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Using HEC-1
on a Personal Computer

Training Document No. 32

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This document describes how to use the HEC-1, "Flood Hydrograph Package," on the personal computer (PC). It does not describe how to perform a hydrologic investigation. An overview of how the program is installed on the PC is provided; but, the reader is referred to the separate installation instructions for the full explanation on loading HEC-1 onto the PC.

This training document (No. 32) describes how to use the menu program to: select files; use COED to create and edit files; execute HEC-1; and view, graph, and print the results. Use of the HECDSS (Data Storage System) to generate report quality graphics and use of an interactive input program (HEC-1IN) to generate input data are also described.

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Using HEC-1
on a Personal Computer

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Hydrologic Analysis with HEC-1
on a Personal Computer

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Chapter 1

Introduction

1.1   Program Development

The HEC-1, Flood Hydrograph Package, computer program was originally developed in 1967 by Leo R. Beard and other members of the Hydrologic Engineering Center (HEC) staff. The first version of the HEC-1 program package was published in October 1968. It was expanded and revised and published again in 1969 and 1970. The first package version represented a combination of several smaller programs which had previously been operated independently.

Input and output formats were almost completely restructured in order to simplify input requirements and to make the program output more meaningful and readable when the 1970 version underwent a major revision in 1973. In 1981 the computational capabilities of the dam-break (HEC-1DB), project optimization (HEC-1GS) and kinematic wave (HEC-1KW) special versions were combined. These were put into a single easy to use package. In late 1984 a microcomputer version (PC version) was developed.

The latest version, Version 4.0 (September 1990), represents improvements and expansions to the hydrologic simulation capabilities together with interfaces to the HEC Data Storage System (DSS). The DSS capability allows storage and retrieval of data from/for other computer programs as well as the creation of report-quality graphics and tables. New hydrologic capabilities include Green and Ampt infiltration, Muskingum-Cunge flood routing, reservoir releases input over time, and improved numerical solution of kinematic wave equations. The Muskingum-Cunge routing may also be used for the collector and main channels in a kinematic wave land surface runoff calculation.

1.2   Overview of the HEC-1 Package

The basic steps in rainfall-runoff simulation include:

Gathering data (topographic maps, precipitation and streamflow data, aerial photos, soils and land use information, etc....).

Estimate model parameters (unit hydrograph, loss rate, and routing parameters, etc...).

Develop HEC-1 input data file representing the watershed and rainfall-runoff.

Simulate the flood event by executing HEC-1.

Review and evaluate model results as compared to observed information. (HEC-1 output and/or graphical displays with DSS.)

Calibrate model parameters to obtain best fit of several observed events.

Use calibrated model for design or analysis purposes.

The programs distributed with the HEC-1 package provide the necessary tools to accomplish all the basic steps for a rainfall-runoff simulation on the personal computer (PC). The computational process for doing a flood runoff analysis is illustrated in Figure 1. A menu program, MENU1, has been developed to provide program users convenient access to the HEC-1 package of programs and related files, when operating a PC with a hard disk. The MENU1 program, described in chapter 3, eliminates repeated typing of program and filenames while using the HEC-1 package of programs.

Text editors can be used to create or modify an input data file for the HEC-1 program. The Corps editor COED, has been developed with some features specifically designed around the HEC format for computer program input. COED will place the input data in the format expected by HEC-1 as the data file is created. It also has help information for HEC-1 input data. Chapter 4 provides information on creating and editing input files with COED.

An interactive data input program (HEC1IN) has been developed for new to intermediate users of the HEC-1 program. This program leads the user through a sequence of formatted screens and tables that describe the watershed and the type of hydrologic processes to be used in the computations. After all the screens and tables are filled out, the program creates a skeleton HEC-1 input file. This file will contain all of the data records required to simulate the rainfall-runoff process, but not all of the data. It is the users responsibility to edit the file (using COED or any other text editor) and fill in the necessary data associated with each record. Appendix A of this document contains more information about the HEC1IN program.

After the HEC-1 input file is developed, the model can be executed. Chapter 5 provides information on running HEC-1 on the PC. Once the HEC-1 program has finished executing, the user can begin to review the results. Reviewing model results is described in Chapter 6.

1.3   Acknowledgments

This document was developed by Gary W. Brunner. Arlen Feldman, Chief of the Research Division, provided valuable input and editorial comments. Word processing and graphics were accomplished by Diane Harris and Penni Baker.

1.4   Program Documentation

The primary documentation for the HEC-1 program is the User's Manual. The manual provides a complete description of the HEC-1 program capabilities, theoretical basis for computations, and example problems with input and output. A careful review of the User's Manual should be made before using the computer program.
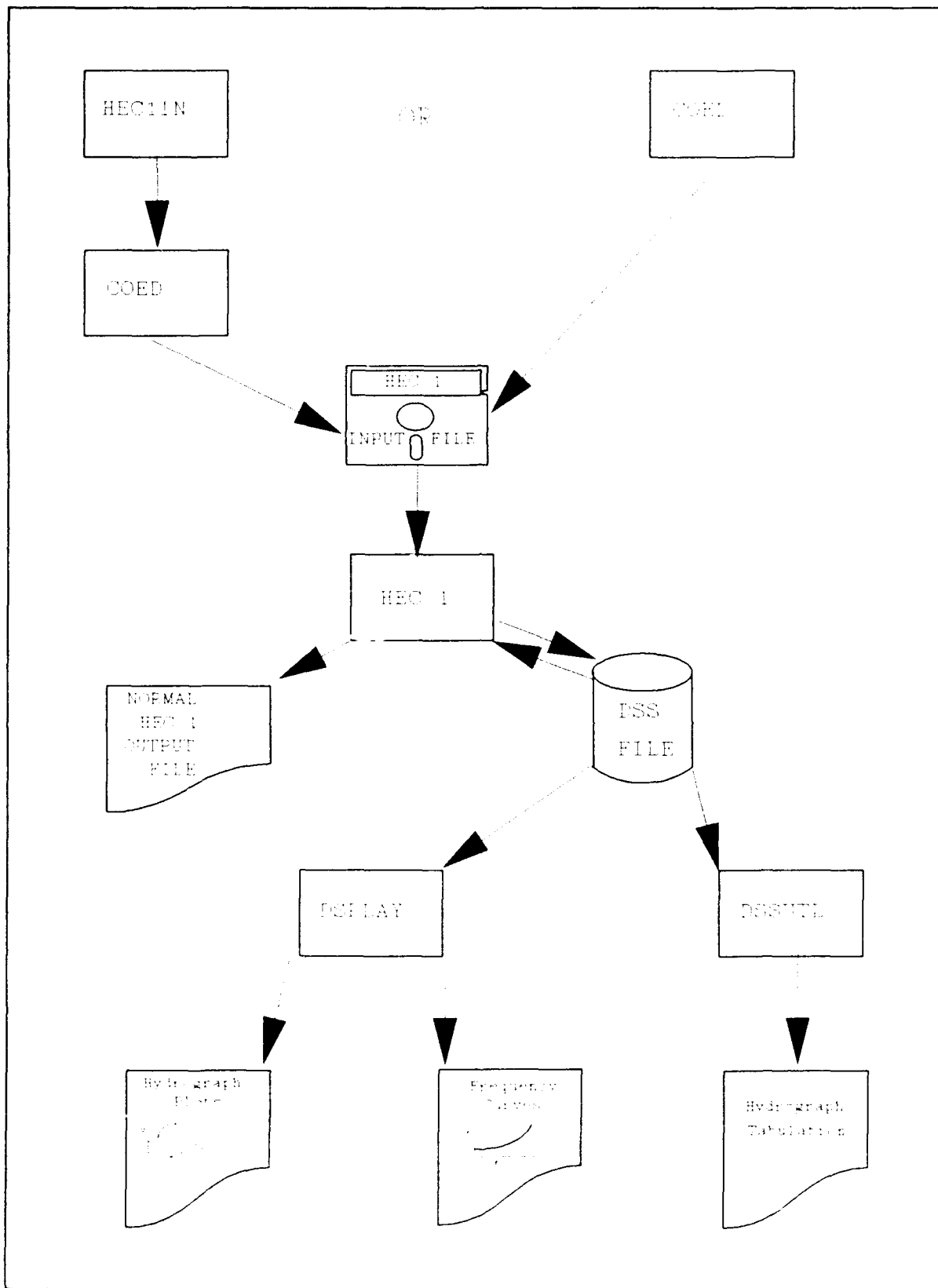
Figure 1. HEC-1 Computation Process

Supplemental technical information is available through the following HEC publications:

Probable Maximum Storm (Eastern United States) (HMR52) User's Manual

Training Document No. 10, Introduction and Application of Kinematic Wave Routing Techniques Using HEC-1.

Training Document No. 15, Hydrologic Analysis of Ungaged Watersheds with HEC-1

Training Document No. 19, Application of Spatial Data Management Techniques to HEC-1 Rainfall - Runoff Studies

Technical Paper No. 54, Adjustment of Peak Discharge Rates for Urbanization

Technical Paper No. 59, Testing of Several Runoff Models on an Urban Watershed

Technical Paper No. 62, Flood Hydrograph and Peak Flow Frequency Analysis

Technical Paper No. 70, Corps of Engineers Experience with Automatic Calibration of a Precipitation - Runoff Model

Technical Paper No. 100, Probable Maximum Flood Estimation - Eastern United States

Technical Paper No. 116, The HEC's Activities in Watershed modeling

Technical Paper No. 118, Real-Time Snow Simulation Model for the Monongahela River Basin

Technical Paper No. 121, Development, Calibration and Application of Runoff Forecasting Models for the Allegheny River Basin

Technical Paper No. 122, The Estimation of Rainfall for Flood Forecasting Using Radar and Rain Gage Data

Computer Program Documentation No. 45, HECDSS, User's Guide and Utility Program Manuals

Computer Program Documentation No. 56, Corps of Engineers Editor Users's Manual (COED)

Supplemental information on the computer hardware/software installation for HEC-1 is available through the following HEC publications:

Installation Instructions for Microcomputer Version of HEC-1

HEC-1 Flood Hydrograph Package, Large-Array Version Implementation

Installation Instructions for Device Drivers

The supplemental material, as well as other HEC publications, are listed in the Publication Catalog; along with prices and ordering information. This free catalog is available from:

Hydrologic Engineering Center
609 Second Street
Davis, CA 95616-4687

HEC provides training in HEC-1 primarily for Corps and other Federal offices; Basic and Advanced HEC-1 courses and a Floodplain Hydrology Course are offered. HEC also provides user assistance for Corps offices and other federal agencies. There are several university extension short courses on the use of the HEC-1 program. A one-week course provides a good overview of the basic program capabilities.

For those unable to attend a course, there are video tapes of most lectures given in HEC training courses on HEC-1. The tapes are distributed only in the USA by a contractor. A Video Tape Catalog with ordering information is available from the HEC at no charge.

1.5   Program Distribution

Corps of Engineers offices and other Federal agencies may receive copies of the HEC-1 package from HEC at no charge. Other offices may obtain the program from National Technical Information Service (NTIS) or a number of private distributors. A list of these private distributors is available from HEC.

A free Computer Program Catalog is available from HEC. The catalog provides a description of all available computer programs and program support information. The catalog can be ordered at the address shown on the previous page.

Chapter 2

Program Installation Overview

This chapter is only an overview of the installation instructions. Please see separate "Installation Instructions for Microcomputer Version of HEC-1" for detailed installation information.

2.1   Computer Requirements

This version of HEC-1 will run on an IBM or compatible microcomputer that has the following:

* **640 Kilobytes (KB) of Random Access Memory (RAM), with 571,000 bytes of base memory free for program execution.**

* **MS DOS 2.1 or greater.**

* **One 5¼ inch floppy diskette drive (360 Kb or 1.2 Mb).**

* **A 10 Megabyte (or larger) hard disk (a minimum of 3 Mb of storage should be available when installing the system).**

* **A math coprocessor (8087, 80287, or 80387) is highly recommended, but not required. The math coprocessor will greatly reduce the execution time of the program (increases computational speed by a factor of 5 to 10).**

NOTE: GSS DEVICE DRIVERS REQUIRED

The HECDSS DSPLAY graphics program included with the HEC-1 package of programs requires GSS device drivers to create graphical displays. Device drivers are software packages for specific plotters, printers and graphics adapters. Please review the installation instructions for device drivers.

GSS device drivers for non-Corps offices may be obtained from GSS (Graphic Software Systems, Inc., 9590 S.W. Gemini Drive, Beaverton, OR 97005). Device drivers for Corps of Engineers offices may be obtained from HEC (Hydrologic Engineering Center, 609 Second Street, Davis, CA 95616).

2.2   Installation Options

Installation is usually accomplished through the execution of an interactive program called
INSTALL1 which is provided with the HEC-1 package. See "Installation Instructions for Microcomputer
Version of HEC-1" for details. The INSTALL1 program:

- Creates directories **\HECEXE** and **\HECEXE\SUP**. The **\HECEXE** directory is used to
  store all of the executable programs and the **\HECEXE\SUP** subdirectory is used for
  any supplemental files required by the executable programs.

- Uncompresses and copies files into the appropriate directories.

- Displays information about modifying the **CONFIG.SYS** and **AUTOEXEC.BAT** files in
  order to execute the programs.

The recommended directory configuration that **INSTALL1** creates is shown in Figure 2. After
completing the installation, make sure that your PC has all of the same files in the **\HECEXE** and
\HECEXE\SUP directories as shown in Figure 2. Alternative installation instructions (not using
INSTALL1) are provided in "Installation Instructions for Microcomputer Version of HEC-1." However, the
INSTALL1 program is the preferred method for HEC-1 installation on your computer.

2.3   Contents of the HEC-1 Package Diskettes

The **HEC-1** computer program, example input data, example output, menu system and auxiliary
programs are provided on five **360 Kb**, 5 1/4 inch floppy diskettes. The files may be de-archived and
loaded onto your computer using the INSTALL1 program or by manual installation; see separate
"Installation Instructions for Microcomputer Version of HEC-1."

2.4   Memory Requirements

The standard HEC-1 Package of programs was compiled under the **DOS** operating system, and is
therefore constrained to the **640 kilobytes** of main memory limitation. In order for the **HEC-1** package
to function correctly, there must be **571,000 bytes** of base memory available for program execution.
The **DOS** command CHKDSK can be run to determine the amount of available base memory on your
machine. If you do not have enough free memory, check your **AUTOEXEC.BAT** file to see if you are
loading any **RAM** resident programs. You may have to remove some RAM resident programs to
obtain the needed base memory. A large-array version of HEC-1 is available that requires 2.5
megabytes of total memory. See "HEC-1 Flood Hydrograph Package, Large-Array Version
Implementation."

2.5   Configuration of Computer System

To allow access of the executable programs from any directory, it will be necessary to edit the
AUTOEXEC.BAT file to include a path to the **\HECEXE** directory. Many **HEC** programs require the
capability to open more than eight (8) files at any one time. Because eight is the system default, you
will need to modify your **CONFIG.SYS** file to include the following two lines: **FILES=20**, and
BUFFERS=15.

For more information concerning the **PATH** command and the **AUTOEXEC.BAT** and **CONFIG.SYS**
files, consult your **DOS** manual and "Installation Instructions for Microcomputer Version of HEC-1."
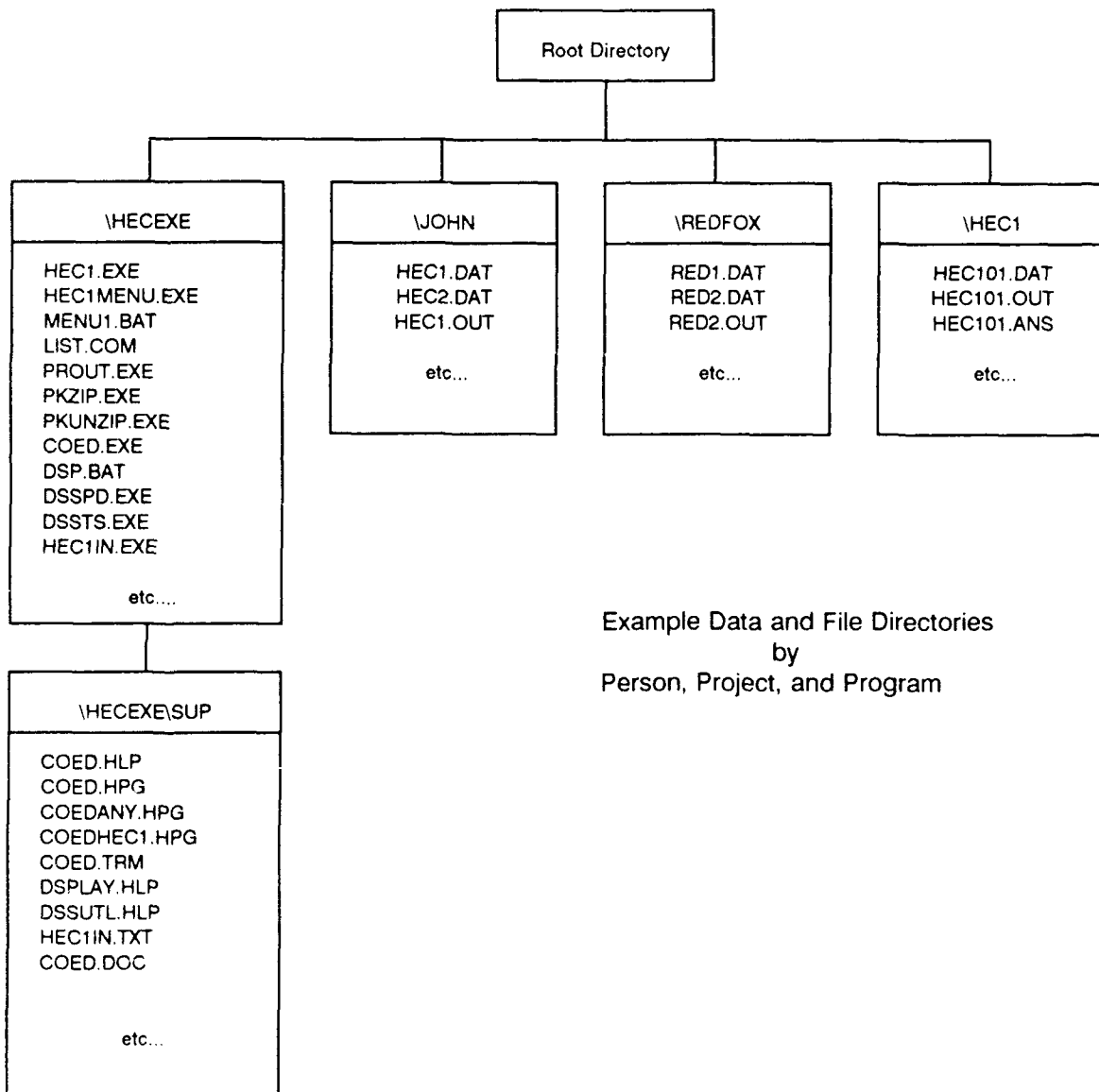
```
                          ┌──────────────────┐
                          │  Root Directory  │
                          └──────────────────┘

┌──────────────────┐  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
│     \HECEXE      │  │    \JOHN     │  │   \REDFOX    │  │    \HEC1     │
├──────────────────┤  ├──────────────┤  ├──────────────┤  ├──────────────┤
│ HEC1.EXE         │  │ HEC1.DAT     │  │ RED1.DAT     │  │ HEC101.DAT   │
│ HEC1MENU.EXE     │  │ HEC2.DAT     │  │ RED2.DAT     │  │ HEC101.OUT   │
│ MENU1.BAT        │  │ HEC1.OUT     │  │ RED2.OUT     │  │ HEC101.ANS   │
│ LIST.COM         │  │              │  │              │  │              │
│ PROUT.EXE        │  │   etc...     │  │   etc...     │  │   etc...     │
│ PKZIP.EXE        │  └──────────────┘  └──────────────┘  └──────────────┘
│ PKUNZIP.EXE      │
│ COED.EXE         │
│ DSP.BAT          │
│ DSSPD.EXE        │
│ DSSTS.EXE        │
│ HEC1IN.EXE       │
│                  │
│     etc....      │
└──────────────────┘

┌──────────────────┐            Example Data and File Directories
│   \HECEXE\SUP    │                          by
├──────────────────┤            Person, Project, and Program
│ COED.HLP         │
│ COED.HPG         │
│ COEDANY.HPG      │
│ COEDHEC1.HPG     │
│ COED.TRM         │
│ DSPLAY.HLP       │
│ DSSUTL.HLP       │
│ HEC1IN.TXT       │
│ COED.DOC         │
│                  │
│     etc...       │
└──────────────────┘
```

Figure 2.   Recommended HEC Directory Configuration

Chapter 3

HEC-1 Package Menu Program

3.1   Purpose of Program

The HEC-1 package menu, MENU1, has been created to aid the user in operating the program on the PC. The menu system provides the capability to: create and edit input files; execute HEC-1, DSPLAY, HEC1IN, and DSSUTL programs; and to display output conveniently to the screen or the printer. The following provides a description of the menu operation.

3.2   Program Operations

After all of the files have been installed on your hard disk, execution of the HEC-1 Package Menu program is accomplished by typing **MENU1** and pressing the **<ENTER>** key. You must execute the menu system through this batch file or the programs will not function correctly. The HEC-1 Package Menu should appear on the screen as shown in Figure 3. As you can see there are five choices, with the first choice being highlighted. Also highlighted is a status line at the bottom of the screen. This status line is used to direct the user on how to proceed at any point. The background and text colors of the menu can be changed for color monitors by pressing the F9 and F10 keys, respectively. The program will save the selected colors via the PARMS.DFT file. In general the menu operates by using the cursor arrow keys to move to the desired option, and then pressing **<ENTER>** to execute that option. Another way to execute an option is to press the number of the desired function. The following paragraphs describe each of the five options specifically.

```
┌──────────────────── HEC1 Package Menu ────────────────────┐
│                                                           │
│                                                           │
│            ▐1. Define input/output files▌                 │
│                                                           │
│             2. Create/edit input file                     │
│                                                           │
│             3. Run HEC1                                    │
│                                                           │
│             4. Display output to console                  │
│                                                           │
│             5. Exit to DOS                                 │
│                                                           │
│                                                           │
│                                                           │
│                                                           │
├───────────────────┬──────────────────┬──────────────────┤
│ Input: HEC101.DAT │ Output: HEC101.OUT│ DSS: HEC101.DSS  │
├───────────────────┴──────────────────┴──────────────────┤
│ Press number or <Enter> to select highlighted option ; ↑↓ moves cursor │
└──────────────────── October 1989 Menu ────────────────────┘
```
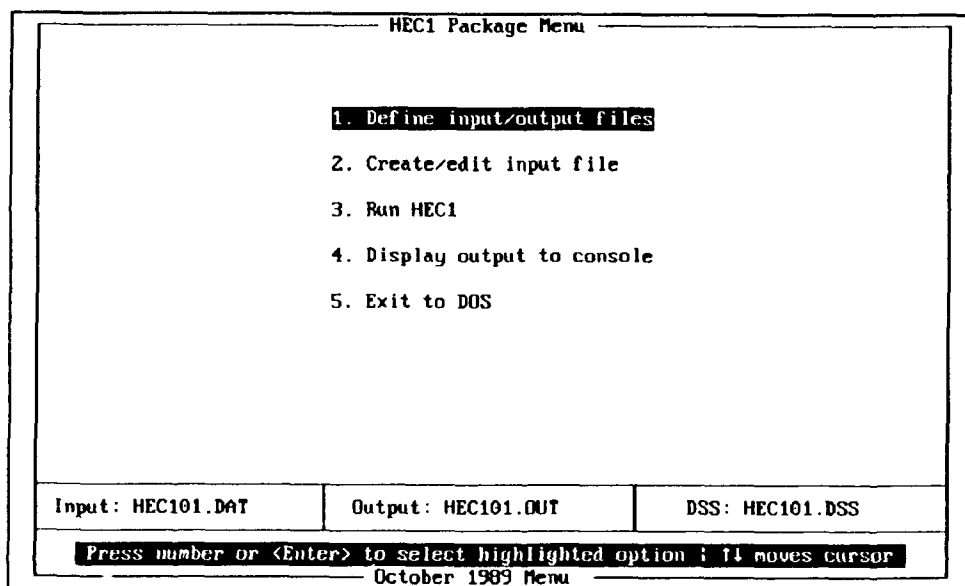
Figure 3. HEC-1 Package Menu

9

1.   **Define Input/Output/DSS Files:**

This option is used to define the target input and output filenames that will be used when executing HEC-1. When this option is selected a pop-up menu will appear as shown in Figure 4. The menu is set up to use the default extensions ".DAT", ".OUT", and ".DSS" for the input, output and DSS filenames, respectively. This can be overridden by turning off the default extension option. The filenames can be entered directly, or a "?" can be entered to get a listing of the files available on the current data directory. You may choose a file by using the cursor keys to highlight the appropriate filename and then pressing the **<ENTER>** key. If the input file does not exist, you will be asked if you would like to create it. If you say yes to this question, a blank file will be created with the name that you specified. The next step would be to execute option 2 (Create/edit input file), which will allow you to enter the necessary data. Also note that at the bottom of the screen there is a line that displays the names of the current input, output and DSS files that are being used.


```
┌──────────────────── HEC1 Package Menu ────────────────────┐
│                                                           │
│                                                           │
│                   ▐1. Define input/output files▌          │
│                                                           │
│    ┌────────────────────────────────────────────┐        │
│    │ ▐Input file ...HEC101.DAT▌                   │        │
│    │  Output file ..HEC101.OUT                    │        │
│    │  DSS file .....HEC101.DSS                    │        │
│    │                                              │        │
│    │  Default extensions ..YES                    │        │
│    │  Data directory ......C:\HEC1                │        │
│    │                                              │        │
│    │  Return to previous menu                     │        │
│    └────────────────────────────────────────────┘        │
│                                                           │
│                                                           │
│  ┌──────────────────┬──────────────────┬────────────────┐ │
│  │ Input: HEC101.DAT│ Output: HEC101.OUT│ DSS: HEC101.DSS│ │
│  └──────────────────┴──────────────────┴────────────────┘ │
│        ▐Type file name or press ? for file directory▌     │
└──────────────────── October 1989 Menu ────────────────────┘
```

Figure 4.   Define Input/Output/DSS Files Menu

2.   **Create/Edit Input File:**

This option is used to create an input file, or to edit an existing input file, to be used by HEC-1. This option will only function if you have also installed the full screen editor COED on to your system ("COED," Corps of Engineers Editor, November 1987). If you have COED on your system, this option will allow you to go into the full screen editor with the previously defined input filename as the target file. When COED is executed through the menu system, the HEC-1 help file is automatically loaded and the editor goes directly into full screen mode. While in COED you can create or edit an HEC-1 input data file. When you are finished the program will return to the main HEC-1 Package Menu. For help in using COED refer to the COED User's Manual. The next chapter describes "creating an input data file" in detail.

3. **Run HEC1 (or DSPLAY, HEC1IN, and DSSUTL):**

This option executes the HEC1, DSPLAY, HEC1IN, and DSSUTL programs. To switch between programs, just press the space bar while option 3 is highlighted. The input, output and DSS filenames, defined under option 1, will be passed to the appropriate programs. When the HEC-1 program is finished executing, you should get the message "NORMAL END OF HEC-1" if your input data were entered correctly. If you do not get this message, more than likely there is an error in your input data file. Review the output file, using the next option, to learn more about any possible input data errors. If no errors occurred, and the "NORMAL END OF HEC-1" message was printed, just press any key to return to the main HEC-1 Package Menu.

4. **Display Output to the Console (or printer):**

This option is used to display output to the console or the printer. To switch from console to printer, just press the space bar while you are on option 4 (in other words, while option 4 is highlighted). If you choose to view output on the console, the utility LIST will be executed with the output filename being passed to it. If you choose to send output to the printer, the utility PROUT will be executed with the output filename being passed to it. Note: printer output is 132 characters wide. Therefore, set your printer font accordingly. Upon completion of either task, control will be given back to the HEC-1 Package Menu.

5. **Exit to DOS:**

If this option is chosen it is assumed that you are completely finished with the menu system and control is given back to DOS.

Chapter 4

Input Data Files

4.1　General

The HEC-1 program is a batch program. That means the necessary data for the program is provided as input at program execution and the program processes the entire job to completion. The program user does not interact with the program during execution. This section describes the sequence of an HEC-1 computation process, the input data format, and the basic steps for creating and storing an input data file.

4.2　Input Data Format

The structure of the HEC-1 input data file can be seen by reviewing any of the test data sets provided with the program. The detailed input description is provided in Section 10 of the HEC-1 User's Manual. See tables 10.4 through 10.11 of the HEC-1 User's Manual for summaries of data required for several different simulation options.

The format for the HEC-1 data is a "standard" HEC format. The concept is based on the eighty-column data card associated with batch input. The term card is used here even though the cards are more appropriately defined as records in a file. The first two columns are used for record identifier (ID); the program reads and sorts through the data based on the record ID. Each record is divided into ten (10) fields of eight columns each. However, a variable in field one may only occupy record columns 3 through 8 because the record ID is in columns 1 and 2. The HEC-1 User's Manual, and this text, refer to the individual records by their ID and the variable location of the record by the field number (1 through 10).

4.3　Creating an Input File

Data entry into fields requires careful counting of columns to ensure that the data are located in the correct fields. If a datum is entered across a boundary (column) between fields, the program will read part of the value as one variable and the remainder of the datum as the value for the variable in the next field.

There are several options available to assist the program user to enter data into fields without counting record columns to space data entries into the correct fields. The HEC-1 program will accept input data in "FREE" format and convert the data into fixed-format (see Section 4.3.3, "Other Methods"). The preferred data entry method is the Corps' interactive edit program, COED. It will automatically place input data into the standard (10 fields of eight columns) format. COED also provides on-screen help features that enhance the data entry function of the editor. The use of COED and other tools is described in the following sections.

4.3.1   Using COED

Creating or editing an input file from MENU1 calls COED. Calling COED from MENU1 also includes two parameters: **FS** and **HP HEC1**. If you run COED separately, these parameters can be entered while in COED. Entering **HP HEC1** will cause the HEC-1 input help file to be loaded, providing the tab settings for data entry and the input variables for HEC-1. Entering **FS** puts you into the Full Screen working environment. COED operates as a command editor (where you enter edit command codes and parameters) and also as a full screen editor (like a word processor). See the COED User's Manual for detailed documentation. Figure 5 shows an input data file in COED full screen edit mode, which is better for data entry.

```
TOF..
ID  TEST EXAMPLE NO. 13
ID  USE OF DSS TO READ AND WRITE DATA
ID  USE OF THE DSPLAY PROGRAM TO PLOT RESULTS
IT      15 14SEP89     1200       100
KK  SUB1
BA   5.7
BF   100     -.20    1.020
PB
ZR=PI A=EXAMPLE13 B=SUB1 C=PRECIP-INC E=1HOUR F=OBS
LU   0.3    0.15
UC   2.0     5.5
ZW  A=EXAMPLE13 C=FLOW F=COMP
KK   CMP
ZR=QO A=EXAMPLE13 B=SUB1 C=FLOW E=10MIN F=OBS
ZZ
EOT..




ID . . . . . . . . . . . . . Title information. . . . . . . . . . . . . . . .
Help=F1                                              Col=1    Line=1
```

Figure 5. HEC-1 Input Data File in COED Full Screen Mode

Once in COED, with HEC-1 help file and full screen edit mode, data entry will automatically use the first two columns for the record identifier, the next six columns for Field 1, and the remaining nine sets of eight columns as Fields 2 through 10. With the cursor at the first column, enter any appropriate HEC-1 record identifier (e.g., ID). The bottom of the screen will display a line of input information for the entered identifier (e.g., *Title Information* for ID). If the identifier is not appropriate for HEC-1, the bottom of the screen will display an error message. For example, if the invalid record identifier ZX is entered, you will get the message:

ZX > >   > > >   **Record ID not valid for HEC-1 Input** < < <   < < <

For title record information the entire line is available to enter text; there are no fields. For data records, most fields represent variables, and the variables are shown on the line at the bottom of the screen. For example, enter IT, and the variables for the IT record are shown on the bottom line. Use the **<TAB>** key (usually shown with two horizontal arrows) to move the cursor from field to field The

cursor automatically moves to the right of each field. Data entry will also fill the field from the right. Therefore, the data are always right justified.

Data entry only affects the field the cursor is on. Therefore, inserting or deleting data in a field only works in the one field. If you continue to enter data in a field, the previously entered data is displaced to the left until it is moved completely out of the field. Use the <TAB> key, or a cursor key, to move to another field. Use the <SHIFT><TAB> to move the cursor to the left.

Help information for COED is provided by pressing <F1>. The function keys are defined, and a list of additional help information is provided, as shown in Figure 6. The COED User's Manual is essentially provided through the help file.

Figure 6. COED Help Screen

Help information for HEC-1 variables is provided by pressing <ALT><F1>. The HEC-1 ID in columns one and two provides the line of variables, for that record type, listed at the bottom of the screen. Moving the cursor to any field on the data input line and pressing <ALT><F1> provides the input description for that field's variable. Therefore, while you are entering data, you can obtain the input description for any input variable in the HEC-1 program.

With the HEC-1 help file loaded, COED can recognize legal input types. That is, the program will not accept a letter <O> for an entry that requires a number. This feature should reduce illegal input data errors.

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4.3.2 Using the Interactive Input Program, HEC1IN

The HEC1IN program was designed to aid beginning and first-time users in developing the correct sequence of records for an HEC-1 input file. Currently the program is limited to the basic rainfall-runoff processes available in the HEC-1 program. The use of this program consists of filling out a series of tables that describe the watershed and the type of hydrologic techniques that will be used to analyze the basin. Once all of the necessary information is entered, a skeleton HEC-1 input file can be created. The skeleton file will contain all of the data records needed to simulate the rainfall-runoff process for the user's watershed, but not all of the actual data. The file will contain the two-character alphabetic codes in columns one and two for each line of input. It is the users responsibility to edit the file (using COED or any other text editor) and fill in the necessary data associated with each record. Review section 10 of Appendix A of the HEC-1 user's manual for details about the input structure and specific data requirements for each record. Appendix A of this document is a detailed description of the Interactive Input Developer for HEC-1 (HEC1IN).

4.3.3 Other Methods

COED and HEC1IN have been developed to facilitate the creation of input data files. However, any other program that creates text files can be used. This may be convenient when some of the data needed is already in the file format of another program. Conversely, if the data is a block of time series data, it may be more practical to incorporate it into an input data file that is created using COED or HEC1IN There are avenues for doing this without manually retyping the data into an HEC-1 input data file. The data can be moved as a block using COED or some other text editor. See the GET command in the COED manual. Bringing blocks of data in from an external source does carry with it the burden of converting it into HEC-1 input file format. One method is to use the *FREE command before the block of data and a *FIX command after the data. All records between these commands will be preprocessed into the standard 8-character field structure. This method depends on the data meeting the minimal requirements of the free-format. See the HEC-1 user's manual for more information on the *FREE command. Another way to use time series data without retyping it into an HEC-1 input data file is to incorporate it into an input file for use with DSSTS. DSSTS creates a DSS file from the text data given in the input. This method accommodates up to 132 columns of data per line instead of the 80 columns allowed by the previous method. The following section gives references for DSSTS.

4.4 Using HEC Data Storage System (HECDSS) for Input Data

Several HECDSS utility programs are included in the HEC-1 package. Programs DSSTS and DSSPD can be used to input time series data and paired function data into a DSS file. Once data are stored in DSS, program DSSUTL can be used to perform various tabulation and data manipulations. Plots and tables can also be generated with a program called DSPLAY. Detailed information on any of the utility programs can be found in the HECDSS User's Guide and Utility Program Manuals. Use of macros with DSS utility programs is described in the PREAD user's manual. The input records used to interface between HEC-1 and DSS are described in Appendix B of the HEC-1 user's manual.

Chapter 5

Program Execution

5.1   Executing HEC-1 Through the Menu System

After installation and prior to execution, your system must be rebooted. You are now ready to test the computer program. The preferred mode of execution is through the menu system, though you can run the program without going through the menu (see Section 5.2, "Executing HEC-1 Without the Menu"). To execute the program through the menu system do the following:

1. Go to the directory containing your HEC-1 data files (e.g., **CD\HEC1,** see Figure 2).

2. Type **MENU1** and press the **<ENTER>** key. This will invoke the batch file used to run the menu system of programs. You must operate the menu system through this batch file or the HEC-1 Package of programs will not function correctly.

3. The HEC-1 Package Menu should now appear on the screen, as shown in Figure 3. As you can see you have five choices.

4. If you have reviewed the section on the HEC-1 Package Menu you will know that it is necessary to do option 1 first. While option 1 is highlighted press the **<ENTER>** key and then type in the input file name in the pop up window shown in Figure 4. For this example type **HEC101** for the input filename and the default extension ".DAT" will be provided for you. Also provided automatically will be the output file name **HEC1.OUT** and the DSS file name **HEC101.DSS.** This is accomplished by having the default extension option turned on. If you do not wish to use the default extensions, you may turn this option off by pressing the space bar while the default extension option is highlighted.

5. If your input file needs editing, you should select option 2. For now we will bypass this step since the defined input file, "HEC101.DAT," already exists and requires no further editing. If you wish to create or edit your own input file you should use option 2.

6. Now select option 3 which is to run HEC-1. Note that the input, output and DSS file names are passed to the HEC-1 program. When the HEC-1 program has finished executing, you should see the message, "NORMAL END OF HEC-1." To return control back to the main HEC-1 Package Menu, press any key.

7. At this point you may want to view the output on the screen, to do this select option 4. Viewing output on the screen is done by executing the LIST utility. LIST has several nice features for viewing the output file. To become more familiar with the LIST features type a "?" or F1 while in the LIST utility, or review the LIST.DOC file. To get out of LIST type an X or ESC, which will terminate the program and give control back to the HEC-1 Package Menu. You may also want to send the output to the printer to get a hard copy. This can be accomplished by toggling the printer using the space bar while option 4 is highlighted, and then pressing the <ENTER> key. Note: output is 132 columns wide so you may need to set your printer font accordingly.

8. At this point you can exit the menu program by invoking option 5, or you can continue working with the previous four options.

5.2   Executing HEC-1 Without the Menu System

Though the preferred mode to execute HEC-1 is through the MENU1 program, you can run the program without using the menu. One such application would be for running several HEC-1 jobs in series without further user input. To run the program without using the menu system, do the following:

*   Go to the directory in which your data are stored (e.g.,\HEC1).
*   Type **HEC1 INPUT=inpname OUTPUT=outname DSS=dssname** then press the <ENTER> key.

Where: inpname = The name of the input file (e.g., HEC101.DAT).
       outname = The name of the output file (e.g., HEC101.OUT).
       dssname = The name of DSS file (e.g., HEC101.DSS).

Chapter 6

Reviewing Model Results

6.1   General

The major portion of the HEC-1 model results is in the form of an ASCII file, often referred to as the HEC-1 "Output File." This file includes an echo print of the users input data, intermediate simulation results, summary tables, and error messages. The degree of detail of virtually all of the program output can be controlled by the user.

Besides the normal HEC-1 output file, model results can be written to the HEC Data Storage System (HECDSS or just DSS). The DSS system stores data in a fashion convenient for inventory, retrieval, archiving, and model use. The DSS was primarily designed for water resources applications. Using DSS provides a means for storing and maintaining data in a centralized location, providing input to and storing output from applications programs, transferring data between application programs, and displaying the data in graphs and tables.

6.2   HEC-1 Formatted Output File

OUTPUT is the "print" file from HEC-1. Generally, this file would go directly to a disk file or to the printer. Because the printer is usually very slow, it is often easier to write the HEC-1 output to a disk file and review it with a program like LIST. There may be several computer runs required before the final results are obtained. By using the disk file approach, only the final results would be sent to the printer.

The OUTPUT file is easy to review from MENU1. Move the cursor to "4. Display output to console," and press <ENTER>. This will call LIST with the output filename. Portions of the output file can be printed from LIST; P turns the printer on or off. Press <F1>, while in LIST, to see available LIST commands.

The entire output file can be sent to the printer from MENU1. At "4. Display output to console" press the <SPACE BAR> to display "Display output to printer," and press <Enter>. This will send the output file to the printer with the utility program PROUT. PROUT will recognize the carriage control characters in the output file and thus provide spacing and paging as a high-speed printer would. PROUT output can be set to 80 or 132 columns. PROUT does not set the printer width; that must be done external to the program.

The DOS COPY command can be used to send the output file to the printer (e.g., COPY A:HEC101.OUT PRN). As with PROUT, this will tie up the computer while the file is printing. Alternatively, the DOS PRINT command can be used (e.g., PRINT A:HEC101.OUT). The system will

request the name of the print device; simply press <ENTER> to send the output to the printer. This approach does not tie up the computer. However, neither of the above approaches will allow your printer to recognize the print control characters in column one of the output file. Therefore, the printed output will not start a new page or skip a line the way the file would be normally printed if directed to the printer at the time of execution.

To use PROUT as a separate program, at the DOS prompt enter:

PROUT "filename" "column width"

where: "filename" is the output file to print
"column width" is the column width for the printer

(e.g., PROUT A:HEC101.OUT 132)

6.3   Using DSPLAY to Generate Graphs and Tables

In the case that model results have been stored in a DSS file, the DSS utility program DSPLAY can be used to dsplay the data in tables and graphs. Appendix B provides an overview of DSPLAY for the PC. Detailed information about DSPLAY can be found in the HECDSS User's Guide and Utility Program Manuals.

DSPLAY uses proprietary "drivers." Drivers provide a means of plotting on several different types of devices (monitors, pen plotters, printers, etc.), without having information about each device in the program. More information about the drivers can be found in "Installation Instructions for Device Drivers."

6.4   Using HEC-1 and DSPLAY Output in Other Programs

HEC-1 and DSPLAY output can be incorporated into documents via word processors or used in spreadsheets and graphics packages. Procedures for importing text and graphics files into other programs will vary across programs. Refer to their respective manuals for more information. The following paragraphs highlight some concepts related to incorporation of HEC-1 and DSPLAY output into other programs.

The HEC-1 output file is an ASCII text file that can be used in other programs that allow importation of text. In the case of word processors, there are a few generic tips that will facilitate the process. When selecting the method of bringing text into your word processor, choose to have carriage return/ line feed combinations converted to "hard" returns to avoid unintentional concatenation of lines. Similarly, select a font that is monospaced (i.e., not proportional spaced) so that the HEC-1 output will not be distorted. If the entire width of an HEC-1 output file is to be used in the context of an 8 1/2 by 11 inch page, a small font, such as 16.6 characters per inch, and reduced margins will be needed because the HEC-1 output is 132 columns wide. Once the HEC-1 output file is in your word processor, it can be printed or altered.

Any graph or table that can be generated and shown on the screen by DSPLAY can also be generated and sent to a CGM graphics file instead. This enables the use of DSPLAY output in other graphics programs or word processors that use the CGM file format. To generate a CGM file in DSPLAY, the DEVICE command is used with the META parameter before the desired PLOT or TABULATE commands are issued. Refer to the HECDSS Users Guide and Utility Program Manuals for more information on the DEVICE command.

Appendix A

Interactive Input Developer for HEC-1
(HEC1IN)

Introduction

Overview of the HEC1IN Program

This program was designed to aid beginning and first-time users in developing the correct sequence of records for an HEC-1 input file. Currently the program is limited to the basic rainfall-runoff processes available in the HEC-1 program. The use of this program consists of filling out a series of tables that describe the watershed and the type of hydrologic techniques that will be used to analyze the basin. Once all of the necessary information is entered, a skeleton HEC-1 input file can be created. The skeleton file will contain all of the data records needed to simulate the rainfall-runoff process for the user's watershed, but not all of the actual data. The file will contain the two-character alphabetic codes in columns one and two for each line of input. It is the users responsibility to edit the file (using COED or any other text editor) and fill in the necessary data associated with each record. Review section 10 and Appendix A of the HEC-1 User's Manual for details about the input structure and specific data requirements for each record.

Computer Requirements

The HEC1IN program was developed for IBM-compatible computers with the MS DOS operating system. The following is required in order to execute the program:

* **MS DOS 2.1 (or later)**
* **512 Kb of RAM (300 Kb free)**
* **One 360 Kb floppy-disk drive (or 1.2 Mb)**
* **10 Megabyte or larger hard-disk**

The HEC1IN program is included in the HEC-1 package of software. Installation is accomplished through the use of the HEC-1 install program. For further information on installing the HEC1IN program, review the HEC-1 package installation instructions.

Acknowledgements

This program was designed by Mr. Gary W. Brunner and Mr. Arlen D. Feldman of the Hydrologic Engineering Center. The computer program was written in FORTRAN and assembly language by Gary W. Brunner, Denise Nakaji, and Tracy Colwell.

Executing the HEC1IN Program

Running From The HEC-1 Menu System (MENU1)

Executing the HEC1IN program can be accomplished through the HEC-1 menu system (MENU1). As shown in Figure A.1, while option three of the menu is highlighted, press the space bar to change the program execution to HEC1IN. Then press the <ENTER> key to execute the HEC1IN program.

```
┌──────────────────────── HEC1 Package Menu ────────────────────────┐
│                                                                    │
│                                                                    │
│                   1. Define input/output files                     │
│                                                                    │
│                   2. Create/edit input file                        │
│                                                                    │
│                   3. Run HEC1IN                                     │
│                                                                    │
│                   4. Display output to console                     │
│                                                                    │
│                   5. Exit to DOS                                    │
│                                                                    │
│                                                                    │
│                                                                    │
├──────────────────┬─────────────────────┬──────────────────────────┤
│ Input: (specify) │ Output: CON         │ DSS: (specify)           │
├──────────────────┴─────────────────────┴──────────────────────────┤
│       Press <Space bar> to toggle choice & <Enter> to select      │
└──────────────────────── October 1989 Menu ───────────────────────┘
```

Figure A-1. HEC-1 Menu System

Files Associated With The HEC1IN Program

The HEC1IN program uses three files during execution:

1. HEC1IN.TXT - Text file containing HEC1IN screens.
2. filename - User-specified name for the HEC-1 input file.
3. filename.INT - File containing information entered into HEC1IN tables.

The HEC1IN.TXT file should be placed in the \HECEXE\SUP directory. This file contains all of the screens that come up in the HEC1IN program. The user-specified HEC-1 input file is identified while in the MENU1 program. The third file (filename.INT) is used to store all of the information that the user enters during the HEC1IN session. This file is given the same name as the user-specified HEC-1 input file, but the extension ".INT" is attached. The ".INT" file is preserved so the user can exit the HEC1IN session at any time and return to it as necessary.

WARNING: data should not be added to the HEC-1 input file until the user is completely finished building the skeleton file with HEC1IN. The HEC1IN program re-writes the skeleton HEC-1 input file and will not preserve data added by using COED.

Creating an Input Data File

General Philosophy of the Program

In general, this program operates by filling out a series of formatted screens and tables that describe the rainfall-runoff process that the user is trying to simulate. The river basin shown in Figure A.2 will be used in the following demonstration of HEC1IN.
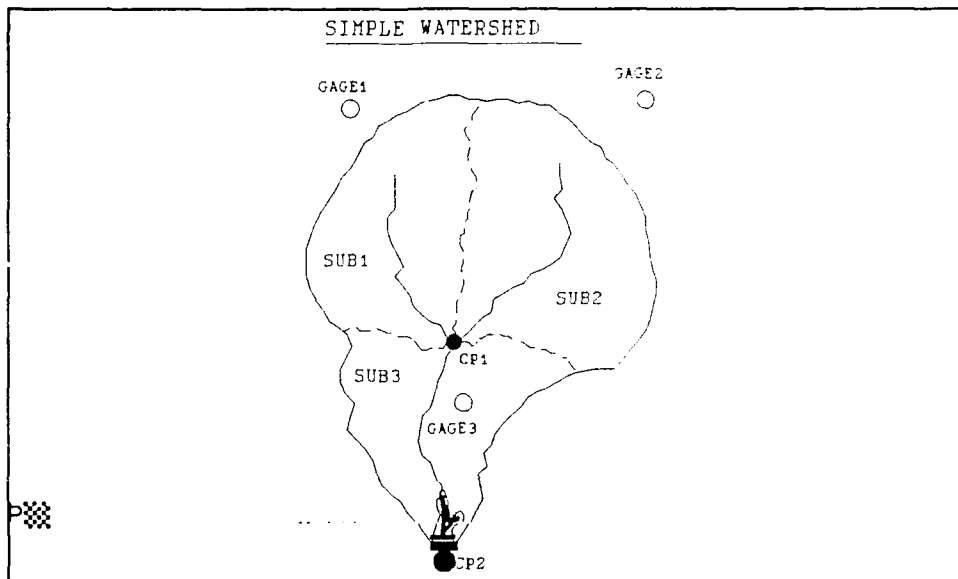
Figure A-2. Example Watershed

When HEC1IN is executed, the first screen to be filled out by the user is shown in Figure A.3. This Job Initialization screen is used to enter job title information and time specifications. In the job title information section, the user should enter comments that describes the rainfall-runoff process that is being simulated. Under the time specifications section, the user is required to enter a computation interval, simulation starting date and time, and the number of hydrograph ordinates to be computed. The computation interval is one of the most important parameters required by the model. The length of the computation interval is dependent on the size of the smallest subbasins and routing reaches within your watershed. A general rule of thumb is that the computation interval should be less than one fifth (1/5) of the smallest subbasin's time of concentration (Tc). The total simulation time for the job is the number of ordinates multiplied by the computation interval. Remember, the total simulation time should equal or exceed the duration of the precipitation event being analyzed.

```
                    JOB INITIALIZATION DATA          FILE: TEST.DAT

Please fill out this table completely, then press the <F8> key to get to the
next screen.

    ┌─────────────────────────────────────────────────────────────────┐
    │ Enter job title information (At least one line must be entered):  │
    │                                                                    │
    │ 1.TEST OF THE HEC1IN PROGRAM                                       │
    │ 2.SIMPLE THREE SUBBASIN WATERSHED          .                      │
    │ 3.GARY W. BRUNNER                                                  │
    │                                                                    │
    │ Simulation time specifications                                    │
    │                                                                    │
    │    1. Enter computation time interval in minutes    :        5    │
    │                                                                    │
    │    2. Enter the simulation starting date (e.g., 17MAR88):  17MAR88 │
    │                                                                    │
    │    3. Enter the simulation starting time (e.g., 1645)   :    1200  │
    │                                                                    │
    │    4. Enter the number of ordinates to compute (300 Max):    300   │
    └─────────────────────────────────────────────────────────────────┘

  F1Help                            F6Creat  F7Prev  F8Next  F9Save  F10Exit
```

Figure A-3. Job Initialization Data

The next screen that the user must fill out is shown in Figure A.4. The subbasin connectivity table is used to enter a name for each of the subbasins in the watershed and to describe how these subbasins fit together. The term "Headwater Subbasin" is used for those subbasins where a stream initiates. Every subbasin that is entered in the table must be assigned a downstream control point name. For those subbasins that are not headwater subbasins, an upstream control point name must also be provided. This control point name must be the same as the downstream control point name of the subbasin immediately upstream.


```
                  SUBBASIN CONNECTIVITY TABLE       FILE: TEST.DAT

Enter a name for each subbasin in your watershed.
(maximum of six (6) letters/numbers)

    ┌─────────┬─────────┬─────────┬─────────┬────────┬─────────┐
    │ Subbasir│Headwater│ Upstream│Downstream│Reservoir│Reservoir│
    │Identifier│Subbasin │Control Point│Control Point│(Y/N)│Identifier│
    │         │ (Y/N)   │  Name   │  Name   │        │         │
    ├─────────┼─────────┼─────────┼─────────┼────────┼─────────┤
    │  SUB1   │    Y    │   N/A   │   CP1   │   N    │   N/A   │
    │  SUB2   │    Y    │   N/A   │   CP1   │   N    │   N/A   │
    │  SUB3   │    N    │   CP1   │   CP2   │   Y    │   RES1  │
    └─────────┴─────────┴─────────┴─────────┴────────┴─────────┘

 F1Help        F3Del            F6Creat  F7Prev  F8Next  F9Save  F10Exit
```

Figure A-4. Subbasin Connectivity Table

After the user has completely filled out the subbasin connectivity table for all of the subbasins within the watershed, simply press the F8 function key to go to the next screen. The third screen, which is titled "Subbasin Runoff Table," is shown in Figure A.5. The subbasin runoff table is used to

identify the methodologies that will be used in developing a runoff hydrograph for each subbasin. The information required consists of: basin area; the type of precipitation data that will be used; a loss rate function; rainfall excess to runoff transformation (unit hydrograph or kinematic wave); and whether or not baseflow will be added to the direct runoff. The available choices for each column are shown in a menu at the top of the screen. The <TAB> key is used to move through the menu choices and the <ENTER> key is used to make a selection from the menu. Selecting a specific hydrologic method will depend upon the amount of historical data available; the experience of the user; and the characteristics of the watershed to which the method will be applied. Detailed explanations of the techniques listed in the menus are found in chapter three of the HEC-1 User's Manual.

```
                          SUBBASIN RUNOFF TABLE          FILE: TEST.DAT

    INIT/CONST  SCS  GREEN/AMPT  HEC EXP  HOLTAN
    Initial & Constant Loss Rate Method


    +----------+--------+--------+-----------+-------------+--------+
    | Subbasin | Basin  | Precip | Loss Rate |   Runoff    |Baseflow|
    |Identifier| Area   | Method |  Method   |Transformation| (Y/N) |
    +----------+--------+--------+-----------+-------------+--------+
    |   SUB1   |  5.0   | GAGED  | INIT/CONST|    SCS      |   Y    |
    |   SUB2   |  4.0   | GAGED  |    SCS    |    SCS      |   Y    |
    |   SUB3   |  6.0   | GAGED  | GREEN/AMPT|   CLARK     |   Y    |
    |          |        |        |           |             |        |
    |          |        |        |           |             |        |
    |          |        |        |           |             |        |
    |          |        |        |           |             |        |
    |          |        |        |           |             |        |
    +----------+--------+--------+-----------+-------------+--------+

 F1Help                              F6Creat F7Prev F8Next F9Save F10Exit
```

Figure A-5. Subbasin Runoff Table

The next screen will depend upon what was entered into the subbasin runoff table for precipitation. If the user had entered "Gaged" or "Basin Average" precipitation, then a precipitation table will come up to get more information. Otherwise, the program will go straight to the channel routing table. Shown in Figure A.6 is the gaged precipitation table.

The gaged precipitation table is used to identify all of the gages (recording and nonrecording) that will be used in developing rainfall hyetographs for the watershed. The user is required to enter a name for each gage; whether the gage is recording or non-recording; and if the data will be entered incrementally or cumulatively. If the "Basin Average" precipitation method had been chosen by the user, the program will only ask if the data is going to be entered incrementally or cumulatively. When using the basin average precipitation method, the user must compute the basin average precipitation for each subbasin outside of the model and enter it directly. Computing the basin average precipitation can be accomplished by using Thiesson polygon or isohyetal averaging techniques.

If hydrograph routing is required, the next screen will be the channel routing table. The channel routing table, shown in Figure A.7, is used to define which routing techniques will be used to route hydrographs from upstream to downstream control points. The HEC1IN program will automatically

```
                          GAGED PRECIPITATION TABLE        FILE: TEST.DAT

  RECORDING   NON-RECORDING
  Precipitation is recorded in short time intervals (e.g. 1 hour, 15 minutes, ...)


              ┌────────────┬────────────┬────────────┐
              │Precipitation│ Recording  │Incremental │
              │   Gage     │    or      │    or      │
              │ Identifier │Non-Recording│Cumulative  │
              ├────────────┼────────────┼────────────┤
              │   GAGE1    │ RECORDING  │INCREMENTAL │
              │   GAGE2    │ RECORDING  │INCREMENTAL │
              │   GAGE3    │NON-RECORDING│   N/A     │
              │            │            │            │
              │            │            │            │
              └────────────┴────────────┴────────────┘


   F1Help         F3Del               F6Creat F7Prev F8Next F9Save F10Exit
```

Figure A-6. Gaged Precipitation Table

determine the number of routing reaches are required. The upstream and downstream control points for each routing reach will be displayed in the table. The user is required to enter a name that will uniquely identify each routing reach, and then select the type of routing technique that will be used for that particular reach. The selection of a routing methodology is dependent upon the available data, the physical characteristics of the channel, and the nature of the flood wave to be routed. To learn more about a specific routing technique, please review chapter three of the HEC-1 user's manual.

```
                          CHANNEL ROUTING TABLE          FILE: TEST.DAT

  MUSKINGUM   MUSK/CUNGE   STORAGE ROUTING   NORMAL DEPTH   K.W.   STRAD/STAG
  Muskingum/Cunge Channel Routing


              ┌──────────┬──────────┬──────────┬──────────┐
              │  From    │   To     │ Channel  │ Channel  │
              │ Control  │ Control  │Identifier│ Routing  │
              │  Point   │  Point   │          │ Method   │
              ├──────────┼──────────┼──────────┼──────────┤
              │   CP1    │   CP2    │  ROUT1   │MUSK/CUNGE│
              │          │          │          │          │
              │          │          │          │          │
              │          │          │          │          │
              │          │          │          │          │
              │          │          │          │          │
              └──────────┴──────────┴──────────┴──────────┘


   F1Help                       F6Creat F7Prev F8Next F9Save F10Exit
```

Figure A-7. Channel Routing Table

25

The last screen that may appear is used for reservoir routing. The reservoir routing table, shown in Figure A.8, will only come up if the user has specified that a reservoir is located in at least one of the subbasins. The reservoir routing table is used to identify how the elevation versus volume and elevation versus outflow relationships will be defined in the model. The user can define the storage behind the dam by entering elevation versus volume directly, or elevation versus surface area, and the HEC-1 program will calculate the volumes. To describe the outflow from the dam, the user can enter a single rating curve (which is a composite of all outflow mechanisms) or explicitly describe the physical dimensions of each outflow mechanism. The model also has the capability to simulate a dam breach or flow going over top of the dam.

```
┌──────────────────────────────────────────────────────────────────────┐
│                    RESERVOIR ROUTING TABLE        FILE: TEST.DAT       │
│                                                                        │
│  Do you want Elevation vs Volume (V) or Elevation vs Area (A) to describe the │
│  storage behind the dam?                                               │
│                                                                        │
│  ┌─────────┬──────────┬───────────┬────────┬────────┬──────┬─────────┐ │
│  │Reservoir│Elevation vs│User Defined│Low Level│Spillway│ Dam  │   Dam   │ │
│  │Identifier│Volume/Area│Elev vs Outflow│Outlets │        │Breach│Overtopping│ │
│  │         │  (V/A)   │   (Y/N)   │ (Y/N)  │ (Y/N)  │(Y/N) │  (Y/N)  │ │
│  ├─────────┼──────────┼───────────┼────────┼────────┼──────┼─────────┤ │
│  │  RES1   │    V     │     N     │   Y    │   Y    │  N   │    Y    │ │
│  │         │          │           │        │        │      │         │ │
│  │         │          │           │        │        │      │         │ │
│  │         │          │           │        │        │      │         │ │
│  └─────────┴──────────┴───────────┴────────┴────────┴──────┴─────────┘ │
│                                                                        │
│  F1 Help              F6 Creat  F7 Prev  F8 Next  F9 Save  F10 Exit    │
└──────────────────────────────────────────────────────────────────────┘
```

Figure A.8 Reservoir Routing Table

After all of the tables have been filled out completely, the HEC-1 input file can be created by simply pressing the F6 function key. The HEC-1 input file generated for this example is shown in Table A.1. **Remember**, the HEC-1 input file will only contain the two character identification codes for each record required for the rainfall-runoff simulation. It is the user's responsibility to edit the file and fill in all of the necessary data for each record.

WARNING: data should not be added to the HEC-1 input file until the user is completely finished building the skeleton file with HEC1IN. The HEC1IN program re-writes the skeleton HEC-1 input file and will not preserve data added by using COED.

Help System

Help within the HEC1IN program is available by pressing the F1 function key. The first two screens of the help system deal with editing and function keys, while the third screen is specific to the HEC1IN tables. The first screen of the help system lists all of the available function keys and their

corresponding capabilities. The second help screen describes how the key pad, <TAB> key, and <ENTER> key can be used to enter and edit information. The third help screen is always specific to the table the user was working in when the F1 key was pressed. Therefore, if the user is working on the subbasin connectivity table when the F1 key is pressed, the third help screen will describe what information is required for that specific table. Moving through the help screens is accomplished by pressing any key. After the third screen is viewed, pressing any key will return the user back to the table being used when help was requested.

Table A-1

HEC-1 Input File for Example Watershed

```
ID TEST OF THE HEC1IN PROGRAM
ID SIMPLE THREE SUBBASIN WATERSHED
ID GARY W. BRUNNER
IT        5 17MAR88      1200        300
IO
PG GAGE1
PI
PG GAGE2
PI
PG GAGE3
* **********
KK   SUB1
KM Basin runoff calculation for     SUB1
BA    5.0
BF
PT
PW
PR
PW
LU
UD
* **********
KK   SUB2
KM Basin runoff calculation for     SUB2
BA    4.0
BF
PT
PW
PR
PW
LS
UD
* **********
KK   SUB2
KM Combining two hydrographs at control point      CP1
HC      2
* **********
KK ROUT1
KM Muskingum-Cunge channel routing from      CP1 to      CP2
```

```
RD
* **********
KK   SUB3
KM Basin runoff calculation for    SUB3
BA    6.0
BF
PT
PW
PR
PW
LG
UC
* **********
KK   SUB3
KM Combining two hydrographs at control point       CP2
HC       2
* **********
KK   RES1
KM Reservoir routing operation
RS
SV
SE
SL
SS
ST
* **********
ZZ
```

Appendix B

Overview of DSPLAY for the PC

DSPLAY is a HECDSS utility program that allows the user to plot or tabulate data stored in an HECDSS (HEC Data Storage System) file. The PC version of DSPLAY can generate plots on several different devices (such as monitors, printers, and plotters) and also generate metafiles.

Executing DSPLAY

DSPLAY can be executed through the menu programs (e.g. MENU1, MENU5, etc.) or a special batch file labeled DSP.BAT. Before running DSPLAY, the GSS device drivers must be loaded into memory. Loading the device drivers is accomplished by executing the DRIVERS.EXE program. The menu programs, as well as the DSP batch file, automatically load the device drivers, execute the DSPLAY program, and unload the device drivers when the user is finished working in DSPLAY. DSPLAY and the device drivers require about 350 Kb of free base memory. If the DSPLAY program aborts with the message "Program to big to fit in memory," remove any RAM resident programs that you may have loaded in the AUTOEXEC.BAT file. Reboot your computer and try running DSPLAY again.

User Input Commands

DSPLAY is a "command" driven program, rather than being menu driven. Input consists of a command, option(s), and parameter(s) in the following format:

Command.Option(s), Parameter(s)

A list of the most frequently used DSPLAY commands is shown in Table 1. In general, the user enters a sequence of commands to generate a plot. The following is an example sequence of commands to plot data stored in a DSS file. These commands would be entered after selecting DSPLAY on a menu or running DSP.BAT.

Command	Description
CA.NA	Develop a new catalog of all the data stored in the currently opened DSS file and display it in an abbreviated format on the screen.
TI 17JAN90 1200 18JAN90 1800	Establish a time window for retrieving and plotting data.
PL 1,3	Plot on the screen (default device) data referenced by pathnames 1 and 3 in the DSS file catalog listing.

DEV PRINTER	Change device option to the printer.	
PL	Send the previously defined plot (PL 1,3) to the printer.	
DEV SCREEN	Reset current device to the screen.	
FI	End DSPLAY session and return to main menu or DOS.	

For more information on DSPLAY's capabilities and commands, refer to "HECDSS User's Guide and Utility Program Manuals," or type "HELP" while in DSPLAY. The online help system in DSPLAY has the most current information on commands.

Table B-1
Frequently Used DSPLAY Commands

Command	Purpose	Examples
CATALOG	Catalog of all pathnames in the opened DSS file.	CA (List files in catalog) CA.N (New Catalog) CA.A (Abbreviated List)
PLOT	Used to plot data in the DSS file opened.	PL 1,3 (Plot Paths 1 and 3) PL A=SCIOTO,C=FLOW (plot data with pathnames that have A=SCIOTO and C=FLOW) PL (Plot last specified plot)
OPEN	Open a new DSS file.	OP filename
FINISH	Terminate the DSPLAY session.	FI
DEVICE	Used to specify which device the plot will be sent to.	DEV SCREEN (This is the default) DEV PRINTER (PLOTTER, MOUSE, or META)
HELP	List or define available DSPLAY commands.	HE (List all available commands) HE PL (Define PLOT command)
TABULATE	Display the data in tabular form.	TA 2 (Tabulate data in path 2) TA A=SCIOTO C=FLOW
TIME	Used to specify a time window for retrieving and plotting data.	TI 01DEC88 0900 02DEC88 1200 (set time for retrieving window from beginning date and time to ending date and time)
STATUS	List the current DSPLAY settings.	ST (List all status settings)

Advanced DSPLAY Operations: Environment Settings

The default attributes of most device drivers can be changed using the DOS SET command before running DSPLAY. The following is a description of the most commonly used SET commands dealing with the GSS software.

A. Printers

Printers have a wide selection of SET commands, though not all printers recognize each SET command.

ORIENTATION=[PORTRAIT, LANDSCAPE] rotates the printer output.
PORTRAIT   no rotation (default)
LANDSCAPE   rotates the plot by ninety degrees

<div align="center">

C:\> **SET ORIENTATION=LANDSCAPE**

</div>

PAPER=[NARROW, WIDE, ISOA4] the paper size can be changed, which will scale the plot to fill the page. Not all page sizes are supported by every printer.

NARROW 8.5x11 (default)
WIDE   11x14
ISOA4   210x297mm

<div align="center">

C:\> **SET PAPER=WIDE**

</div>

TEMPDIR=<directory> specifies the directory where the printer driver writes a temporary file. Unless a directory is specified, the file is written to the current directory. If DSPLAY isn't aborted the temporary file is automatically deleted when the printer is finished. Example:

<div align="center">

C:\> **SET TEMPDIR=C:\GSS**

</div>

PLISTSIZE=<buffer size> allocates space for a printer I/O buffer. Increasing its size will reduce the amount of disk access. The default buffer size is 512 bytes, and the maximum buffer size allowed is 64K. Example:

<div align="center">

C:\> **SET PLISTSIZE=2048**

</div>

RESOLUTION=<resolution> several printers wi'' support multiple resolutions. The coarser the resolution, the faster the plot will be completed.

Printer	Resolution (bpi)			
Canon Laser Beam Printer 8II	300	150		
Epson LQ	180	120		
HP DeskJet	300	150	75	
HP LaserJet	300	150	100	75
HP ThinkJet	192	96		
IBM Proprinter II/XL	120	60		
IBM Proprinter X24 and XL24	180	120		
NEC Pinwriter P5	180	120		
Okidata 290-Series Printers	120	60		
IBM Quietwriter II	120	60		
Toshiba P321SL/P351	360	180		
Xerox 4045 Laser Printer	300	150		

<div align="center">

C:\> **SET RESOLUTION=192**

</div>

B. Versatec Printers

The Versatec printer driver recognizes ORIENTATION, TEMPDIR and PLISTSIZE set commands.

PAPER=[A,B,C,D,E,F] set the page size according to the ANSI standard:

C:\> **SET PAPER=B**

VERSA=<printer code> tells the printer driver which Versatec Printer it is controlling.

Printer	Printer Code
V-80	V80 (default)
C25xx	25xx
CE 32xx	32xx
CE 34xx	34xx
72xx	72xx
74xx	74xx
ECP 42	9242
Versacolor	VERSACO

C:\> **SET VERSA=7236**

C. Plotters

ORIENTATION=[LANDSCAPE, PORTRAIT] works the same for either printers or plotters.

FLAGGING=[HARDWARE, XONOFF] will change the handshaking protocol for HP and HP Graphics Language Plotters.

C:\> **SET FLAGGING=XONOFF**

The plotter redirect and type set commands, while having the same form, don't have a specific set command.

Plotter Driver	<device driver>	<device type>
HP Pen Plotter	HPPLOT	
HP Graphics Language	HPGLPLTR	HP_TYPE
Houston Instruments	HIPLOTTR	HI_TYPE
Roland DG Plotters	ROLAND	RD_TYPE

<DEVICE DRIVER>=[COM1, COM2, COM3, COM4] will redirect the plotter to a different serial port. The Roland DG Plotter driver only supports COM1. If the plotter is redirected, remember to set the Baud rate for that serial port as well.

C:\> **SET HPPLOT=COM3**

<DEVICE DRIVER> = <output file> will redirect the plotter instructions to a file. This set command is only supported by the HP Graphics Language and Houston Instrument drivers.

C:\> SET HIPLCTTR=PLOTTER.GLP

<DEVICE TYPE> = <plotter code>,<page size>,<number of pens> tells the plotter driver what model plotter it is controlling.

Plotter	Plotter Code	Defaults (Page size & Number of Pens)	
Roland DG			
880 and 980	980	A	8
885 and 990	990	B	8
2000	2000	C	8
3300	3300	D	8
Hewlett Packard			
6180, 7370 or 7440	7440	A	8
7371 and 7470	7470	A	2
7372 and 7475	7475	B	6
6182 and 7550	7550	A	8
6184, 6186, 7374, 7375, 7570, 7580, 7585, 7586, 7595 and 7596	7580	D	8
Houston Instruments DMP			
29	29	B	8
40	40	B	1
41	41	C	1
42	42	A	1
51	51	C	1
52	52	A	1
56	56	B	1
61	61	B	1
62	62	B	1

The Page Size is the ANSI page size [A - F]. The Houston Instruments driver will also support the ISO European page sizes [A0 - A4].

C:\> SET HI_TYPE=29
C:\> SET HP_TYPE=7475,A,4
C:\> SET RD_TYPE=980,,6