



**US Army Corps
of Engineers**

The Hydrologic
Engineering Center

1

AD-A209 458

COMPUTING WATER SURFACE PROFILES WITH HEC-2 ON A PERSONAL COMPUTER

DTIC
ELECTE
MAY 23 1989
S D

DECLASSIFICATION STATEMENT A
Approved for public release
Distribution Unlimited

Training Document No. 26

SEPTEMBER 1988

004

REPORT DOCUMENTATION PAGE		1. REPORT NO. DOD/SW/DK-89/015b	2.	3. Recipient's Accession No.
4. Title and Subtitle Computing Water Surface Profiles with HEC-2 on a Personal Computer (Training Document No. 26)			5. Report Date September 1988	
7. Author(s) The Hydrologic Engineering Center			8. Performing Organization Rept. No.	
9. Performing Organization Name and Address Department of Army The Hydrologic Engineering Center Corps of Engineers 609 Second Street Davis, CA 95616			10. Project/Task/Work Unit No.	
12. Sponsoring Organization Name and Address Department of Army The Hydrologic Engineering Center Corps of Engineers 609 Second Street, Davis, CA 95616			11. Contract(C) or Grant(G) No. (C) (G)	
			13. Type of Report & Period Covered	
15. Supplementary Notes For diskette see: Related Documents:HEC-2 Water Surface Profiles Programmer's Manual (9-82, rev. 10-84);HEC-2, Water Surface Profiles User's Manual (9-82 rev. 5-85);Supplement to HEC-2 Users Manual (9-88). Copies avail.from HEC.			14.	
16. Abstract (Limit: 200 words)				
<p>A package of computer programs has been developed to compute water surface profiles and display the tabular and graphical form. The package is based on the Corp's Water Surface Profile Program HEC-2. This document presents each program in the package and provides user guidance.</p>				
17. Document Analysis a. Descriptors				
b. Identifiers/Open-Ended Terms				
c. COSATI Field/Group				
18. Availability Statement Release Unlimited		19. Security Class (This Report) Unclassified 20. Security Class (This Page) Unclassified		21. No. of Pages 70 22. Price A04

DO NOT PRINT THESE INSTRUCTIONS AS A PAGE IN A REPORT

INSTRUCTIONS

Optional Form 272, Report Documentation Page is based on Guidelines for Format and Production of Scientific and Technical Reports, ANSI Z39.18-1974 available from American National Standards Institute, 1430 Broadway, New York, New York 10018. Each separately bound report—for example, each volume in a multivolume set—shall have its unique Report Documentation Page.

1. **Report Number.** Each individually bound report shall carry a unique alphanumeric designation assigned by the performing organization or provided by the sponsoring organization in accordance with American National Standard ANSI Z39.23-1974, Technical Report Number (STRN). For registration of report code, contact NTIS Report Number Clearinghouse, Springfield, VA 22161. Use uppercase letters, Arabic numerals, slashes, and hyphens only, as in the following examples: FASEB/NS-75/87 and FAA/RD-75/09.
2. **Leave blank.**
3. **Recipient's Accession Number.** Reserved for use by each report recipient.
4. **Title and Subtitle.** Title should indicate clearly and briefly the subject coverage of the report, subordinate subtitle to the main title. When a report is prepared in more than one volume, repeat the primary title, add volume number and include subtitle for the specific volume.
5. **Report Date.** Each report shall carry a date indicating at least month and year. Indicate the basis on which it was selected (e.g., date of issue, date of approval, date of preparation, date published).
6. **Sponsoring Agency Code.** Leave blank.
7. **Author(s).** Give name(s) in conventional order (e.g., John R. Doe, or J. Robert Doe). List author's affiliation if it differs from the performing organization.
8. **Performing Organization Report Number.** Insert if performing organization wishes to assign this number.
9. **Performing Organization Name and Mailing Address.** Give name, street, city, state, and ZIP code. List no more than two levels of an organizational hierarchy. Display the name of the organization exactly as it should appear in Government indexes such as Government Reports Announcements & Index (GRA & I).
10. **Project/Task/Work Unit Number.** Use the project, task and work unit numbers under which the report was prepared.
11. **Contract/Grant Number.** Insert contract or grant number under which report was prepared.
12. **Sponsoring Agency Name and Mailing Address.** Include ZIP code. Cite main sponsors.
13. **Type of Report and Period Covered.** State interim, final, etc., and, if applicable, inclusive dates.
14. **Performing Organization Code.** Leave blank.
15. **Supplementary Notes.** Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of . . . Presented at conference of . . . To be published in . . . When a report is revised, include a statement whether the new report supersedes or supplements the older report.
16. **Abstract.** Include a brief (200 words or less) factual summary of the most significant information contained in the report. If the report contains a significant bibliography or literature survey, mention it here.
17. **Document Analysis.** (a). **Descriptors.** Select from the Thesaurus of Engineering and Scientific Terms the proper authorized terms that identify the major concept of the research and are sufficiently specific and precise to be used as index entries for cataloging.
(b). **Identifiers and Open-Ended Terms.** Use identifiers for project names, code names, equipment designators, etc. Use open-ended terms written in descriptor form for those subjects for which no descriptor exists.
(c). **COSATI Field/Group.** Field and Group assignments are to be taken from the 1964 COSATI Subject Category List. Since the majority of documents are multidisciplinary in nature, the primary Field/Group assignment(s) will be the specific discipline, area of human endeavor, or type of physical object. The application(s) will be cross-referenced with secondary Field/Group assignments that will follow the primary posting(s).
18. **Distribution Statement.** Denote public releasability, for example "Release unlimited", or limitation for reasons other than security. Cite any availability to the public, with address, order number and price, if known.
19. & 20. **Security Classification.** Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED).
21. **Number of pages.** Insert the total number of pages, including introductory pages, but excluding distribution list, if any.
22. **Price.** Enter price in paper copy (PC) and/or microfiche (MF) if known.

OPTIONAL FORM 272 BACK (4-77)

TRAINING DOCUMENT NUMBER 26

COMPUTING WATER SURFACE PROFILES WITH HEC-2 ON A PERSONAL COMPUTER

Description and User Guidance

SEPTEMBER 1988

Vernon R. Bonner



THE HYDROLOGIC ENGINEERING CENTER
WATER RESOURCES SUPPORT CENTER
U.S. ARMY CORPS OF ENGINEERS
609 SECOND STREET
DAVIS, CA 95616-4687

(916) 551-1748

Accession For	
NTIS CRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
PC. 15.95 } NTIS	
By MF 6.95 }	
Distribution	
Availability Codes	
Dist	Avail and/or Special
A-1	21

COMPUTING WATER SURFACE PROFILES WITH HEC-2 ON A PERSONAL COMPUTER

TABLE OF CONTENTS

CHAPTER	Page
1. INTRODUCTION	
1.1 Program Development	1
1.2 Overview of the HEC-2 Package	1
1.3 Acknowledgments	3
1.4 Program Documentation	4
1.5 Computer Equipment Requirements	5
1.6 Program Distribution	5
2. LOADING PROGRAMS ON YOUR COMPUTER	
2.1 Contents of the HEC-2 Package Diskettes	6
2.2 Program Installation on a Hard-disk System	6
2.3 Program Execution on a Hard-disk System	8
2.4 Running on a Two Floppy-diskette System	9
2.5 Files Associated with the Programs	11
2.6 Files Included on the Diskettes	11
3. HEC-2 PACKAGE MENU PROGRAM	
3.1 Program Purpose	13
3.2 Program Set-up	13
3.3 Program Operation	13
4. CREATING AN INPUT DATA FILE	
4.1 Sequence of HEC-2 Computations	19
4.2 Input Data File Format	19
4.3 COED Application	20
4.4 File Creation and Storing	22
5. CHECKING AN INPUT FILE FOR ERRORS	
5.1 Purpose of EDIT2 Program	23
5.2 EDIT2 Program Execution	23
5.3 Types of Data Checks Performed	24
5.4 Error Messages Provided	24
5.5 Correcting Input Data Errors	25
6. COMPUTING WATER SURFACE PROFILES	
6.1 HEC-2 Program Execution	26
6.2 Program Output Files	27
6.21 OUTPUT - Formatted Output File	27
6.22 TAPE95 - Intermediate Profile Results	28
6.3 Output Control	29
6.4 Model Calibration	30
6.5 File Archives	30

TABLE OF CONTENTS (Continued)

CHAPTER	<u>Page</u>
7. REVIEWING THE HEC-2 FORMATTED OUTPUT FILE	
7.1 Printout Sequence	32
7.2 Special Notes	33
7.3 Reviewing Output File with Program LIST	33
7.4 Output Review	34
8. CREATING SUMMARY OUTPUT TABLES	
8.1 Purpose of SUMPO Program	37
8.2 Program Operation	37
8.3 Select Pre-defined Summary Tables	39
8.4 Create Summary Tables	42
9. PLOTTING WITH PLOT2	
9.1 Purpose of PLOT2 Program	46
9.2 Program Operation	46
9.3 Output Devices	47
9.4 Pen Plotter Setup	48
9.5 Profile Plots	48
9.6 Cross-section Plots	54
9.7 Rating Curve Plots	59
10. REFERENCES	63

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1.	HEC-2 Computational Process	2
2.	PC Hard Disk Organization Using HEC Application Programs	7
3.	HEC2 Package Menu, MENU2	14
4.	Define Input/Output Files Menu	15
5.	MENU2 Data File Listing	16
6.	HEC-2 Input Data File in COED Full Screen Mode	20
7.	COED Help Screen	21
8.	SUMPO Main Menu	38
9.	SUMPO Define Files & Printer Width Menu	39

TABLE OF CONTENTS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
10.	SUMPO Pre-defined Summary Tables Menu	40
11.	SUMPO Cross-section Selection Menu	41
12.	SUMPO Profile Selection Menu	42
13.	SUMPO Create Table Menu	43
14.	SUMPO Saved Variables Menu	45
15.	PLOT2 Main Menu	47
16.	Pen Plotter Switch Setting	48
17.	PLOT2 Profile Plots Menu	49
18.	PLOT2 Profile Options Menu	49
19.	PLOT2 Plotting Options Menu	51
20.	PLOT2 Profile Colors Options Menu	52
21.	PLOT2 Profile Selection Menu	53
22.	Example Profile Plot	54
23.	PLOT2 Cross-Sections Plots Menu	55
24.	PLOT2 Cross-section Options Menu	55
25.	PLOT2 Plotting Options Menu	56
26.	PLOT2 Cross-section Color Options Menu	57
27.	Example Cross-section Plot	58
28.	PLOT2 Rating Curve Plot Menu	59
29.	PLOT2 Rating Curve Options Menu	59
30.	PLOT2 Rating Curve Plotting Options Menu	60
31.	PLOT2 Rating Curve Color Options Menu	61
32.	Example Rating Curve	62

1. INTRODUCTION

A package of computer programs have been assembled to compute water-surface profiles and display the results on a personal computer (PC). The package is based on the HEC-2 Water Surface Profile computer program. The Users Manual provides detailed information for the HEC-2 program. This document provides installation information and presents a description of each component of the PC package.

1.1 Program Development

The HEC-2 computer program was originally developed in the Hydrologic Engineering Center (HEC) by Bill S. Eichert. The present version is the product of development involving several HEC engineers. The basic computational capabilities for calculating water surface profiles remain essentially unchanged; however, numerous supplemental capabilities have been added over the years.

In response to a high demand from both the Corps and private engineering sectors, the HEC implemented HEC-2 for MS-DOS compatible microcomputers (PC) in 1984. The edit program for HEC-2 data (EDIT2) was also converted at that time. The PC program distribution started in the fall of that year. The programs were modified in 1986 to meet Fortran 77 standards. The 1984 PC versions maintained all the capabilities of the original mainframe version of the program, except for internal trace and comment information.

In 1986 a package of programs was provided in an attempt to bring together all the necessary tools to accomplish a complete computation and display of water surface profiles on a personal computer. The Draft version of this Training Document was developed in support of that package of programs.

Since the 1986 release, refinements to the programs have continued. The 1988 Fortran 77 version of HEC-2 was created with a number of added features, with an emphasis on hydraulic design applications. Additionally, some improvements have been made to each program in the PC package.

1.2 Overview of the HEC-2 Package

Once the cross section and field information has been gathered, the basic steps for computing water surface profiles include: (1) develop data file representing the physical reach under study, (2) check the data file for proper format and data errors, (3) compute water surface profiles, (4) review and evaluate computed results, and (5) produce required displays of computed results. The computational process is illustrated in Figure 1. The programs provided with the HEC-2 package provide the necessary tools to accomplish all the basic steps on a PC.

A menu program, MENU2, has been developed to provide program users convenient access to the HEC-2 package of programs and related files, when operating a PC with hard-disk storage. The menu, described in Chapter 3, eliminates repeated typing of program and file names in order to use the programs in the package.

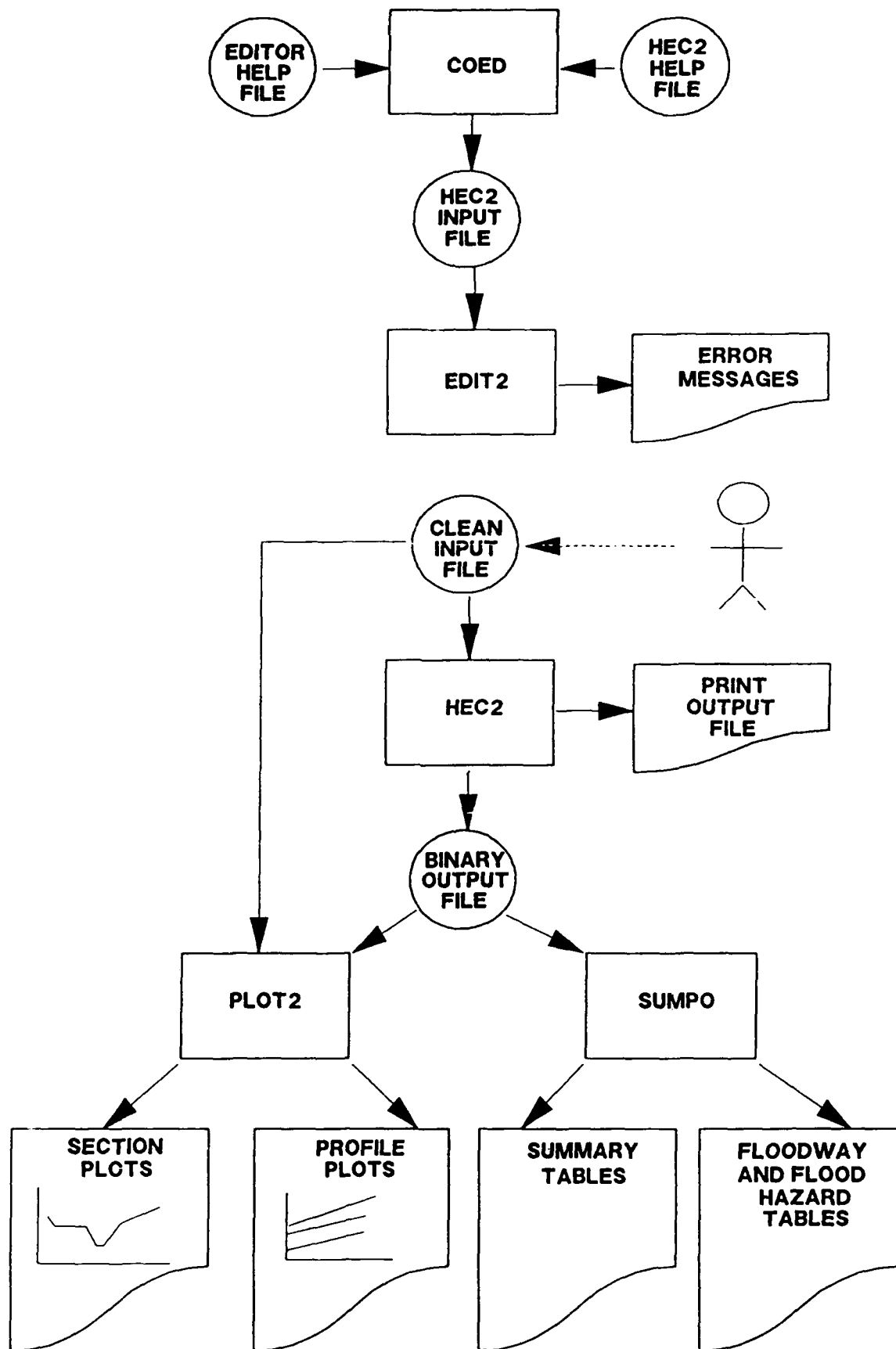


Figure 1. HEC-2 Computational Process

Text editors can be used to create and modify an input data file for the HEC-2 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 for HEC-2 as the data file is created. It also has help file information on HEC-2 variables. Chapter 4 provides information on creating and editing HEC-2 input files.

Checking an HEC-2 data input file is facilitated with the EDIT2 computer program. The program provides tests for proper input sequence, format, and data ranges. Running the input data file with EDIT2 is recommended to assist in locating input errors. Chapter 5 describes the EDIT2 program, the types of error messages, and the typical corrections required.

The HEC-2 program operates with the input data file to compute the water surface profiles. The optional capabilities, provided in the program, can also be used to solve many flood plain hydraulic problems. Chapter 6 provides information on running HEC-2 on a PC.

Once the HEC-2 program has been executed, the job of reviewing the results begins. Chapter 7 describes the HEC-2 output and gives some guidelines for output review. The use of computer program SUMPO to create summary tables of results is presented in Chapter 8, and the use of computer program PLOT2 for graphical displays is presented in Chapter 9. PLOT2 duplicates most of the capabilities of the Hydraulics Graphics Package, which produces HEC-2 cross section and profile plots in interactive or batch modes on the Corps' mainframe computers.

1.3 Acknowledgments

Vern Bonner, Chief, Training Division, is the author of this document. Dan Hoggan provided document revisions for the updated 1988 versions of the programs. Some of the concepts presented were derived from training materials on HEC-2, developed over the past decade. John Peters, Richard Hayes, and Alfredo Montalvo were major contributors to those training materials.

The HEC-2 computer program was developed by Bill S. Eichert, the current Director of HEC. The program is the product of development, primarily involving those HEC engineers mentioned above. The PC version of the program was created in 1984 by Alfredo Montalvo. The 1988 version was developed by Randy Hills.

The SUMPO program was developed, from the HEC-2 output routines, by Al Onodera. The program was converted for the PC by Alfredo Montalvo. The menus for the current PC version of the program were developed by Keith Knight.

The PLOT2 program was developed by Bob Barkau. Keith Knight added new menus, scaling options, rating curve routines and restructured the program. PLOT2 uses plot subroutines developed by Microcompatibles, Inc.

The menu program, MENU2, was developed by Keith Knight. It provides convenient access to the HEC-2 package and the utilities LIST PROUT and COED.

The PC version of COED, with full-screen edit capability, was developed at HEC by Art Pabst and Bill Charley from the command-line editor, in use on the Harris Computers in the Corps of Engineers since 1980. Many of the features of the new PC version are also available on the new Harris Computer version.

The LIST program is a public domain utility written by Vernon D. Buerge, AAI Systems, Inc. The program is presently distributed as Share-Ware with a request for a gift to support development.

1.4 Program Documentation

The primary documentation for the HEC-2 program is the Users Manual. The Manual provides a complete description of the HEC-2 program capabilities, theoretical basis for computations, program input and program output. A careful review of the Users Manual should be made before using the computer program. There is no users manual for the EDIT2, SUMPO, or PLOT2 computer programs. This material is the only documentation for those programs.

Supplemental information is available through the following HEC publications:

HEC-2 Programmers Manual. (Applicable for mainframe application of the program)

IHD Volume 6, Water Surface Profiles. (General theory and concepts for computing profiles)

Training Document No. 5, Floodway Determination Using Computer Program HEC-2. (Presents FEMA based floodway procedures in HEC-2)

Training Document No. 6, Application of the HEC-2 Bridge Routines. (Included as Appendix IV in HEC-2 in Users Manual)

Training Document No. 18, Application of the HEC-2 Split Flow Option. (Present concepts and procedure for using option to compute overflow from water surface profiles).

Technical Paper No. 11, Survey of Programs for Water Surface Profiles. (1968 comparison of available programs)

Technical Paper No. 20, Computer Determination of Flow Through Bridges. (Description of HEC-2 bridge hydraulics)

Technical Paper No. 69, Critical Water Surface by Minimum Specific Energy Using the Parabolic Method. (Description of the HEC-2 critical depth computation procedure)

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:

**The Hydrologic Engineering Center
Water Resources Support Center
609 Second Street
Davis, CA 95616-4687**

The HEC provides training in HEC-2 in a Basic and an Advanced HEC-2 course and in a Flood Plain Hydrology Course. The HEC also provides user assistance for program users. There are several university extension short courses on the use of the HEC-2 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-2. The tapes are distributed only in the U.S.A. by a contractor, which may vary from year to year. A Video Tape Catalog with ordering information is available from the HEC at no charge.

1.5 Computer Equipment Requirements

The following equipment is required to run the HEC-2 package of programs on MS-DOS microcomputers.

DOS 2.0 (or later) Operating System

512K-byte (or more) RAM Memory

Two 5 1/4 inch floppy-disk drive (360 KB or 1.2 MB), or

One 5 1/4 inch floppy-disk drive and one 10MB (or larger) hard-disk drive

(NOTE: a hard-disk is required for MENU2 use)

The graphic displays from PLOT2 can be sent to the screen or an HP 7475A pen plotter. Either of the following graphics cards (or their equivalent) is required:

IBM Color Graphics Adapter (CGA), or

IBM Enhanced Color Graphics Adapter (EGA)

A separate version is available for Hercules Graphics Adapter (PLOT2H).

The programs will take advantage of a math coprocessor (8087, 80287, or 80387) if present in your computer. This coprocessor greatly speeds up program run time and is recommended, but it is not necessary for program accuracy.

1.6 Program Distribution

Most computer programs of the HEC are available to public agencies and private individuals at a cost to cover reproduction, documentation, and handling. (The distribution fee includes one copy of the program documentation.) Corps of Engineers offices and other Army agencies may receive copies from HEC at no charge. Other offices may obtain the program from NTIS or a number of private distributors.

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

2. LOADING PROGRAMS ON YOUR COMPUTER

The floppy diskettes you receive are double-sided, double density, capable of holding approximately 360K bytes of information. They were created using MS-DOS 2.0, or higher. Many of the program files have been written in an archive form and are labeled with the .ARC extension. These files must be processed with the PKXARC program before they can be used.

2.1 Contents of the HEC-2 Package Diskettes

The HEC-2 package of programs, example input data, example output, menu system and full screen editor (COED) are provided on four 5 1/4 inch double-sided 360 KB floppy diskettes as follows:

INSTALL DISKETTE:	HEC2DAT.ARC	LIST.DOC
	PKARC.COM	README.DOC
	PKXARC.COM	CONFIG.SYS
	PXARC.DOC	UTILPROG.ARC
	PKXARC.DOC	

COED DISKETTE:	COEDHLP.ARC	COED.TRM
	COEDHPG.ARC	COED.XTK
	COEDDOC.ARC	

HEC2EXE DISKETTE: HEC2EXE.ARC

SUP2EXE DISKETTE: SUP2EXE.ARC

NOTE: All files with the .ARC extension are archived files. They must be unpacked by the program PKXARC provided on the INSTALL DISKETTE. PKXARC.DOC contains documentation for the program.

2.2 Program Installation on a Hard-disk System

1. You will need to create three directories. One of the directories should be labeled \HECEXE. The directory will be used to store all of the HEC executable programs. A second directory should be labeled \HECEXE\SUP. This directory will be used to store all of the supplemental files required by the executable programs. A third directory should be created to store data files. This directory can be given any name. As shown in Figure 2, you may want this data directory to represent a specific project, person, or program. For this example, we will use \HEC2 for the data directory.

Go to the disk-drive (e.g., C:) where you will install the software. From the Root Directory (C:\) enter the following:

MD \HEC2

MD \HECEXE

MD \HECEXE\SUP

These commands will create the Directories, as shown in Figure 2.

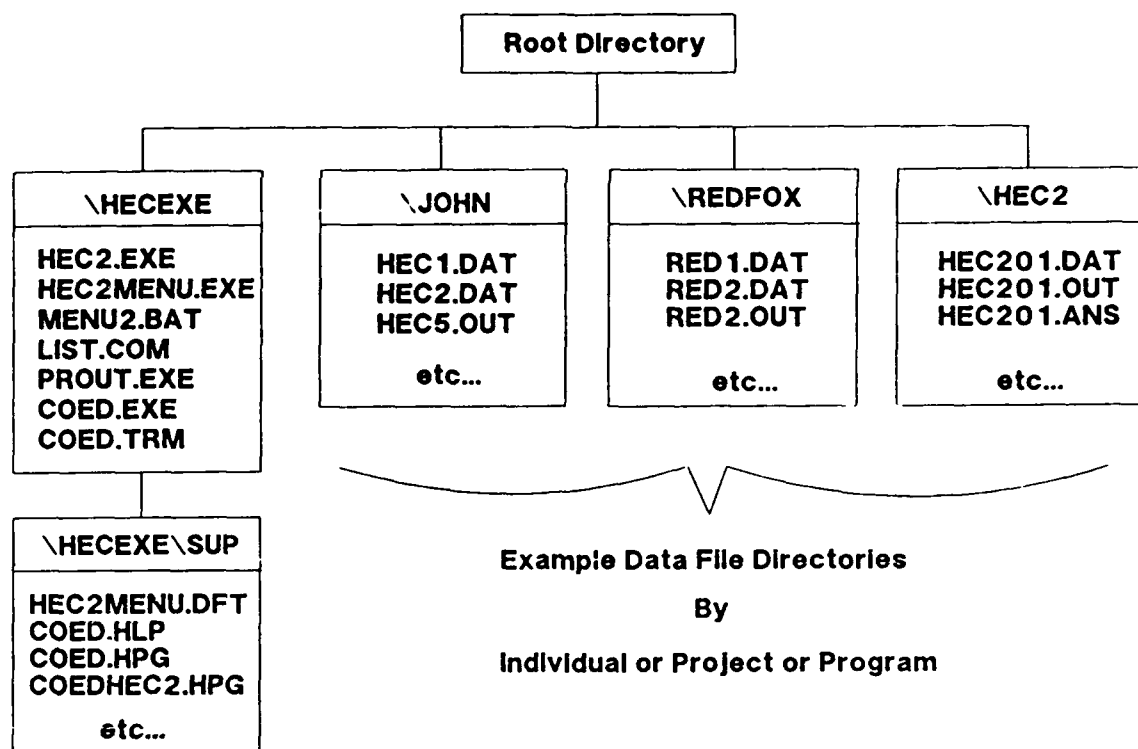


Figure 2. PC Hard Disk Organization Using HEC Application Programs

2. Place the INSTALL diskette into the A: drive. You will need to copy the PKXARC.COM and CONFIG.SYS files into your root (C:\) Directory. At the DOS prompt enter the following:

COPY A:PKXARC.COM

COPY A:CONFIG.SYS

The PKXARC.COM program will be used to de-archive the HEC-2 package of programs and to copy them to the hard-disk.

I M P O R T A N T ! The CONFIG.SYS file contains two lines: FILES=20, and BUFFERS=20. Many HEC programs require the capability to open more than eight (8) files at any one time. Because eight (8) is the system default, you will need the CONFIG.SYS file in the root directory (or on the DOS diskette) to set the limits to 20.

3. The next step will de-archive the HEC-2 test input and output files. If you do not want these files copied to your hard disk, skip to step 4.

If you want a copy of the test files written to your hard-disk, at the DOS prompt enter the following:

PKXARC A:HEC2DAT \HEC2

4. The next step will install the Full Screen Editor, COED, onto your hard-disk. COED provides advanced editing features and help files for input information for several HEC programs. To install COED, place the **COED diskette into the A: drive**, and at the DOS prompt, enter the following:

PKXARC A:COEDEXE \HECEXE

PKXARC A:COEDHLP \HECEXE\SUP

PKXARC A:COEDDOC \HECEXE\SUP

PKXARC A:COEDHPG \HECEXE\SUP

These commands will de-archive the files and copy COED into directory C:\HECEXE and the various COED Help files into the C:\HECEXE\SUP directory.

5. To copy the HEC-2 package of programs onto the hard-disk, place the **HEC2 diskette into the A: drive**, and at the DOS prompt, enter the following:

PKXARC A:HEC2EXE \HECEXE

When the transfer is complete, insert the **SUP2 Diskette into the A: drive**, and at the DOS prompt, enter the following:

PKXARC A:SUP2EXE \HECEXE

These commands will de-archive the HEC-2 package of programs and copy them to the C:\HECEXE directory.

6. **I M P O R T A N T !** To allow access of the executable programs from any directory, it is necessary to edit the **AUTOEXEC.BAT** file to include a **PATH** to the **HECEXE** directory. The **AUTOEXEC.BAT** file should be in your root (C:\) directory. The following is an example **PATH** command that would allow access to the **\HECEXE** directory as well as the root:

PATH C:\C:\HECEXE

N O T E: The **PATH** should also include your DOS directory and any other utility directory you want access to for general use computer programs. For more information on the **PATH** command and the **AUTOEXEC.BAT** file, consult you DOS manual.

2.3 Program Execution on a Hard-disk System

After installation and prior to execution, your system must be rebooted. This will provide the computer the revised information from your **CONFIG.SYS** and **AUTOEXEC.BAT** files. You are now ready to test the computer program. The preferred mode of execution is through the Menu system, although you can run the individual programs in the package separately.

To run the programs from MENU2, enter the following at the DOS prompt:

CD \HEC2

MENU2

The MENU2 menu will appear on the screen and you are ready to use the programs in the package. See Chapter 3 for a description of the MENU2 program options. Each of the individual programs is described in the chapters that follow.

To run the individual programs, the program name is entered along with the associated file names. If the file names are not given, the program will prompt you for the files. For example, to run HEC-2, enter the following at the DOS prompt:

HEC2 IN=A:HEC2##.DAT OUT=TEST##.OUT TAPE95=TEST##.T95

where: HEC2## is the test input data file (use A: if it's on the A Drive) and ## is the test number 01 through 17.

If you do not specify the files on the execution line, the program will request the file names as follows:

ENTER THE FILENAME FOR INPUT [CON]

ENTER THE FILENAME FOR OUTPUT [CON]

ENTER THE FILENAME FOR TAPE95

By pressing the Enter Key <ENTER> in response to the questions, the default option will be selected.

The computed results from your output file can be compared with the output files provided for each test. Once you have verified that the program indeed runs on your computer, you can begin creating your own input data for the program. See Chapter 4 for information on input file creation. To run the program with your own data, issue the same commands using the file names for your data.

Most of the HEC computer programs create and delete their own scratch files. If a program should terminate abnormally, you may see files on your system called TAPE92, TAPE93, etc. You may delete or rename these files as needed.

2.4 Running on a Two Floppy-diskette System

Before you can use the HEC-2 package programs, you will have to de-archive the programs with PKXARC. The following assumes two diskette drives labeled A: and B:.

1. First the PKXARC program must be copied onto a blank, Formatted diskette. Insert the **INSTALL** diskette into the default drive (this example assumes A:) and the Formatted diskette into the other drive. At the DOS prompt, enter the following:

COPY PKXARC.COM B:

2. Remove the **INSTALL** diskette, and insert the **HEC2** diskette into drive A:. At the DOS prompt, enter:

B:PKXARC A:HEC2EXE B:"program"

Where: "program" is the program to de-archive. The default is all programs; however, all programs will not fit on the target diskette. The same procedure can be used to de-archive programs from the SUP2 diskette.

3. To run HEC-2, put the diskette with HEC-2 into drive B.
4. Put the diskette to receive output data and scratch files into drive A.
5. Be sure drive A is the default drive, the prompt will be "A>".
6. Start the execution of HEC-2 by entering

B:HEC2

7. The computer will return:

ENTER THE FILENAME FOR INPUT [CON]

At this time, remove the HEC-2 diskette from drive B, and put the diskette with the input file into drive B.

8. In response to the question, enter the name of the input file. For example,

B:HEC201.DAT

9. The computer will now return:

ENTER THE FILENAME FOR OUTPUT [CON]

To select the default, press the Enter Key <ENTER> and the output will be displayed on the screen. Otherwise enter PRN for printer or a file name for disk storage (e.g., B:TEST01.OUT). Remember that the provided output file for the test data is HEC2##.OUT, so do not use that name or the file will be written over.

10. The program will then respond with:

ENTER THE FILENAME FOR TAPE95

To select the default, TAPE95, press the Enter key. This option is usually selected.

11. The program is now executing and will display a message:

Starting profile number #

CWSEL for cross section xx is yy

Where: # is the sequential number of the profile.
xx is the cross section number.
yy is the computer water surface elevation (CWSEL).

When complete, the following message will be displayed:

Normal program termination

The following chapters provide information on creating input data files and executing all the programs in the HEC2 package. Please refer to the appropriate chapter for program instructions.

2.5 Files Associated with the Programs

Files Created by HEC-2. Besides INPUT (TAPE5) and OUTPUT (TAPE6), up to nine files may be created in an HEC-2 application. They are as follows:

<u>File</u>	<u>Type</u>	<u>Data</u>
TAPE7	FORMATTED	Storage-outflow data for streamflow routing
TAPE10	FORMATTED	Reformatted data from the free format option
TAPE90	SCRATCH	Split flow data
TAPE91	SCRATCH	Cross-section data file
TAPE92	SCRATCH	Cross-section plots
TAPE93	SCRATCH	Information for profile plots
TAPE94	SCRATCH	Comment records
TAPE95	UNFORMATTED	Computed profiles
TAPE96	FORMATTED	Archive data

Scratch files are deleted when the program terminates normally. The other files are retained for later use.

2.6 Files Included on the Diskettes

The files provided in the HEC-2 package include the following:

HEC2DAT.ARC Archived file of input and output data for 17 example data sets. Input files will be labeled HEC201.DAT - HEC217.DAT, and output files will be labeled HEC210.ANS - HEC217.ANS after they are de-archived during installation.

PKARC.COM Software used to archive the HEC2 PACKAGE of programs into smaller files with the extension .ARC. An archive is a collection of one or more files placed into a single archive file. Each file in an archive is compressed to save disk space, backup storage space, and file transfer time.

PKXARC.COM Software used to de-archive files with the extension .ARC into their original form.

PKARC.DOC & PKXARC.DOC Documentation for the PKARC and PKXARC programs.

LIST.DOC Documentation for the LIST program.

README.DOC File containing this implementation guide.

CONFIG.SYS The configuration file for files and buffers.

COEDEXE.ARC Archive of the COED executable (COED.EXE).

COEDHLP.ARC Archive of the COED help screens.

COEDHPG.ARC Archive of the COED help files.

COEDDOC.ARC Archive of the COED documentation.

COED.TRM File where COED default settings are saved.

COED.XTK Crosstalk file that emulates a Televideo terminal.

HEC2.EXE The HEC-2 program to compute water surface profiles.

HEC2MENU.EXE The executable portion of the menu program.

MENU2.BAT The batch file that is used to run the MENU2 program.

LIST.COM Utility used to provide convenient screen displays of files written to disk.

PROUT.EXE Utility used to send output files to the printer with the carriage control invoked.

PLOT2.EXE Program to plot cross-sections from an input data file and data profiles from the HEC-2 TAPE95 file (CGA or EGA version).

PLOT2H.EXE The PLOT2 program for the Hercules Graphics Adapter (HGA version).

SUMPO.EXE Program to provide summary tables from the TAPE95 file, written by HEC-2. Summary tables are similar to the tables created by HEC-2 using the J3 card.

EDIT2.EXE Program to check an input data file for errors and inconsistencies.

3. HEC-2 PACKAGE MENU PROGRAM

3.1 Program Purpose

A menu program, MENU2, has been created to provide convenient access to all the programs in the HEC-2 package, including COED and LIST, when operating on hard-disk systems. All of the programs in the package can operate independently without the menu; however, it should make it more convenient to define and transfer file names among the various programs in the package. The following provides a description of the menu operation.

3.2 Program Set-up

For a hard-disk system, the executable programs in the HEC-2 package would be stored in a directory (e.g., \HECEXE), along with the menu batch file, MENU2. Refer to Chapter 2 of this document for installation instructions. The DOS PATH command is used to list the directories to be searched for commands or batch files. The installation instructions include adding \HECEXE to the PATH. Usually the PATH command is included in the AUTOEXEC.BAT file so that it automatically enters the command when you boot the system. Refer to your DOS Manual for information on the PATH command and the AUTOEXEC.BAT file.

The data files for HEC-2 should be developed in a separate Working Directory (e.g., \HEC2). The test data can be copied into this directory if you want to run the Standard Tests. Program execution will occur in this directory; therefore, all input, output and scratch files will be in this directory.

3.3 Program Operation

The HEC-2 programs in the \HECEXE directory can be called while operating in any other directory because the PATH includes \HECEXE. To operate the HEC-2 package, change into the Working Directory (e.g., \HEC2), and execute the MENU2 program.

```
C:> CD \HEC2
```

```
C:> MENU2
```

The menu, shown in Figure 3, will appear. All the programs in the HEC-2 package can be executed from this menu, as well as defining input and output file names. The background and text colors can be changed for color monitors by pressing the F9 and F10 keys, respectively. The program will save the selected colors and file names.

HEC2 Package Menu		
1. Define input/output files 2. Create/edit input file 3. Run HEC2 4. Display output to console 5. Exit to DOS		
Input: (specify)	Output: CON	Tape95: (specify)
Press number or <Enter> to select highlighted option : ↑↓ moves cursor		
July 1988 Menu		

Figure 3. HEC2 Package Menu, MENU2

1. Define input/output files

This option is used to define the target input and output file names that will be used when executing HEC-2, and the support programs. When this option is selected, a pop-up menu will appear as shown in Figure 4.

2. Create/edit input file

This option will only function if you have also installed the full screen editor COED on your system. Selecting this option will call COED with the previously defined input file name, call the COED Help file for HEC-2, COEDHEC2.HPG, and open the file in full screen mode.

3. Run HEC2

This option executes HEC2 and the support programs EDIT2, PLOT2, and SUMPO. The program selection is made by moving the cursor to this line and pressing the space bar until the desired program is displayed.

4. Display output to console

This option is used to display output to the console or the printer. To switch from console to printer, press the space bar while option 4 is highlighted. Program LIST is called with the output file name to provide console display, and PROUT is called to send output to the printer.

5. Exit to DOS

Selecting this option will exit you from the MENU2 program and return control to DOS. The defined file names and screen colors will be saved.

The menu operates by using the cursor arrow keys to move to the desired operation and then pressing <ENTER>, or by pressing the number of the option desired. The menu options are listed in the order of a typical application. The following sections describe each option. First the input and output file names must be defined.

If the file names have been defined in a previous session, the input and output files are shown at the bottom of the menu. The file names are stored when you exit MENU2 and recalled when you return to the menu. At the start, the input file name will show "(specify)".

To define, or change the files, move the cursor to 1. Define Input/Output files and press <ENTER> or enter <1>. A menu will pop up (see Figure 4) for the INPUT, OUTPUT, and TAPE95 files. Also, note the Default extensions and Data directory options.

HEC2 Package Menu		
1. Define input/output files		
<div> Input file ...(specify) Output file ..CON Tape95 file ...(specify) Default extensions ..YES Data directoryC:\HEC2 Return to previous menu </div>		
Input: (specify)	Output: CON	Tape95: (specify)
Type file name or press ? for file directory		
July 1988 Menu		

Figure 4. Define Input/Output Files Menu

With Default extensions .. YES, you only enter the file name (without extension) for the input file. This feature provides the same file name for all the files with the following extensions for HEC-2 files:

- .DAT for input data files
- .OUT for output "Print" files
- .T95 for the binary TAPE95 files

The automatic extension feature can be turned off by moving the cursor to Default extensions and pressing the Space Bar to toggle the choice to NO.

The default directory for file definition is shown next to **Data directory**. The directory can be changed by moving the cursor to that location and editing/entering the directory name. This allows access to data files in different drive and directory locations.

The file name can be entered, or enter a question mark <?>. For the <?> entry, a list of files on the current directory will be displayed, see Figure 5 below. The cursor keys can be used to highlight the desired file, and pressing <ENTER> will select the highlighted file. The Default extension option, described above, will limit the file listing to those with the appropriate assumed extension, e.g., .DAT for data files.

HEC2 Package Menu

1. Define input/output files

Input file ...*.DAT
 Output file ..CON
 Tape95 file ..(specify)

Directory of: C:\HEC2

page 1 of 2

BEAR1 .DAT	GWASH .DAT	LEE2 .DAT	OGLE1 .DAT	REDFOX .DAT
BEAR2 .DAT	HEC201 .DAT	METHOD4 .DAT	OGLE2 .DAT	REDFOXAC.DAT
COW-CK .DAT	HEC208 .DAT	NBRIDGE .DAT	PARMS .DAT	SBRIDGE .DAT
COW-CK1 .DAT	HEC217 .DAT	NORMAL .DAT	PESCALEV.DAT	SIMPLEFW.DAT
COW-CK2 .DAT	HEC2MENU.DAT	NORMALBT.DAT	PLOT2 .DAT	SPECIAL .DAT
FLATPROF.DAT	LEE .DAT	NORMALX2.DAT	PLOTEST .DAT	SPECIALX.DAT
FLOOD .DAT	LFE1 .DAT	OGLE .DAT	RED100 .DAT	SUMPO .DAT

PgUp - previous page
PgDn - next page

Input: (specify)

Output: CON

Tape95: (specify)

Press <Enter> to select file name : f1←→ to move cursor through file names

July 1988 Menu

Figure 5. MENU2 Data File Listing

If you enter an input file name that does not exist, the program will echo:

File does not exist.
 Would you like to create
 it (y/n)?

Enter <y> and the file name will be created.

When all the file names have been defined, move the cursor to **Return to previous menu** and press <ENTER>. This will return you to the MENU2 menu. With Default extensions option on, the cursor will automatically move to the Return position after the input file name is defined; you only have to press <ENTER>.

After the files have been defined, you may want to enter data in a new input file or edit an existing file. Move the cursor to 2. **Create/Edit Input file**, or enter <2> to call COED. The program will echo:

Edit "filename" (y/n)?

to check the "filename" before calling COED with the defined input file name. Enter <y> or press <ENTER> to proceed. Enter <n> if you want to change "filename"; then enter the desired file name to edit.

COED is called with the HEC-2 Help file <HP HEC2> and the Full Screen option <FS>. This will load the HEC-2 input variables Help file, set the Tab setting for input to the HEC-2 program, and put you in the full screen edit mode. As each record ID is entered in columns 1 and 2 of a line, the variables for that ID are displayed at the bottom of the screen. Also, the input description for each variable is available within COED. Within COED the <F1> key provides on-screen help, or refer to the HP command instructions in the COED Manual. Chapter 4 of this document also provides additional information. If the automatic HEC2 Help file does not load, carefully review the COED installation. The assumed configuration is shown in Figure 2.

When you have completed the edit session, exit COED (usually with the SAVE option). With the completion of COED, or any program in the package, the screen will display:

Strike a key when ready . . .

This allows you to see if there are any error messages written to the screen from the current program operation. Pressing any key will return the MENU2 menu.

After the input file has been created or edited, it is a good practice to check the file with EDIT2. To run one of the programs, move the cursor to 3. **Run HEC2**. The program to run can be changed by pressing the <Space bar>. (The instructions are shown at the bottom of the menu.) Press the <Space bar> until **EDIT2** is displayed, and then press <ENTER>. The defined input file will be processed with EDIT2, and the output will be written to the specified output file. When the job is complete, press any key to return to the Package Menu. The specified output file will contain the EDIT2 output.

If a file name was given, item 4. **Display Output to console** can be used to display the output file with program LIST. Simply enter the number <4>, or move the cursor to that line and press <ENTER>. LIST provides a screen display of the output file, using the cursor keys to move through the file. The <End> and <Home> keys are convenient for moving to the bottom or beginning of the file. Press <F1> to see the LIST commands.

If the input file needs correction, move the cursor to line 2. and press <ENTER>, or enter <2> and the input file will be directed to COED for editing. If the input file is ready to run with HEC-2, move the cursor to line 3. and toggle the program to HEC2, with the <Space bar>, and press <ENTER>. The input will be passed to HEC-2 and the job executed. When complete, press any key to return to the MENU2 Menu.

After running HEC-2, programs SUMPO and PLOT2 can be used to examine the results from the job. They are called from line 3, in the same manner as HEC-2, described above. Chapters 8 and 9 provide detailed descriptions of the SUMPO and PLOT2 programs.

The HEC-2 output file can be reviewed on the screen with LIST by entering <4>, as described above. Also, LIST can also be used to print portions of the output file. A complete printing of the output file can be obtained by pressing the <Space bar> to display 4. Display output to printer. A utility program, PROUT, will print the output file with the carriage controls. PROUT will print with either 80- or 132-character line length. However, you must set the printer prior to starting the MENU2 program.

When complete, press number <5> or move the cursor to line 5. Exit to DOS and press <ENTER>. That will take you out of the Menu and return you to the DOS prompt.

4. CREATING AN INPUT DATA FILE

The HEC-2 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-2 computation process, the input data format, and the basic steps for creating and storing an input data file.

4.1 Sequence of HEC-2 Computations

The HEC-2 program is designed to compute multiple profiles with a given data set describing a river reach. The data set for the first profile defines the starting conditions and the physical river reach. If additional profiles are to be computed, the starting conditions for the subsequent profiles are provided at the bottom of the input data file that defines the first profile. Five data records (T1, T2, T3, J1, & J2) are allowed for additional profiles. **NOTE: The 1988 version of HEC-2 does not require three title records.**

As HEC-2 computes water surface elevations for each given cross section, the results are written to a file, TAPE95. There is also a sequential writing of results to the Output file. When the program has completed one profile, the starting conditions are determined (if provided) for the next profile. The program repeats the process of computing the water surface profile with the new starting conditions and the original river reach data set. The multiple profiles are computed for as many profiles as are defined in the input data set. The data set ends with three (3) blank lines (Not required for the 1988 Version) and an ER record.

Once all the profiles are computed, the program reads TAPE95 and formats the summary tables requested by the input data. (See Section 6.1 for more information on HEC-2 operation and Section 6.2 for descriptions of program output files.)

4.2 Input Data File Format

The structure of the HEC-2 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 Appendix VII of the Users Manual.

The format for the HEC-2 data is a "standard" HEC format. The concept is based on the 80-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-2 Users 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).

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-2 and EDIT2 programs will accept input data in "FREE" Format and convert the data into Fixed-Format. However, the Corps' interactive edit program, COED, will automatically place input data into standard (fields of eight) format. COED also provides on-screen help features that enhance the data entry function of the editor. The use of COED is assumed in the following sections.

4.3 COED Application

Creating or editing an input file from MENU2 calls COED. Calling COED from MENU2 also includes two parameters: FS and HP HEC2. If you run COED separately, these parameters can be entered while in COED. Entering HP HEC2 will cause the HEC-2 input help file to be loaded, providing the tab settings for data entry and the input variables for HEC-2. 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 Users Manual for detailed documentation. Figure 6 shows an input data file in COED Full screen edit mode, which is better for data entry.

TOF..										
T1 WATER SURFACE PROFILES WORKSHOP SOLUTION										
T2 COED INPUT PREPARATION FOR PC VERSION										
T3 RED FOX RIVER Q = 1000 cfs										
J1	0	2	0	0	0	0	0	0	3.8	
QT	3	1000	6500	10000						
NC	0	0	0	.1	.3					
NH	5	.1	415	.05	650	.03	710	.05	1020	.10
NH	1635									
X1	1	11	650	710						
GR	25	20	18	110	17	415	14	650	1	675
GR	0	690	1	710	13	710	14	1020	14	1590
GR	25	1635								
NH	4	.1	415	.05	575	.03	640	.1	1250	
X1	2	10	575	640	500	500	500			
GR	25	30	20	110	20	200	17	415	10	575
GR	4	500	4	615	18	640	18	1195	25	1250
NC	.1	.05	.03							
X1	3	10	370	600	400	400	400			
GR	25	40	22	260	18.7	370	15	420	7.1	500
GR	7.5	530	17.3	560	20	600	22	850	25	875
NH	5	.1	130	.05	330	.036	460	.05	610	.1
NC XNL XNR XNCH CCHU CEHU										
Help=F1										
										Col=1 Line=6

Figure 6. HEC-2 Input Data File in COED Full Screen Mode

Once in COED, with HEC-2 Help file and full screen edit mode, data entry will automatically use the first two columns for ID, the next 6 columns for Field 1, and the remaining 9 sets of 8 columns as Fields 2 through 10. With the cursor at the first column, enter any appropriate HEC-2 ID, e.g., T1. The bottom of the screen will display a line of input information for the entered ID (e.g., **FIRST TITLE RECORD** for T1). If the ID is not appropriate for HEC-2, you will get the message:

ID >> >>> Record ID not valid for HEC-2 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 J1, and the variables for the J1 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 7. The COED User Manual is essentially provided through the help file.

F1 Help			F2 COED Help Screen	
Ctl-F1	Help	Restore PC Setup	PC Function Key Usage Help - Request help/Resume editing Restore - Restore line Delete-Ln - Delete current line Insert-Ln - Insert line mode (toggle) Command - Single line edit command Line-Edit - Go into line edit mode Quit - Exit without saving file Save - Save file and resume edit File - Save file and exit COED Help Var - Help for program variable Erase Fld - Erase characters in field	
Shf-F1				
Alt-F1	Help Var			
F3	Delete-Ln	Insert-Ln		
Ctl-F3	-	-		
Shf-F3	Erase Fld	-		
Alt-F3	-	-		
F5	-	-		
Ctl-F5	-	-		
Shf-F5	-	-		
F7	-	-		
Ctl-F7	-	-		
Shf-F7	-	-		
Alt-F7	-	-		
F9	Command	Line Edit		
Ctl-F9	-	Quit		
Shf-F9	-	Save		
Alt-F9	-	File		
			Press <ENTER> for next help screen Press <F1> to resume edit	

Figure 7. COED Help Screen

Help information for HEC-2 variables is provided by pressing <Alt><F1>. The HEC-2 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-2 program.

With the HEC-2 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.

4.4 File Creation and Storing

Basically, the input file is made up of the Title records, the Job records that define starting conditions and program options, and a series of cross-sections that define the river reach. Refer to the User Manual, Appendix VII, for input descriptions. A Functional Use Index in Appendix VII shows the records to use for various program options.

The first profile data usually begins with the Title records (1988 version allows any number of Titles) and ends with the EJ record. For multiple profiles, three more Title records and a J1 and J2 record are provided to define the starting conditions for each succeeding profile. After the EJ record, only Title records, J1, J2, and JR are allowed to define each succeeding profile. An ER record ends the input data file; blank records are not required with the 1988 version. See Test 2 input for an example of a four-profile job.

To create an input file, the editor program COED is executed along with an input file name. If the file does not exist, the file is created and is then available for data entry. The data are entered, starting with the first record, and sequentially entered through the required data set for the reach. For subcritical water surface profiles, the cross-section data starts with the most downstream section, and the cross-sections are defined sequentially upstream to the end of the reach, which would represent the first profile.

The input data file is saved with the appropriate command. Usually, the **FILE** command is used. It saves the edited file and exits the COED program. The **FILE** command can be invoked by pressing the <Alt><F10> keys. While in full screen mode, a single COED command can be entered for the E> prompt, which can be obtained by pressing the <F9>. Pressing <F10> will change COED into the Command mode of operation. Entering <FS> will take COED back to full screen mode.

When complete, exit the text editor, and the input data file is now available to use with the various programs. Chapter 5 describes how to check the input data file. Before running HEC-2 with your data, it is strongly recommended that the input data file be checked with **EDIT2**.

5. CHECKING AN INPUT FILE FOR ERRORS

Once an HEC-2 input data file has been developed, the data should be checked for format errors and possible input errors. The HEC-2 program provides input data checks; but if there is a fatal error, the program will stop. If there were several fatal data errors, it would require several attempts with HEC-2 before each one was found. The input data file should first be checked with the EDIT2 program.

5.1 Purpose of EDIT2 Program

The EDIT2 program will process an entire HEC-2 input data file and provide a list of all the data errors found. Not only does the program identify fatal errors, it also identifies data inconsistencies and possible input errors.

The EDIT2 program will also process Free-Format data and create a Fixed-Format file, as described in Section 4.2. The Fixed-Format data are written to a file (TAPE10), which can be renamed and used for subsequent processing. Generally, it is easier to read and work with the Fixed-Format file because the data are all in their record fields and line up in columns.

5.2 EDIT2 Program Execution

The EDIT2 program can be conveniently run from MENU2. Move the cursor to line 3., press the <Space bar> until the line indicates **RUN EDIT2**, and then press <ENTER>.

The EDIT2 program uses the HEC-2 input data file as its input; no additional input is required. There are three control variables that can be changed by using the optional ED card (see HEC-2 Input Data Description, Appendix VII). The ED card must be the first card in the data file. With it, you can: (1) suppress the listing of the input data, (2) set the column width of the output to 80 without carriage control (default 132), and (3) change the range of elevation difference (default 150) that is used to check for possible errors in input elevations for cross sections. If the difference in elevation in a cross section exceeds the test value, a message is printed indicating a possible input error. If you have an 80-character printer, you may want to use the ED card to set the EDIT2 output to 80.

The HEC-2 input data listing (unless suppressed) and error messages are written to an output file. It is more convenient to direct the output to disk via an output file name; MENU2 will transfer the defined input and output file names. Then, when EDIT2 is finished, you can review the output file with program LIST by selecting option 4. **Display output to console** in MENU2. If there are error messages, you can print them from LIST by turning on the Print Option <P>. The screen display will be sent to the printer. The entire output file can be sent to the printer from MENU2 by pressing the space bar to toggle to 4. **Display output to printer** and pressing <ENTER>. Also, LIST is useful when reviewing the input file because it will display illegal characters that may be in the file.

To execute the EDIT2 program as a separate program, at the DOS prompt enter:

EDIT2 INPUT="filename" OUTPUT="filename"

Where: "filename"= the input and output file names
e.g., HEC205.DAT for input, and HEC205.OUT for output

use: OUTPUT CON for screen
PRN for printer

This assumes that the program and data are in the current default drive. Otherwise, also indicate the proper drive for the program and data. If the input and/or output file names are not given, the program will request the name of the file. In response, enter the file name.

5.3 Types of Data Checks Performed

There are three basic levels of data checks and error messages provided by the EDIT2 program: **ERROR**, **CAUTION**, and **NOTE**.

ERROR messages are provided for those errors that are definitely wrong and probably will stop the HEC-2 program or cause erroneous results. **CAUTION** messages are provided when there may be an error because the data are inconsistent with typical applications of the program. These checks cannot be absolute because there may be situations where the input data are correct. **NOTES** are mostly informational to alert the user to some data entry that may be inconsistent or different than expected. Notes do not necessarily mean the data entry is wrong.

5.4 Error Messages Provided

The program provides numerous checks, and the messages are, hopefully, complete enough to focus the user on the source of the problem. There is no separate list of error checks and messages. The user must interpret the information based on the input data. If some messages do not make sense, correct the ones that do and check the data again.

The general format for the messages is: **Section number - Error type - Card identifier - Message**. (e.g., 51925.000 - NOTE - GR RECORD - STA = 260.000 MINIMUM ELEVATION NOT WITHIN CHANNEL.) Generally, the minimum elevation of a cross section would be within the channel. For this section, the minimum elevation is at station 260, which is not between the left and right banks. This may be an error or maybe it is what the user wants. Obviously, only the person developing the model can make the final determination.

Often the message will focus on the variable that appears to be the problem source. (e.g., 51500.00 - NOTE - QT RECORD - NUMQ = 8 DOES NOT EQUAL NUMBER OF Q READ = 7) If you are not familiar with the variable, refer to the HEC-2 Input Description. Review the card description, variable definition and input description. Usually the variable description will be sufficient to understand the error message. In the example above, the NUMQ variable defines the number of flow values, which was given as 8. However, the QT card only had 7 flow values defined.

5.5 Correcting Input Data Errors

When **CARD OUT OF ORDER** error messages occur, many subsequent error messages may be generated. The **CARD OUT OF ORDER** error messages should be dealt with first. If in doubt about card order, refer to the foldout page at the end of the Users Manual. This Summary of Input Cards shows the cards in their relative order of input. Carefully review your input file, and arrange the card sequence to follow the sequence shown in the Summary.

After correcting the input order, recheck the data file with EDIT2. If there are error messages, try to correct the errors. There may be some messages, including **ERRORS**, that are given even when you have the data set the way you want it. Be sure you understand why your data are causing the message. If the data are the way you want them, go ahead and run the data with HEC-2. However, you may want to place a message in your input file, using the Comment card, to explain any apparent discrepancy. This would help any reviewer, testing your data set with EDIT2, understand why there were still error messages generated from your input data file.

6. COMPUTING WATER SURFACE PROFILES

After the input data file for HEC-2 has been created, checked with EDIT2 and the errors corrected, the data can be submitted to the HEC-2 program to compute water surface profiles. This section describes the basic operation of the HEC-2 program, the program output files, and program options for output.

6.1 HEC-2 Program Execution

The HEC-2 program can be easily executed from MENU2. Move the cursor to option 3., press the <Space bar> until **Run HEC2** is displayed, and then press <ENTER>. The files defined at the bottom of the menu display will be used by HEC-2. If the same output file name is used for an EDIT2 run and then with HEC-2, the output file will be written over. This should not be a problem because most people do not save their EDIT2 output once they have eliminated the input data errors.

The HEC-2 program uses the input data file as its input. If the ED record, described in Section 4.2, was used for EDIT2, it can remain in the data file. HEC-2 will ignore the record. If a Free-Format data file is used (described in Section 4.2), the HEC-2 program will convert the data into Fixed-Format, the same as EDIT2. The program user should save the Fixed-Format file for use with HEC-2 because it saves the added time for format conversion every time you execute the program.

To execute HEC-2 as a separate program, at the DOS prompt enter:

HEC2 INPUT= "filename" OUTPUT=" filename" TAPE95=" filename"

Where: "filename" = the input, output, and Tape95 file names

(e.g., HEC2 INPUT=HEC205.DAT OUTPUT=HEC205.OUT TAPE95=HEC205.T95)

This assumes that the program and data are in the current default drive. Otherwise, also indicate the proper drive for the program and data. If the input and/or output file names are not given, the program will request the names for the files. If you respond with the Enter key, the default file name will be used.

As HEC-2 computes water surface profiles, it will send messages to the screen. The first is the "Title" from fields 2-4 on the third title record (T3). Following the "Title," the message:

Starting profile number #

CWSEL for cross section xx is yy

Where: # is the sequential number of the profile.
xx is the cross section number.
yy is the computed water surface elevation.

These messages are written to the screen so you will know how far your job has progressed.

When the job is complete, the following message will be displayed:

Normal program termination

If you are operating from MENU2, the following message will also be displayed:

Strike a key when ready . . .

This allows you to see any error messages that may be written to the screen from an abnormal termination. Missing input data or illegal data characters can cause Fortran error messages, which are written to the screen.

6.2 Program Output Files

As indicated above, there are several input/output files associated with HEC-2. Besides the standard INPUT and OUTPUT, there are TAPE95 and TAPE10. TAPE95 is an unformatted output file with all the variables, listed in the Users Manual Input Description under the J3 record, written for each section and every profile computed. TAPE10 is the file containing the Fixed-Format input data, if a Free-Format data file was read as INPUT.

There are two additional output files you can request. The Archive option (see AC input description in the HEC-2 Users Manual) provides a Formatted output file, similar to the intermediate output file TAPE95. The Archive file is written to TAPE96 and contains the input plus the same output variables as TAPE95, except they are formatted. This means they can be read with LIST or printed like any other standard ASCII file.

An HEC-2 modified input file can be created and saved for subsequent computations. (See the J2 field 8, IBW, input description for the 1988 version of HEC-2.) The intent is for applications using the CHIMP routine, where the user can request the data set, as modified by the channel modification routine. The file contains the input data, as modified by all the HEC-2 options used. The modified input file is written to TAPE16.

To save any HEC-2 generated file, such as TAPE96 or TAPE16, you can specify the file name on the command line, or you can rename the file. Use the DOS COPY or REN (RENAME) commands. For example, from the DOS prompt enter:

REN TAPE96 REDFOX.ARC

This will rename TAPE96 to REDFOX.ARC. The TAPE files are rewritten every time HEC-2 is run, so you must change the name of any file you want to save before running HEC-2 again.

6.21 OUTPUT - Formatted Output File. OUTPUT is the "print" file from HEC-2. Generally, this file would go directly to the printer or to a disk file. Because the printer is usually very slow, it is often easier to write the HEC-2 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 MENU2. Move the cursor to line 4. **Display output to console**, and press <ENTER>. This will call LIST with the output file name. To help locate specific areas in the output file, there are labels of ***PROF #** (where # is the number of the profile) at the start of each profile. At the start of the output for each cross section, there is a ***SECNO #** (where # is the cross section number). By using the appropriate find command to locate a character string (e.g., F in LIST), the user can find the start of any profile's output and the start of any cross section's output. 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 MENU2. At line 4, 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:TEST5.OUT PRN). However, this will tie up the computer while the file is printing. Alternatively, the DOS PRINT command can be used, (e.g., PRINT A:TEST5.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 1 of the output file. Therefore, the printed output will not start a new page or skip lines 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" "columnwidth"

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

(e.g., **PROUT A:TEST5.OUT 132**)

6.22 TAPE95 - Intermediate Profile Results. This file contains the results of the profile calculation written for summary output displays. When HEC-2 is computing the profile, it is writing the results to TAPE95 after each cross section computation is complete. When the last profile is complete, the program develops requested summary tables by reading the results from TAPE95 and writing the requested data in the summary table format. Refer to the J3 record description in the Users Manual for a description of the summary table capability of HEC-2.

The TAPE95 file is a binary file and cannot be read with a text editor. However, the summary output portion of the HEC-2 program has been converted to a separate program SUMPO, and graphical displays can be developed with program PLOT2. These programs use TAPE95 as the "input" and interactively provide output. Chapter 8 provides a description of the SUMPO program, and Chapter 9 provides a description of PLOT2.

MENU2 default extension option automatically provides for an extension of ".T95" for the TAPE95 file. However, if you did not define an alternative file name for TAPE95, you will need to rename TAPE95 to avoid writing over it with a subsequent execution of HEC-2. Every time HEC-2 is run, TAPE95 is written over again. If you are running more than one HEC-2 model, use the DOS command RENAME to save the file under a new file name.

To save TAPE95 under a new name enter:

RENAME TAPE95 "filename"

(e.g., RENAME TAPE95 TEST5.T95)

The DOS COPY command can also be used to save TAPE95 under a different name and, if desired, in a different location.

6.3 Output Control

The HEC-2 Users Manual describes program output in Chapter 6. Table 4, in that Chapter, lists various output options and the Control Cards required to activate those options. Standard Test 5 illustrates the use of the options to suppress the printer plot of profiles (J2.3 = -1), to develop summary tables (J3 record) and to control the sequential output (J5 record). You can review the input and output for Test 5 by looking at files HEC205.DAT and HEC205.OUT, respectively. These files are provided on the diskettes with the HEC-2 program package.

The HEC-2 program automatically prints a plot of the computed profile at the end of each profile computation, if there are 5 or more cross sections. Cross-section printer plots must be requested (variable IPLOT on J2.2 or X1.10). Test 1 provides an example of cross-section and profile printer plots (see file HEC201.OUT). With the availability of PLOT2 to provide a graphic display of cross sections and profiles, there is little value to the printer profile plot. By setting the PRFVS variable to -1 (J2.3) for each profile, the printer plots will be suppressed.

The J3 record is provided in the input data file to define the desired summary tables. The Input Description in the Users Manual describes the options available. There are predefined tables that are called with a single code number, and there are user-defined tables that are created by listing the code number for the variables desired. Test 5 shows an example of each.

The advantage of using the summary tables is the convenience of seeing the computed results for all the profiles displayed together for each cross section. The summary tables are at the end of the OUTPUT file. By looking at the end of the output first, the user can get an overview of the computed results. Chapter 6 provides some suggestions for reviewing the HEC-2 output. If there are tables that were not requested at the time of execution, they can be developed using the SUMPO program described in Chapter 7.

The J5 record can be used to selectively eliminate or request sequential output for cross sections. The J5 option is sometime used to reduce printed output from HEC-2 to a minimum. A better approach is the use of a disk file for the HEC-2 output. The sequential output contains helpful information for the analysis of the computed profile. If there are inconsistencies in the computed results, the sequential file is usually necessary to analyze the problem.

6.4 Model Calibration

Model calibration is an important phase of the initial model development. The number and accuracy of the cross sections and the loss coefficients are the most important (significant) input items. The calibration process should start with the best estimates for loss coefficients and a reasonable range for their values. By computing profiles for historic floods and checking computed results with observed values, some measure of the model accuracy can be determined.

If loss coefficients are to be adjusted during the calibration process, it is reasonable to assume that the absolute value of the coefficients are not known, but the relative magnitude among the coefficients may be reasonable. The input variable FN (J2.6) is a factor to multiply all the Manning's 'n' values in the model. By using the FN factor, the 'n' values can be proportionally raised and lowered. This approach is convenient for calibration and sensitivity analysis.

The other major model adjustments are with the cross sections. The spacing of the cross sections is one of the most important factors in the accuracy of the computed profile. Results from the Water Surface Profile Accuracy Study indicate that the spacing between sections is more important than the absolute accuracy of the sections themselves (USACE, 1986). Typically, there is an insufficient number of sections. If more sections can be obtained from the field, the repeat section capability and available topographic mapping should be used to add cross sections, where needed in the model.

Chapter 7 provides some suggested items to review in the HEC-2 output. Generally, the initial model will require adjustment to the input parameters and additional data. The program user should never assume that the model is adequate just because the program can execute the data set.

6.5 File Archives

The entire HEC-2 INPUT, TAPE95 and OUTPUT files for a project can be maintained on a diskette for future reference or computations. By using the DOS COPY command, the files can be transferred to a diskette, which can be stored with other project documents. Also, the diskette could be a part of the project report. The HEC-2 Archive option, described in Section 6.2, can also be used to provide a complete input/output file.

A file name convention, like that used in the MENU2 package, provides a convenient, easily recognized set of information. Assuming all the information was on a hard-disk (drive C), the following DOS commands can be used to copy the information to a diskette:

COPY C:PROJECT.DAT A:

COPY C:TAPE95 A:PROJECT.T95

COPY C:PROJECT.OUT A:

Where: **PROJECT** is the filename used for the study.

With all the project files on a diskette, the information is readily available for review. The original input data could be used to make additional profile computations. Selected portions of the HEC-2 output file can be printed by writing them to a separate file and then copying that file to the printer. Or, the SUMPO program can be used to extract the desired summary tables from TAPE95 for printing. Also, PLOT2 can be used to plot cross sections with the input file and profiles with TAPE95.

7. REVIEWING THE HEC-2 FORMATTED OUTPUT FILE

The HEC-2 output file contains information that cannot be obtained from the TAPE95 file. This chapter describes the HEC-2 output file and gives some guidelines for the review of output. Because the program is basically designed to continue computations if possible, the fact that the program executes a complete job does not necessarily mean that the results are good. The user must carefully review the results to ensure that they represent the study reach and that they are reasonable and consistent.

7.1 Printout Sequence

The HEC-2 output file starts with a banner blocked off with an asterisk (*). The banner gives the program's release date, last update, and an error corrections and modifications list. The error corrections represent updates that corrected deficiencies or errors in the program. As errors are discovered, they are corrected and documented. After several have been found, the program is updated, and all program users are notified. The modifications represent enhancements to the program. The Foreword in the Users Manual gives a summary of the program modifications.

The data input for the first profile (T1 through EJ records) is listed below the banner. There is an input option to suppress the input listing, but this is discouraged. Most problems with the program execution come from input problems. Therefore, it is extremely helpful to have the input data for the job listed with the output.

Following the input listing, the output for the first profile is printed, starting with the *PROF 1 note. The printout for each section consists of a block of 40 variables that are displayed at the top of the page. The values for those variables are displayed in the same spatial arrangement as the variable list. Appendix VI Output Data Description gives the definition of all the variables displayed. The section number (SECNO) is listed in the upper left-hand corner for easy reference; also *SECNO # is printed before the output display for each section.

Following the printout for each section, the program provides a printer plot of the profile. Output for Test 1 gives an example of the profile printer plot. With the availability of PLOT2 to plot profiles graphically, there is little added value to the printer plots. They can be suppressed by setting the variable PRFVS (J2.3) to -1 for each profile computed.

The second and subsequent profiles start with an input listing for that profile, which consists of the title and job records. There are no other data for the subsequent profiles; the remainder of the data are the same as the data listed at the beginning. After the input listing, the sequential output for the second, or subsequent, profile is printed. The sequence is repeated until the last profile output is printed.

Following the last profile, the summary printout is provided. The summary printout is called by setting the NPROF variable (J2.1) to 15 on the last profile's input (use -1 for a single profile run). The summary tables are defined by the data provided on the J3 record, or there is a default table if the J3 record is omitted.

For additional summary tables, the program SUMPO can provide the same tables interactively using the TAPE95 file from HEC-2.

The output file will also contain printer plots of cross sections, if requested. The IPLOT variable (J2.2 or X1.10) requests the cross section plot for all the sections in a profile or a single section, respectively. However, with the graphic cross section plots available from PLOT2, the printer plots are not usually requested.

7.2 Special Notes

Throughout the sequential cross section printout there may be informational notes. Some notes provide general comments like the initialization of contraction and expansion coefficients (e.g., CCHV= 0.100 CEHV= 0.300) or use of the NH record (1490 NH RECORD USED). Other notes indicate potential computation problems (e.g., 1340 RECORD NOT RECOGNIZED).

The notes are usually printed with a number and message. The number is the statement number in the HEC-2 program where the message is generated. To locate the message source, the program source listing would be required. However, the Users Manual Appendix V, Special Note Listing, explains special notes that commonly appear as part of the normal sequential output. The notes are listed in the order of their statement number.

The Special Notes should be carefully reviewed to assure there are no computational problems identified by the program. If the note message and the explanation in Appendix V are not sufficient for you to understand the problem, contact the HEC for additional explanation.

7.3 Reviewing Output File with Program LIST

The LIST program is a public domain utility that provides a convenient way of viewing text (ASCII) files on the screen. It has the advantage of allowing you to shift your view of the output from left to right, as well as up and down. Because the standard output file from HEC-2 is 132 characters wide, the ability to shift your view of the output file in all four directions makes it easy to scan an entire output file on an 80-character screen.

The program uses the cursor control keys in a logical manner. Page Up and Down moves you up and down through the file in blocks of text. Up and Down Arrows move you one line at a time. Left and Right Arrows shift the text left and right 20 columns. Home and End Keys move you to the beginning and to the end of the file.

Help is called with the <F1> Key or a question mark <?>. The Help file list includes the commands and the control keys to call the commands. Often, several logical choices of control keys are used to call a command.

Escape key <Esc>, as well as the letters <Q> and <X>, will terminate the program.

MENU2 calls LIST when you select **4. Display output to console**. To execute LIST as a separate program, from the DOS prompt enter:

LIST "filename" (also enter: drive: and \pathname\ if required)

If you don't include the "filename", the program will respond:

Enter file name:

Input the file name, and the program will display the first block of text in the file. Also, there is a partial list of program commands shown at the bottom of the screen. The program makes it easy to view the output file on the screen. There is also a print on/off switch, called by the letter <P>, which sends the viewed output to the printer. This feature makes it easy to print selected portions of the output file.

7.4 Output Review

Generally, the summary tables are the first place to review output for a large job. The summary gives a total view of the multiple profile job; it would also show whether the entire job executed. If you did not request a summary table, the program SUMPO can be used to generate summary tables from the TAPE95 written by the HEC-2 run. See Chapter 8 for a description of the SUMPO program.

The end of the summary table has the **SUMMARY OF ERRORS**. This listing provides some of the more important error messages and notes from the sequential output. The notes are written with the section number, profile number and error message. These error messages are the same as the Special Notes provided in the sequential cross section printout. **Review the notes** to see if there are computational problems. Some notes, like **Critical Depth Assumed**, may be an indication that there are problems with some of the section solutions.

From the data provided by **Summary Table 150**, review the computed water surface elevations (CWSEL), the CWSEL difference for each profile (DIFWSP), and the CWSEL difference between sections (DIFWSX). If increasing discharges were used in each profile, one would expect to see the water surface elevation at a section increasing. As the solution steps upstream, for a subcritical profile, the water surface should generally increase. The increase between sections should be similar for the profiles. The review process should look for inconsistencies. The reviewer should be able to predict and explain the solution obtained.

Top width (TOPWID) is another important variable to review. The HEC-2 program does not check on continuity between cross sections. It is possible to obtain a solution that shows a width of 5,000 feet at one section and 500 feet at the next section, a short distance away. Often the varying top width is a result of the flow being in the channel at one section and in the overbanks at the next section. The reviewer must decide whether the transition is physically possible.

In cases where the overbank flow only appears at one section, and not at the adjacent upstream or downstream sections, it is obvious that the flow cannot be fully utilizing the overbank area at the one section. At locations where radical changes in top width occur, determine with the aid of a topographic map the path that the flow is likely to follow. Compare the mapped path with the cross section location and orientation used in the model. There may be a need to add or modify the cross

section definition based on the initial model results. Remember that the model should only have the conveyance portion of the cross section. Ponding areas should not be included.

Another way to check the continuity of flow between sections is by comparing the flows in the three flow elements (QLOB, QCH, QROB) from section to section. An alternative approach is to look at the percentage of flow (QLOBP, QCHP, QROBP). Flow distribution should not vary too greatly from one cross section to the next. It would be unreasonable for 70 percent of the flow to be in the left overbank portion of one cross section and none of the flow in the left overbank of an adjacent section. If that occurs because of ponding, then that area should not be included in the conveyance calculations. The effective area option, IEARA (X3.10 = 10), is often used to eliminate ineffective overbank areas from conveyance calculations.

Review the energy loss computation. A good variable to review, from section to section, is the energy slope (SLOPE). The slope is very sensitive to changes in conveyance. No matter which method is used for averaging energy slope between sections, the change of slope between sections should not be too large. If, from one cross section to the next one upstream, SLOPE decreases by more than 50 percent, or increases by more than 100 percent, the reach length may be too long for accurate determination of energy losses. Adding more cross sections would be advisable.

The conveyance for a section (.01K) is also a good variable to review, in the manner described above for SLOPE. The conveyance ratio between upstream to downstream cross sections is provided by variable KRATIO. The 1988 version of HEC-2 provides a warning message if KRATIO is less than 0.7 or greater than 1.4. Additional cross sections should be added when the ratio is outside this range and the length between the sections is large.

The review of summary output often raises a number of questions. The sequential output file should be examined to determine the reasons for the observed inconsistencies. The review process should answer the "why did it happen" and "is it reasonable" questions.

The Special Notes should all be reviewed. Often they will provide clues to computational problems.

Critical Depth solutions should be examined. The program will often revert to a critical depth solution when the computation process cannot find a balance between the assumed and computed water surface elevation. Many times this is a result of large changes in conveyance between cross sections that are too far apart. The usual solution is to add more cross sections. Also, there is an option (J6.1) to have the program select the equation for computing the friction losses based on the flow conditions. Sometimes this approach will provide a solution balance, but it is not a substitute for a sufficient number of cross sections.

Interpolated cross sections should be carefully reviewed. Using the program option (J1.7) for providing interpolated cross sections is generally discouraged. The interpolated section is only provided when the change in velocity head between sections exceeds the given value for HVINS. This means that there may be interpolated sections in one profile and not in the next. The interpolated sections will be based on the current given section adjusted in elevation and width-based change in elevation between the two sections and the area ratios for the channel portion of the cross sections. Sometimes the adjustments are not reasonable. It is generally recommended that interpolated sections be inserted by the user.

Check the velocities in the cross sections. Very high velocities and large changes in velocities between sections may be indicating problems with the model data. Are the velocities shown realistic for the study reach?

Review every bridge solution carefully. The sequential cross section output displays are the most complete presentation of the bridge solution. The HEC-2 predefined tables 100 and 105 are helpful for a summary table review of Special Bridge solutions. Table 100 provides the variables associated with the energy loss computations at the Special Bridge. Table 105 provides the distribution of flow and energy losses for the four cross sections in the vicinity of the Special Bridge. Both tables will provide the information for every Special Bridge in the data set.

Special Bridge results in the sequential cross section output should be reviewed for the transition of flow up to and away from the bridge. The computation sequence and total structural losses, computed within the Special Bridge routine, should be reviewed. Appendix IV, in the HEC-2 Users Manual, describes the application of the bridge routines. Program users should be familiar with the material in that text. In Appendix IV, Figure 3, Special Bridge Method General Logic Diagram, shows the solution process. By following the diagram, the Special Bridge solution can be traced. If there is a problem with the solution, the basis for the critical decision in the routine and the necessary input changes to alter the solution can be determined.

Normal Bridge solutions need to be carefully reviewed too. The bridge is processed as a cross section, and the output is essentially the same as any other section in the sequential output. There are no checks for pressure or weir flow conditions. Therefore, the user must carefully review the solution with respect to the water surface elevation and where it is within the bridge. The program distributes flow in the section based on the distribution of conveyance. The computed water surface elevation could be within the bridge or over the bridge deck. No special notes or messages are provided to indicate the pressure or weir flow condition.

Look at the input data first for the source of errors. If the data ran before, assume that some change you made caused the problem you see. With the input and editing process, it is easy to make mistakes. If there is a read error, look at your input file with program LIST. It will show illegal characters. Look at the input listing from HEC-2. That shows what the program used for the solution at hand. While a program error is possible, usually the source of your errors is in that listing.

Sketch the cross sections and the computed flow path on a topographic map. This will give a general picture of the model results. It is also a convenient way of checking the output from the program, by comparing it with the map representation of the study reach.

The program user should treat the input data for the study reach as an initial model. It is reasonable to expect several iterations before the data are properly assembled. The first level is usually based on the physical nature of the study reach. The basic input errors should be mostly found by the EDIT2 program. Then the HEC-2 results are reviewed for consistency and reasonable results. The initial model was based on the expected flow of water through the study reach. Sometimes the results are not consistent with the initial assumption. The model then must be redefined to reflect the added information gained from the initial results.

8. CREATING SUMMARY OUTPUT TABLES

Summary tables offer the advantage of presenting the computed results from HEC-2 multiple water surface profiles all together for each cross section. If a range of discharges were used, or if profiles were computed for before and after conditions in the reach, the summary tables provide a convenient display for comparing the computed results for all those profiles.

8.1 Purpose of SUMPO Program

Computer program SUMPO is a separate version of the summary printout routines from HEC-2. All the basic capability of the HEC-2 program summary output can be obtained from the binary HEC-2 output file TAPE95. The program is menu driven to provide convenient interactive access to TAPE95 results.

The two basic capabilities in SUMPO are: (1) selecting a standard HEC-2 defined summary table (as described in the J3 Card Input Description) and (2) creating summary tables by defining the variables to display in the table. The program also allows the user to store the created summary table variable lists for future use. With this capability, the user can create, store, and recall variable lists for frequently used summary tables.

8.2 Program Operation

To run program SUMPO you must first run HEC-2. HEC-2 produces the binary output file, TAPE95, which is the input data file for SUMPO. TAPE95 is the default file name from HEC-2, but a different file name can be provided when running HEC-2 (see Chapter 6).

In MENU2, call SUMPO by moving the cursor to line 3., and press the space bar until you see: **3. Run SUMPO**; then press <ENTER>. The TAPE95 file name will be transferred to SUMPO. With the automatic extension feature in MENU2, the "given name" plus the extension .T95 will be used.

If you have not assigned a file name to TAPE95, you can rename it before you run HEC-2 again because each HEC-2 execution will write over the information on TAPE95. To change the file name, use the DOS **RENAME** or **COPY** command (e.g., **COPY [d:][path] TAPE95 [d:][path]MYJOB.T95**).

To execute SUMPO as a separate program, from the DOS prompt enter:

SUMPO

The program will respond with the SUMPO Main Menu. The Main Menu, shown in Figure 8, allows you to: 1. Define files and printer width, 2. Select pre-defined summary tables, 3. Create Summary tables, 4. Display output to console/printer, and 5. Exit SUMPO. To make a selection, use the Up or Down Arrows to move the cursor and press <ENTER>, or enter the line number. (The instructions are printed at the bottom of the Menu Frame.)

S U M P O		
1. Define files & printer width 2. Select pre-defined summary tables 3. Create summary tables 4. Display output to console 5. Exit SUMPO		
Input: REDFOX.T95	Output: REDFOX.SMP	Printer width: 88
Press number of desired option or ↑ ↓ with <Enter>		

Figure 8. SUMPO Main Menu

The background and text color can be changed by using the <F9> and <F10> keys, respectively, to toggle through the color choices. The screen color will change as you go through the choices so you can see the choice. The defaults for files are: TAPE95 for the input file, CON (console) for the output file, and 80 for the printer width. The files and printer width setting are shown at the bottom of the menu. If you are running SUMPO from MENU2, the screen colors and file names will be transferred to SUMPO.

To change the files or printer width, press <ENTER> while the cursor is on line 1., or enter <1>. A window will appear with **Input file**, **Output file**, **Printer width**, and **Return to menu** (see Figure 9). For **Input file** the default, TAPE95, can be changed by entering the desired file name or a <?> and <ENTER>. With the <?> entry, a window will appear showing the files in the default directory. Use the cursor key to move to the desired file name, and press <ENTER>; the selected file will be transferred opposite the **Input file**.

For **Output file**, the automatic extension option assigns .SMP to the file name. This prevents writing summary tables over the HEC-2 printed output file, which has the extension of .OUT. SUMPO provides the MENU2 output display capability with LIST and PROUT. Therefore, it is better to write summary tables to an output file instead of "CON" and "LPT1" for a file name. To make a selection, use the cursor arrows to move the cursor to **Output file** in the menu, and enter the new name or <?>. As described above, the <?> will cause the files in the directory to be displayed, and the desired file can be selected by moving the cursor to the file name and pressing <ENTER>. Remember to include the drive and path, if necessary.

S U M P O		
<div style="border: 2px solid black; padding: 10px; margin: 10px auto; width: 80%;"> <p>Files and printer width</p> <p>Input file ... REDFOX.T95</p> <p>Output file .. REDFOX.SMP</p> <p>Printer width .. 80 columns</p> <p>Return to previous menu</p> </div>		
Input: REDFOX.T95	Output: REDFOX.SMP	Printer width: 80
<div style="border: 1px solid black; padding: 2px;"> Enter file name or press ? for file list ↑ ↓ moves cursor </div>		

Figure 9. SUMPO Define Files & Printer Width Menu

Printer width can be defined as 80 or 132 columns. Move the cursor to that line, and use the space bar to toggle between the two choices. The choice depends on your printer size and setting. (Note: This does not change the printer; printer settings must be made directly with the printer.)

When the file names and printer width are correct, move the cursor to **Return to Menu**, and press <ENTER>. The window will vanish, and the new settings will be shown at the bottom of the menu.

From the Main Menu you can go to menus for **Select pre-defined summary tables** or **Create summary tables**, which are the two options available in SUMPO. If you want one of the HEC-2 pre-defined tables, described in the HEC-2 Users Manual Input Description for the J3 record, move the cursor to line 2., and press <ENTER>, or enter <2>. If you want to create a summary table by selecting the variables to be displayed in the table, move the cursor to line 3., and press <ENTER>, or enter <3>. To exit the program and return to DOS or MENU2, move the cursor to **Exit SUMPO**, and press <ENTER>, or enter <4>.

8.3 Select Pre-defined Summary Tables

The Pre-defined Summary Tables Menu provides the HEC-2 pre-defined summary tables. The HEC-2 Users Manual Input Description for the J3 record lists the available tables, which are the same as those provided in the Menu, shown in Figure 10. The tables are defined by a single code number that calls the variable list within HEC-2 and SUMPO.

S U M P O

Pre-defined summary tables

Cross section output at bridges	100
Four cross-section output at bridges	105
Encroachment data	110
Floodway width	115
Channel improvement	120
Standard summary	150
Floodway data	200
Floodway Insurance zone data	201
Recall saved variable table	(specify)
Return to previous menu	

Input: REDFOX.T95	Output: REDFOX.SMP	Printer width: 80
press <Enter> to select summary table ↑ ↓ moves cursor		

Figure 10. Pre-defined Summary Tables Menu

To select a table, use the Up or Down Arrows to move the cursor to the code number desired, and press <ENTER>. If the input data file is not properly defined, the program will respond:

File does not exist --[filename]
press <Esc>

With this response, press the <Esc> key and return to the Main Menu to redefine the input file name. The file may not have been located because the default drive is not the same as the drive where the input file is located. If that is the problem, redefine the input file name, making sure that the drive and path for the file has been correctly specified (e.g., [d:] [path] TAPE95). If you cannot see the problem, exit the program, and use the DOS DIRECTORY command to check the file names (e.g., DIR [d:] [path]).

After the data file has been read, for those tables that normally list all cross sections, the program will respond:

Output all cross sections (y/n) ?

If output for all cross sections is desired, press the <y> key. If limited output is desired, press the <n> key, and the Cross Section Selections Menu will appear, shown in Figure 11.

S U M P O

Cross-sections available

1.000
2.000
3.000
4.000

press "c" to continue

Input: REDFOX.T95
Output: REDFOX.SMP
Printer width: 80

Use ↑ ↓ ← and → to move cell || Press <Enter> to pick item

Figure 11. SUMPO Cross-section Selection Menu

The cursor location is indicated by the highlighted section number. To select the cross sections to be used in the summary table, move the cursor to the desired section numbers, and press <ENTER>. The selected section numbers will have a pointer on them. When all the desired section numbers to be printed have been selected, press the letter <C> to continue. The program will respond:

Output all profiles (y/n) ?

If output for all profiles is desired, press the letter <y>. If only some of the profiles are desired, press the letter <n>. The program will display the Profile Selection Menu; see Figure 12.

As with the cross-section selection, the cursor location is indicated by the blinking profile number. Move the cursor to the profile numbers desired, and press <ENTER>. The selected profile numbers will remain highlighted. When the desired selections have been made, press the letter <C> to continue. The program will respond:

Include summary errors in output (y/n)?

The Summary of Errors provides error messages for those cross sections that had some computation problem. Enter <y> for the messages (the recommended choice), or <n> for no messages. The program will respond:

Append output to output file (y/n)?

A <y> entry will add the current summary table to the end of the existing output file. A <n> entry will write the current summary table over the existing output in the file. This choice allows you to add to or delete the previous summary

information in the file. The program will then respond:

```
-----SUMPO ready to output ---
* press <Enter> to continue
* press <Esc> to abandon output
```

This gives you the option to stop the process, <Esc> and make another choice. Press <ENTER> and the summary table will be written to the designated output file. When complete, the SUMPO Main Menu is displayed, and the cursor is located on line 4. **Display output to console.** This provides for a review of the summary table with program LIST, or press the space bar to toggle the choice to 4. **Display output to printer.**

S U M P O		
<div style="border: 2px solid black; padding: 10px; margin: 10px auto; width: fit-content;"><div>Profiles available</div><div>profile 1</div><div>profile 2</div><div>profile 3</div></div>		
press "c" to continue		
Input: REDFOX.T95	Output: REDFOX.SMP	Printer width: 80
Use ↑ ↓ ← and → to move cell Press <Enter> to pick item		

Figure 12. SUMPO Profile Selection Menu

The Pre-defined Summary Tables Menu (shown in Figure 10) also has an option: **Recall saved variables**. This option provides a user-defined, variable list file created and saved with the Create Summary Tables option. Section 8.4, below, provides a description of the SUMPO Create Table Menu and instructions for the available options.

8.4 Create Summary Tables

The SUMPO Create Table Menu provides the output variables available for you to create a summary table. See Figure 13 for an example of the Menu. User defined tables are created in two steps. First, the variables desired are selected. The selected variables are shown at the top of the Menu, in the section labeled **Selected Variables**. There will be indicator bars for the undefined variables and positions for up to eight or thirteen possible variables in a table, depending on the page width defined in the Main Menu. The second step is the actual writing of the summary table to the designated output file name.

S U M P O									
Selected variables									
SECNO									
Available variables									
SECNO	DEPTH	USEL	CRIWS	WSELK	EG	HU	HL	OLOSS	
Q	QLOB	QCH	QROB	TOPWID	AREA	TWA	UOL	XLBEL	RBEL
TIME	VLOB	UCH	UROB	K*XL	K*XLCH	K*XLNR	K*WTM	STCHL	STCHR
10*KS	K*CHSL	XLCH	PERENC	STENCL	ELENCL	STENCR	ELENCR	SSTA	ENDST
ALPHA	QLOBP	QCHP	QROBP	BW	CLSTA	UEXR	UEXT	ELMIN	TELMX
8.81K	KRATIO	DIFWSX	DIFWSP	DIFKWS	DIFEG	CASE	IHLEQ		
H3	EGLWC	EGPRS	QPR	QWEIR	ELLC	ELTRD	CLASS		
p 0 - Output summary data									
r S - Save selected variables									
e R - Recall saved variables									
s I - Ice variable table									
s X - eXit to previous menu									
Input: REDFOX.T95			Output: REDFOX.SMP			Printer width: 88			
<Enter> to select variable <Ctrl> <Left> <Right> to change field f1 moves cell									

Figure 13. SUMPO Create Table Menu

To select a variable for the summary table, use the cursor keys to move among the **Available variables**, and press <ENTER> when the desired variable is highlighted. For example, to select SECNO, press <ENTER> when it is highlighted, and SECNO will appear in the **Selected variables** list. The highlighted location marker in the **Selected variables** will automatically advance to the next position in the list. Continue to use the cursor arrow keys to move the cursor through the array of variables, and press <ENTER> when the cursor is on the desired variable. Each selected variable will appear in the **Selected variables** list, and the highlighted location marker will continue to advance to the next position in the list.

If you make a mistake and want to change a variable in the **Selected Variables** list, hold the Control key <Ctrl>, and use the Left or Right Arrow keys to move the highlighted position marker in the **Selected Variables** list. (The program will not allow you to move the cursor beyond locations of defined variables, which could leave blanks in the summary table.) When the position marker is over the variable you want to change, release the Control key, and use the arrow keys to move the cursor to the desired variable in the **Available variables** array and press <ENTER>. The selected variable will replace the highlighted variable in the **Selected variables** list.

Below the **Available variables** array there is a selection menu that provides options to: **Output summary data**, enter <O>; **Save selected variables**, enter <S>; **Recall saved variables**, enter <R>; **make Ice variable table available**, enter <I>; and **eXit to previous menu**, enter <X>. All these options are called by pressing the letter associated with the option. Each option is described in the following paragraphs.

Once you have selected the variables you want for your summary table, simply press the letter <O>. The program will respond with the same series of questions:

Output all cross sections (y/n)?

Output all profiles (y/n)?

Include summary errors in output (y/n)?

Append output to output file (y/n)?

After you have entered the desired response to the questions, the program will respond:

```
-----SUMPO ready to output ---  
* press <Enter> to continue  
* press <Esc> to abandon output
```

This gives you the option to stop the process, <Esc> and make another choice. If you press <ENTER>, the summary table will be written to the location defined as the "Output File" in the Main Menu. Then the Main menu will appear, and the cursor will be on line 4. **Display output to the console**. Press <ENTER>, and the output file will be displayed with program LIST.

If you want to save a variable list for future use in generating summary tables, press the letter <S>. The menu will prompt you:

File to Save to -

Enter the file name desired; the program will add the extension .VAR. On a hard-disk system, it is best to save the file in the default directory; otherwise, include the appropriate drive and path, if you do not want the default drive (e.g., A:TABLE1). The saved file will contain the code number and the variable name for the variables selected. The file can be displayed on the screen from the DOS prompt, as any text file, using the DOS TYPE command, or the program LIST.

To recall a saved file of variables in SUMPO, press the letter <R>. The program will respond:

File to Read from -

Enter the file name (e.g., A:TABLE1) or a question mark <?>. With the <?> entry, a window will appear showing the files in the default directory with the .VAR extension, as shown in Figure 14. Move the cursor to the desired file name, and press <ENTER> to select the file. Once entered, the variables from the file will be displayed in the **Selected variables** section of the menu. If there are more variables than positions (e.g., 13 variables and only 80 columns for output), only the first variables of the list will be included.

The variables listed in the **Selected variables** list can be edited by moving the cursor (using the <Ctrl> key and arrows) to the variable to be changed. Then move the cursor to the variable desired, and press <ENTER>. Changing the variables in the **Selected variables** list will alter the variables written to summary output, but it will not change the variables list saved on the disk. To transfer the new variables

list to the saved file, the variables must be written to a file again (i.e., enter <R> and then enter the same file name to write over the old file, or enter a new file name to save the modified list of selected variables separate from the original).

S U M P O									
Name of file to read from: *.UAR									
Selected variables									
SECNO									
Available variables									
SECNO	DEPTH	USEL	CRIWS	WSELK	EG	HU	HL	OLOSS	
Q	QLOB	QCH	QROB	TOPWID	AREA	TWA	UOL	XLBEL	RBEL
TIME	ULOB	UCH	UROB	K*XML	K*XMCH	K*XNR	K*WTN	STCHL	STCHR
10*KS	K*CHSL	XLCH	PERENC	STENCL	ELENCL	STENCH	ELENCR	SSTA	ENDSI
A	C:\HEC2								
B	REDFOX .UAR								
H									
P									
r									
e									
s									
S									
Input: REDFOX.T95			Output: REDFOX.SMP			Printer width: 80			
Use ↑ ↓ ← → to move cell Press <Enter> to pick item									

Figure 14. SUMPO Saved Variables Menu

Ice variables are not frequently used, so they were not included with the variables array. By pressing the letter <I>, the ice variables are displayed in the empty box area, in the lower right of the Create table menu; see Figure 13. When the Ice variables are displayed, the cursor will only operate within the lower box. The variables selection process, described above, is the same except now the ice variables are selected. To return to the variables array again, simply press the letter <I> again. The ice option operates as an on/off switch.

To return to the Main Menu, enter the letter <X>. The Escape Key <Esc> can also be used.

To exit the SUMPO program and return to DOS, or MENU2, move the cursor to Exit in the Main Menu, and press <ENTER>.

9. PLOTTING WITH PLOT2

Graphical displays are often the most effective method of presenting input data and computed results. Plots of the cross-section data can often provide helpful information for screening the input and for analysis of computed results. Profile plots of water surface elevation, or other variables, provide an overview of the results, distributed over the study reach in a way that tables of numbers cannot. The following chapter describes the capabilities of the PLOT2 program and the procedures for obtaining graphical displays of HEC-2 cross sections, computed profiles, and rating curves.

9.1 Purpose of PLOT2 Program

Computer program PLOT2 was developed to provide a quick and simple graphical display of cross-section data and computed results from HEC-2. The PLOT2 program provides the capability to plot cross-section data, including the changes to the section caused by the HEC-2 options that modify section data. Also, profiles and rating curves of the output variables, available on TAPE95, can be plotted. Default settings for options allow plotting with a minimum of effort. Plots can be displayed on the screen or directed to an HP 7475A (or equivalent) pen plotter. Screen displays of plots can be printed on DOS GRAPHICS compatible printers using the print screen <PrtSc> option. The program was developed using GRAPHMATIC and PLOTMATIC subroutines by Microcompatibles, Inc.

9.2 Program Operation

Cross-section plots can be developed from HEC-2 input data files. For cross-section plots, the water surface elevation can also be plotted from the HEC-2 computed results on TAPE95. Profile plots and rating curves are developed from the TAPE95 file; therefore, you must first run HEC-2 before plotting profiles with PLOT2.

PLOT2 is called from MENU2 by moving the cursor to line 3, and pressing the <SPACE BAR> until **Run PLOT2** is displayed; then press <ENTER>. To execute PLOT2 as a separate program, from the DOS prompt enter:

PLOT2

The program will respond with a PLOT2 Title Page. Press any key and the PLOT2 Menu will appear; see Figure 15. The PLOT2 Menu allows you to call the menus for the Profile, Cross-section, or Rating Curve plot routines. The up and down arrows move the cursor through the options. Pressing the <ENTER> key selects the highlighted option. Also, the number of the option can be entered to make a selection. The screen colors can be changed by using the function keys F9 and F10 for background and foreground colors, respectively.

P L O T 2

1. Plot profiles
 2. Plot cross sections
 3. Plot rating curves
 4. Exit PLOT2

Press number of menu option or ↑ ↓ and press <Enter>

Figure 15. PLOT2 Main Menu

9.3 Output Devices

The graphic displays from PLOT2 can be directed to the screen or an HP 7475A pen plotter. Either of the following graphics cards (or their equivalent) is required:

- IBM Color Graphics Adapter**
- or,
- IBM Enhanced Color Graphics Adapter**
- or,
- Hercules Graphics Adapter** (in the separate version PLOT2H)

The plot device is set in the Plotting Options Menu, which can be called from the Profile, Cross-section, or Rating curve Menus (see Figure 19). The options are selected by using the <SPACE BAR> to toggle through the **Plot device** options. The choices are:

- COLOR GRAPHICS ADAPTER** for color graphics adapter
- and: **ENHANCED GRAPHICS ADAPTER** for enhanced graphics adapter
- or: **HERCULES GRAPHICS ADAPTER** for the Hercules version
- and: **HP7475A PLOTTER - (8.5" X 11")** for 8.5" x 11" pen plotter
- HP7475 PLOTTER - (11" X 17")** for 11" x 17" pen plotter

A printed copy of the plot on the screen can be obtained, provided your printer is set to graphics mode. For IBM Graphics compatible printers, use the **DOS GRAPHICS** command prior to executing PLOT2. Then generate the desired plot on the screen, and use the Print Screen <PrtSc> entry on your keyboard to copy the plot on your printer.

9.4 Pen Plotter Setup

Pen plotter graphics are directed to the plotter via COM1. The output port can be changed in the Plotting Options Menu by setting the **Plot device** to HP7475A and then moving the cursor to **Plot sent to** and using the <SPACE BAR> to toggle through the choices: two COM ports (COM1 or COM2) or an output file PLOT.HP. The PLOT.HP file allows you to create the plots on a computer without a plotter, and then transfer the file to another computer for plotting. Also, the plotter **Baud rate** default setting of 2400 can be set from 1200 to 9600. Just before the plots are written, the switch settings are displayed to the screen; see Figure 16. Press the <SPACE BAR> to plot, or press <Esc> to cancel the plot.

The plot operation uses PLOTMA7IC routines from Microcompatibles, Inc. The following instructions for the printer settings are from their documentation. The plotter can be switched for certain parameters (e.g., BAUD rate, length of word, parity, programmed on state, paper dimensions) on the rear panel of the plotter, as described in the Operator's Manual. The switches should be set for a 2400 BAUD transmission rate, 8 bit word, one stop bit, no parity, programmed on state (Y/D switch set to D), and the US - A4 switch should be set to US (indicating 8.5 X 11 inch paper). The A4 size paper can still be used with your plotter even with the dip switch set to US. This switch just defines the active plotting region. Review the Operator's Manual for switch selection, and insure that the specified choices have been made.

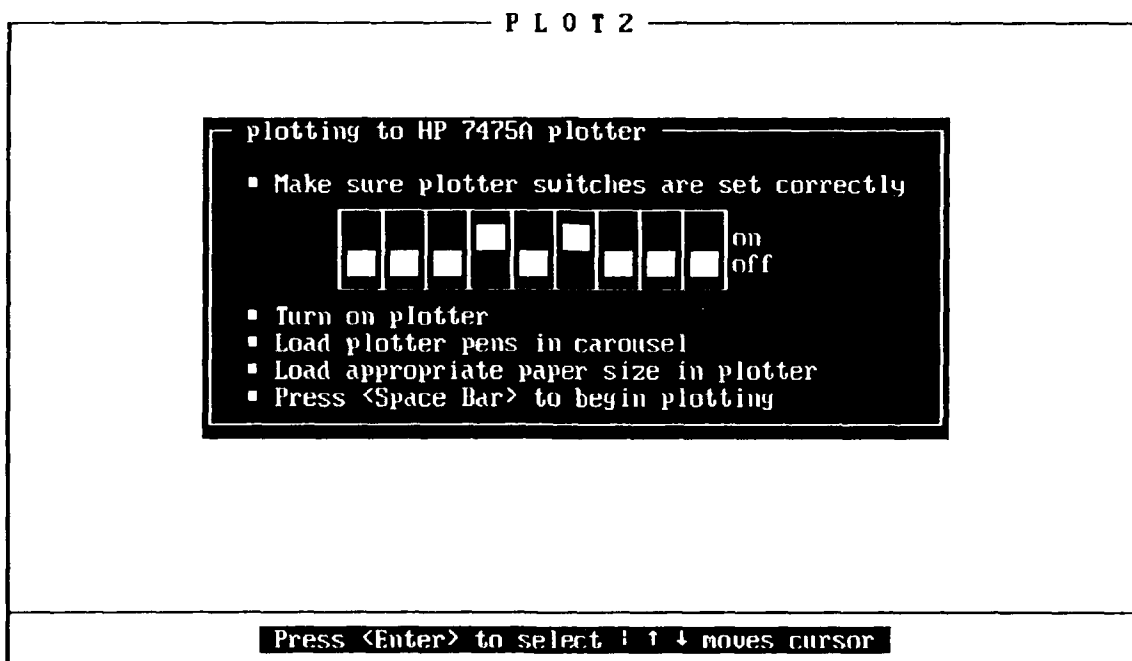


Figure 16. Pen Plotter Switch Setting

9.5 Profile Plots

Profile plots can be developed for any of the variables written to TAPE95. The default settings in the menus for profile plots assume that water surface profiles will be plotted. To develop profile plots, move the cursor to 1. **Plot profiles** in the Main Menu, and press <ENTER>, or enter <1>. The Profile Plots Menu, shown in Figure 17, will appear.

P L O T 2

Profile plots

Profile options
Plotting options
Plot profiles
Return to main menu

HEC2 Tape95 file name REDFOX.T95
 Landmark Label file name .. (specify)

Press <Enter> to select : ↑ ↓ moves cursor

Figure 17. PLOT2 Profile Plots Menu

In the **Profile Plots Menu**, **Profile options** and **Plotting options** provide menus to specify what will be plotted, what options will be used, and to title and label your plot. The menus are called by moving the cursor to the choice desired and pressing <ENTER>. The menu for **Profile options** is shown in Figure 18, and the menu for **Plotting options** is shown in Figure 19.

P L O T 2

Profile options

Variable vs. distance CWSEL (1)
 Plot invert profile Yes
 Plot landmark labels No
 Mark cross-section locations ... No
 Plot profile legend No
 1: Invert 6: 11:
 2: profile 1 7: 12:
 3: profile 2 8: 13:
 4: profile 3 9: 14:
 5: 10: 15:

 Units of river distance Feet
 Starting river distance000
 Begin profile @ cross section .. 1.000
 End profile @ cross section 4.000

 Return to previous menu

Press + , to change parameter : ↑ ↓ moves cursor

Figure 18. PLOT2 Profile Options Menu

There are two files indicated at the bottom of the Profile Plots Menu. The **HEC2 TAPE95 file name** is the HEC-2 program intermediate output file TAPE95, which is the input file for Profile Plots. The file name can be changed by entering a new file name in its place, or by entering a question mark <?>. The question mark entry will provide a menu of file names in the default directory. Use the cursor keys to highlight the desired file, and press <ENTER>. The selected file name will transfer into the Menu location. The **Landmark Label filename** has no default value. If this option is requested (see Figure 18. PLOT2 Profile Options Menu), then the file name must be entered.

The input file names should be defined before entering either options menu because data are obtained from the HEC-2 binary file to define default values for several options. To enter the **Profile options**, move the cursor to that location, and press <ENTER>.

The first line in the Profile Options Menu is for selecting the **Variable vs. distance** to plot. The default variable for this selection is CWSEL for Computed Water Surface Elevation. The variable code number is (1), as defined in the HEC-2 User's Manual Input description for the J3 record. To select a different variable to plot, the right and left cursor arrows may be used to toggle through the entire list of variables available. The variable name and code number are displayed for each variable.

Once the desired variable to plot is displayed, the up and down cursor keys can be used to move through the options in the menu. The **Plot invert profile** option has a default choice of Yes, which means that the invert profile will be plotted with the profile plot of the selected variable.

The **Plot landmark labels** option has a default choice of No. To change these options, move the cursor to the option, and use the <SPACE BAR> to toggle the choices between Yes and No.

The landmark label requires a file containing: distance, variable code number, and label. An example of the landmark file is shown below:

4000 1	{ Distance Variable }
UNKNOWN BRIDGE	{ Label to display }
6000 1	{ Distance Variable }
USGS GAGE	{ Label to display }

This file can be created with any text editor.

Mark cross-section locations option has a default value of No. You can toggle to Mark or Mark & number using the <SPACE BAR> while the option is highlighted. The profile plot will then show arrow marks, or marks and numbers, at cross section locations.

Plot profile legend has a default value of No. If legends for the profile plots are desired, move the cursor to that option, and press the <SPACE BAR> to change the option to Yes. The cursor keys can then move the cursor to profile 1:, etc. At each location enter the appropriate legend; up to eight characters are allowed. If the **Plot invert profile** option is set to Yes, the legend label Invert will be shown for the first profile.

The Units of river distance has a default value of Feet; but this can be changed to Miles, Meters, or Kilometers using the <SPACE BAR> to toggle through the choices. The 1988 version of HEC-2 reads the units and starting distance, if given, on TAPE95.

Starting river distance is set to 0.000. A different starting value can be entered. The entered value is added to the channel reach lengths to define the horizontal distance along the profile plot. Care should be taken to ensure that the Units of river distance and Starting river distance are consistent with the units used for the model reach lengths.

Begin profile @ cross section and End profile @ cross section options have the starting and ending cross-section numbers for the data set (SECNO on the X1). The values are read from the binary output file, TAPE95. The default values provide a plot for the entire study reach. The starting and ending section numbers for the profile plot can be changed by using the vertical cursor arrow keys to the option and then using the horizontal cursor arrow keys to toggle through the section numbers. The program will not allow the starting section number to be equal, or upstream from the ending section number.

After all the profile options have been set, move the cursor to Return to previous menu and press <ENTER>. The Profiles Plots Menu will be displayed. The second option on the menu is Plotting options. Move the cursor to that option, and press <ENTER>. The Plotting Options Menu, shown in Figure 19, provides for two titles on the plot. The Title 1: displays the title information input on the third title record (T3), as read from TAPE95. The title can be edited, or replaced, depending on the insert mode setting; press <Ins> to change from insert to overwrite. Title 2: allows you to enter a second title.

P L O T 2

Plotting options

Title 1: FOX RIVER Q = 1000 cfs
Title 2:

X axis label Distance
Y axis label Elevation

Full grid display .. Yes

Plot device Color graphics adapter [CGA]
Plot sent to COM

X axis scales Fill plot area
Y axis scales Automatic

Select color options

Return to previous menu

Enter new parameter : ↑ ↓ moves cursor

Figure 19. PLOT2 Plotting Options Menu

If the plot axes need a different label, move the cursor to the appropriate axis and enter, or edit, the label. A plotted grid can be added to the plot by moving the cursor to **Full grid display** and pressing the <Space Bar> to change the No to Yes.

The **Plot device** can be changed, as described in Section 9.3. For screen displays, the correct graphics adapter for your computer should be displayed. If it is not correct, the screen plot will appear as assorted characters. If an HP pen plotter is selected as the plot device, the **Plot sent to** will display **COM1**, the default. The output port can be toggled to **COM2**, by using the <SPACE BAR>. Also, a file **PLOT.HP** can be selected.

The **X axis scales** default is **Fill plot area**, while the **Y axis scales** are set to **Automatic** for each plot. Press the <SPACE BAR>, and the following options are provided: scales set to 1, 2, or 5 times a power of 10, **Fill plot area**, and **Max scale for all**. **Fill plot area** would normally be used for one scale while fixing the other scale. **Max scale for all** provides a fixed scale based on the maximum range of the data values.

Select color options provides a menu to set the pen number for pen plots and the line colors for EGA color screen displays. The **Color options** menu is shown in Figure 20. For profile plots, the options are for the Text, Axis, and the profiles to be plotted.

P L O T 2

Color options

line type	HP pen number	line color
Text	1	white
Axis and grid	1	white
Invert	1	white
Profile 1	1	white
Profile 2	1	white
Profile 3	1	white
Profile 4	1	white
Profile 5	1	white
Profile 6	1	white
Profile 7	1	white
Cross-section symbols	1	white
Return to previous menu		

Press <Space bar> to toggle parameter : ↑ ↓ ← → moves cursor

Figure 20. PLOT2 Profile Colors Options Menu

When complete, move the cursor to **Return to previous menu** and press <ENTER>. The Escape Key <Esc> will also return you to the previous menu. The Profile Plots Menu, shown in Figure 17, will be displayed.

When all desired options are set, move the cursor to **Plot profiles** to initiate the plot. The program will respond:

Plot all profiles (y/n)?

If yes, enter <y>, and the plot will go to the plot device defined in the Plotting Options Menu. If no, enter <n>, and a profile selection menu, as shown in Figure 21, will appear indicating the profiles available. The cursor location highlights the profile number. Use the cursor arrow keys to move through the choices, and press <ENTER> to select profile numbers to plot. The selected profile numbers will show an arrow marker. After selecting the desired profiles, press <c> to continue the plot.

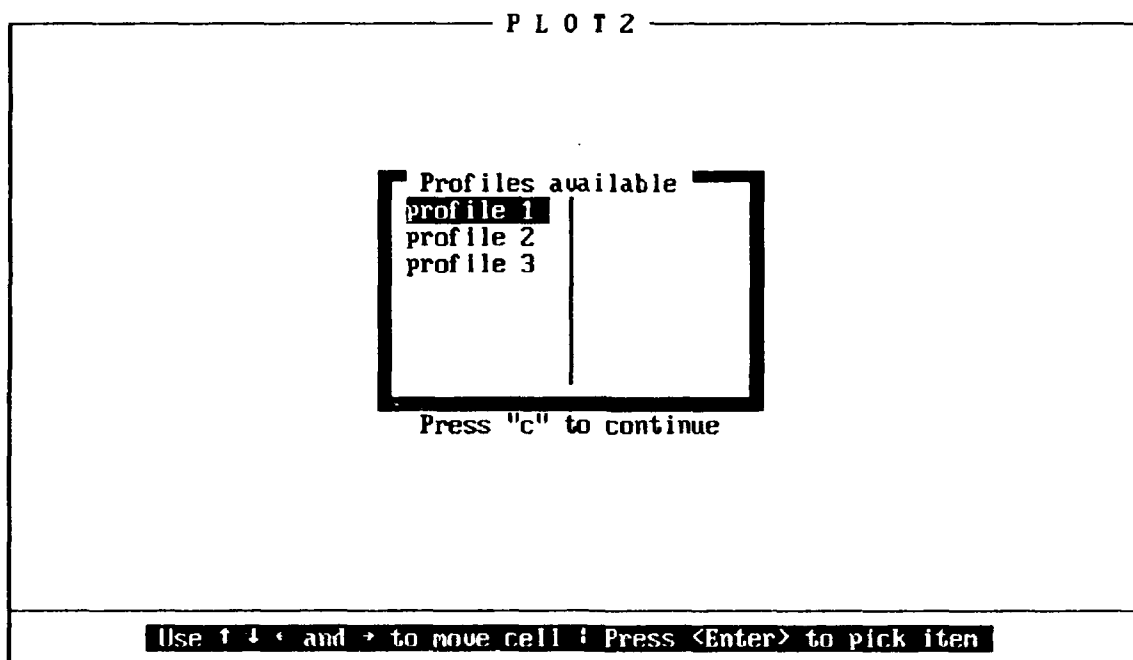


Figure 21. Profile Selection Menu

If the **Plot profile legend** option was selected, a choice between the legend at the top or bottom of the plot is offered with the following:

Legend box top or bottom (t/b)

Enter your choice, and then the plot will be sent to the designate output device. If the plot is displayed to the screen, it will stay there until you press <ENTER>. If you want to copy the plot to your printer, press the Print Screen key <PrtSc> while the plot is on the screen. **Remember that you must enter the DOS GRAPHICS command before entering PLOT2.** Figure 22 provides an example EGA graphics profile plot, with the legend on top.

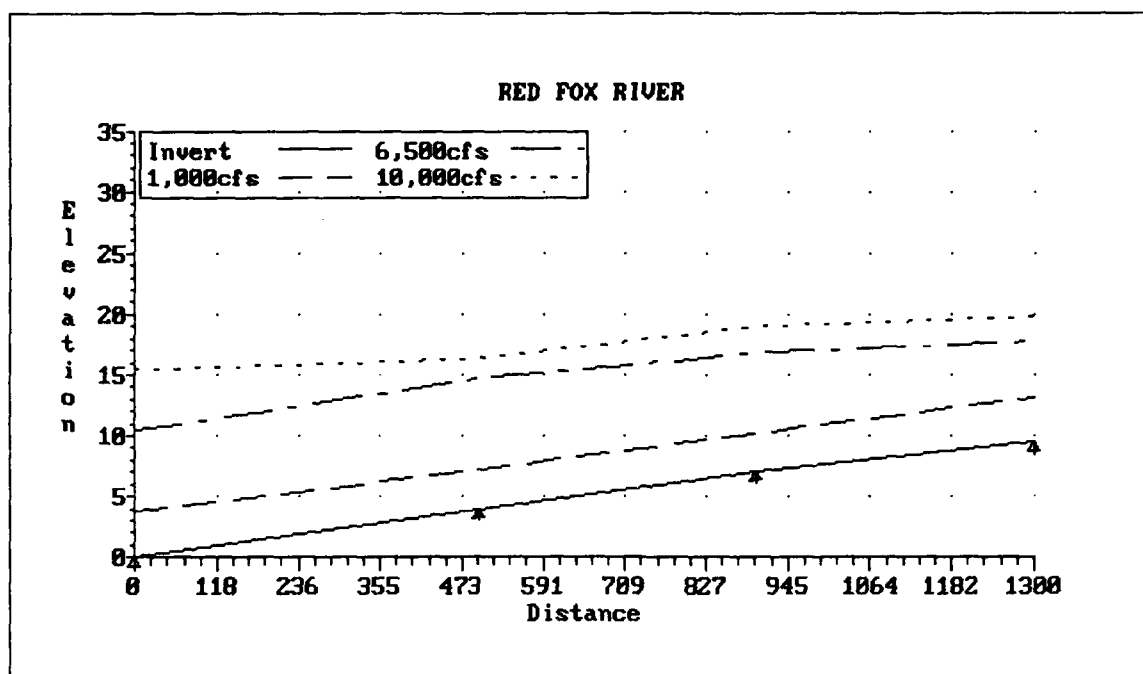


Figure 22. Example Profile Plot

When you have completed all the desired profile plots, return to the Main Menu by moving the cursor to that location and pressing <ENTER>. The Escape Key <Esc> will also return you to the Main Menu.

From the Main Menu, you can call cross-section plots or exit the program.

9.6 Cross-section Plots

You enter cross-section plots from the Main Menu by moving the cursor to 2. Plot cross sections and pressing <ENTER>, or by entering <2>. A sample Cross-Section Plots Menu is shown in Figure 23. From the menu you can call menus to define Cross-section options and Plotting options.

The HEC2 input file name must be entered for cross-section plots. There is no default; the menu will display (specify). (If you are operating from MENU2, the file names will be transferred to PLOT2.) The input file name can be entered from the keyboard or a question mark <?> can be entered. The question mark entry will provide a menu with the file names available in the directory. The cursor keys will move the cursor around the file names, and pressing <ENTER> will transfer the highlighted filename into the menu.

The HEC2 Tape95 file name is only required if the water surface elevation is to be plotted with the cross section. The default file name, TAPE95, can be changed, as described above for the input file name.

P L O T 2

Cross-section plots

Cross-section options
Plotting options
Plot cross sections
Return to main menu

HEC2 input file name ... REDFOX.DAT
HEC2 Tape95 file name .. REDFOX.T95

Press <Enter> to select : ↑ ↓ moves cursor

Figure 23. PLOT2 Cross-Sections Plots Menu

Move the cursor to: **Cross-section options**, and press <ENTER> to select the items to plot. The **Cross-section Options Menu** is shown, with the default settings, in Figure 24. Use the up and down cursor keys to select an option, and press the <SPACE BAR> to toggle between Yes and No.

P L O T 2

Cross-section options

Plot water surface elevations .. Yes
Label left/right banks Yes
Plot bridge geometry Yes
Label n-value regions No
Plot encroachments (X3) Yes
Plot effective area Yes
Plot channel improvement No

Return to previous menu

Press <Space bar> to toggle parameter : ↑ ↓ moves cursor

Figure 24. PLOT2 Cross-section Options Menu

If channel improvement is to be plotted, there are five choices: Field 6 to Field 10. The field number defines the field of the CI record to obtain bottom width information. (See HEC-2 Input Description for the CI record for a complete description.)

When the plotting options are properly set, move the cursor to **Return to previous menu**, and press <ENTER>. Pressing <Esc> will also return you to the Cross-section plots menu.

In the Cross-section plots menu, move the cursor to **Plotting options**, and press <ENTER> to define titles, axes labels, and add a grid to the plot. Figure 25 shows the Plotting options menu with its default settings.

— P L O T 2 —

Plotting options

Title 1: FOX RIVER Q = 1000 cfs
Title 2:

X axis label Distance
Y axis label Elevation

Full grid display .. Yes

Plot device Color graphics adapter [CGA]
Plot sent to COM

X axis scales Fill plot area
Y axis scales Automatic

Select color options

Return to previous menu

Press <Enter> to select item : ↑ ↓ moves cursor

Figure 25. PLOT2 Plotting Options Menu

With the cursor positioned at Title 1:, type in the first title line. Then move the cursor to Title 2:, if desired, and enter the second title line. For X axis label, the default label **Distance** may be used, or an alternative label may be written over the default label. Units, if appropriate, can be added on the same line. Similarly, for the Y axis label the default label **Elevation** may be used, modified with units added, or replaced by entering a new label. A **Full grid display** is provided with the plot. To turn off the grid, move the cursor to that line, and press the <SPACE BAR> to toggle the choice from Yes to No.

As described in Section 9.4, options for graphics adapter and output device can be selected. For HP pen plotters, the output port can be set to COM1 or COM2, as appropriate.

The X axis scales default is **Fill plot area**, and the Y axis scales default is **Automatic** for each plot. To change the scale, press the <SPACE BAR> and the

following options are provided: scales set to 1, 2, or 5 times a power of 10, Fill plot area, and Max scale for all. Fill plot area would normally be used for one scale while fixing the other scale. Max scale for all provides a fixed scale based on the maximum range of the data values.

Select color options provides a menu to set the pen number for pen plots and the line colors for EGA color screen displays. The Color options menu is shown in Figure 26. For cross-section plots, the options are for the Text, Axis, and the section features to be plotted.

P L O T 2

Color options

line type	HP pen number	line color
Text	1	white
Axis and grid	1	white
Cross-section geometry	1	white
Water surface elevation(s) ...	1	white
Left/right overbank symbols ..	1	white
Bridge geometry	1	white
n-values descriptions	1	white
Encroachments	1	white
Effective area	1	white
Return to previous menu		

Press <Space bar> to toggle parameter : ↑ ↓ ← → moves cursor

Figure 26. PLOT2 Cross-section Color Options Menu

After the plotting options have been defined, move the cursor to **Return to previous menu** and press <ENTER>. Or press <Esc> to return.

In the Cross-section Plots menu, move the cursor to **Plot cross sections**, and press <ENTER>. If the input data file name is not defined correctly, the program will provide the following message:

**PLOT2 cannot continue until the
appropriate input files have been
specified.**

Press <ESC> to continue.

Return to the Cross-section Plots menu and check the file names. Remember to provide the drive and directory, if necessary. You can enter <?> to review the files in the default directory.

If the file names are correct, the program will provide the following message:

Plot all cross-sections (y/n)?

If all cross sections are to be plotted, enter <y>, or press <ENTER> and the program will start plotting with the first cross section in the data set. If you enter <n>, the program will provide a menu of cross sections available. The cursor arrow keys will move the cursor around the listing of cross-section numbers. To plot a cross section, press <ENTER> while the cursor is on the desired cross section. Figure 27 is an example cross-section plot with Manning's n values and water surface elevations plotted for three profiles.

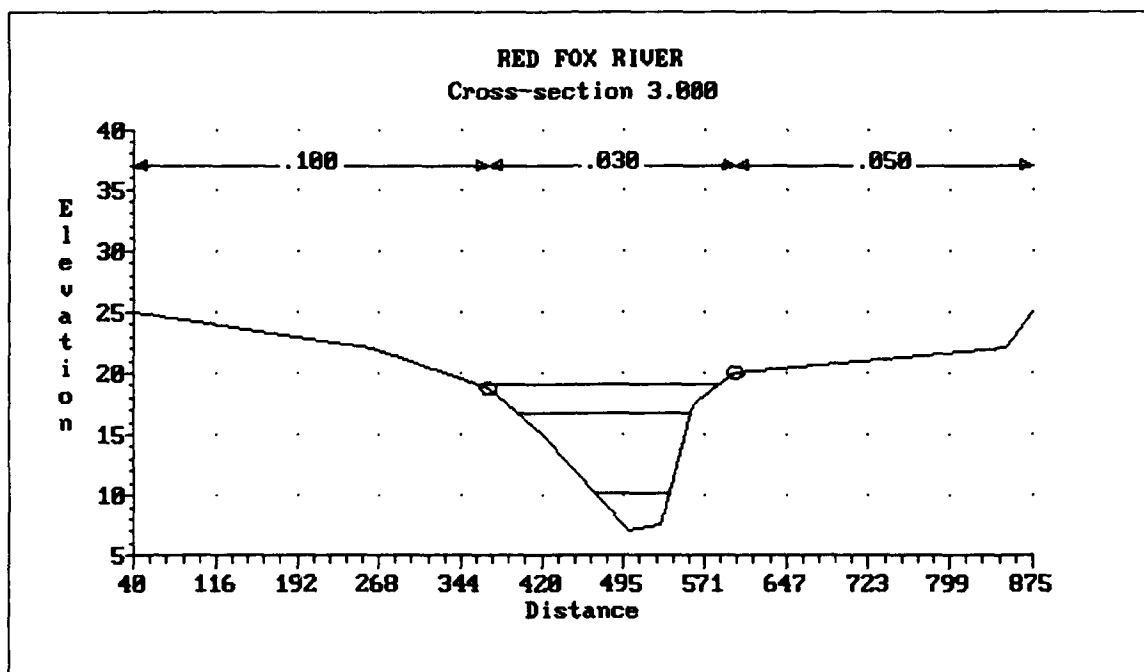


Figure 27. Example Cross-section Plot

With the cross-section plot on the screen, you can obtain a printed copy of the display by entering <PrtSc>. Be sure that you have set your printer to graphic mode. To clear the plot from the screen, press <ENTER>. If you are selecting cross sections to plot from the menu of available cross sections, the program will return to that menu. If you are plotting all cross sections, the program will plot the next section.

When plotting has been completed, press <Esc> to return to the Cross-section Plots menu. To return to the main menu, press <Esc> or move the cursor to **Return to previous menu** and press <ENTER>.

From the PLOT2 Main Menu, you can enter <4> or move the cursor to 4. Exit PLOT2 and press <ENTER> to leave the PLOT2 program. Or you can plot Rating curves by pressing <3>. The Rating Curve Plot Menu, shown in Figure 28, will appear.

9.7 RATING CURVE PLOTS

The rating curve option is called from the PLOT2 Main Menu by moving the cursor to 3. Plot rating curves and pressing the <ENTER> key, or by entering <3>. The rating curve menu, shown below, appears. The two options menus have default values, so you can start plotting rating curves immediately. However, selecting **Rating curve options** will display the menu shown in Figure 29, with the default settings as shown.

— P L O T 2 —

Rating curve plots

Rating curve options

Plotting options

Plot rating curves

Return to main menu

HEC2 Tape95 file name .. REDFOX.T95

Press <Enter> to select : ↑ ↓ moves cursor

Figure 28. PLOT2 Rating Curve Plot Menu

— P L O T 2 —

Rating curve options

X axis variable Q (43)

Y axis variable CWSEL (1)

Mark points Yes

Minimum value added .. No

X axis minimum value .. .000

Y axis minimum value .. ELMIN

Return to previous menu

Press <Space bar> to toggle parameter : ↑ ↓ moves cursor

Figure 29. PLOT2 Rating Curve Options Menu

The **Rating curve options** menu allows you to define the variables to plot, mark the computed points, and add a minimum value. Default minimum values are 0.0 for most variables and the minimum cross-section elevation (ELMIN) for elevation variables. The default variables to plot, shown in Figure 29, are flow (Q variable 43) versus computed water surface elevation (CWSEL variable 1). The variables can be changed by pressing the left cursor arrow to decrease, or the right cursor arrow to increase, the variable number. The sequential order of the variables is listed in the input description for the J3 record. The order is the same as the order of the variables in TAPE95. Refer to the input description to see the sequential order of the variables.

Move the cursor down to **Mark points** by pressing the down arrow. The default is to mark the computed points with a circle. The option can be turned off by pressing the <SPACE BAR> to change Yes to No.

The minimum value can be added by moving the cursor down to **Minimum value added** and pressing the <SPACE BAR> to change No to Yes. The default is 0.00 for variables that would typically have a zero minimum. The zero minimum can be modified by entering a numeric value. The alternate default is the minimum cross-section elevation (ELMIN) for elevation variables like water surface and energy elevation.

If the default settings are acceptable, you can quickly return to the rating curve menu by pressing escape <Esc>. After setting the options, you can return by moving the cursor to **Return to main menu** and pressing <ENTER>. Pressing <Esc> does not save the changes you make.

The **Plotting options** menu is called by moving the cursor to that line and pressing <ENTER>. The menu shown in Figure 30 will appear.

P L O T 2

Plotting options

Title 1: FOX RIVER Q = 1000 cfs
Title 2:

X axis label Q
Y axis label CWSEL

Full grid display .. Yes

Plot device Color graphics adapter [CGA]
Plot sent to COM

X axis scales Fill plot area
Y axis scales Automatic

Select color options

Return to previous menu

Press <Enter> to select item : ↑ ↓ moves cursor

Figure 30. PLOT2 Rating Curve Plotting Options Menu

The rating curve **Plotting options** menu is similar to the other menus for plotting options. The default **Title 1:** is the title from the T3 record, fields 2-4. The title can be edited using insert and delete keys, or replaced by typing over it.

The X and Y axis labels are set to the variable names selected for plotting in the rating curve options menu. The label can be changed by using the cursor to highlight the line, and entering a new label. For example, you may want to change Q to Flow in cfs.

A **Full grid display** is provided, by default. To eliminate the grid, highlight that option, and press the <SPACE BAR> to change Yes to No.

The **Plot device** and **Plot sent to** options are the same as described in Section 9.4. Also, the scales options are the same as previously described. The pen number, for pen plots, and the line color, for EGA color graphics display, can be set by moving the cursor to **Select color options** and pressing the <SPACE BAR>. The menu shown in Figure 31 will be displayed.

P L O T 2

Color options

line type	HP pen number	line color
Text	1 ...	white
Axis and grid	1 ...	white
Curve	1 ...	white
Point symbols	1 ...	white
Return to previous menu		

Press <Space bar> to toggle parameter : ↑ ↓ ← → moves cursor

Figure 31. PLOT2 Rating Curve Color Options Menu

The cursor location is indicate by the highlighted line and a blinking marker. One column is for the pen number, and the other is the color of the plot lines for the screen display. The <SPACE BAR> is used to toggle through the choices. The left and right cursor arrows move the marker between columns, and the up and down arrows move the highlighted line.

Pressing escape <Esc> will return you to the **Plotting options** menu without any changes to the default color settings. If you change the settings, move the cursor to the bottom line, **Return to previous menu**, and press <ENTER>.

From the rating curve menu, move the highlighted line to **Plot rating curves** and press **<ENTER>**. The following message will be displayed:

Plot all cross-sections (y/n)?

Pressing **<y>** or **<ENTER>** will give you a rating curve for every cross section. Pressing **<n>** will give you a menu of available cross sections. Use the up and down cursor arrow keys to highlight the section numbers, and press **<ENTER>** to select the desired cross sections. When you have selected the desired section numbers, press **<c>** to start plotting. Figure 32 is an example of the EGA graphics plot. After each plot, press the **<SPACE BAR>** or **<ENTER>** to obtain the next plot. If you are plotting to the screen, you can use the print screen option **<PrtSc>** to obtain a copy of the plot on a graphics compatible printer set to graphics mode.

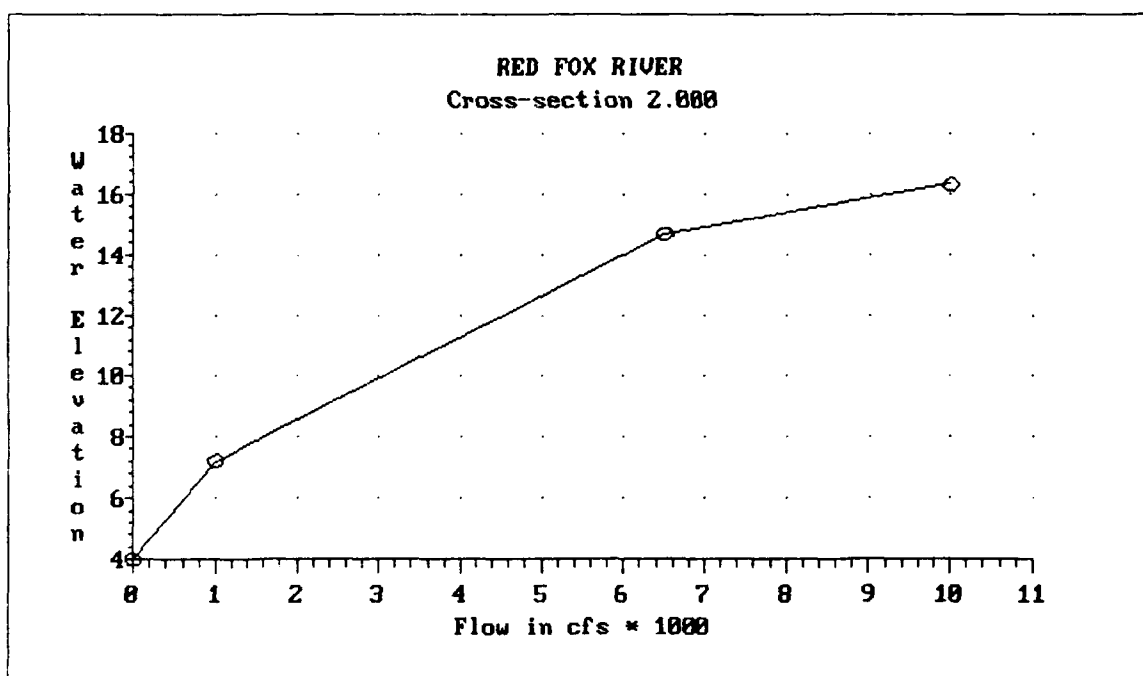


Figure 32. Example Rating Curve

After you have completed plotting, return to the **PLOT2** main menu, and move the cursor to line 4. Exit **PLOT2** and press **<ENTER>**, or simply press the **<4>** key. If you called **PLOT2** from **MENU2**, you will be returned to **MENU2**. If you called **PLOT2** from **DOS**, you will be returned to the **DOS** prompt.

10. REFERENCES

1. Bonner, V.R., "Application of the HEC-2 Bridge Routines," Training Document 6, The Hydrologic Engineering Center, Davis, CA, June 1974.
2. Bonner, V.R., "Floodway Determination Using Computer Program HEC-2," Training Document 5, The Hydrologic Engineering Center, Davis, CA, revised January 1988.
3. Buerg, V.D., 1986, "LIST Version 6.0," Program Documentation File, copyright by Vernon D. Buerg, 456 Lakeshire Drive, Daly City, CA 94015.
4. Eichert, B.S., "Survey of Programs for Water Surface Profiles," Technical Paper 11, The Hydrologic Engineering Center, Davis, CA, August 1968.
5. Eichert, B.S., "Critical Water Surface by Minimum Specific Energy Using the Parabolic Method," Technical Paper 69, The Hydrologic Engineering Center, Davis, CA, 1969.
6. Eichert, B.S. and Peters, J.C., "Computer Determination of Flow Through Bridges," Technical Paper 20, The Hydrologic Engineering Center, Davis, CA, July 1970.
7. Microcompatibles, Inc., "GRAFMATIC Scientific/Engineering Graphics," Silver Spring, MD, 1983.
8. Microcompatibles, Inc., "PLOTMATIC Scientific/Engineering Pen Plotter GRAPHICS," Silver Spring, MD, 1984.
9. Montalvo, A.E., "Application of the HEC-2 Split Flow Option," Training Document 18, The Hydrologic Engineering Center, Davis, CA, April 1982.
10. Thomas, W.A., "Water Surface Profiles," IHD Volume 6, The Hydrologic Engineering Center, Davis, CA, July 1975.
11. U.S. Army Corps of Engineers, The Hydrologic Engineering Center, "HEC-2 Water Surface Profiles," Users Manual, Davis, CA, September 1982.
12. U.S. Army Corps of Engineers, The Hydrologic Engineering Center, "Hydraulics Graphics Package," Users Manual, Davis, CA, September 1983.
13. U.S. Army Corps of Engineers, The Hydrologic Engineering Center, "Water Surface Profile Accuracy Analysis," Research Document, Davis, CA, 1986.
14. U.S. Army Corps of Engineers, The Hydrologic Engineering Center, "COED Corps of Engineers Editor" DRAFT User Description, Davis, CA, January 1987.
15. U.S. Army Corps of Engineers, Waterways Experiment Station, "Graphics Compatibility System (GCS)," Programmer's Reference Manual, Vicksburg, MS, 1979.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution of this document is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Training Document #26			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION The Hydrologic Engineering Ctr.		6b. OFFICE SYMBOL (If applicable) CEWRC-HEC	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) 609 Second Street Davis, CA 95616			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
11. TITLE (Include Security Classification) Computing Water Surface Profiles with HEC-2 on a Personal Computer (Unclassified)					
12. PERSONAL AUTHOR(S)					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) September 1988	
15. PAGE COUNT					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Water surface profiles, computer program, personal computer		
FIELD	GROUP	SUB-GROUP			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) A package of computer programs has been developed to compute water surface profiles and to display the results in tabular and graphical form. The package is based on the Corps' Water Surface Profile Program HEC-2. This document presents each program in the package and provides user guidance.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Vern Bonner, Training Division, HEC			22b. TELEPHONE (Include Area Code) (916) 551-1748		22c. OFFICE SYMBOL CEWRC-HEC