TWRI Special Report 90-1

A&M WATERSHED MODEL USERS MANUAL

by: Wesley P. James

Phillip W. Winsor, John F. Bell

Melvin G. Spinks, Alfred J. Garcia

Dan Pridal, John Warinner

Kelly Kaatz, Veronica Morgan

Mike Reedy, Cedric Robinson

January 1990

WATER RESOURCES ENGINEERING

Texas A&M University

CIVIL ENGINEERING DEPARTMENT

COLLEGE STATION TX 77843-3138

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The research on which this report is based was financed in part by the United States Government Corps of Engineers through the Texas Engineering Experiment and the Geological Survey through the Texas Water Resources Institute. Contents of this publication do not necessarily reflect the views and policies of the United States Government, nor does mention of trade names or commercial products constitute their endorsement by the U.S. Government.

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CHAPTER I

1. INTRODUCTION

1.1 Model Philosophy

The A&M Watershed model was developed to simulate a flood event caused by a rain storm. The model can be used to compute the discharge, water velocity, and water surface elevation in a stream for a flood. It is a user friendly model developed for the microcomputer. The model was designed to limit the number of technical options available to the user and at the same time provide a maximum number of data input options. The model has two loss rate functions (curve number procedure and the Green-Ampt equation), one unit hydrograph (two parameter gamma function), two stream routing methods (storage and hydraulic), one pipe routing procedure (hydraulic), one reservoir routing procedure (continuity equation storage-discharge method), and one method for water surface profile computation (standard step). The technical options were selected to minimize the requirement for historical streamflow data and field measurements and maximize the use of available data such as topographic maps and aerial photography.

1.2 Overview

Hydrology is concerned with the quantitative evaluation of the hydrologic cycle. The watershed area is divided into subbasins and the runoff resulting fram a rain storm is computed for each subbasin. The model uses the SCS (Soil Conservation Service) curve number procedure or Green-Ampt equation to estimate the runoff and the unit hydrograph method to compute the runoff hydrograph. The general concept of streamflow forecasting is shown in Figure 1.1. Runoff hydrographs can be added and routed to provide the streamflow discharge for any location along the channel. Routing is a procedure computing the downstream or outflow hydro-graph of a reach when the upstream or inflow hydrograph is known.

After the stream discharge is computed the program determines the water surface profiles for gradually varied subcritical flow. The program uses normal depth when the flow is supercritical. The headlosses through bridges, culverts, and weirs can be included in the computation.

The program handles a single channel system or a branching system where water surface profiles are to be computed for one or more tributaries to the main channel. Hydrologic computations of the streamflow begin at the uppermost subbasin and continue downstream. After the hydrologic computations of all branches have been completed, streamflows for the main channel are computed starting upstream and continuing in the downstream direction. The water surface profile computations proceed in just the opposite sequence as the hydrologic streamflow computations. Water surface profile computations start at the lower end of the main channel and continue upstream. The water surface profiles along the branches are computed last with each branch starting at the main channel and continuing upstream. The model uses the same stream cross sections for stream routing and water surface profile computations.

A flow diagram for the A&M Watershed Model is shown in Figure 1.2. The two main functions of the model are to (1) generate data files, and (2) compute flow rates and water surface elevations. Data files must be completed before the hydrology computations can begin. Data files include:

1. System file (number and location of branches),
2. Subbasin data files (subbasin characteristics),
3. Precipitation files (accumulative rainfall),
4. Routing reach file (start and end river station of each reach),
5. Reservoir routing files (storage and discharge table),
6. Command file (sequence of hydrologic operations),
7. Cross section files (valley and channel characteristics),

8. Structure files (bridges, culverts and weirs),
9. Urban channel (gutters, pipes and channels), and
10. Encroachment and channel improvement file (flow limits.on each side of channel).

The seven commands utilized in the hydrologic computations are ADD, ROUTE, STORE, SPLIT, PROFILE, DETENT, and END. These commands will be discussed in detail in Chapter II.

The model was written for a microcomputer using interactive programming to prompt the user for the input data. Help options and error traps have been added to the model to assist the user in running the programs. The model has been developed for an IBM compatible microcomputer with 512K memory, two disk drives, and a printer. The model requires that the program disk be in one drive and the data disk be in a second drive. When the program disk is run, the user can specify the disk drives to be used by the model such as two floppy disks using drives A&B, a floppy disk and a hard disk using drives A&C, or other combination specified by user.

The program includes the following subprograms:

LIABLE -Condition of use and disk drive specification,
MODEL -Generate data files,
RAIN -Generate precipitation file,
POND -Generate reservoir routing file,
XSECT -Generate cross section files,
ROAD -Generate stream structure file,
RADAR -Generate precipitation file from weather radar data,
URBPROG -Generate urban channel data file,
EDIT -Edit data files,
EDIT2 -Edit data files,
EDIT3 -Edit data files,
A&M -Hydrologic model,
RATERES -Compute rating tables and reservoir routing,
PROFILE -Compute water surface profile,
STRMRT -Hydrologic and hydraulic stream routing,
HYDCAL6 –Hydrograph blending, and
PIPEROUT –Hydraulic routing through pipes.

The data disk includes a data file called TEXAS. This file includes the coefficients necessary to compute the statistical rainfall for each county in Texas. SCS precipitation distributions I, IA, II, III and Dimensionless are also stored on disk.

Several of the subprograms have been modified and combined into a package for design. The design programs are on disk; three and include:

1. Detention basin design with hydrograph analysis,
2. Culvert design with hydrograph analysis,
3. Texas R.R. Commission sedimentation pond design with hydrograph analysis,
4. Design and analysis of open channels,
5. Culvert analysis based on peak discharge,
6. Flood frequency analysis.
7. Hydraulic jump and stilling basin design, and
8. Rating table for channel connecting two reservoirs.

All computations in the model are in English units. Input data in Metric units are stored on file in Metric units but converted to English units before being used in the model. Output data from the model are stored in files in English units. For Metric units the output files are converted to Metric before being printed on the screen or printer. Input files may be in either English or Metric units. The model is on five disks. Disk one includes Model programs, disk two includes Hydrology programs, disk three includes Design programs, disk four includes data files and disk five includes Qedit program.

1.3 Contents of Manual

The manual describes the model components and concepts, computational methods, input data requirements, model operation and example problems. Model components including subbasins, main channel, branches, stream routing reaches, reservoirs, and structures are described in Chapter II. The procedure for dividing the watershed into subbasins the ID numbering system for the model components, the measuring system used to locate model components, and the command diagram for displaying the sequence of operations in the model are described in Chapter II. Input requirements for each data file are also described in Chapter II along with alternate options for entering the data.

Included in Chapter III is a description of the computational procedures used in the model to determine runoff, synthetic unit hydrograph, reservoir routing, stream routing, and water surface profiles. A description of the options available to the user when running the model is included in Chapter IV. Analysis and display of model results are also discussed in Chapter IV. Applications in urban hydrology are discussed in Chapter V. To illustrate the flexibility and utilization of the model, several example problems are included in Chapter VI.