------------------------------------------------------
 OPERATION #  3              TABLE:  PRINT-INFO                    OCCURRENCE #  1
-------------------------------------------------------------------------------
   - <PLS > ********************* Print-flags ************************* PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ********
  MIN           2    2    2    2    2    2    2    2    2    2    2    2    1    1
  MAX           6    6    6    6    6    6    6    6    6    6    6    6 1440   12
  CURRENT       4    4    4    4    4    4    4    4    4    4    4    4    1    9
>                   3
  CURRENT       4    3    4    4    4    4    4    4    4    4    4    4    1    9
> D
-------------------------------------------------------------------------------
 OPERATION #  3              TABLE:  GEN-INFO                      OCCURRENCE #  1
-------------------------------------------------------------------------------
    <PLS >      Name          NBLKS   Unit-systems   Printer***
    # -  #                         User  t-series Engl Metr***
                                        in  out        ***
  MIN                             1    1    1    1    0    0
  MAX                             5    2    2    2   99   99
  CURRENT                         1    1    1    1    0    0
>                                                      ?
  PUNIT(1)   indicates the destinations of printout in English
  units.   A value 0 means no  printout is required in English
  units.    A non-zero  value means  printout  is required  in
  English units and the value is  the Fortran unit no.  of the
  file to  which the  printout is  to be  written.  Note  that
  printout for each  Pervious Land Segment can  be obtained in
  either the English or Metric systems,  or both (irrespective
  of the system used to supply the inputs).

  CURRENT                         1    1    1    1    0    0
>                                                      6
  CURRENT                         1    1    1    1    6    0
> D
-------------------------------------------------------------------------------
 OPERATION #  3              TABLE:  PWAT-PARM1                    OCCURRENCE #  1
-------------------------------------------------------------------------------
    <PLS >                  Flags                          ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE    ***
  MIN           0    0    0    0    0    0    0    0    0
  MAX           1    1    1    1    1    1    1    1    1
  CURRENT       0    0    0    0    0    0    0    0    0
>                             ?                        ?
  VCSFG:value  of  1 means vary interception  storage capacity
  monthly; 0 means use annual value.

  VLEFG:value   of  1  means vary  lower  zone  E-T  parameter
  monthly; 0 means use annual value.

  CURRENT       0    0    0    0    0    0    0    0    0
>                                                      1
  CURRENT       0    0    0    0    0    0    0    0    1
> D
```

```
 OPERATION #  3              TABLE:  PWAT-PARM2                    OCCURRENCE #  1
    <PLS > ***
    # -  # ***FOREST      LZSN     INFILT      LSUR      SLSUR      KVARY      AGWRC
MIN              0.    0.0100 1.0000E-4    1.0000 1.0000E-6         0. 1.0000E-3
MAX          1.0000    100.00    100.00      NONE     10.000       NONE     1.0000
CURRENT          0.      NONE      NONE      NONE       NONE         0.       NONE
>                         6.0       0.1         ?       0.05
LSUR  is the length of the assumed overland flow plane.

BAD VALUE FOR FOLLOWING PARAMETER, WILL ATTEMPT TO USE DEFAULT.
    LSUR,  CURRENT  =  -0.1000E+31 MIN      =    1.000     MAX       =   -999.0
BAD VALUE FOR FOLLOWING PARAMETER, WILL ATTEMPT TO USE DEFAULT.
   AGWRC,  CURRENT  =  -0.1000E+31 MIN      =   0.1000E-02 MAX       =    1.000
CURRENT          0.    6.0000    0.1000      NONE     0.0500         0.       NONE
>                                              100.                            .99
CURRENT          0.    6.0000    0.1000    100.00     0.0500         0.     0.9900
> D
 OPERATION #  3              TABLE:  PWAT-PARM3                    OCCURRENCE #  1
    <PLS >***
    # -  #*** PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
MIN              NONE       NONE         0.     1.0000         0.         0.         0.
MAX              NONE       NONE     10.000     2.0000     1.0000     1.0000     1.0000
CURRENT        40.000     35.000     2.0000     2.0000         0.         0.         0.
> D
 OPERATION #  3              TABLE:  PWAT-PARM4                    OCCURRENCE #  1
    <PLS >                                                                    ***
    # -  #      CEPSC      UZSN      NSUR     INTFW       IRC      LZETP***
MIN              0.    0.0100 1.0000E-3       0.         0.         0.
MAX          10.000    10.000    1.0000      NONE     1.0000     1.0000
CURRENT          0.      NONE    0.1000      NONE       NONE         0.
>                         0.6                 2.0        0.4
CURRENT          0.    0.6000    0.1000    2.0000     0.4000         0.
> D
 OPERATION #  3              TABLE:  MON-LZETPARM                  OCCURRENCE #  1
    <PLS >  Lower zone evapotransp   parm at start of each month       ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC***
MIN              0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
MAX          1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
CURRENT          0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
>               .1   .1   .2   .3   .4   .5   .5   .5   .4   .3   .2   .1
CURRENT      0.100 0.100 0.200 0.300 0.400 0.500 0.500 0.500 0.400 0.300 0.200 0.100
> D
 OPERATION #  3              TABLE:  PWAT-STATE1                  -OCCURRENCE #  1
    <PLS >  PWATER state variables***
    # -  #***    CEPS      SURS        UZS       IFWS       LZS        AGWS       GWVS
MIN              0.         0. 1.0000E-3         0. 1.0000E-3         0.         0.
MAX          100.00     100.00    100.00     100.00    100.00     100.00     100.00
CURRENT          0.         0. 1.0000E-3         0. 1.0000E-3         0.         0.
> D
```

```
  PROCESSING EXT SOURCES

  PROCESSING SCHEMATIC BLOCK:
  THE FOLLOWING OPERATION(S) ARE NOT CONNECTED IN THE SCHEMATIC.

    PERLND  3

  FURTHER CHANGES TO THE SOURCES FOR ANY OPERATION?
> N

  PROCESSING TIMESERIES FOR PERLND  3

  FIRST COMPLETE REQUIRED INPUT TIMESERIES DETAILS.

  PROCESSING TIMESERIES:  EXTNL  PETINP 1 1

  NO SOURCE OPERATIONS, EXTERNAL SOURCE REQUIRED.

  EXTERNAL SOURCES FOR: PERLND   3     EXTNL  PETINP 1 1
  NO CURRENT SOURCES.

  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> ?
   Valid responses are:
   ADD     ,     MODIFY ,     DELETE ,     LIST   ,     DONE
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> A
  IS THE SOURCE TSS OR SEQ?
> TSS

  ENTER VALUES FOR TSS SOURCE.

            DSN <--MULT-->  TRAN
              # <-FACTOR->  STRG
  MINIMUM     2        none  none
  MAXIMUM  9999        none  none
  DEFAULT  none      1.0000  SAME
  CURRENT  none      1.0000  SAME
   Enter changes ( ? for help, D for done ) in correct columns.
>           70                      DIV
  CURRENT   70      1.0000  DIV
   Enter changes ( ? for help, D for done ) in correct columns.
> D
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> L
  EXTERNAL SOURCES FOR: PERLND   3     EXTNL  PETINP 1 1
       <-Volume-> <Member> SsysSgap<--Mult-->Tran
       <Name>   # <Name> # tem strg<-factor->strg
    1  TSS      70 EVAP     ENGL          1.0000DIV
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> ?
   Valid responses are:
   ADD     ,     MODIFY ,     DELETE ,     LIST   ,     DONE
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> DO

  PROCESSING TIMESERIES:  EXTNL  PREC   1 1
```

```
  NO SOURCE OPERATIONS, EXTERNAL SOURCE REQUIRED.

  EXTERNAL SOURCES FOR: PERLND   3     EXTNL  PREC   1 1
  NO CURRENT SOURCES.

  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> A
  IS THE SOURCE TSS OR SEQ?
> T

  ENTER VALUES FOR TSS SOURCE.

           DSN <--MULT-->  TRAN
             # <-FACTOR->  STRG
  MINIMUM    2       none  none
  MAXIMUM 9999       none  none
  DEFAULT none     1.0000  SAME
  CURRENT none     1.0000  SAME
   Enter changes ( ? for help, D for done ) in correct columns.
>           10
  CURRENT   10     1.0000  SAME
   Enter changes ( ? for help, D for done ) in correct columns.
> D
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> L
  EXTERNAL SOURCES FOR: PERLND   3     EXTNL  PREC   1 1
       <-Volume-> <Member> SsysSgap<--Mult-->Tran
       <Name>   # <Name> # tem strg<-factor->strg
    1  TSS     10 URF      ENGL          1.0000SAME
  WHICH SOURCE TIMESERIES OPERATION OPTION DO YOU WANT?
> DON
  ARE THERE OPTIONAL 'INPUT' OR 'OUTPUT' TIMESERIES OR 'DONE'?
> DONE
  DO YOU WISH TO MAKE CHANGES IN YOUR UCI FILE?
> N
  LIST, SAVE, OR DELETE THE TEMPORARY UCI FILE?
> L
  RUN
  GLOBAL
    SAMPLE TEST RUN FOR RAINFALL-RUNOFF
    START       1980 10  1        END    1981  9 30
    RUN INTERP OUTPUT LEVEL    3
    RESUME     0 RUN     0 TSSFL    15
  END GLOBAL
  OPN SEQUENCE
      INGRP              INDELT  0: 5
        PERLND       3
      END INGRP
  END OPN SEQUENCE
  EXT SOURCES
  TSS     10 URF      ENGL         1.0000SAME PERLND   3     EXTNL  PREC   1 1
  TSS     70 EVAP     ENGL         1.0000DIV  PERLND   3     EXTNL  PETINP 1 1
  END EXT SOURCES
  NETWORK
  END NETWORK
  EXT TARGETS
  END EXT TARGETS
```

```
  PERLND
    ACTIVITY
      <PLS >                Active Sections                                  ***
      # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC***
      3         0    0    1    0    0    0    0    0    0    0    0    0
    END ACTIVITY
    PRINT-INFO
      <PLS > ********************* Print-flags ************************* PIVL  PYR
      # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
      3         4    3    4    4    4    4    4    4    4    4    4    4    1    9
    END PRINT-INFO
    GEN-INFO
      <PLS >      Name           NBLKS   Unit-systems   Printer***
      # -  #                          User  t-series Engl Metr***
                                        in  out          ***
      3                             1    1    1    1    6    0
    END GEN-INFO
    PWAT-PARM1
      <PLS >                    Flags                              ***
      # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE        ***
      3         0    0    0    0    0    0    0    0    1
    END PWAT-PARM1
    PWAT-PARM2
      <PLS > ***
      # -  # ***FOREST      LZSN     INFILT      LSUR      SLSUR      KVARY      AGWRC
      3              0.    6.0000    0.1000    100.00    0.0500         0.    0.9900
    END PWAT-PARM2
    PWAT-PARM3
      <PLS >***
      # -  #**** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
      3        40.000    35.000    2.0000    2.0000        0.        0.        0.
    END PWAT-PARM3
    PWAT-PARM4
      <PLS >                                                          ***
      # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
      3              0.    0.6000    0.1000    2.0000    0.4000        0.
    END PWAT-PARM4
    MON-LZETPARM
      <PLS >  Lower zone evapotransp   parm at start of each month       ***
      # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC***
      3     0.1000.1000.2000.3000.4000.5000.5000.5000.4000.3000.2000.100
    END MON-LZETPARM
    PWAT-STATE1
      <PLS >  PWATER state variables***
      # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
      3              0.        0. 1.0000E-3        0. 1.0000E-3        0.        0.
    END PWAT-STATE1
  END PERLND
  END RUN
  LIST, SAVE, OR DELETE THE TEMPORARY UCI FILE?
> SA
  IS THE COPY TO BE A SEQUENTIAL OR DIRECT ACCESS FILE?
> SEQ
  NAME OF FILE TO STORE THE TEMPORARY UCI FILE JUST CREATED?
> ELKFOOT.INPUT
  LIST, SAVE, OR DELETE THE TEMPORARY UCI FILE?
> DEL
  ARE YOU FINISHED?
> Y
  **** STOP
```

Session 5

Once the data have been loaded on the TSS file with the previous steps, various kinds of data analyses can be done. The types of analyses are anticipated to expand as additional needs are identified. The latest list of analyses can be obtained by entering a question mark in response to the second prompt that asks for a model or process. Further options may be identified by entering a question mark to the first or second prompt of each model or process. This session describes the procedures to obtain plots on the printer graphics terminal plotter. Plots on the printer only require a 132-character printer with carriage control. Plots on graphics devices use the software package DISSPLA from Issco, Inc. Data can be plotted from the TSS file or from a sequential file using the HSPF PLTGEN format. ANNIE is used to select options on how the data from the PLTGEN or TSS file should be plotted. The PLTGEN file can have up to 10 different time-series. ANNIE can select up to 5 time-series for each plot. For example, an HSPF run might be made with the PLTGEN operation to get four simulated streamflow datasets, and two precipitation datasets. Then with the observed streamflow on a TSS file, ANNIE can plot any or all combinations of simulated flow, observed flow, and precipitation.

Time steps for the plots can be equal to or greater than the time intervals on the TSS or PLTGEN file. Thus, 15-minute precipitation values can be plotted with daily precipitation on a daily time step of visual comparison. When the time interval for the data is less than the time step selected for the plot, ANNIE will ask whether the data on the file should be summed or averaged before plotting. Time steps for the plot must always be an even multiple of the time interval of the data.

For the printer, three types of plots are available: monthly bargraphs, daily flows, or storm event plots of up to 366 time steps. For graphics

devices, two types of plots are available: daily flows or storm event plots. ANNIE is used to select the time period, time step, time-series data, plotting symbols, scales, logarithmic or arithmetic axes, and titles. An interactive session with ANNIE is shown below. Following that are examples of the kinds of plots that can be created.

```
   ************************************************************
   ******              WELCOME TO "ANNIE"                ******
   ******       VERSION DATED OCTOBER 31, 1984           ******
   ************************************************************
   DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
 > L
   WHAT MODEL OR PROCESS DO YOU WANT TO USE?
 > PL
   FILE TYPE FOR INPUT?
 > ?
    Only 2 file types (formats) can be used.
    Use REFORMAT option in ANNIE to convert if necessary.
    If some of the data is on each file, enter both.
    Valid responses are:
    PLTGEN   ,    TSSFILE ,    BOTH    ,    DONE
   FILE TYPE FOR INPUT?
 > TSS
   NAME OF YOUR TSS FILE?
 > ELKHORN.TSS
   NAME OF FILE FOR PRINTER PLOT OR GRAPHICS OUTPUT?
 > MPLOT
   ENTER TIME STEP FOR THE PLOT (MINUTES).
   (Hit return for 1440)
 > ?
    1440 min = 1 day, 2880 = monthly.
    Min acceptable value is 1,  Max acceptable value is 2880
   ENTER TIME STEP FOR THE PLOT (MINUTES).
   (Hit return for 1440)
 > 2880
   WHICH DATASET NUMBER?
 > 30
   DO YOU WANT TO SUM OR AVERAGE THE TIMESTEPS?
 > SUM
   ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
 > PRECIPITATION
   ANOTHER DATASET?
 > Y
   WHICH DATASET NUMBER?
 > 40
   DO YOU WANT TO SUM OR AVERAGE THE TIMESTEPS?
 > AVE
   ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
 > OBS. STREAMFLOW
   ANOTHER DATASET?
 > Y
   WHICH DATASET NUMBER?
 > 81
   DO YOU WANT TO SUM OR AVERAGE THE TIMESTEPS?
 > AVE
   ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
 > SIM. STREAMFLOW
   ANOTHER DATASET?
 > Y
   WHICH DATASET NUMBER?
 > 82
   DO YOU WANT TO SUM OR AVERAGE THE TIMESTEPS?
 > AVE
   ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
 > INTERFLOW + BASEFLOW
```

```
  ANOTHER DATASET?
> Y
  WHICH DATASET NUMBER?
> 83
  DO YOU WANT TO SUM OR AVERAGE THE TIMESTEPS?
> AVE
  ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
> BASEFLOW
  ENTER TITLE FOR PLOT. (MAX 80 CHAR)
> MONTHLY STREAMFLOW
  ENTER LABEL FOR Y-AXIS. (MAX 40 CHAR)
> AVERAGE-FLOW (CU. FT. PER SEC.)
  ENTER STARTING DATE.
> 1980/10/1
  ENTER ENDING DATE.
> 1982/9/30
  24 POINTS ARE TO BE PLOTTED.
  PATIENCE, DATA FILE BEING READ.
  GRAPHIC DEVICE?
> ?
   The same plot can be made on several devices or on the same
   device with a different scale.  When finished or ready for next
   set of data, enter DONE.  Printer is for plots on the line
   printer or a  132 character terminal.  Graphic devices require
   the DISSPLA software (Issco, Inc).  If your device is not
   included, contact Alan Lumb, US Geological Survey, Reston VA.
   Valid responses are:
   CALCOMP   , TAB-G     , ZETA      , HOUSTON   , HP        , TEKTRONIX ,
   PRINTER   , OTHER     , DONE
  GRAPHIC DEVICE?
> PR
  VARIABLE IS:PRECIPITATION
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> ?
   Plot designed for up to 5 time series (4 plotted, 1 listed).
   The listed variable is printed at the top of the plot,
   Valid responses are:
   PLOTTED ,    LISTED
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> LIST
  VARIABLE IS:OBS. STREAMFLOW
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> PLO
  ENTER SYMBOL TO BE USED FOR PLOTTING.
> O
  VARIABLE IS:SIM. STREAMFLOW
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> PLOT
  ENTER SYMBOL TO BE USED FOR PLOTTING.
> S
  VARIABLE IS:INTERFLOW + BASEFLOW
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> PL
  ENTER SYMBOL TO BE USED FOR PLOTTING.
> .
  VARIABLE IS:BASEFLOW
  IS ABOVE VARIABLE TO BE PLOTTED OR LISTED?
> PLOT
  ENTER SYMBOL TO BE USED FOR PLOTTING.
> :
```

```
      TIME-SERIES              MINIMUM    MAXIMUM
   ------------------          -------    -------
   OBS. STREAMFLOW              0.001       1.15
   SIM. STREAMFLOW              0.027       1.40
   INTERFLOW + BASEFLOW         0.024       1.12
   BASEFLOW                     0.018       0.30
  LOGARITHMIC OR ARITHMETIC SCALE FOR Y-AXIS?
> A
  ENTER MINIMUM VALUE FOR THE PLOT.
  (Hit return for 0.)
>
  ENTER MAXIMUM VALUE FOR THE PLOT.
  (Hit return for 1.5)
>
  SHOULD THE AREA UNDER EACH CURVE BE SHADED?
> ?
   For printer plots, the selected symbols are used to shade
   under each curve.
   For graphic plotter you will be asked additional
   questions if you want shading.
   Valid responses are:
   NO  ,        YES
  SHOULD THE AREA UNDER EACH CURVE BE SHADED?
> N
  SHOULD PLOTS BE CALENDAR YEAR OR WATER YEAR.
> W
  PLOT COMPLETE.
  PLOT FILE MUST BE PRINTED WITH FORTRAN CARRIAGE CONTROL.
  DO YOU WANT TO PLOT SAME DATA AGAIN?
> N
  FINISHED ALL REQUESTED PLOTS.
  FILE TYPE FOR INPUT?
> TSS
  NAME OF YOUR TSS FILE?
> ELKHORN.TSSELKHORN>TSS
  NAME OF FILE FOR PRINTER PLOT OR GRAPHICS OUTPUT?
> DPLOT
  ENTER TIME STEP FOR THE PLOT (MINUTES).
  (Hit return for 1440)
> 1440
  WHICH DATASET NUMBER?
> 30
  ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
> PRECIPITATION
  ANOTHER DATASET?
> Y
  WHICH DATASET NUMBER?
> 40
  ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
> OBS. STREAMFLOW
  ANOTHER DATASET?
> Y
  WHICH DATASET NUMBER?
> 81
  ENTER LABEL (NAME) FOR DATASET. (MAX 20 CHAR)
> SIM. STREAMFLOW
  ANOTHER DATASET?
> NO
  ENTER TITLE FOR PLOT. (MAX 80 CHAR)
> CALIBRATION RUN #3, ELKHORN BRANCH
```

```
 ENTER LABEL FOR Y-AXIS. (MAX 40 CHAR)
> STREAMFLOW, IN CUBIC FEET PER SECOND
 ENTER STARTING DATE.
> 1980/10/1
 ENTER ENDING DATE.
> 1982/9/30
 WHICH MONTH DO YOU WANT EACH PLOT TO END?
 (Hit return for 12)
> 9
 730 POINTS ARE TO BE PLOTTED.
 PATIENCE, DATA FILE BEING READ.
 GRAPHIC DEVICE?
>'HP
 WHICH MODEL SERIES?
> 7475
 VARIABLE IS:PRECIPITATION
 IS ABOVE VARIABLE TO BE A BAR GRAPH AT TOP OF PLOT?
> Y
 COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> ?
  Enter BLACK unless color graphics device is being used.
  CYAN is a blueish color.  MAGNENTA is passionate pink.
  Valid responses are:
  BLACK   ,    MAGNENTA,    RED     ,    YELLOW  ,    GREEN   ,    CYAN    ,
  BLUE    ,    WHITE
 COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> BLUE
 VARIABLE IS:OBS. STREAMFLOW
 COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> BLU
 LINE TYPE?
> ?
  Enter one of the following to select the type of line.
    NONE   = no line, only symbols.
    SOLID  = solid line, symbols may be added.
    DASH   = dashed line.
    DOT    = dotted line.
    DT-DSH = dot-dash line.
    BAR-GR = small bar-graph of variable at top of the plot,
             usually used for precipitation.
  Valid responses are:
  NONE  ,      SOLID ,      DASH  ,      DOT   ,      DT-DSH,      BAR-GR

 LINE TYPE?
> SOL
 SYMBOL?
> ?
  Select one of the symbols. 'X on a +' is an X superimposed
  on a plus(+). Star is an asterisk.
  Valid responses are:
  NONE    ,    SQUARE  ,    CIRCLE  ,    TRIANGLE,    PLUS    ,    X       ,
  DIAMOND ,    X ON A +,    DOT
 SYMBOL?
> NONE
 VARIABLE IS:SIM. STREAMFLOW
 COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> RED
 LINE TYPE?
> SOLID
```

```
  SYMBOL?
> NONE
       TIME-SERIES          MINIMUM    MAXIMUM
  ------------------------  -------    -------
  OBS. STREAMFLOW             0.000       6.80
  SIM. STREAMFLOW             0.000      12.76
  LOGARITHMIC OR ARITHMETIC SCALE FOR Y-AXIS?
> L
  ENTER MINIMUM VALUE FOR THE PLOT.
  (Hit return for 1.0000E-4)
> 0.01
  ENTER MAXIMUM VALUE FOR THE PLOT.
  (Hit return for 10.)
> 10.0
  MAXIMUM =    10.000
  MINIMUM =     0.010
  ARE THESE VALUES OK?
> Y
  SHOULD THE AREA UNDER EACH CURVE BE SHADED?
> NO
  DOUBLE CHECKING DATA AGAINST SELECTED MIN AND MAX.
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
         0.0000 TO          0.0100
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
        12.7569 TO         10.0000
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
         0.0000 TO          0.0100
  VERTICAL PAGE SIZE (INCHES)?
  (Hit return for 7.5)
>
  HORIZONTAL PAGE SIZE (INCHES)?
  (Hit return for 10.)
>
  LETTER SIZE (INCHES)?
  (Hit return for 0.1)
>
  SIMPLIFIED OR DETAILED PLOTS?
> DET
  AFTER PLOT IS FINISHED, HIT RETURN KEY TO CONTINUE.
  -PLOT COMPLETED-
>
  DO YOU WANT TO PLOT SAME DATA AGAIN?
> N
  365 POINTS ARE TO BE PLOTTED.
  PATIENCE, DATA FILE BEING READ.
  GRAPHIC DEVICE?
> HP
  WHICH MODEL SERIES?
> 7475
  VARIABLE IS:PRECIPITATION
  IS ABOVE VARIABLE TO BE A BAR GRAPH AT TOP OF PLOT?
> Y
  COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> BLUE
  VARIABLE IS:OBS. STREAMFLOW
  COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> BLU
  LINE TYPE?
> SOL
  SYMBOL?
> NON
```

```
  VARIABLE IS:SIM. STREAMFLOW
  COLOR OF PEN OR LINE IF APPROPRIATE, ELSE ENTER BLACK.
> RED
  LINE TYPE?
> SOL
  SYMBOL?
> NON
        TIME-SERIES          MINIMUM    MAXIMUM
   ------------------------  -------    -------
    OBS. STREAMFLOW            0.000      3.80
    SIM. STREAMFLOW            0.015      6.05
  LOGARITHMIC OR ARITHMETIC SCALE FOR Y-AXIS?
> L
  ENTER MINIMUM VALUE FOR THE PLOT.
  (Hit return for 1.0000E-5)
> 0.01
  ENTER MAXIMUM VALUE FOR THE PLOT.
  (Hit return for 1.)
> 10.0
  MAXIMUM =     10.000
  MINIMUM =      0.010
  ARE THESE VALUES OK?
> Y
  SHOULD THE AREA UNDER EACH CURVE BE SHADED?
> N
  DOUBLE CHECKING DATA AGAINST SELECTED MIN AND MAX.
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
          0.0000 TO          0.0100
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
          0.0000 TO          0.0100
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
          0.0000 TO          0.0100
  *** WARNING *** VALUE OFF SCALE, SO VALUE WAS RESET.
          0.0000 TO          0.0100
  VERTICAL PAGE SIZE (INCHES)?
  (Hit return for 7.5)
>
  HORIZONTAL PAGE SIZE (INCHES)?
  (Hit return for 10.)
>
  LETTER SIZE (INCHES)?
  (Hit return for 0.1)
>
  SIMPLIFIED OR DETAILED PLOTS?
> DET
  AFTER PLOT IS FINISHED, HIT RETURN KEY TO CONTINUE.
  -PLOT COMPLETED-
>
  DO YOU WANT TO PLOT SAME DATA AGAIN?
> N
   END OF DISSPLA 9.0 -- 5280 VECTORS GENERATED IN 2 PLOT FRAMES.
       PROPRIETARY SOFTWARE PRODUCT OF ISSCO, SAN DIEGO, CA.
   1174 VIRTUAL STORAGE REFERENCES; 4 READS; 0 WRITES.
  FINISHED ALL REQUESTED PLOTS.
  FILE TYPE FOR INPUT?
> DONE
  ARE YOU FINISHED?
> YE
  **** STOP
```

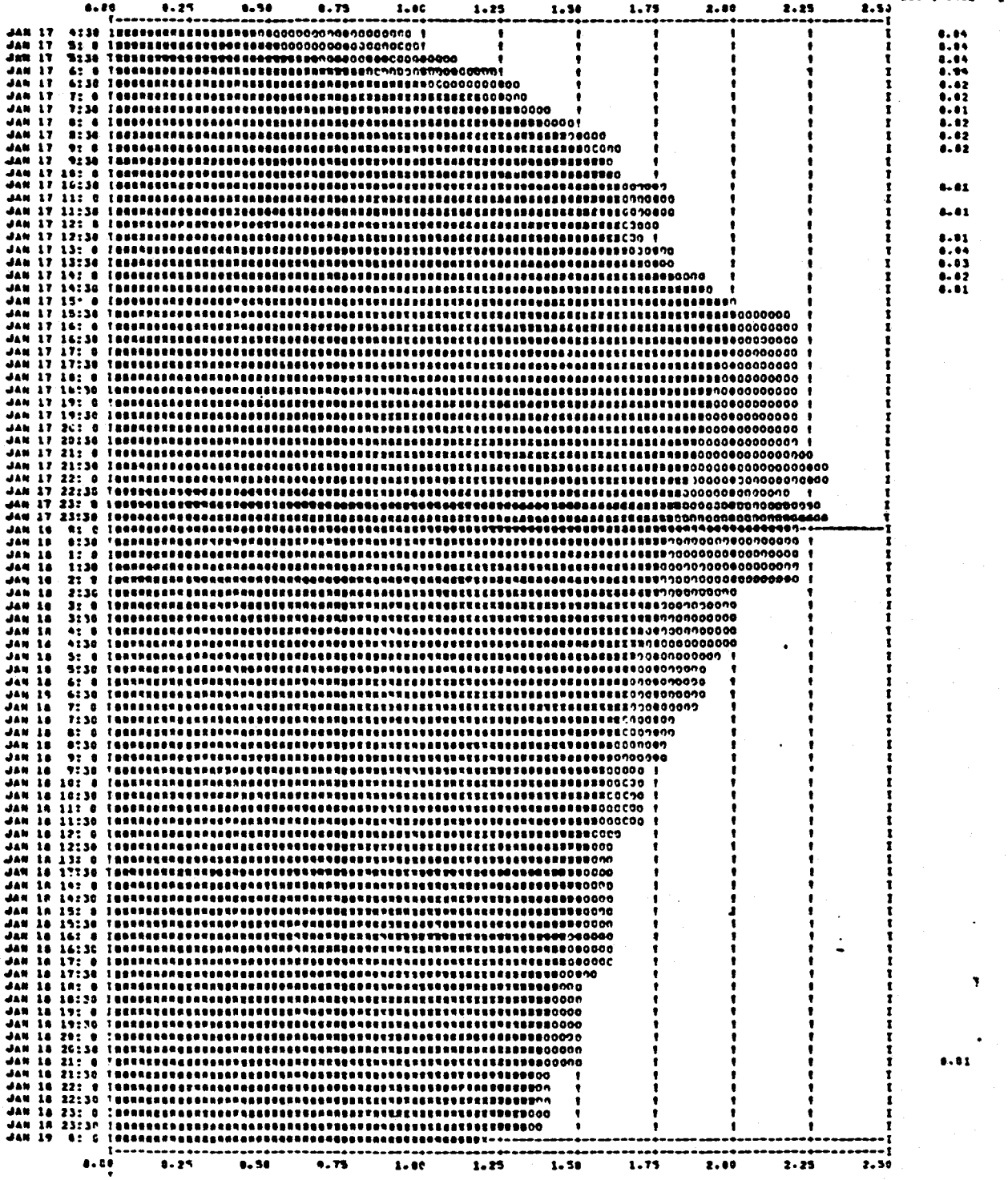
UNIT HEASPAU CR CALIBRATION

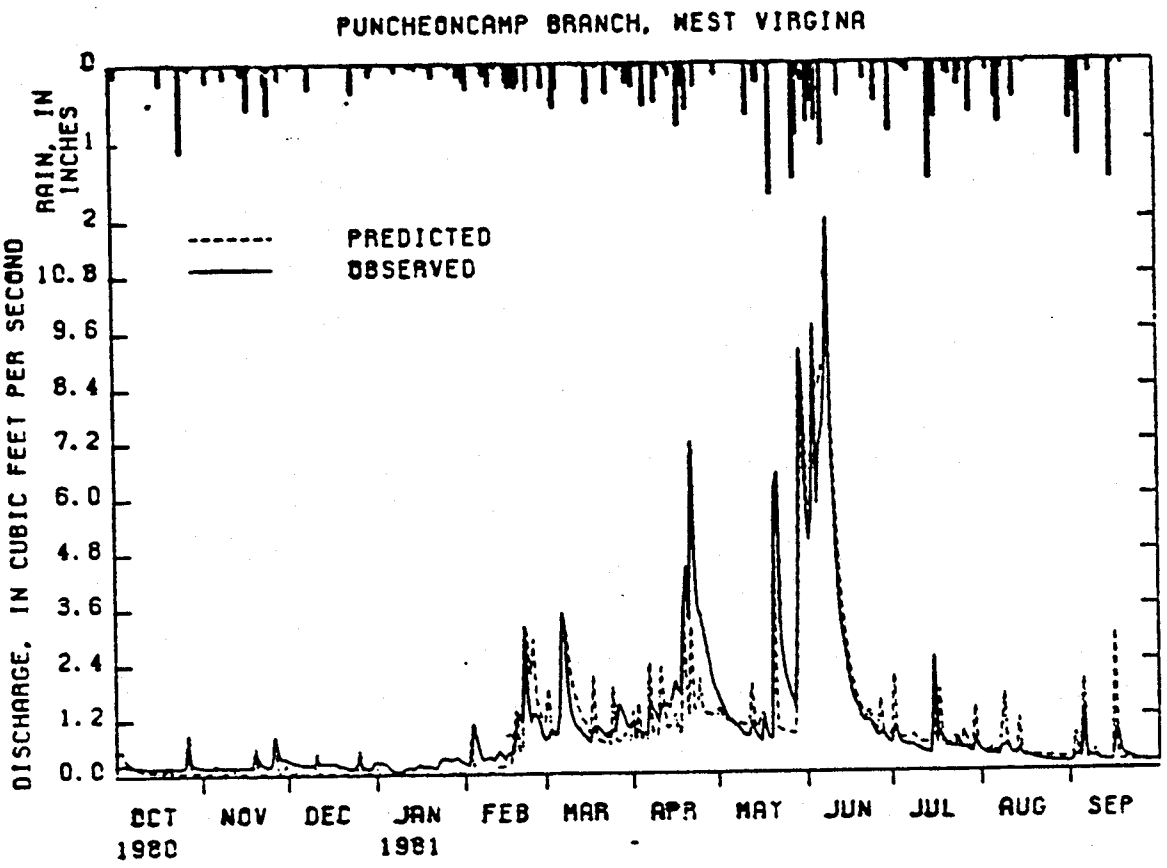
WATER YEAR= 1981

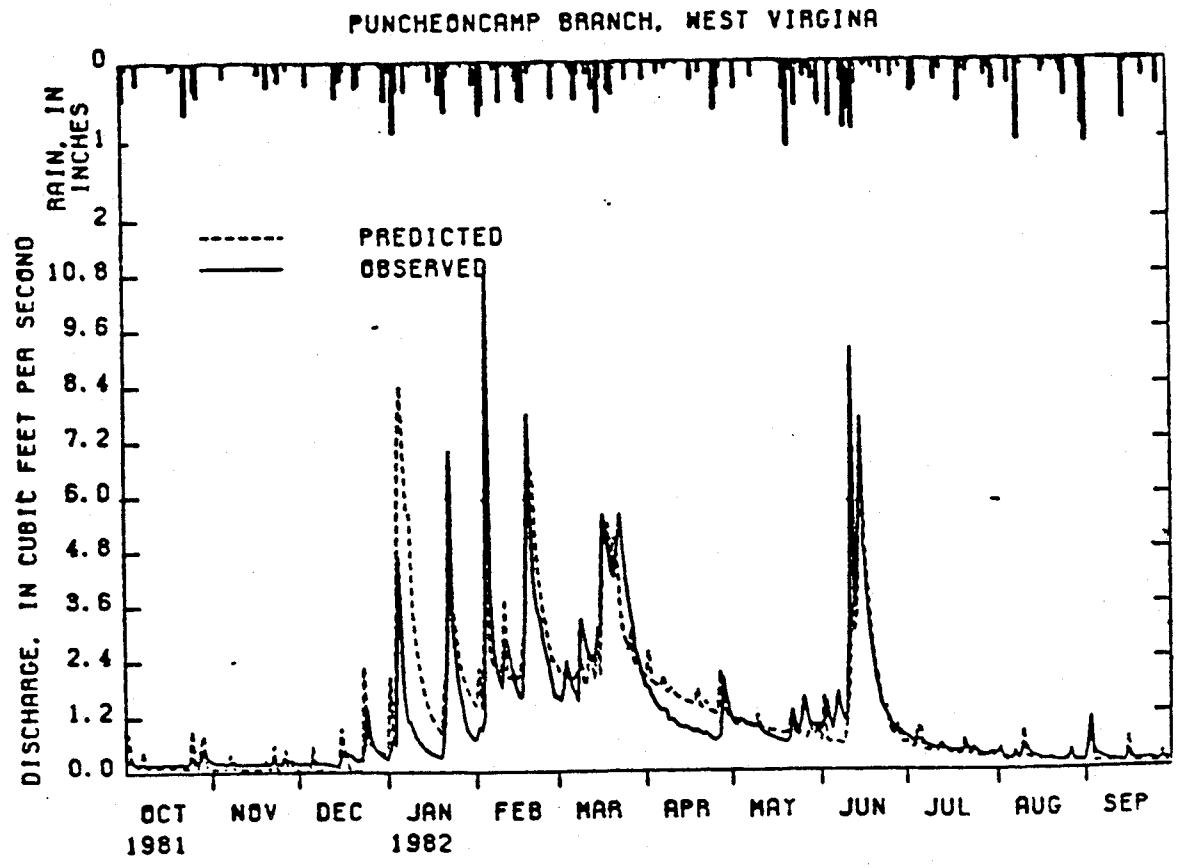
O = OBSERVED
X = PREDICTED

UNIT VALUES

PRECIP, BASE 1

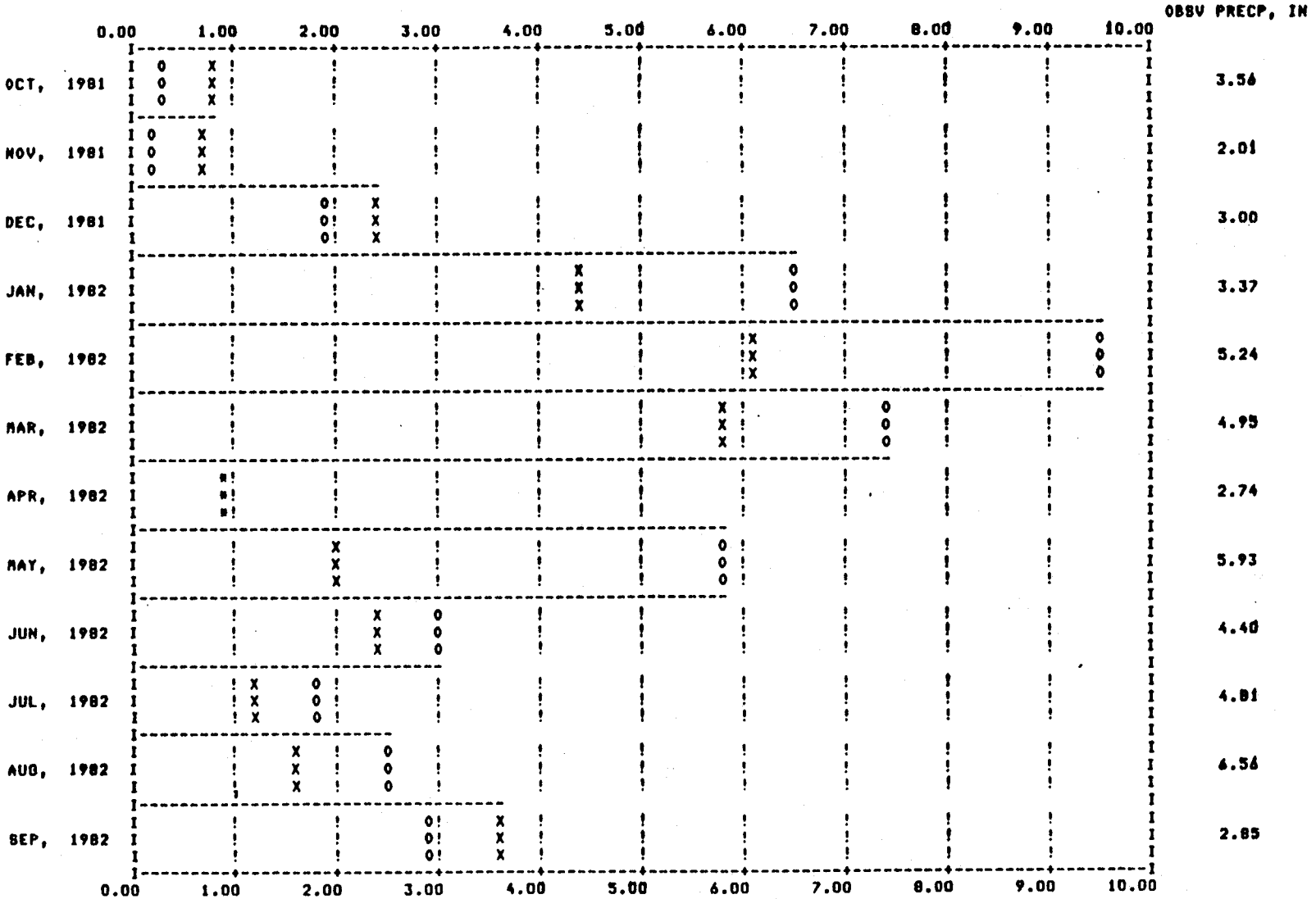



PUNCHEONCAMP BRANCH, WEST VIRGINA
RAIN, IN INCHES
0
1
2
DISCHARGE, IN CUBIC FEET PER SECOND
10.8
9.6
8.4
7.2
6.0
4.8
3.6
2.4
1.2
0.0
PREDICTED
OBSERVED
OCT
1980
NOV
DEC
JAN
1981
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP


PUNCHEONCAMP BRANCH, WEST VIRGINA
RAIN, IN INCHES
0
1
2
DISCHARGE, IN CUBIC FEET PER SECOND
10.8
9.6
8.4
7.2
6.0
4.8
3.6
2.4
1.2
0.0
PREDICTED
OBSERVED
OCT
1981
NOV
DEC
JAN
1982
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP

X = PRED DISCH (CFS)
O = OBSV DISCH, CFS

DISCHARGE, IN CUBIC FEET PER SECOND



Session 6

Flow duration is another type analysis of data that can be done with ANNIE. Currently, only data in the HSPF PLTGEN format can be used. PLTGEN formated files can be created with HSPF, PRMS, or DR3M. One or two time series can be selected for each analysis. If one time series is selected only a flow-duration is done. When two time series are selected, several types of error analysis are performed in addition to the flow-duration analysis on each time series. Absolute errors, standard errors, and an error matrix by class interval are computed with two time series. Also a printer plot of both flow-duration curves is made.

Flow-duration analyses can be made by selecting the STATISTICS option in ANNIE. Other statistical analyses are anticipated. An interactive session with ANNIE for flow-duration analysis is shown below.

```
  ************************************************************
  ******              WELCOME TO "ANNIE"                ******
  ******       VERSION DATED OCTOBER 31, 1984           ******
  ************************************************************
  DO YOU HAVE NO, SOME, OR LOTS OF EXPERIENCE USING ANNIE?
> L
  WHAT MODEL OR PROCESS DO YOU WANT TO USE?
> S
  TYPE OF STATISTICAL ANALYSIS?
> ?
   DURATION - duration and error analysis
   DONE -     finished with these type of analyses
   Valid responses are:
   DURATION  ,  DONE
  TYPE OF STATISTICAL ANALYSIS?
> DU
  NAME OF INPUT PLTGEN FILE?
> TEST.PLTGEN
  PRECIPITATION
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  OBSERVED FLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> Y
  SIMULATED FLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> Y
  IS THIS THE MEASURED OR SIMULATED VARIABLE?
> S
  INTER+BASEFLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  BASEFLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  POTENTIAL ET
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
  N
  ACTUAL ET
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  PLTGEN FILE STARTS AT 1980 OCT. 1 24:0
  ENTER STARTING DATE.
> 1980/10/1
  ENTER ENDING DATE.
> 1982/8/31
  LOWER BOUND FOR CLASS INTERVALS?
  (Hit return for 1.)
> 0.1
  UPPER BOUND FOR CLASS INTERVALS?
  (Hit return for 1000.)
> 90.0
  FILE BEING READ.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
```

```
  DO YOU WANT OUTPUT ON THE TERMINAL OR A FILE?
> F
  NAME OF OUTPUT FILE?
> DURATION.OUT
  PRINTER PLOT?
> Y
  ERROR MATRIX?
> Y
  TYPE OF STATISTICAL ANALYSIS?
> DU
  NAME OF INPUT PLTGEN FILE?
> TEST.PLTGEN
  PRECIPITATION
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  OBSERVED FLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> Y
  SIMULATED FLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  INTER+BASEFLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  BASEFLOW
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  POTENTIAL ET
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  ACTUAL ET
  DO YOU WANT TO ANALYZE THE ABOVE TIME SERIES?
> N
  PLTGEN FILE STARTS AT 1980 OCT. 1 24:0
  ENTER STARTING DATE.
> 1980/10/1
  ENTER ENDING DATE.
> 1982/8/31
  LOWER BOUND FOR CLASS INTERVALS?
  (Hit return for 1.)
> 0.1
  UPPER BOUND FOR CLASS INTERVALS?
  (Hit return for 1000.)
> 90.0
  FILE BEING READ.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  STILL READING FILE.
  DO YOU WANT OUTPUT ON THE TERMINAL OR A FILE?
> F
  NAME OF OUTPUT FILE?
> DURATION.OUT2
  TYPE OF STATISTICAL ANALYSIS?
> DO
  ARE YOU FINISHED?
> Y
  **** STOP
```

CALIBRATION RUN #4: LEFTFORK, TUG FORK

TOP OF CLASS INTERVAL	NUMBER OF CASES	MEAN ABSOLUTE ERROR(1)		ROOT MEAN SQUARE ERROR(2)		BIAS(3)	
		AVERAGE	PERCENT	AVERAGE	PERCENT	AVERAGE	PERCENT
0.100	2	0.521	840.4	0.521	857.2	0.521	840.4
0.120	0	0.000	0.0	0.000	0.0	0.000	0.0
0.150	9	0.475	365.8	0.561	429.1	0.475	365.8
0.190	31	0.535	321.6	0.652	387.8	0.535	321.6
0.230	73	0.800	386.7	1.139	550.5	0.800	386.7
0.280	50	0.673	259.1	1.066	417.6	0.673	259.0
0.340	49	0.848	274.5	1.114	356.4	0.842	272.5
0.420	28	0.976	256.8	1.182	309.9	0.976	256.8
0.520	40	1.002	215.9	1.218	262.9	1.002	215.9
0.640	50	0.960	168.1	1.268	223.7	0.960	168.1
0.790	36	1.402	193.0	2.473	323.4	1.402	193.0
0.970	26	1.542	178.6	1.900	222.4	1.487	172.8
1.200	38	1.397	131.5	1.993	188.5	1.167	109.9
1.500	67	1.681	131.5	2.999	232.9	1.354	106.2
1.800	34	1.606	103.0	2.127	136.9	1.064	68.6
2.200	34	1.944	97.2	3.999	199.4	1.256	63.0
2.700	22	1.123	45.0	1.231	49.2	-0.672	-26.6
3.300	25	2.483	84.1	5.480	188.4	1.443	49.3
4.100	27	2.557	70.9	4.118	114.6	0.629	16.9
5.000	19	6.315	142.6	10.144	225.9	4.557	102.5
6.200	19	1.699	30.6	2.052	37.0	-0.727	-13.4
7.600	10	3.239	47.0	4.356	62.3	0.124	0.6
9.300	6	9.560	112.4	10.667	126.0	7.374	86.8
11.000	4	3.780	38.7	5.004	51.9	0.911	10.1
14.000	1	0.906	7.6	0.906	7.6	-0.906	-7.6
17.000	0	0.000	0.0	0.000	0.0	0.000	0.0
21.000	0	0.000	0.0	0.000	0.0	0.000	0.0
26.000	0	0.000	0.0	0.000	0.0	0.000	0.0
32.000	0	0.000	0.0	0.000	0.0	0.000	0.0
39.000	0	0.000	0.0	0.000	0.0	0.000	0.0
48.000	0	0.000	0.0	0.000	0.0	0.000	0.0
60.000	0	0.000	0.0	0.000	0.0	0.000	0.0
73.000	0	0.000	0.0	0.000	0.0	0.000	0.0
90.000	0	0.000	0.0	0.000	0.0	0.000	0.0
	700	1.517	139.2	3.029	961.0	1.047	177.5

STANDARD ERROR OF ESTIMATE = 2.8446
= (n/n-1)*square root((tot.col.5)**2 - (tot.col.7)**2)

(1) AVERAGE = sum (|S-M|/n)
PERCENT = 100.0 * (sum(|S-M|/M))/n for all M > 0.0

(2) AVERAGE = square root(sum((S-M)**2)/n)
PERCENT = 100.0 * square root(sum(((S-M)/M)**2)/n) for all M > 0

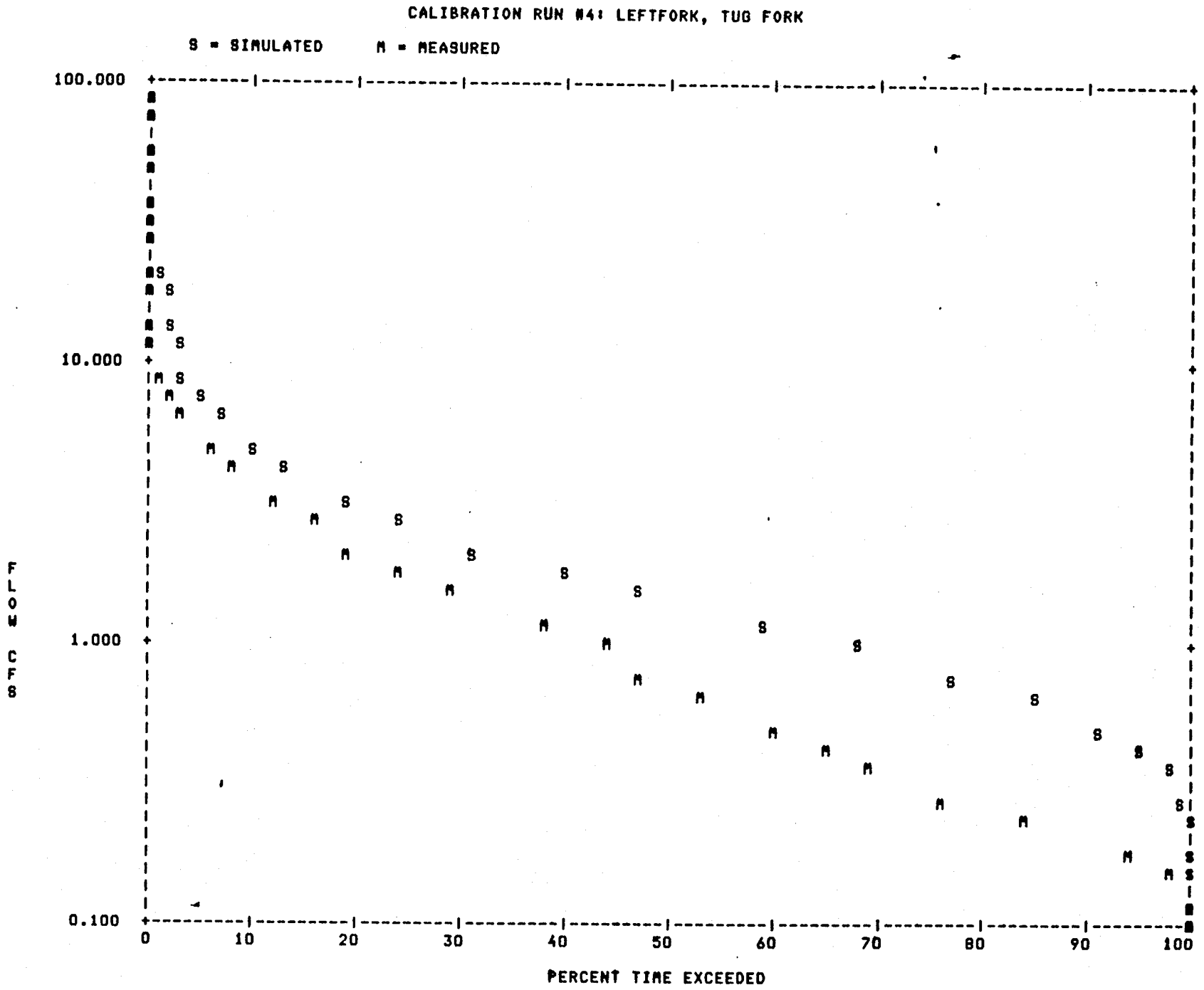
(3) AVERAGE = sum (S-M)/n
PERCENT = 100.0 * (sum ((S-M)/M)/n) for all M > 0.0

S = SIMULATED VALUE
M = MEASURED VALUE
sum = SUMMATION
n = NUMBER OF PAIRS OF VALUES
| | = ABSOLUTE VALUE

note: Percents for the first class interval and the total should not be used if there are measured events that are zero.

CALIBRATION RUN #4: LEFTFORK, TUG FORK

TOP OF CLASS INTERVAL	NUMBER OF CASES		PERCENT TIME		PERCENT CASES EXCEEDING INTERVAL		AVERAGE	
	MEAS	SIM	MEASURED	SIMULATED	MEASURED	SIMULATED	MEASURED	SIMULATED
0.100	2	0	0.29	0.00	99.71	100.00	0.065	0.000
0.120	0	0	0.00	0.00	99.71	100.00	0.000	0.000
0.150	9	0	1.29	0.00	98.43	100.00	0.130	0.000
0.190	31	0	4.43	0.00	94.00	100.00	0.165	0.000
0.230	73	1	10.43	0.14	83.57	99.86	0.207	0.226
0.280	50	3	7.14	0.43	76.43	99.43	0.261	0.262
0.340	49	9	7.00	1.29	69.43	98.14	0.306	0.309
0.420	28	22	4.00	3.14	65.43	95.00	0.376	0.381
0.520	40	28	5.71	4.00	59.71	91.00	0.468	0.470
0.640	50	41	7.14	5.86	52.57	85.14	0.577	0.576
0.790	36	58	5.14	8.29	47.43	76.86	0.713	0.711
0.970	26	59	3.71	8.43	43.71	68.43	0.873	0.888
1.200	38	65	5.43	9.29	38.29	59.14	1.065	1.079
1.500	67	83	9.57	11.86	28.71	47.29	1.281	1.338
1.800	34	54	4.86	7.71	23.86	39.57	1.568	1.649
2.200	34	62	4.86	8.86	19.00	30.71	1.965	1.994
2.700	22	44	3.14	6.29	15.86	24.43	2.491	2.432
3.300	25	39	3.57	5.57	12.29	18.86	2.996	2.969
4.100	27	38	3.86	5.43	8.43	13.43	3.574	3.563
5.000	19	25	2.71	3.57	5.71	9.86	4.374	4.409
6.200	19	20	2.71	2.86	3.00	7.00	5.642	5.533
7.600	10	16	1.43	2.29	1.57	4.71	6.760	6.768
9.300	6	9	0.86	1.29	0.71	3.43	8.583	8.594
11.000	4	5	0.57	0.71	0.14	2.71	9.950	10.070
14.000	1	3	0.14	0.43	0.00	2.29	12.000	12.649
17.000	0	4	0.00	0.57	0.00	1.71	0.000	15.568
21.000	0	5	0.00	0.71	0.00	1.00	0.000	18.814
26.000	0	5	0.00	0.71	0.00	0.29	0.000	22.879
32.000	0	2	0.00	0.29	0.00	0.00	0.000	31.286
39.000	0	0	0.00	0.00	0.00	0.00	0.000	0.000
48.000	0	0	0.00	0.00	0.00	0.00	0.000	0.000
60.000	0	0	0.00	0.00	0.00	0.00	0.000	0.000
73.000	0	0	0.00	0.00	0.00	0.00	0.000	0.000
90.000	0	0	0.00	0.00	0.00	0.00	0.000	0.000
	700	700	100.000	100.000			1.414	2.461


CALIBRATION RUN #4: LEFTFORK, TUG FORK
S = SIMULATED
M = MEASURED
100.000
10.000
1.000
0.100
FLOW CFS
0
10
20
30
40
50
60
70
80
90
100
PERCENT TIME EXCEEDED

CALIBRATION RUN #4: LEFTFORK, TUG FORK

CLASS INTERVAL	NUMBER OF DEVIATIONS BETWEEN INDICATED PERCENTAGES							
	-60	-30	-10	0	10	30	60	
0.100	0	0	0	0	0	0	0	2
0.120	0	0	0	0	0	0	0	0
0.150	0	0	0	0	0	0	0	9
0.190	0	0	0	0	0	0	0	31
0.230	0	0	0	0	0	0	0	73
0.280	0	0	0	1	1	2	6	40
0.340	0	0	2	1	2	2	2	40
0.420	0	0	0	0	0	1	2	25
0.520	0	0	0	0	0	0	3	37
0.640	0	0	0	0	0	2	7	41
0.790	0	0	0	0	0	1	3	32
0.970	1	0	1	0	0	0	3	21
1.200	1	6	1	2	1	0	3	24
1.500	1	13	7	4	2	2	10	28
1.800	1	10	2	1	1	0	4	15
2.200	0	10	5	0	3	3	3	10
2.700	1	13	5	0	0	1	0	2
3.300	0	7	6	2	2	1	1	6
4.100	3	10	1	2	3	1	2	5
5.000	0	7	1	1	0	1	0	9
6.200	0	7	4	3	1	2	0	2
7.600	1	4	0	1	1	1	1	1
9.300	0	2	0	0	0	0	0	4
11.000	0	0	3	0	0	0	0	1
14.000	0	0	0	1	0	0	0	0
17.000	0	0	0	0	0	0	0	0
21.000	0	0	0	0	0	0	0	0
26.000	0	0	0	0	0	0	0	0
32.000	0	0	0	0	0	0	0	0
39.000	0	0	0	0	0	0	0	0
48.000	0	0	0	0	0	0	0	0
60.000	0	0	0	0	0	0	0	0
73.000	0	0	0	0	0	0	0	0
90.000	0	0	0	0	0	0	0	0
	9	89	38	19	17	20	50	458

PART C

PROGRAMER'S GUIDE

PART C. PROGRAMER'S GUIDE

INTRODUCTION

ANNIE was developed with a set of software utilities and information files so that additional models and processes could be added easily. The first task of the programer in adding a new process or model is the design and coding of a subroutine or set of subroutines that contains the logical sequence of prompts and user responses. The second task is creating the information file that supports those subroutines.

DEFINITIONS OF TERMS

Several terms are used in this section that have specific meaning and are defined below:

Utilities -- Fortran subroutines or functions written for ANNIE and listed in Appendix A that have general usage not specific to a process or model.

Subroutines -- Fortran subroutines written for ANNIE that are specific to a model or process.

TSS file -- Time-Series Store, an indexed direct access file for storing time-series data.

Message file -- Direct-access file that contains the questions and acceptable responses that are read by the utilities QFOPEN, QRESP, QRESPI, QRESPR, QRESPS, QRESPM, QRESPX and PRNTXT.

Input stream -- Sequential file with 80-character lines that are input to a specific hydrologic model.

Model -- Hydrologic model that requires an input stream which is created or updated by ANNIE.

Process -- Operations on time-series data other than a hydrologic model.

STRUCTURE

ANNIE has a main program that:

1. Opens the message files.
2. Reads from the message file to fill an array for the pointers for subroutines that uses the message file.
3. Reads from the message file an array for the Fortran unit numbers of files to be used.
4. Determines user's level of experience and prints text for the beginner.
5. Calls three subroutines, INIT, PROCES, and FINISH.

INIT determines what the user wants to do and opens the necessary files. PROCES calls the appropriate subroutines that call for the prompts and acts on the responses for the various processes or models. FINISH creates permanent copies of files, if necessary, and closes files. All three subroutines and the subroutines for specific models or processes use the set of utilities that are listed in Appendix A.

Figures 4-6 show the structure charts for ANNIE that include all but the utilities. Note that the structure charts are similar to the option tree or menu of figure 2.

FILES

ANNIE uses several files to minimize the amount of code required so that (1) minicomputers might be used, and (2) changes in the questions and valid responses can be made without recompiling the code. Eight types of files are used (fig. 3).

1. Message file for questions and valid responses.
2. Model information files (which alternatively could be part of the message file).
3. Direct access file of an input stream to a hydrologic model.
4. Sequential file of an input stream to a hydrologic model.
5. Direct access file for working copy of the input stream.
6. Sequential input file of time-series data.
7. Sequential output file for printer, plotters, or further processing.
8. Time-Series Store (TSS file).

MESSAGE FILE

The message file is a direct access file with record lengths of 132 characters (see Appendix B). Records 25 and 27 in the message file contain Fortran unit numbers for all the files that may be used by ANNIE. These unit numbers can be changed without recompiling the code. The files listed in records 25 and 27 should be sufficient and used when writing new processes for ANNIE. If not, a new unit number can be added to record 27.

Records 11, 13, and 15 of the message file contain the offsets (group offsets) for each group of questions and valid responses. A group is generally a subroutine or a group of related subroutines that use the message file. At the beginning of each group in the message file as determined from the group offset, records are found that provide the offsets for each question within the group. This system for locating questions in the message file provides flexibility and allows modifications to the message file without recompiling the code. With this system, questions within a group can be moved and locations for that group can be changed with no changes in the software. of the software. However, if a new question is added to a group,

code also would be added to the subroutine to use the new question. Although adding questions to the message file requires changes and compilation of the subroutine, modifying the question or the valid responses or relocating the question is simply done by editing the message file. Utility subroutines QFOPEN, QRESP, QRESPI, QRESPR, QRESPS, QRESPM, QRESPX, and PRNTXT are designed to use the message file.

Entries in the message file have a very specific format (fig. 7-11). Each entry can be one or more records. For each question/response entry, the format types are:

P - Print text that solicits no response, for utility PRNTXT.

I - Prints question that solicits an integer response that will be checked against a minimum and maximum value, for utility QRESPI.

S - Prints question that solicits an integer or alphanumeric response that will be checked against a list of valid responses, for utility QRESPS.

L - Prints question that solicits an alphanumeric response that will be checked against a list of valid responses; however, the location in the list is returned, for utility QRESP.

R - Prints question that solicits decimal response that will be checked against a minimum and maximum value, for utility QRESPR.

X - Other uses by a subroutine.

C - Comment line not used by ANNIE.

M - Prints question then line heading for multiple responses. Each input is checked as appropriate. For utilities QRESPM and QRESPX.

F - Prints question for file name if needed and provides characteristics for the Fortran 77 OPEN statement for utility QFOPEN.

(Column numbers appear above boxes)

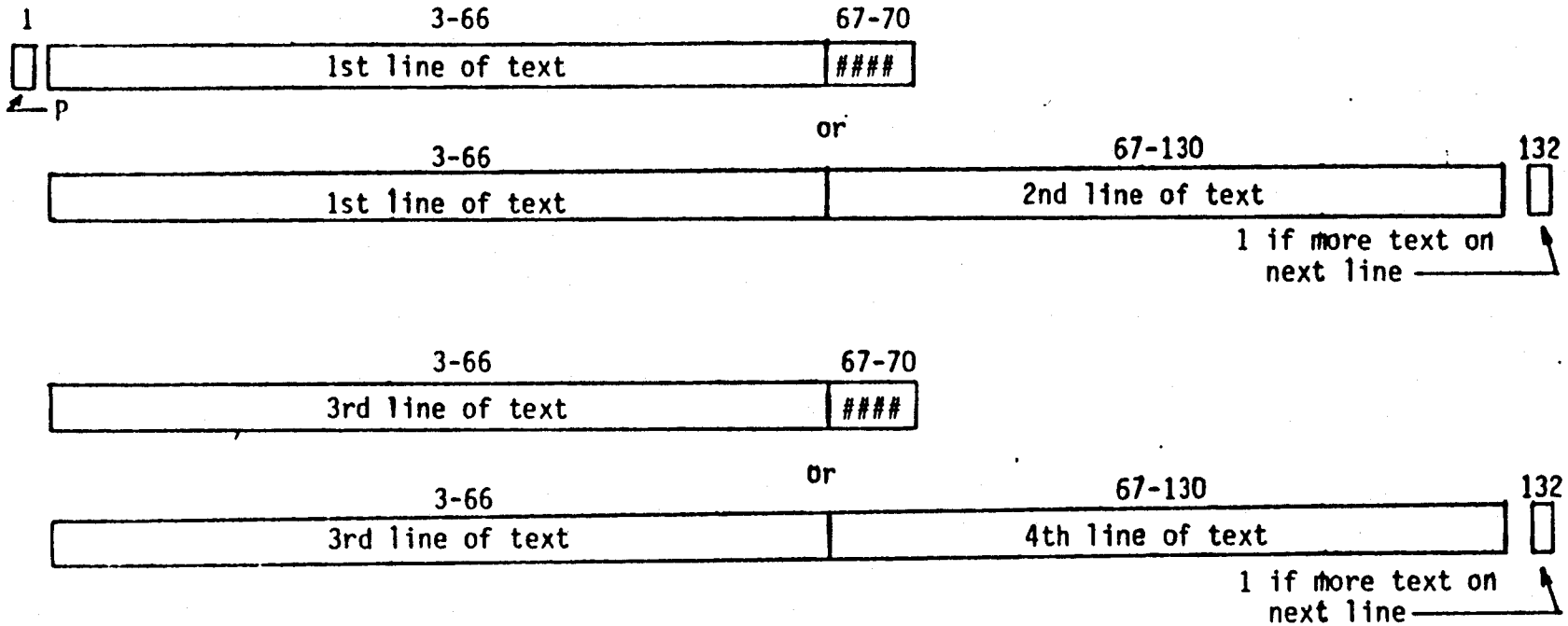


Figure 7.--PRNTXT format for message file.

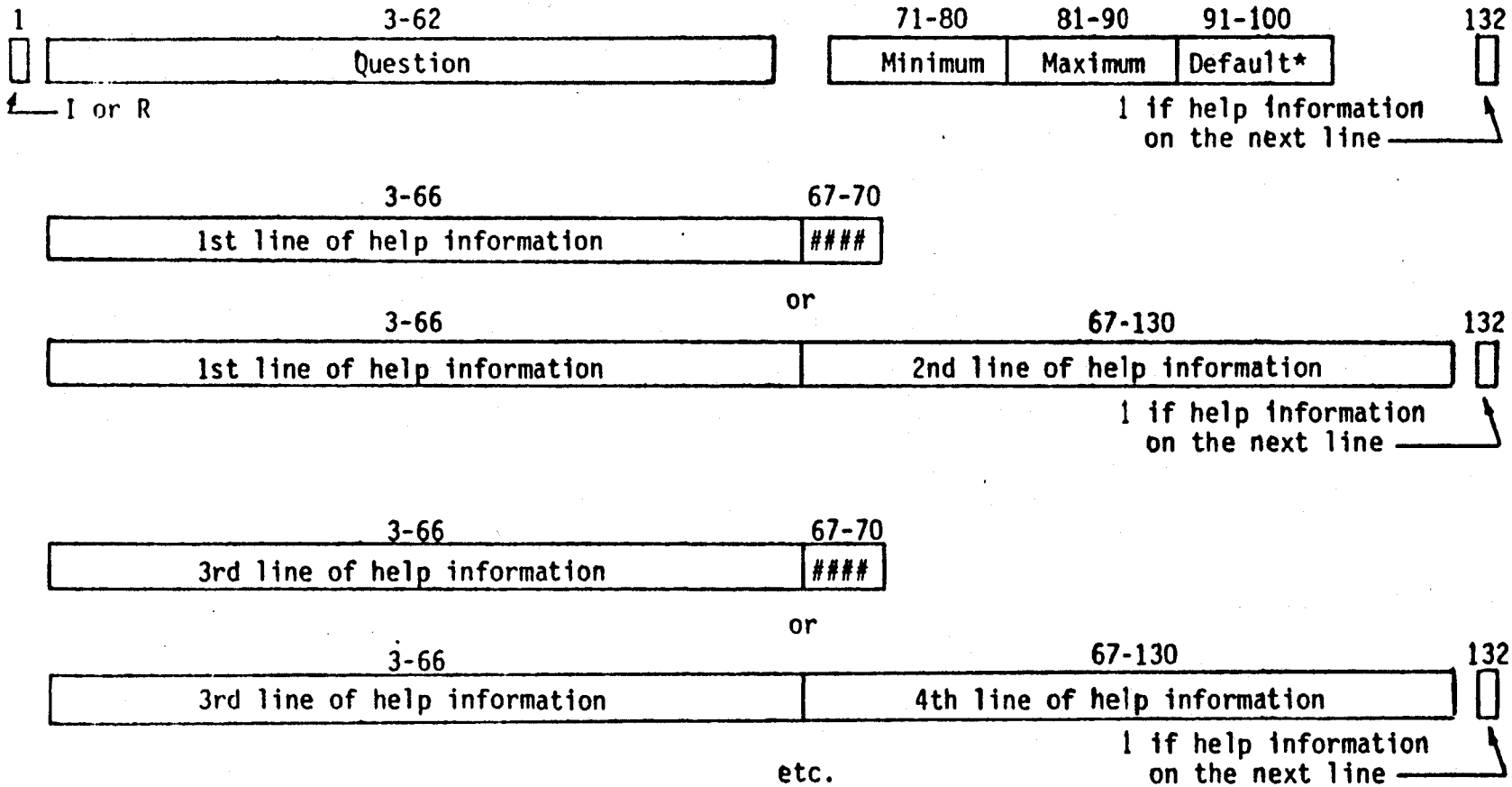


Figure 8.--QRESPI and QRESPR format for message file.

(Column numbers appear above boxes)

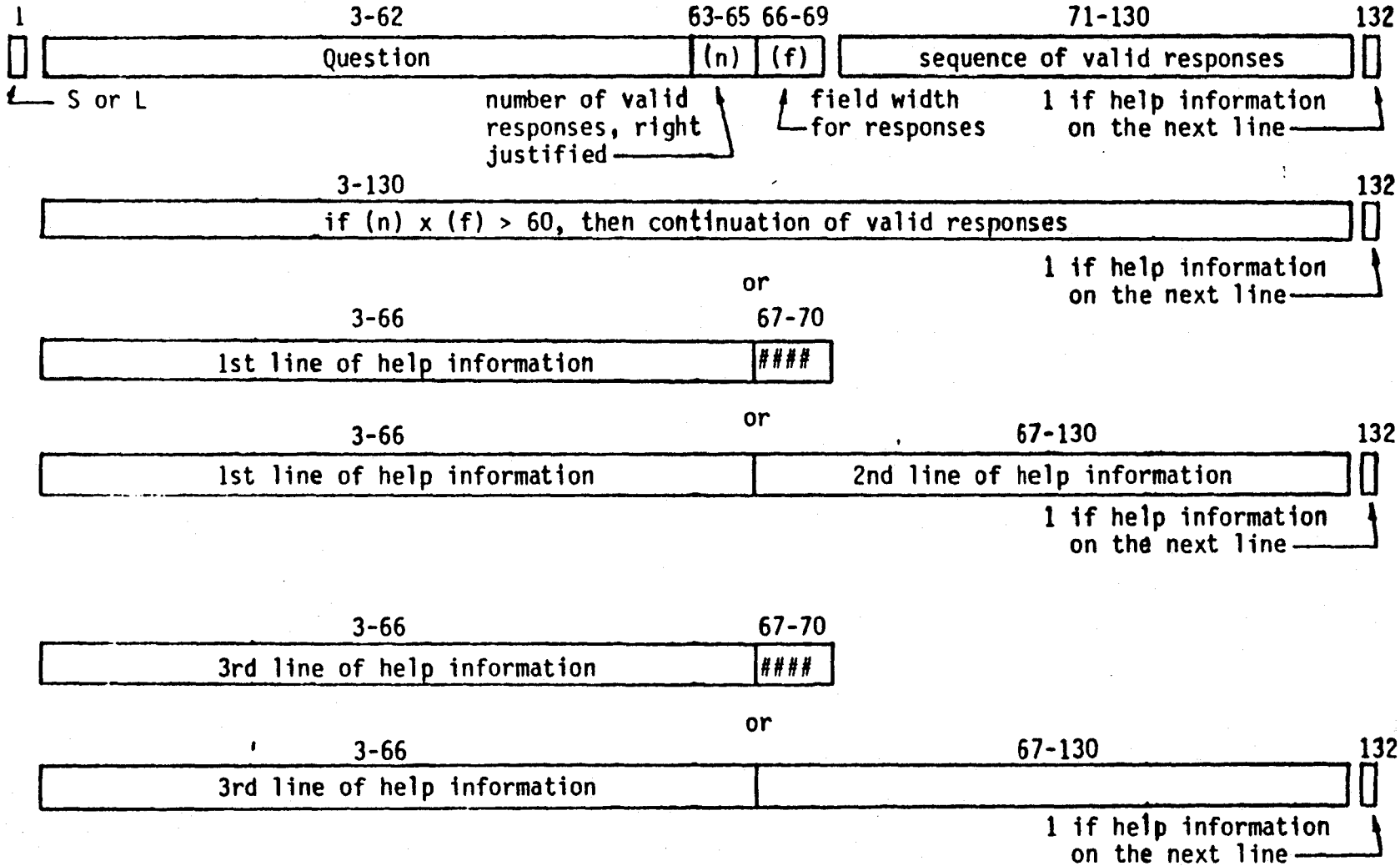


Figure 9.--QRESP and QRESPS formats for message file.

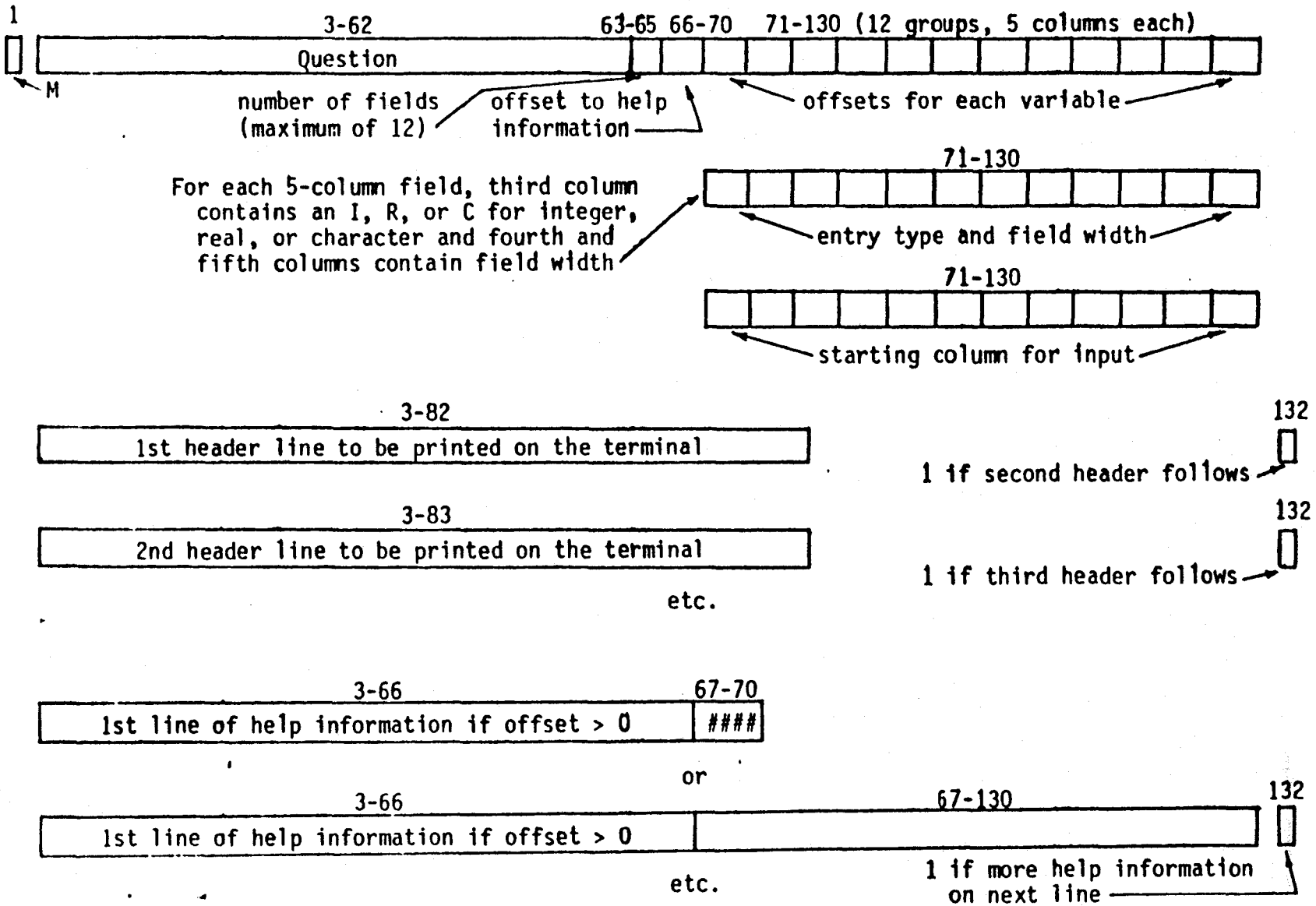


Figure 10.--QRESPM format for message file.

(Column numbers appear above boxes)

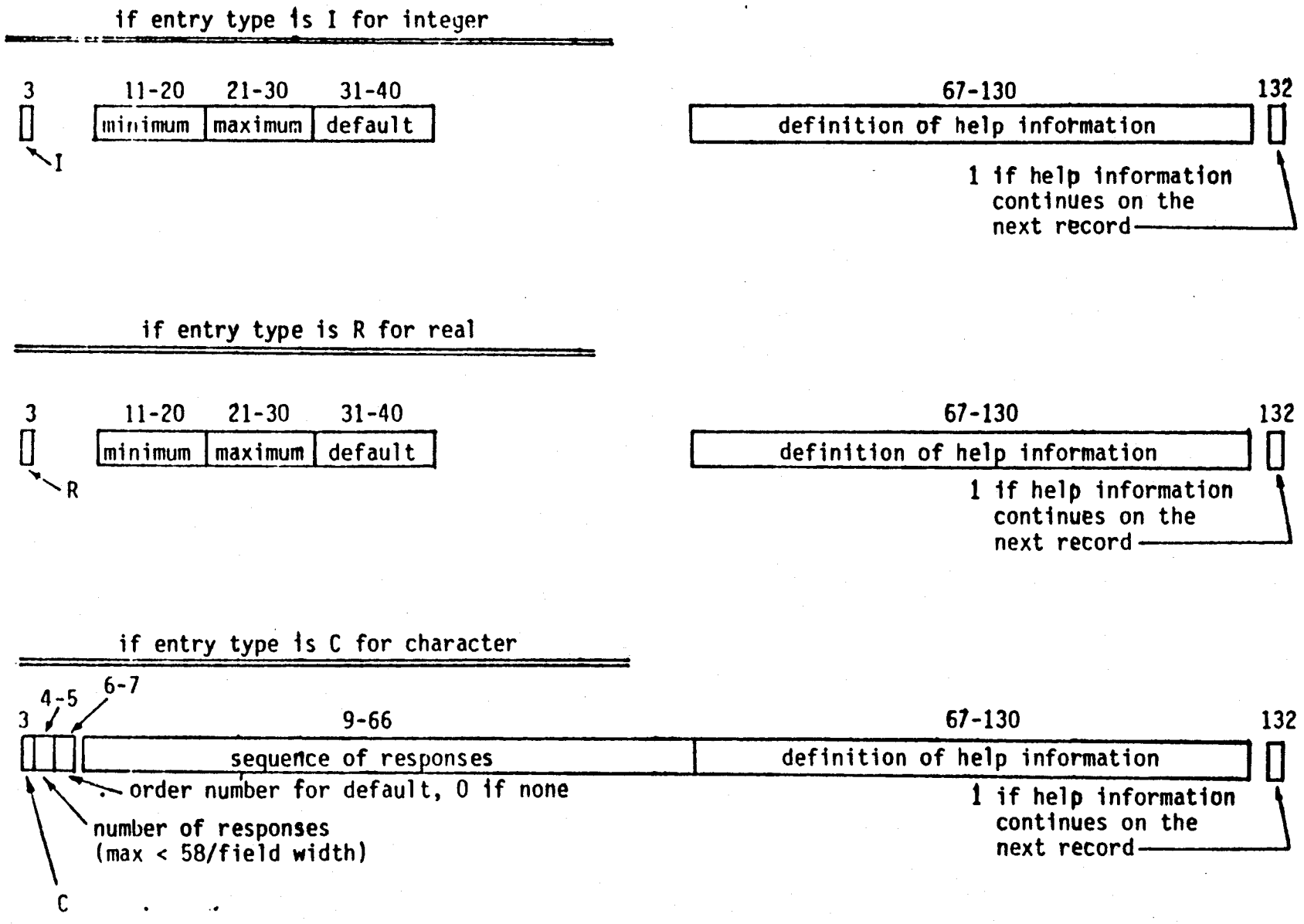
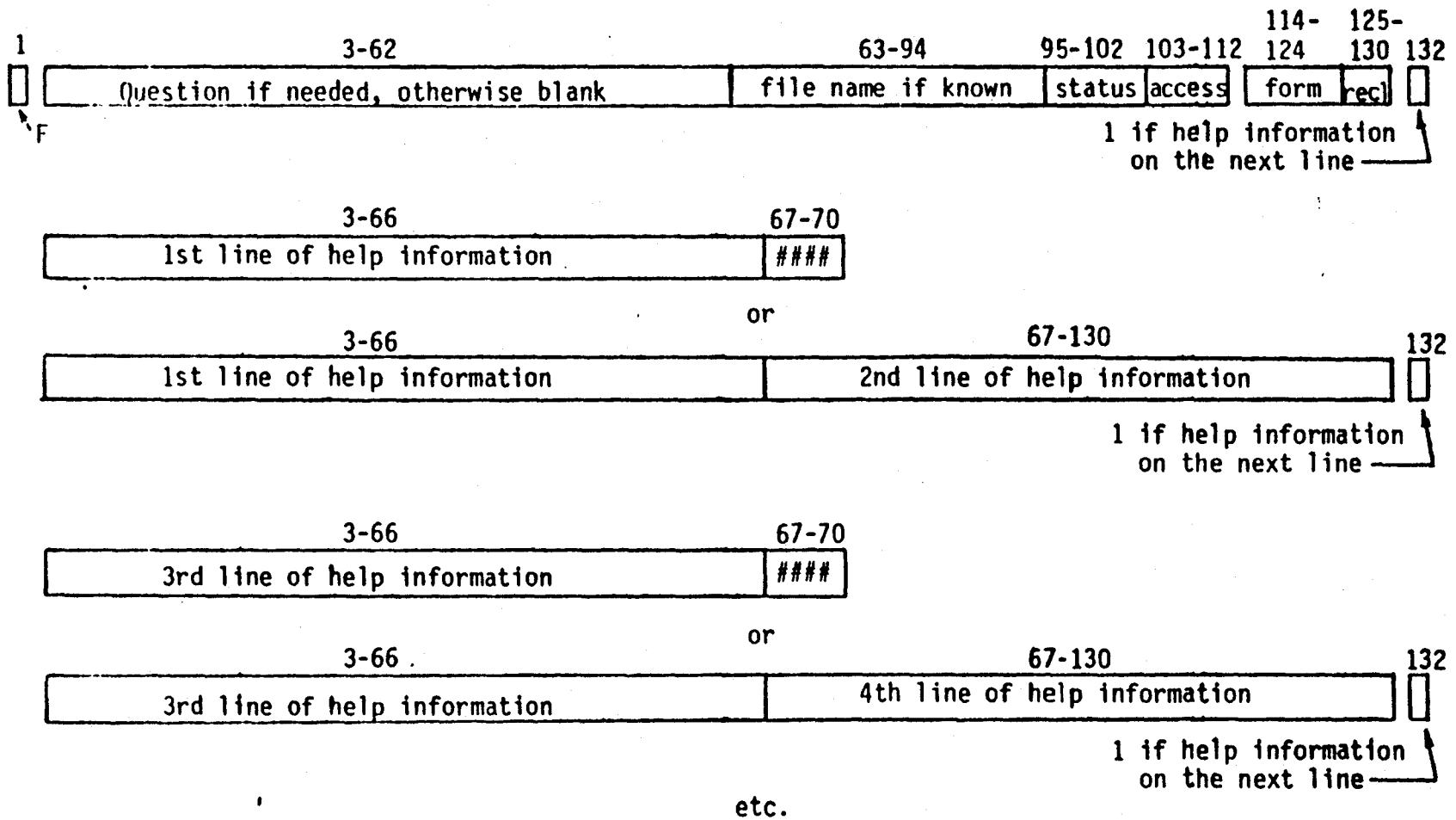


Figure 10.--QRESPM format for message file (continued).

(Column numbers appear above boxes)



status = NEW, OLD, SCRATCH, or UNKNOWN.
access = DIRECT or SEQUENTIAL.

form = FORMATTED or UNFORMATTED.
recl = record length in characters for FORMATTED, record length in 16-bit words for UNFORMATTED.

Figure 11.--FOPEN format for message file.

MODEL INPUT FILE

Files containing lines of input to a specific model can be of three types: 80-character/line sequential file, 84-character/line direct access file, or 92-character/line direct access file. The first file is the usual input for most models and can be read by ANNIE for updating, written by ANNIE, or submitted by ANNIE as a batch job. The 84-character direct access file is used only by the model HSPF, which ANNIE can read and write. The 92-character direct access file is the working copy of the model input. This file has a longer record size so that forward and backward pointers can be added to each record. Pointers are needed when the input lines to a model are to be added, deleted, or replaced. The file for the working copy is automatically opened and closed and is transparent to the user.

STEPS TO ADD ANOTHER MODEL OR PROCESS TO ANNIE

Although the steps to add a model or process to ANNIE look complex, the files and procedures are well defined and, once learned, the programing can be very efficient.

ANNIE utilities are very similar to subroutines that are written for plotting. Subroutines for plotting call utilities such as SCALE and AXIS. In the same way, ANNIE subroutines for developing input to models or processes call the utilities listed on Appendix A. Most of the utilities are for manipulation of a string of characters, to ask a question and get a response, or to modify the model input stream. Familiarity with these utilities is necessary to write a subroutine. The utilities are described in detail in Appendix A.

A subroutine for a specific model or process contains the logical sequences for the prompts and user responses. The purpose of the subroutine is simply to call for a prompt to the user then act on the response or place the response in the appropriate columns of the appropriate record for the model input stream. In its simplest form the subroutine for a model input stream uses the question/response utilities to get the input values, then uses character-to-character utilities to place the value in the right columns, and finally uses the line add/replace/delete utilities to put a completed line in the model input stream. Complications arise when one input value is used to determine whether or not other input values are needed. Further complications arise when an existing model input stream is to be updated. The complexity of the resulting subroutine logic will reflect the complexity of the input required by the model.

Steps

First Step

The subroutine or group must be added to the group offsets on records 11, 13, 15, or 17 of the message file where an unused position is available. Also, the call to the subroutine must be added to the subroutine PROCES and added as a valid response to the question in the PROCES block of the message file. In the new subroutine, the common block CANCM usually is needed. The rest of the new subroutine requires no more modifications in ANNIE.

Second Step

For all new subroutines, the following coding conventions should be followed:

1. The arguments of the subroutine are listed on subsequent lines with separate lines for input arguments, modified arguments, and output

arguments which are identified in the continuation column 6 as I, M, or O, respectively.

2. Comment lines to describe the purpose of the subroutine and define the subroutine arguments are next.

3. Next are the type declarations for each of the subroutine arguments even if they are already explicitly defined.

   CHARACTER declarations should not be used.

   INTEGER declarations should be used for character data with only one character per word. This is necessary for use of the utilities.

4. Common blocks are added with a system dependent INCLUDE or INSERT command.

5. Type declarations for all the local variables should be listed next. Even the explicitly defined variables should be included. If one of the function utilities is used, type declarations are needed for the functions. Again, CHARACTER declarations should not be used.

6. Data initializations follow for variables defined with the data statement. Alphanumeric characters should be defined as hollerinth data.

7. Read formats starting with 1000 are listed next followed by the write formats starting with 2000. Note that the number and content of format statements are held to a minimum with the use of the message file.

8. The code begins with appropriate two-column indentation for program logic, and statement numbers range from 1 to 999 and increase as one reads down the code. Only one return statement should be used at the end of the program. Other recommended conventions are found in Part C of the HSPF User's Manual.

Third Step

When using the message file, reference has to be made to specific records in the message file. This is accomplished with a group number and a question number to get the group offset and question offset. The group number is the position in records 11, 13, and 15 at the front of the message file and those are 12 positions per record. For example, group number 7 has an offset at position 7 in record 11 and group number 15 has an offset at position 3 in record 13. Group offsets are from record zero and question offsets are from the group offset. Question offsets begin 2 records beyond the record for the group offset. Since there are also 12 positions per record for the question offsets, which are spaced every other record, the offsets for the first 12 questions are found on the third record of the group and the next 12 questions are found on the fifth record of the group. The record number (offset) for the group plus the question offset locates the record with the desired question.

Though initially confusing, this method of relating group numbers and question numbers in the code to records in the message file becomes easy to use. Utilities, PRNTXT, QFOPEN, QREC, QRESP, dRESPI, QRESPR, QRESPS, QRESPM, and QRESPX are used with the message file. For clarity in the code, a comment statement should be inserted before a call to any one of the above utilities to indicate the nature of the question on the message file. Occasionally, data can be stored on the message file that is directly retrieved from the subroutine with a formatted direct access read statement. These reads also must have a group number and question number for the location of the appropriate record which is marked by an X in column 1.

Fourth Step

If the responses to the prompts are to be used to develop model input streams, the user responses must be translated to an 80-character string, TXTN, which is declared as INTEGER with a dimension of 80. This string is added to the model input file with the utilities UCIADD or UCIREP. Translation of the user responses to the TXTN string is accomplished with the character conversion utilities, CHRCHR, INTCHR, CHRDIG, CHRINT, CHRDEC, DIGCHR, LENSTR, CHRINS, CHRDEL, and DECCHR. When QRESPM is used, the 80-character string, TXTN, is already provided and the translations do not need to be done. When all the lines have been completed, program control returns to the subroutine PROCES.

REFERENCES

Johanson, Robert C., Imhoff, John C., and Davis, Harley H., Jr., 1981, User's manual for Hydrological Simulation Program - Fortran (HSPF), (Release 7.0): Environmental Research Laboratory, Athens, Ga.

Johanson, Robert C., and Kittle, John L., 1983, Journal of technical topics in civil engineering: American Society of Civil Engineers, v. 109, no. 1, p. 41-57.

APPENDICES

APPENDIX A--Utility Routines

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Miscellaneous

CHKINT (IMIN, IMAX, IDEF, IVAL, ICHK)

Type: SUBROUTINE

Purpose: Checks an integer value, IVAL, against minimum, IMIN, and maximum, IMAX, values. If the integer value is zero, then the integer value is set to the default, IDEF. This utility is used by utilities PAPTBI and QRESPI and is sometimes used directly by subroutines for specific models.

Arguments	I/M/O	Type	Explantion
IMIN	input	INTEGER	Minimum allowable value for IVAL, if IMIN = -999 then no lower limit exists for IVAL.
IMAX	input	INTEGER	Maximum allowable value for IVAL, if IMAX = -999 then no upper limit exists for IVAL.
IDEF	input	INTEGER	Default value for IVAL used only when IVAL is zero.
IVAL	modify	INTEGER	The integer value to be checked against the lower and upper limit or changed to the default value if it is zero.
ICHK	output	INTEGER	Set to zero, 0, if IVAL out of range or set to one, 1, if IVAL within range.

CHKREA (RMIN, RMAX, RDEF, RVAL, RCHK)

Type: SUBROUTINE

Purpose: Checks a decimal (real) value, RVAL, against minimum, RMIN, and maximum, RMAX, values. If the decimal value is zero, then the decimal value is set to the default, RDEF. This utility is used by the utilities PAPTBR and QRESPR and normally not used directly by subroutines for specific models.

Arguments	I/M/O	Type	Explanation
RMIN	input	REAL	Minimum allowable value for RVAL, if RMIN = -999.0 then no lower limit exists for RVAL.
RMAX	input	REAL	Maximum allowable value for RVAL, if RMAX = -999.0 then no upper limit exists for RVAL.
RDEF	input	REAL	Default value for RVAL, used only when RVAL is zero.
RVAL	modify	REAL	The real value to be checked against the lower and upper limit or changed to the default value if it is zero.
RCHK	output	INTEGER	Set to zero, 0, if RVAL out of range or set to one, 1, if RVAL within range.

CHKSTR (LEN, NSTR, STR1, STR2)

Type: INTEGER FUNCTION

Purpose: Compares the strings, STR1, to a group of strings in STR2. Returns the array location of the string that matches or a zero if there is no match. This utility is used by QRESPS and is sometimes used by subroutines for specific models.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of strings for the comparison, number of characters.
NSTR	input	INTEGER	Number of strings to be compared.
STR1(LEN)	input	INTEGER 1-D ARRAY	Character string of size LEN used to compare.
STR2(LEN, NSTR)	input	INTEGER 2-D ARRAY	Character strings of size LEN by NSTR used to be compared with string STR1.
CHKSTR	output	INTEGER	Return order number in array STR2 when a match to string STR1 is found.

CHRCHR (LEN, STR1, STR2)

Type: SUBROUTINE

Purpose: Moves a specified number of characters, LEN, from one string, STR1, to another, STR2. This utility is used by PAPTBI, PAPTBR, QRESPI, QRESPR, and QRESPS and is often used by subroutines for specific models. It is especially useful to place a character string of an input parameter into the 80-character string for a line of model input.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of string to be transferred from one array to the other.
STR1(LEN)	input	INTEGER 1-D ARRAY	Character string as input of size LEN beginning at location 1 unless the array location is given in STR1 in the calling program.
STR2(LEN)	modify	INTEGER 1-D ARRAY	Character string as output of size LEN beginning at location 1 unless the array location is given in STR2 of the calling program.

CHRDEC (LEN, STR)

Type: REAL FUNCTION

Purpose: Converts a character string to a decimal (real) number if all characters are 0 thru 9, ., +, or -. If a conversion cannot be made, a decimal value of -10^{30} is returned. This utility is used by PAPTBR and QRESPR and could be useful in subroutines for specific models for cases when PAPTBR and QRESPR are not used.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of string to be converted.
STR(LEN)	input	INTEGER 1-D ARRAY	Character string of size LEN to be converted to a decimal number.
CHRDEC	output	REAL	Real number unless conversion was unsuccessful, then equal to -10^{30}.

CHRDEL (LEN, COL, STR)

Type: SUBROUTINE

Purpose: Deletes a character from a string of characters. All characters to the right of the position of the deleted character are moved one position to the left. The last character of the string is made a blank. This utility is used for manipulation of a date string.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of the character string.
COL	input	INTEGER	Position of the character in the string to be deleted.
STR(LEN)	modify	INTEGER 1-D ARRAY	Character string of size LEN.

CHRDIG (CHR)

Type: INTEGER FUNCTION

Purpose: Converts a single character to an integer if the character is 0 thru 9. If not, return a value of -1. This utility is used by CHRINT, CHRREA, and DATSTR but not usually by subroutines for specific models.

Arguments	I/M/O	Type	Explanation
CHR	input	INTEGER	Character to be converted to integer.
CHRDIG	output	INTEGER	Integer number unless conversion unsuccessful, then equal to minus one, -1.

CHRINS (LEN, COL, CHAR, STR)

Type: SUBROUTINE

Purpose: Inserts a character into a string of characters. All characters to the right of and including the position of the new character are moved over one position. This utility is used by a subroutine for specific models for manipulation of a date string.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of the character string.
COL	input	INTEGER	Position of the new character in the string.
CHAR	input	INTEGER	Character to be inserted in the string.
STR(LEN)	modify	INTEGER 1-D ARRAY	Character string of size LEN.

CHRINT (LEN, STR)

Type: INTEGER FUNCTION

Purpose: Converts a character string to an integer, if all characters are 0 thru 9, + or -. If a conversion cannot be made, an integer value of zero, 0, is returned. This utility is used by PAPTBI, ORESPI, and INIT and, also, subroutines for specific models. Used to convert a users character strong response from an integer request.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of string to be converted.
STR(LEN)	input	INTEGER 1-D ARRAY	Character string of size LEN to be converted to an integer.
CHRINT	output	INTEGER	Integer number unless conversion was unsuccessful, then equal to zero.

CTRSTR (LEN, TXTN)

Type: SUBROUTINE

Purpose: Centers the non-blank portion of the character string TXTN. Used for headings and titles of plots and tables.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of character string.
TXTN(LEN)	modify	INTEGER 1-D ARRAY	Character string of length LEN to be centered.

CKDATE (SDATE, EDATE, DFLG)

Type: SUBROUTINE

Purpose: Checks that the end date follows the starting date. A flag is returned to indicate the result of the check. This utility is used by subroutines for specific models and the TSS file management subroutines.

Arguments	I/M/O	Type	Explanation
SDATE(5)	input	INTEGER 1-D ARRAY	Year, month, day, hour, minute array for starting date.
EDATE(5)	input	INTEGER 1-D ARRAY	Year, month, day, hour, minute array for ending date.
DFLG	output	INTEGER	-1 = SDATE before EDATE 1 = SDATE after EDATE

DATCHK (DATE, ERRFLG)

Type: SUBROUTINE

Purpose: Checks that all entries in DATE are acceptable. ERROR is an array set to zero if DATE is acceptable. Year must be between 1800 and 2080, month between 1 and 12, day between 1 and days per month depending on year and month, hour between 0 and 24 and minute between 0 and 60. Month, day, hour, and minute can be zero if all subsequent values are zero, except hour can zero when minute is not zero.

Argument	I/M/O	Type	Explanation
DATE(5)	input	WTEGER 1-D ARRAY	Year, month, day, hour, minute array to be checked.
ERRFLG(5)	output	WTEGER 1-D ARRAY	Array for year, month, day, hour, minute. If equal 0 value then it is acceptable, if value equal 1 then not acceptable.

DATLST (DATE, DATSTR, LEN, ERRFLG)

Type: SUBROUTINE

Purpose: Puts year, month, day, hour, minute array into a 20-character date string. Date string will have year, month as a 4-character abbreviation, day, hour, colon, minute. If DATE is 1980, 2, 5, 6, 30, the DATSTR will be 1980 FEB. 5 6:30. Used to display dates on the terminal.

Argument	I/M/O	Type	Explanation
DATE(5)	input	INTEGER 1-D ARRAY	Year, month, day, hour, minute array to be checked.
DATSTR(20)	output	INTEGER 1-D ARRAY	Date string.
LEN	output	INTEGER	Length of date string including spaces between year and minute.
ERRFLG	output	INTEGER	If value in DATE array not acceptable.

DATNXT (INTRVL, UPBACK, DATE)

Type: SUBROUTINE

Purpose: Adds or subtracts a time interval in minutes from the current time to get a new time. This utility is used by subroutines for specific models and the TSS file management.

Argument	I/M/O	Type	Explanation
INTRVL	input	INTEGER	Time interval in minutes.
UPBACK	input	INTEGER	+1 = move forward in time
			-1 = move back in time
DATE	modify	INTEGER	Year, month, day, hour, minute, array.
			Month is 1-12, hour is 0-24.

DAYMON (YEAR, MONTH)

Type: INTEGER FUNCTION

Purpose: Determines number of days per month. Includes leap year and the 4 century boundary for February.

Argument	I/M/O	Type	Explanation
YEAR	input	INTEGER	Year A.D.
MONTH	input	INTEGER	Month (Jan. = 1, Dec. = 12)
DAYMON	output	INTEGER	Days per month.

DECCHR (REAIN, LEN, JUST, OLEN, STR)

Type: SUBROUTINE

Purpose: Converts a decimal (real) number to a character string to be right or left justified. This utility is used by QRESPR, PAPTBR, and subroutines for specific models. DECCHR is useful to convert a decimal number entered from the terminal to a character string that can be placed in the 80-character string.

Argument	I/M/O	Type	Explanation
REAIN	input	REAL	Decimal number to be converted.
LEN	input	INTEGER	Length of string available for the decimal number.
JUST	input	INTEGER	0 = right justified 1 = left justified
OLEN	output	INTEGER	Actual length of string for the decimal number.
STR(LEN)	output	INTEGER 1-D ARRAY	Character string of size LEN of the decimal number.

DIGCHR (DIG)

Type: INTEGER FUNCTION

Purpose: Converts a digit to a hollerinth character. This utility is used by INTCHR but is not needed by subroutines of specific models.

Argument	I/M/O	Type	Explanation
DIG	input	INTEGER	Integer digit from 0 to 9.
DIGCHR	output	INTEGER	Character from 0 to 9.

ERROR (FIOU, MESSFL, GROUP, QNUM)

Type: SUBROUTINE

Purpose: Writes an error message to an output file, then quits. Used only for fatal system errors. Error message is located on the message file with GROUP and QNUM. This utility is used by INIT and by subroutines for specific models.

Argument	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number of the message file.
GROUP	input	INTEGER	Subroutine or group number on message file.
QNUM	input	INTEGER	Question number in the group.
FIOU	input	INTEGER	Fortran unit number to write the error message. Usually the terminal, TEROFL.

INTCHR (INTIN, LEN, JUST, OLEN, STR)

Type: SUBROUTINE

Purpose: Converts an integer to a character string. The integer can be right justified or left justified. This utility is used by PAPTBI, QRESPI, and DECCHR and is used by the subroutines for specific models. An integer value that has been entered from the terminal needs to be changed to characters that can be inserted in the 80-character string as an input line for a model.

Arguments	I/M/O	Type	Explanation
INTIN	input	INTEGER	Integer value to be converted to a character string.
LEN	input	INTEGER	Length of the character string.
JUST	input	INTEGER	0 = right justify 1 = left justify
OLEN	output	INTEGER	Non-blank length of the string.
STR(LEN)	output	INTEGER 1-D ARRAY	Character string of size LEN of the integer. Characters are * if integer value too big to fit in a string of length LEN.

LENSTR (LEN, STR)

Type: INTEGER FUNCTION

Purpose: Determine the length of a string. Trailing blanks are not considered part of the length. This utility is used by QRESPI, QRESPR, and QRESPS but is not needed in subroutines for specific models.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of the string.
STR(LEN)	input	INTEGER 1-D ARRAY	String of characters of size LEN that may have trailing blanks.
LENSTR	output	INTEGER	Length of the string excluding trailing blanks.

NUMPTS (SDATE, EDATE, TMSTEP, NPTS)

Type: SUBROUTINE

Purpose: Determine the number of time steps between two dates.

Arguments	I/M/O	Type	Explanation
SDATE(5)	input	INTEGER 1-D ARRAY	Year, month, day, hour, minute array for start of the time period.
EDATE(5)	input	INTEGER 1-D ARRAY	Year, month, day, hour, minute array for end of the time period.
TMSTEP	input	INTEGER	Time step in minutes.
NPTS	output	INTEGER	Number of time steps.

PRNTXT (MESSFL, GROUP, QNUM)

Type: SUBROUTINE

Purpose: Prints text from message file to a terminal. This utility is used by the main program, ERROR, PAPTBI, PAPTBR, QRESP, QRESPI, QRESPR, and QRESPS and is used often by the subroutines for specific models. It is especially useful to instruct inexperienced users.

Arguments	I/M/O	Type	Explanations
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on message file.
QNUM	input	INTEGER	Question number in the group.

QDATIM (ISE, DATE)

Type: SUBROUTINE

Purpose: Gets a date as year, month, day, hour and minute. Only year is required. Each entry is checked for a valid range and editing features are provided for corrections. This utility requires the message file. This utility is used by subroutines for specific models and the TSS file management.

Argument	I/M/O	Type	Explanation
ISE	input	INTEGER	ISE = 1 for start date ISE = 2 for end date
DATE(5)	output	INTEGER 1-D ARRAY	Year, month, day, hour, minute array entered by user.

QFCLOS (FIL, DELFG)

Type: SUBROUTINE

Purpose: Fortran 77 routine that is system dependent to close a sequential or direct access file. This utility is used by FINISH and might be used by subroutines for specific processes.

Argument	I/M/O	Type	Explanation
FIL	input	INTEGER	Fortran unit number of file to be closed.
DEEFG	input	INTEGER	= 0 to keep file on system.
			= 1 to delete file from system.

QFOPEN (MESSFL, GROUP, QNUM, DAFL, RETCOD)

Type: SUBROUTINE

Purpose: Fortran 77 routine that is system dependent to open a sequential or direct access file. Used so that any necessary changes for each computer system are isolated to this routine. This utility is used by INIT and subroutines for specific processes.

Argument	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number of the message file.
GROUP	input	INTEGER	Subroutine or group number on the message file.
QNUM	input	INTEGER	Question number in the group.
DAFL	input	INTEGER	Fortran unit number of file to be opened.
RETCOD	output	WTEGER	0 = file opened 1 = file could not be opened

QREC (MESSFL, GROUP, QNUM, IREC)

Type: SUBROUTINE

Purpose: Get record number on message from the group offset and question offset. Used to read data off the message file for lines that have an X in column 1. Also used by QRESP, QRESPI, QRESPR, QRESPM, QRESPX, PRNTXT, and QFOPEN to locate the appropriate question on the message file.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on the message file.
QNUM	input	INTEGER	Question number in the group.
IREC	output	INTEGER	Record number on the message file that contains the question or data.

QRESP (MESSFL, GROUP, QNUM, RESP)

Type: SUBROUTINE

Purpose: Prompts user for a response with a question from the message file. Valid responses also are on the message file to check the value entered from the terminal. The order number of the valid response that the user entered is returned. This utility is used by the main program FINISH and INIT, and the subroutines for specific models.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on message file.
QNUM	input	INTEGER	Question number in the group.
RESP	output	INTEGER	Sequence number of the valid response that matches the value entered from the terminal.

QRESPI (MESSFL, GROUP, QNUM, IVAL)

Type: SUBROUTINE

Purpose: Prompts user for a response with a question from the message file. The range for valid responses also are on the message file to check the value entered from the terminal. The user is continuously prompted until a valid integer has been entered. This utility is used by the subroutines for specific models.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on the message file.
QNUM	input	INTEGER	Question number in the group.
IVAL	output	INTEGER	Valid integer value entered from user's terminal.

QRESPM (MESSFL, GROUP, QNUM, INUM, RNUM, CNUM, IVAL, RVAL, CVAL, TBUFF)

Type: SUBROUTINE

Purpose: Prompts user for multi-response with a question and header line from the message file. Valid responses also are on the message file to match with the response entered from the terminal. The user is continuously prompted until an appropriate integer, real number, or character string has been entered.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on message file.
QNUM	input	INTEGER	Question number in the group.
INUM	input	INTEGER	Number of integer responses to be read.
RNUM	input	INTEGER	Number of decimal responses to be read.
CNUM	input	INTEGER	Number of character responses to be read.
IVAL(INUM)	modify	INTEGER 1-D ARRAY	Array of valid integer values entered from user terminal.
RVAL(RNUM)	modify	INTEGER 1-D ARRAY	Array of valid decimal values entered from user terminal.
CVAL(CNUM)	modify	INTEGER 1-D ARRAY	Array of valid character values entered from user terminal.
TBUFF(80)	output	INTEGER	Array of characters that includes the total response.

QRESPR (MESSFL, GROUP, QNUM, RVAL)

Type: SUBROUTINE

Purpose: Prompts user for a response with a question from the message file. The range for valid responses also are on the message file to check the value entered from the terminal. The user is continuously prompted until a valid decimal number has been entered. This utility is used by the subroutines for specific models.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on the message file.
QNUM	input	INTEGER	Question number in the group.
RVAL	output	REAL	Valid decimal value entered from user's terminal.

QRESPS (MESSFL, GROUP, QNUM, STRLEN, JUST, STR, STRNUM)

Type: SUBROUTINE

Purpose: Prompts user for a response with a question from the message file. Valid responses also are on the message file to match with the character string entered from the terminal. The user is continuously prompted until a valid character string has been entered. This utility is used by QRESP and subroutines for specific models.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on the message file.
QNUM	input	INTEGER	Question number in the group.
STRLEN	input	INTEGER	Length of character string for user's response.
JUST	input	INTEGER	String justification flag 0 = left justified 1 = right justified
STR(STRLEN)	modify	INTEGER 1-D ARRAY	Valid character string of size STRLEN entered from user's terminal.
STRNUM	output	INTEGER	Sequence number of valid user response.

QRESPX (MESSFL, GROUP, QNUM, INUM, RNUM, CNUM, IVAL, RVAL, CVAL, TBUFF)

Type: SUBROUTINE

Purpose: Prompts user for multi-response with a question and header line from the message file. Valid responses also are on the message file to match with the response entered from the terminal. The user is continuously prompted until an appropriate integer, real number, or character string has been entered.

Arguments	I/M/O	Type	Explanation
MESSFL	input	INTEGER	Fortran unit number for the message file.
GROUP	input	INTEGER	Subroutine or group number on message file.
QNUM	input	INTEGER	Question number in the group.
INUM	input	INTEGER	Number of integer responses to be read.
RNUM	input	INTEGER	Number of decimal responses to be read.
CNUM	input	INTEGER	Number of character responses to be read.
IVAL(INUM)	output	INTEGER 1-D ARRAY	Array of valid integer values entered from user terminal.
RVAL(RNUM)	output	INTEGER 1-D ARRAY	Array of valid decimal values entered from user terminal.
CVAL(CNUM)	output	INTEGER 1-D ARRAY	Array of valid character values entered from user terminal.
TBUFF(80)	modify	INTEGER	Array of characters that includes the total response

STRDAT (DSTR, DATE)

Type: SUBROUTINE

Purpose: Finds year, month, day, hour, and minute from a 20-position character string starting with the year and separated by / or one blank. Conversion continues until two blanks are found. The date may be terminated after the year. This utility is used for manipulation of a date string.

Argument	I/M/O	Type	Explanation
DSTR(20)	input	INTEGER 1-D ARRAY	Character string of size 20 of the date.
DATE(5)	output	INTEGER 1-D ARRAY	Integer numbers for year, month, day, hour, and minute.

STRFND (LEN, STR, FLEN, FSTR)

Type: INTEGER FUNCTION

Purpose: Determines position of a string within another string. If string is not found, a value of 0 is returned.

Arguments	I/M/O	Type	Explanation
LEN	input	INTEGER	Length of string to be searched.
STR(LEN)	input	INTEGER	Character string to be searched.
		1-D ARRAY	Requires one character per array element.
FLEN	input	INTEGER	Length of string to be found.
FSTR(FLEN)	input	INTEGER	Character string to be found. Requires
		1-D ARRAY	one character per array element.
STRFND	output	INTEGER	Position in STR where FSTR starts, 0 if not found.

TSDGET (TSSFL, DSN, FMT, DELT, DATSTR, TSTR, NVAL, RDAT, RTNCOD)

Type: SUBROUTINE

Purpose: Gets data to fill array RDAT from the TSS file or a formatted sequential file.

Argument	I/M/O	Type	Explanation
TSSFL	input	INTEGER	Fortran unit number for TSS or sequential file when data are stored.
DSN	input	INTEGER	For TSS, the unique index number to locate dataset. Set to zero for sequential files.
FMT	input	INTEGER	Set to 1 for TSS file. Additional numbers will be added as additional formats for sequential files are added to the code.
DELT	input	INTEGER	Time-step in minutes.
DATSTR(5)	input	INTEGER 1-D ARRAY	Starting date: year, month, day, hour, minute.
NVAL	input	INTEGER	Number of values, size of RDAT array.
RDAT(NVAL)	output	REAL	Array to put data from the file.
RTNCOD	output	INTEGER	Return code. Negative number indicating type of error.

 0 = No error
-1 = Bad Fortran unit number
-2 = Bad format code
-3 = Bad dataset number
-4 = No buffer available for dataset
-5 = Dataset already in use
-6 = Time intervals don't match
-8 = Bad date string
-10 = Data missing for 1 or more years
-12 = Data missing for part of period
-13 = Bad year
-14 = End of data found

TSDPUT (TSSFL, DSN, FMT, DELT, DTOVWR, DATSTR, NVAL, RDAT, RTNCOD)

Type: SUBROUTINE

Purpose: Puts data from array RDAT to the TSS file or a formatted sequential file.

Argument	I/M/O	Type	Explanation
TSSFL	input	INTEGER	Fortran unit number for TSS or sequential file when data are stored.
DSN	input	INTEGER	For TSS, the unique index number to locate dataset. Set to zero for sequential files.
FMT	input	INTEGER	Set to 1 for TSS file. Additional numbers will be added as additional formats for sequential files are added to the code.
DELT	input	INTEGER	Time-step in minutes.
DTOVWR	input	INTEGER	Flag set to 1 if new data is to overwrite existing data on TSS, otherwise zero.
DATSTR(5)	input	INTEGER 1-D ARRAY	Starting date: year, month, day, hour, minute.
NVAL	input	INTEGER	Number of values, size of RDAT array.
RDAT(NVAL)	input	REAL	Array of data to be put on the file.
RTNCOD	output	INTEGER	Return code. Negative number indicating a type of error.

 0 = No error
-1 = Bad Fortran unit number
-2 = Bad format code
-3 = Bad dataset number
-4 = No buffer available for dataset
-5 = Dataset already in use
-6 = Time intervals don't match
-7 = Dataset is write protected
-8 = Bad date string
-9 = Data exist and overwrite flag is 0
-10 = Data missing for 1 or more years
-11 = Dataset must have chronological year order
-12 = Data missing for part of year
-13 = Bad year
-14 = End of data found

UCIADD (TXT, RECPRE, DAFL, RECFRE)

Type: SUBROUTINE

Purpose: Adds a formatted record to a direct access file, usually the working file of input to a model. The working file has forward and backward pointers in working file columns 85-92. The text can be up to 84 characters in length. This utility is used by the subroutines for specific models each time a full line of input has been developed.

Arguments	I/M/O	Type	Explanation
TXT(80)	input	INTEGER 1-D ARRAY	Character string of size 80 of a new record to be added to the file.
RECPRE	input	INTEGER	Number of record in the file which this new record is to follow.
DAFL	input	INTEGER	Fortran unit number of the direct access file for the working copy of the model input.
RECFRE	modify	INTEGER	Next available record on the file.

UCIDEL (RECDEL, DAFL, RECFRE)

Type: SUBROUTINE

Purpose: Deletes a formatted record from a direct access file, usually the working file of input to a specific model. The forward and backward pointers in columns 85-92 are reset. This utility is used by the subroutines for specific models.

Arguments	I/M/O	Type	Explanation
RECDEL	input	INTEGER	Number of the record in the file to be deleted.
DAFL	input	INTEGER	Fortran unit number of the direct access file for the working copy of the model input.
RECFRE	modify	INTEGER	Next available record on the file.

UCILST (INFL, OTFL, CFLG, CCFG)

Type: SUBROUTINE

Purpose: Lists on the terminal the working copy of the user's file of the lines of model input. Copies the working copy to sequential file or direct access file on the disk. This utility is used by FINISH but could be used by subroutines of specific models to list the current contents of the working file on the terminal.

Arguments	I/M/O	Type	Explanation
INFL	input	INTEGER	Fortran unit number of file with current working copy of model input.
OTFL	input	INTEGER	Fortran unit number for terminal or file to receive the working copy of model input.
CFLG	input	INTEGER	1 = output file is direct access 0 = output file is a sequential file or a terminal or printer
CCFG	input	INTEGER	1 = output file expects carriage control in column 1. 0 = output file does not expect carriage in column 1.

UCIREP (REC, TXT, TUCIFL)

Type: SUBROUTINE

Purpose: Replaces a formatted record from a direct access file, usually the working file of input to a specific model. This utility is used by the subroutines for specific models.

Argument	I/M/O	Type	Explanation
REC	input	INTEGER	Number of the record in the file to be replaced.
TXT(80)	input	INTEGER 1-D ARRAY	Character string of size 80 of the replacement record for the file.
TUCIFL	input	INTEGER	Fortran unit number of the direct access file for the working copy of the model input.

APPENDIX B - MESSAGE FILE