Chapter 1

Introduction

1.1

[1] Although Einstein's Bed-Load Function is not included in this version of HEC-6, his concepts of particle movement and interchange have guided development of the algorithms used in HEC-6 to describe the dynamic interactions between bed material composition and bed material transport.

1.2 Applications of HEC-6

A dynamic balance exists between the sediment moving in a natural stream, the size and gradation of sediment material in the stream's boundaries and the flow hydraulics. When a reservoir is constructed, flood damage reduction measures are implemented, or a minimum depth of flow is maintained for navigation, that balance may be changed. HEC-6 can be used to predict the impact of making one or more of those changes on the river hydraulics, sediment transport rates, and channel geometry.

HEC-6 is designed to simulate long-term trends of scour and/or deposition in a stream channel that might result from modifying the frequency and duration of the water discharge and/or stage, or from modifying the channel geometry (e.g., encroaching on the floodplains). HEC-6 can be used to evaluate deposition in reservoirs (both the volume and location of deposits), design channel contractions required to maintain navigation depths or decrease the volume of maintenance dredging, predict the influence that dredging has on the rate of deposition, estimate possible maximum scour during large flood events, and evaluate sedimentation in fixed channels. Some early applications of HEC-6 were described by Thomas and Prasuhn (1977) and more recent application advice is provided by HEC (1992). Guidelines for performing sedimentation studies is given in USACE (1989) and river hydraulics studies in USACE (1993).

1.3 Overview of Manual

This manual describes the fundamental concepts, numerical model limitations and capabilities, computational procedures, input requirements and output of HEC-6. A brief description of model capabilities and the organization of this manual is presented below.

Theoretical Basis For Movable Boundary Calculations (Chapter 2)

This chapter describes the theoretical basis for hydraulic and sediment computations used in the computer program HEC-6. It presents the general capabilities of the program and describes how the computations are performed.

General Input Requirements (Chapter 3)

This chapter describes the general data requirements of HEC-6. It describes the input data required for implementation of specific HEC-6 capabilities.

Program Output (Chapter 4)

This chapter provides information on the various output levels available for displaying the geometric, sediment, and hydrologic data; and for listing the initial and boundary conditions. It also describes how to save desired information at selected times during a simulation.

Modeling Guidelines (Chapter 5)

General modeling guidelines and additional information on how HEC-6 performs its computations are presented in this chapter.

Example Problems (Chapter 6)

This chapter gives example applications of HEC-6. It covers single river and network situations and some commonly used features of the program.

1.4 Summary of HEC-6 Capabilities

1.4.1 Geometry

A river system consisting of a main stem, tributaries and local inflow/outflow points can be simulated. Such a system in which tributary sediment transport is calculated is referred to in this document as a network model. Sediment transport is calculated by HEC-6 in primary rivers and tributaries. There will be upper limits on the number of network branches, number of cross sections, etc., due to computer memory limitations. As these may change among HEC-6 implementations on various computer systems, the user should check the header on the output file to determine the limits of the particular version being used.

1.4.2 Hydraulics

The one-dimensional energy equation (USACE 1959) is used by HEC-6 for water surface profile computations. Manning's equation and *n* values for overbank and channel areas may be specified by discharge or elevation. Manning's *n* for the channel can also be varied by Limerinos' (1970) method using the bed gradation of each cross section. Expansion and contraction losses are included in the determination of energy losses. The energy loss coefficients may be changed at any cross section.

For each discharge in a hydrograph, the downstream water surface elevation can be determined by either a user-specified rating curve or a time dependent water surface elevation. Internal boundary conditions can be imposed on the solution. The downstream rating curve can be changed at any time. Internal boundary conditions can also be changed at any time.

Flow conveyance limits, containment of the flow by levees, ineffective flow areas, and overtopping of levees are simulated in a manner similar to HEC-2. Split flow computations are not done and no special capability for computing energy losses through bridges is available. Supercritical flow, should it occur, is approximated by normal depth; therefore, sediment transport phenomena occurring in supercritical reaches are simplified in HEC-6.

HEC-6 can be executed in "fixed bed" mode, which is similar to an HEC-2 application, in that only water surface profiles are computed. Sediment information such as inflowing sediment load and bed gradations are not needed to run HEC-6 in fixed-bed mode.

1.4.3 Sediment

Sediment transport rates are calculated for grain sizes up to 2048 mm. Sediment sizes larger than 2048 mm, that may exist in the bed, are used for sorting computations but are not transported. For deposition and erosion of clay and silt sizes up to 0.0625 mm, Krone's (1962) method is used for deposition and Ariathurai and Krone's (1976) adaptation of Parthenaides' (1965) method is used for scour. The default procedure for clay and silt computations allows only deposition using a method based on settling velocity.

The sediment transport function for bed material load is selected by the user. Transport functions available in the program are the following:

a. Toffaleti's (1966) transport function
b.

1.5 Theoretical Assumptions and Limitations

HEC-6 is a one-dimensional continuous simulation model that uses a