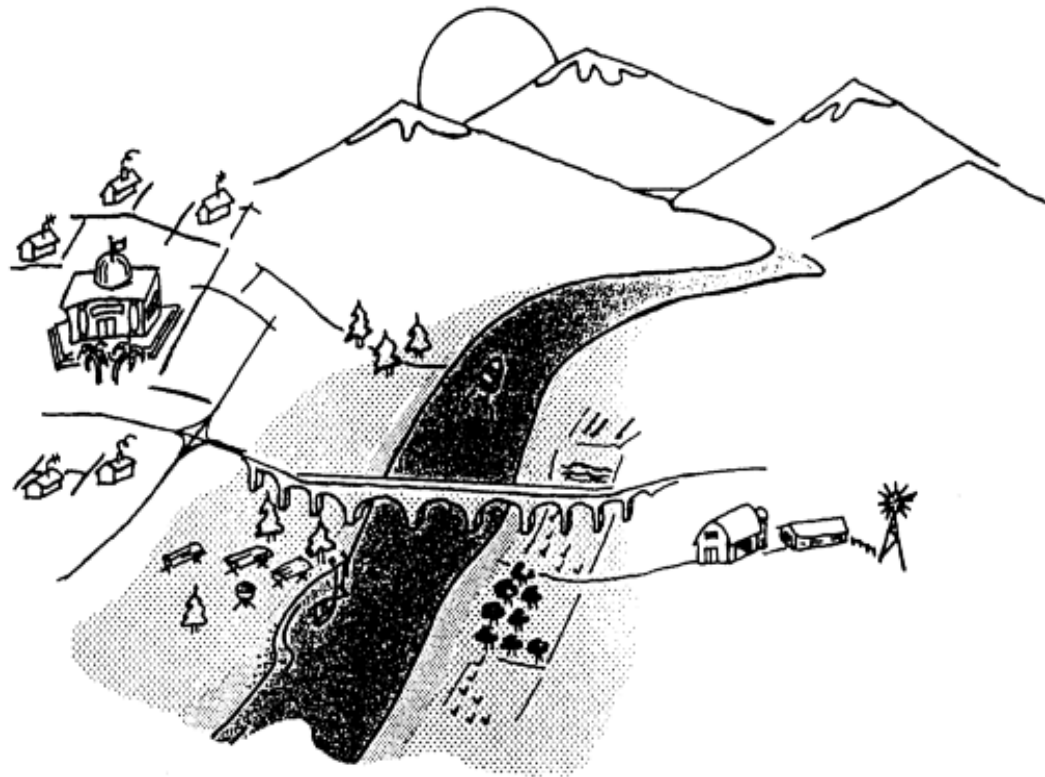




**US Army Corps
of Engineers**
Hydrologic Engineering Center

HEC-RAS

River Analysis System



User's Manual

Version 3.0
January 2001

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE January 2001	3. REPORT TYPE AND DATES COVERED Computer Program Documentation		
4. TITLE AND SUBTITLE HEC-RAS, River Analysis System User's Manual			5. FUNDING NUMBERS	
6. AUTHOR(S) Gary W. Brunner				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US ARMY CORPS OF ENGINEERS HYDROLOGIC ENGINEERING CENTER (HEC) 609 Second Street Davis, CA 95616-4687			8. PERFORMING ORGANIZATION REPORT NUMBER CPD-68	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) <p>The U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) is software that allows you to perform one-dimensional steady and unsteady flow river hydraulics calculations.</p> <p>HEC-RAS is an integrated system of software, designed for interactive use in a multi-tasking, multi-user network environment. The system is comprised of a graphical user interface (GUI), separate hydraulic analysis components, data storage and management capabilities, graphics and reporting facilities.</p> <p>The HEC-RAS system will ultimately contain three one-dimensional hydraulic analysis components for: (1) steady flow water surface profile computations; (2) unsteady flow simulation; and (3) movable boundary sediment transport computations. A key element is that all three components will use a common geometric data representation and common geometric and hydraulic computation routines. In addition to the three hydraulic analysis components, the system contains several hydraulic design features that can be invoked once the basic water surface profiles are computed.</p> <p>The current version of HEC-RAS supports Steady and Unsteady flow water surface profile calculations. New features and additional capabilities will be added in future releases.</p>				
14. SUBJECT TERMS water surface profiles, river hydraulics, steady and unsteady flow, computer program			15. NUMBER OF PAGES 320	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED	

HEC-RAS

River Analysis System

User's Manual

Version 3.0

January 2001

US Army Corps of Engineers
Institute For Water Resources
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616

(530) 756-1104
(530) 756-8250 FAX
www.hec.usace.army.mil

River Analysis System, HEC-RAS Software Distribution and Availability Statement

The HEC-RAS executable code and documentation are public domain software that were developed by the Hydrologic Engineering Center for the U.S. Army Corps of Engineers. The software was developed at the expense of the United States Federal Government, and is therefore in the public domain. This software can be downloaded for free from our internet site (www.hec.usace.army.mil). HEC cannot provide technical support for this software to non-Corps users. See our software vendor list (on our web page) to locate organizations that provide the program, documentation, and support services for a fee. However, we will respond to all documented instances of program errors. Documented errors are bugs in the software due to programming mistakes not model problems due to user-entered data.

Cover sketch adapted from:

Flood Plain Management Program, Handbook for Public Officials
Department of Water Resources
State of California
August 1986

Table of Contents

Foreword	viii
Chapter 1 Introduction	1-1
General Philosophy of the Modeling System	1-2
Overview of Program Capabilities.....	1-2
User Interface.....	1-2
Hydraulic Analysis Components	1-3
Data Storage and Management.....	1-4
Graphics and Reporting.....	1-4
HEC-RAS Documentation	1-5
Overview of This Manual	1-5
Chapter 2 Installing HEC-RAS	2-1
Hardware and Software Requirements	2-2
Installation Procedure	2-2
Uninstall Procedure	2-3
Chapter 3 Working With HEC-RAS - An Overview	3-1
Starting HEC-RAS	3-2
Steps in Developing a Hydraulic Model With HEC-RAS	3-6
Starting a New Project.....	3-6
Entering Geometric Data	3-7
Entering Flow Data and Boundary Conditions	3-9
Performing The Hydraulic Computations	3-10
Viewing and Printing Results	3-12
Importing HEC-2 Data	3-16
What You Should Know First.....	3-16
Steps For Importing HEC-2 Data	3-19
Reproducing HEC-2 Results.....	3-20
Getting and Using Help.....	3-22
Chapter 4 Example Application	4-1
Starting a New Project	4-2
Entering Geometric Data	4-3
Drawing the Schematic of the River System.....	4-3
Entering Cross Section Data	4-4
Entering Junction Data	4-9
Saving the Geometry Data	4-10
Entering Steady Flow Data	4-10
Performing the Hydraulic Calculations	4-13
Viewing Results	4-14
Printing Graphics and Tables	4-20
Sending Graphics Directly to the Printer	4-20
Sending Graphics to the Windows Clipboard	4-20
Sending Tables Directly to the Printer	4-21
Sending Tables to the Windows Clipboard	4-21
Exiting the Program	4-22

Chapter 5 Working With Projects	5-1
Understanding Projects	5-1
Elements of a Project.....	5-2
Plan Files.....	5-2
Run Files	5-2
Output Files	5-3
Geometry Files	5-3
Steady Flow Data Files.....	5-3
Unsteady Flow Data Files.....	5-3
Sediment Data Files	5-4
Hydraulic Design Data Files	5-4
Creating, Opening, Saving, Renaming, and Deleting Projects.....	5-6
Project Options	5-6
 Chapter 6 Entering and Editing Geometric Data	6-1
Developing the River System Schematic.....	6-2
Building the Schematic	6-2
Adding Tributaries into an Existing Reach	6-4
Editing the Schematic.....	6-4
Interacting With the Schematic	6-6
Background Pictures	6-8
Cross Section Data.....	6-9
Entering Cross Section Data	6-9
Editing Cross Section Data.....	6-11
Cross Section Options	6-12
Plotting Cross Section Data.....	6-20
Stream Junctions.....	6-20
Entering Junction Data	6-20
Selecting a Modeling Approach	6-21
Bridges and Culverts	6-22
Cross Section Locations.....	6-23
Contraction and Expansion Losses	6-25
Bridge Hydraulic Computations	6-25
Entering and Editing Bridge Data	6-27
Bridge Design Editor.....	6-40
Culvert Hydraulic Computations	6-42
Entering and Editing Culvert Data	6-43
Bridge and Culvert Options.....	6-48
Bridge and Culvert View Features	6-50
Multiple Bridge and/or Culvert Openings	6-51
Entering Multiple Opening Data.....	6-52
Defining The Openings.....	6-55
Multiple Opening Calculations	6-56
Inline Weirs and Gated Spillways	6-57
Entering and Editing Inline Weir and Gated Spillway Data ..	6-57
Lateral Weirs and Gated Spillways.....	6-65
Entering and Editing Lateral Weir and Spillway Data.....	6-65
Cross Section Interpolation.....	6-73
River Ice	6-79
Entering and Editing Ice Data	6-79

Entering Ice Data at a Cross Section.....	6-79
Entering Ice Data Through a Table.....	6-82
Entering Ice Data at Bridges.....	6-83
Setting Tolerances for the Ice Jam Calculations.....	6-84
Viewing and Editing Data Through Tables.....	6-85
Manning's n or k values.....	6-85
Reach Lengths.....	6-87
Contraction and Expansion Coefficients.....	6-87
River Stationing.....	6-88
Ice Cover.....	6-88
Node Names.....	6-89
Bridge Width Table.....	6-90
Importing Geometric Data.....	6-91
GIS Format.....	6-91
USACE Survey Data Format.....	6-92
HEC-2 Data Format.....	6-92
HEC-RAS Data Format.....	6-92
UNET Geometric Data Format.....	6-92
MIKE 11 Cross Section Data.....	6-93
Geometric Data Tools.....	6-93
Graphical Cross Section Editor.....	6-93
Reverse Stationing Data.....	6-94
Set Ineffective Areas to Permanent Mode.....	6-95
Cross Section Points Filter.....	6-96
Fixed Sediment Elevations.....	6-98
Pilot Channels.....	6-99
GIS Cut Line Check.....	6-101
Attaching and Viewing Pictures.....	6-102
Saving the Geometric Data.....	6-104
 Chapter 7 Performing a Steady Flow Analysis.....	 7-1
Entering and Editing Steady Flow Data.....	7-1
Steady Flow Data.....	7-1
Boundary Conditions.....	7-2
Steady Flow Data Options.....	7-4
Saving the Steady Flow Data.....	7-7
Importing Data from the HEC Data Storage System (HEC-DSS).....	7-7
Performing Steady Flow Calculations.....	7-10
Defining a Plan.....	7-10
Saving the Plan Information.....	7-11
Simulation Options.....	7-11
Starting the Computations.....	7-17
 Chapter 8 Performing an Unsteady Flow Analysis.....	 8-1
Entering and Editing Unsteady Flow Data.....	8-1
Unsteady Flow Data.....	8-1
Boundary Conditions.....	8-2
Initial Conditions.....	8-8
Unsteady Flow Data Options.....	8-10
Saving The Unsteady Flow Data.....	8-11

Performing Unsteady Flow Calculations	8-11
Defining A Plan.....	8-12
Selecting Programs to Run.....	8-13
Simulation Time Window	8-17
Computation Settings	8-18
Simulation Options	8-19
Saving The Plan Information	8-25
Starting The Computations	8-25
Chapter 9 Viewing Results	9-1
Cross Sections, Profiles, and Rating Curves	9-1
Viewing Graphics on the Screen	9-1
Graphical Plot Options.....	9-4
Plotting Velocity Distribution Output.....	9-6
Plotting Other Variables in Profile.....	9-8
Plotting One Variable Versus Another	9-8
Sending Graphics to the Printer or Plotter	9-9
Sending Graphics to the Windows Clipboard	9-10
Stage and Flow Hydrographs	9-10
X-Y-Z Perspective Plots.....	9-11
Tabular Output.....	9-13
Detailed Output Tables.....	9-13
Detailed Output Table Options	9-17
Profile Summary Tables	9-17
User Defined Output Tables	9-20
Sending Tables to the Printer	9-21
Sending Tables to the Windows Clipboard	9-22
Viewing Results From the River System Schematic	9-22
Viewing Ice Information	9-24
Viewing Graphical Ice Information on the Screen	9-24
Viewing Tabular Ice Information	9-26
Viewing Data Contained in an HEC-DSS File.....	9-26
Exporting Results To HEC-DSS	9-30
Chapter 10 Performing a Floodway Encroachment Analysis ...	10-1
General.....	10-2
Entering Floodplain Encroachment Data	10-3
Performing the Floodplain Encroachment Analysis.....	10-6
Viewing the Floodplain Encroachment Results.....	10-7
Chapter 11 Troubleshooting With HEC-RAS	11-1
Built in Data Checking	11-1
Checking The Data as it is Entered	11-1
Checking Data Before Computations are Performed.....	11-2
Errors, Warnings, and Notes	11-3
Log Output.....	11-6
Steady Flow Log Output	11-6
Unsteady Flow Log Output	11-7
Viewing The Log File	11-7
Reviewing and Debugging the Normal Output.....	11-8

Viewing Graphics.....	11-8
Viewing Tabular Output	11-8
The Occurrence of Critical Depth	11-8
Computational Program Does Not Run To Completion	11-9
Chapter 12 Computing Scour at Bridges	12-1
General Modeling Guidelines	12-2
Entering Bridge Scour Data	12-3
Entering Contraction Scour Data	12-4
Entering Pier Scour Data.....	12-6
Entering Abutment Scour Data	12-10
Computing Total Bridge Scour.....	12-13
Chapter 13 Performing Channel Modifications	13-1
General Modeling Guidelines	13-2
Entering Channel Modification Data	13-2
Performing the Channel Modifications	13-6
Comparing Existing and Modified Conditions	13-8
Chapter 14 Using GIS Data With HEC-RAS	14-1
General Modeling Guidelines	14-2
Importing GIS/CADD Data Into HEC-RAS	14-4
Completing The Data and Performing The Computations	14-6
Completing The Geometric Data	14-6
Importing Additional Geometry From The GIS.....	14-6
Entering Additional Cross Section Data.....	14-7
Performing The Computations and Viewing Results.....	14-8
Exporting Computed Results to The GIS or CADD.....	14-9
Appendix A References	A-1
Appendix B HEC-RAS Import/Export Files For Geospatial Data	B-1
Appendix C List of HEC-RAS Output Variables	C-1

Foreword

The U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) is software that allows you to perform one-dimensional steady and unsteady flow river hydraulics calculations. The HEC-RAS software supersedes the HEC-2 river hydraulics package, which was a one-dimensional, steady flow water surface profiles program. The HEC-RAS software is a significant advancement over HEC-2 in terms of both hydraulic engineering and computer science. This software is a product of the Corps' Civil Works Hydrologic Engineering Research and Development Program.

The first version of HEC-RAS (version 1.0) was released in July of 1995. Since that time there have been several releases of this software package, including versions: 1.1; 1.2; 2.0; 2.1; 2.2; 2.21; and now version 3.0 in January of 2001.

Version 3.0 of HEC-RAS is a major advancement over the previous 2.21 version. This new version (3.0) includes unsteady flow routing, as well as split flow optimization for steady flow modeling.

The HEC-RAS software was developed at the Hydrologic Engineering Center (HEC), which is a division of the Institute for Water Resources (IWR), U.S. Army Corps of Engineers. The software was designed by Mr. Gary W. Brunner, leader of the HEC-RAS development team. The user interface and graphics were programmed by Mr. Mark R. Jensen. The steady flow water surface profiles module was programmed by Mr. Steven S. Piper. The unsteady flow equation solver was developed by Dr. Robert L. Barkau. The routines that import HEC-2 and UNET data were developed by Ms. Joan Klipsch. The cross section interpolation routines were developed by Mr. Alfredo Montalvo. The routines for modeling ice cover and wide river ice jams were developed by Mr. Steven F. Daly of the Cold Regions Research and Engineering Laboratory (CRREL).

Many of the HEC staff made contributions in the development of this software, including: Vern R. Bonner, Richard Hayes, John Peters, and Michael Gee. Mr. Darryl Davis was the director during the development of this software.

This manual was written by Mr. Gary W. Brunner.