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SITES 2005
Water Resource Site Analysis Computer Program

User Guide

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Preface

The SITES Water Resource Site Analysis computer program version 2005 will analyze the hydrology and hydraulics for designs typical of NRCS dams and ponds. This user guide will help novice and experienced users prepare input, understand the software methodology, and interpret the output. The information needed to utilize the Integrated Development Environment (IDE) for management of input and output in the Windows® environment is provided in a single location in the guide. The remainder of the guide documents the computational portion of the program and the input and output associated with that portion. Much of the technical information provided in this user guide is repeated in the context sensitive IDE help for convenience. Therefore, the occasional user will generally not be required to become familiar with the details of the control file structure documented herein.

SITES version 2005 is improved over SITES version 2000.5 and the DAMS2 routines from which it is descended through inclusion of the following features:

- An Integrated Development Environment (IDE) has been added for interactive Windows® application and a data integrity check routine is provided to assist in identifying data deficiencies prior to performing computations. The IDE automatically develops the control file used by the computational routine (DAMSITE) from data entered through an interactive user interface. The interface also provides for graphical display of output and comparison of the results from multiple data files.
- Earth Spillway Erosion Technology for stability and integrity analyses is now included in the SITES program. The effects of barriers in the auxiliary spillway can be analyzed. Hood inlet calculations and flood pool drawdown computations are also available. Control words have been added as needed to implement the new features.
- The new default inflow hydrograph generation procedure is similar to that in the revised NRCS WinTR-20 Beta test program (NRCS, 2003), and hydrographs can have up to 5,000 points.
- The Muskingum-Cunge valley flood routing procedure is the default for the damsite executable included with the IDE.
- The default water surface profile procedure (WSPVRT) is based on variable retardance in the auxiliary spillway with the spillway profile defined through the inlet and exit channel to the valley floor.
- The program messages are revised and categorized into errors, warnings, messages, and notes listed and described in Appendix D.
- This version of the program and guide contains terminology reflecting the current Practice Standard 402 for Dams (2002) (TR–60) and the replacement of TR–2 by NEH, Part 628, Dams, Chapter 50, Earth Spillway Design (1998), Chapter 51, Earth Spillway Erosion Model (1998), and Chapter 52, Field Procedures Guide for Headcut Erodibility Index (2001). In these documents, the emergency spillway (ES) is referred to as the auxiliary spillway (AS), and the emergency spillway hydrograph (ESH) is referred to as the stability design hydrograph (SDH). The name of the former DAMS2 program is DAMSITE and the guide's title is SITES User Guide. The design

classes of dams are defined in TR–60 as low hazard, significant hazard, and high hazard replacing the old A, B, and C designations.

- Those control words beginning with ES– have been changed to begin with AS– to reflect the new terminology. Similarly, the DAMS2 control word has been replaced by the SITES control word. The program will currently accept both old and new control words; use of SITES and the AS– revisions are encouraged.
- **The software will automatically design a dam or pond to comply with the NRCS criteria contained in either Practice Standard 402 for Dams (2002) (TR–60) or 378 for Ponds as existed when the software was developed. Criteria are constantly being updated or revised. New criteria may need to be entered manually to override existing default options in the software. If an advanced user operates outside of the IDE using the control file directly, they must enter data for the 24-hour storm to override the default 6-hour B distribution default option in the DAMSITE routine.**

Please report any problems you find to the National Design, Construction, and Soil Mechanics Center Staff (817-509-3752) or the hydraulic engineer in your state.

Acknowledgments

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Contents

Tables

Figures

Control Words

Typical Design Runs

Typical Simulation Runs

Systems

Alternative Input

Changing Defaults

Changing Criteria

Chapter 1
Introduction

This chapter describes the Water Resource Site Analysis Computer Program (SITES) in general terms. Items covered include the program purpose, use, origin, computer requirements, and availability. Succeeding chapters give detailed descriptions of the program and provide information for preparing input and interpreting output. The appendixes contain sample jobs of typical applications, lists of output messages, an index of input records, and blank input worksheets.

Program purpose, use, and origin

The SITES program assists the engineer in the hydraulic and hydrologic analyses of dams. The program develops inflow hydrographs and uses the storage-discharge relationships at dam sites to flood route hydrographs through existing or potential reservoirs. You may directly enter storage-discharge relationships or direct the program to compute these relations from given physical parameters.

Inflow hydrographs may be actual historical data or the program may develop the hydrograph from design rainfall distributions. The program is used in the design and proportioning of dams with floodwater features. You may also use the program to flood route historical or synthetic storms through existing dams and reservoirs and to predict or evaluate earth spillway performance.

The program can provide the hydraulic and hydrologic design for Natural Resources Conservation Service (NRCS) dams that have drainage areas ranging from a few acres to over 100 square miles. The program develops the inflow hydrographs from homogeneous subareas, and combines and valley routes them to the dam site. You may easily test alternative spillway sizes to provide satisfactory proportioning of flood storage and outflow for safety of the structure. NRCS and the Agricultural Research Service (ARS) jointly developed the earth spillway erosion technology incorporated in the program to enhance the safety of spillways while providing economical designs. The program can also compute embankment and other construction quantities to provide information for cost comparisons between alternatives. The supporting Integrated Development Environment (IDE) and data integrity checking routine were developed jointly by NRCS, ARS, and Kansas State University (KSU).

NRCS distributed the original Structure Site Analysis program (DAMS) to users in 1967. The program was the first NRCS effort to develop an integrated program for the hydraulic and hydrologic design of dams. An improved version of the program (DAMS2), released in 1971, incorporated a more flexible input format plus other improvements to the DAMS program. In 1982, an interim personal computer (PC) version was released. The SITES program incorporating new earth spillway erosion technology was made available for use in 1996, and a version utilizing the concept of an Integrated Development Environment for input and output was made available in 1998. The version of SITES described in this guide accommodates changes in NRCS design criteria and includes the earth spillway erosion technology. Other changes assist with the design of dams that have small drainage areas and sites in complex watersheds, including structures in series.

SITES version 2005 is a suite of three computer programs that operate together to provide the desired analyses. The DAMSITE routine that is the focus of this guide performs the actual computations. The SITES and INTCHECK routines described in chapter 3 of this guide assist in input and output data management and interpretation. Although the DAMSITE routine can be used independently by executing the routine from the command prompt, application through the Integrated Development Environment (SITES IDE) is recommended for most analyses.

Data are input to the DAMSITE routine by batch files created using the SITES IDE or an external text processor. These batch files are collections of control words that instruct the program on exactly which procedures and parameter values to use in its calculations. Chapter 4 of this guide has detailed instructions for control word input. When using the SITES IDE for development of the input files, control words are generated automatically from interactive input selections.

The SITES program operates within the Windows® environment. The program is routinely updated to reflect changes in technology and operating systems. Contact the NRCS state office for information on the current status of the program and other application aids.

Program operation

Initiating a DAMSITE run—The DAMSITE run is normally initiated with the Build command from the home screen menu of the IDE as described in chapter 3 of this guide. If executed from the IDE, file naming and management are automatic.

To execute the program without using the IDE, enter **DAMSITE** or the calling path file name preceded by the proper DOS path, and press **return**. Once the program is loaded, the organization responsible for support of the program, the program title, version date or number, and a disclaimer will appear on the screen. Next, a message appears on the screen to press the **return** to continue.

Command line arguments are described later in this chapter.

Disk space—The program next displays an important disk space warning. For a successful run, provide sufficient disk space for temporary and output files. The amount of space required depends on the amount of input data and the number and type of output files and options selected in the input file.

If DAMSITE is loaded and run from a hard disk, ensure that the default drive directory from which the program executes has space (usually 100K to 1Mb) for internal temporary files. The program will automatically erase these files at the normal termination of a job. If any temporary files remain in the directory from aborted jobs (their names start with zz), erase them to save disk space. Enter input files from any drive or directory, including a floppy disk. Direct output data to a file in any drive and directory that has space available.

Input file—After the disk space warning, a prompt appears on the screen for the input drive ID and input file name. The response must include the drive and the directory (path) needed to access the input file (e.g., C:\SITES\testing.dat) unless the file is on the default path. If the specified file does not exist in the given location, the input prompt will reappear.

Output device or file—The next screen prompt is for the primary output device or file name. It is recommended that output be directed to a file for later viewing or printing. Direct output to the screen (CON) or printer (PRN) is possible, but not recommended.

To assign a file name, enter the name with drive and directory (path) as needed (e.g. C:\sites\testing.out). If you enter a return without assigning a file name, the program will assign a default file name consisting of the path and name of the input file, with the extension changed to **out**. The program executes and saves the output to the output file.

Generated files—The program asks for one output drive ID and file name prefix for all generated files if the output is sent to a file. If you assign an output file name and drive, the default for generated files has the same location and prefix although you may specify a different drive ID and/or name. The program automatically assigns different extensions to the generated files depending on the type of file.

If you send the output directly to the screen or to the printer, the program automatically sends other generated files to the input file prefix and location. If a previous run generated files that have the same names, the older files will be replaced.

Table 1–1 lists all program generated files. The generated file names are the file prefix or the watershed ID (you provide in the DAMSITE control record) and an extension assigned by the program. If files with those names already exist, the new files write over the older files. The program deletes all temporary files at the normal end of the job.

The graphics files are ASCII files containing run identification and preselected detailed output data in condensed tabular format. The program generates files containing the auxiliary spillway geologic profile, the inflow and auxiliary spillway outflow hydrographs, and the eroded spillway profile for all runs involving auxiliary spillway analyses. You may also direct the program to save peak, reach, flow duration, hydrograph, and earth spillway erosion output information in separate files. The SITES IDE provides for interpretation of the graphical output (data plots) and for the viewing of text output as well as providing summary information for comparison of output from multiple runs of the DAMSITE routine.

Table 1–1 Description of DAMSITE generated files

Unit [1/]	Type	Name assigned [2/]	Record length	Description
1, 2, 8 and 19	–	–	–	Not used
3	temp.	–	80	Input for reading 80–80 data
4	temp.	–	80	Storage for ASFILE information
5	read	–	80	Standard input unit for reading
6	output	"prefix".OUT	80	Standard output
7	data export	"prefix".DEC	80	Standard output unit for generating rating tables and hydrographs
9	debug	stecd.dum	50	Stability error code status
10	temp.	–	80	Summary table 1 data
11	graphics	"prefix".DRG	95	Condensed rating table data
12	graphics	"prefix".DHY	70	Hydrograph data
13	graphics	"prefix".DEM	84	Condensed embankment data
14, 15, 16	–	–	–	Not used
17	graphics	"prefix".DSM	110	Condensed summary output data
18	graphics	"prefix".DG1	57	Geologic materials for natural surface
or				
18	graphics	"prefix".DG2	57	Geologic materials for existing spillway
20	graphics	"prefix".DG4	28	Inflow and outflow hydrographs
21	graphics	"prefix".DG5	57	Natural surface and AS profile
22	graphics	"prefix".DG6	57	AS profile, geology, and eroded surface
23	data export	"prefix".DSP	72	Convert AS template data to ASSPRFL, ASSURFACE, and associated ASDATA tables
and				
23	debug	"prefix".DWS	71	WSPVRT AS rating computation details
and				
23	debug	dint.dum	89	Integrity detail input and output variables
and				
23	debug	comlog.dum	46	Headcut computation summary
24	debug	wout.dum	87	Integrity surface and erosion output
and				
24	interface	"prefix".DIS		Summary data formatted for use by the Integrated Development Environment (DAMSITE versions only)
75	interface	"prefix".PHY		Hydrographs for display by IDE

1/ Internal location assignment (performed by program)
2/ Automatically uses prefix of user's choice from input, output, or generated filename

Command line arguments—Program releases dated 1995 and later support the use of command line arguments in the initiation of a run. The program allows up to three arguments corresponding respectively to the input, output, and generated (graphics) file names as described above. When using command line arguments, send output to a file. The program automatically overwrites existing output and generated (graphics) files that have the same names. The program does not write the initial disclaimer and system requirements messages to the screen.

When using only two command line arguments, the program takes the base generated (graphics) file name to be the output file name with the extension removed. When using only one command line argument, the program takes the output file name to be the input file name with the extension .OUT, and the generated (graphics) files use the same name with the extensions indicated in table 1–1.

The program treats drive and directory information as part of the base name of the file in the management of command line arguments. Complete or relative path names may be used, but are limited to a total of 66 characters per name including extensions (base name of the generated (graphics) files is limited to 62 characters).

Run time messages—The program displays the status of the computations on the screen when you direct the output to a file or printer. The current structure number and control command (GO,DESIGN, GO,STORM) being processed flashes on the screen. The status line display continues until the job terminates and the program returns to the command prompt.

The program displays error numbers and operating system errors on the screen when you direct the output to a file or to the printer. Examine the output to determine if the job ran correctly and to find the details of program error or warning messages.

Running multiple DAMSITE jobs—The SITES IDE provides the capability of modifying data sets, storing the new control file, and viewing the output from multiple control file runs in a common customized summary table with graphic display capability. This will generally be preferable to the approach of running multiple jobs from a single control file as was appropriate before development of the IDE. Should a situation arise where it is desirable to handle more than one job in the same run, you can accomplish this by inserting complete sets of input data for the jobs back to back under the same input file name. After completing a job or ending it on a fatal error, the program searches for the start of another job. If it does not find another job, the run ends. The output file or printout associated with the assigned input file name will include the output for all the jobs.

Program availability

The Conservation Engineering Division of the NRCS in Washington, DC, distributes the SITES program to NRCS users.

SITES is available on the National Water and Climate Center's Web site at *http://www.wcc.nrcs.usda.gov/hydro/hydro-tools-models-sites.html* and on the list of NRCS Certified (CCE) software at *http://servicecenter.kcc.usda.gov/sfw_s_z.htm*

State and local public agencies may contact the NRCS state conservationist in their state to determine the availability of the program.

Chapter 2

Program Description

This chapter describes the Natural Resources Conservation Service (NRCS) criteria and methodology used in the DAMSITE portion of the SITES computer program. It also includes detailed discussions of the organization, capabilities, and limitations of the program.

NRCS Criteria

NRCS criteria requirements are generally covered through individual Practice Standards (PS) contained in the National Handbook of Conservation Practices.

PS378 titled Ponds and revised in 2002 establishes the minimum criteria for smaller, low hazard dams where:

- Failure of the dam will not result in loss of life; damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.
- The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.
- The effective height of the dam is 35 feet or less.

PS402 titled Dams and revised in 2002 establishes minimum criteria for all other larger and/or higher hazard class dams beyond the scope of PS378. PS402 cites NRCS Technical Release 60 titled Earth Dams and Reservoirs (TR–60) revised in 2005 for criteria details for dams.

The SITES program requires Hazard Class (low, significant, high), criteria type (PS378, TR–60) and size (height and storage) input, and checks these to assure the correct criteria have been specified. The program issues a warning message when incorrect criteria have been specified. It also issues warnings when adjustments are made to proposed dam proportions to meet minimum criteria.

SITES assumes TR–60 as the default criteria, and also assumes the dam drainage area is greater than 20 acres.

SITES is flexible and can be effectively used to analyze and design dams for other criteria by changing default values and providing additional input data.

Methodology

This section describes the basic hydrologic techniques and assumptions used in the SITES program. Terminology in general usage by engineers is not defined. Terminology and acronyms used solely for this computer program are defined the first time they are used.

Figure 2–1 illustrates program terminology for a dam designed according to TR–60 with a single stage principal spillway.

To use this program effectively, you must understand the procedures described in NRCS National Engineering Handbook, Hydrology and Hydraulics (NEH 630 and NEH 5).

Watersheds—Divide the watershed (drainage area above the structure) into as many subwatersheds as required to define hydrologic effects. Hydrologic effects are influenced by tributary entrances, watershed shape, valley slope changes, homogeneity of the runoff curve number, and location of water impoundment areas. The program assumes each (sub)watershed is hydrologically homogeneous. NEH, part 630, chapter 6 has a more complete description of hydrologically homogeneous areas.

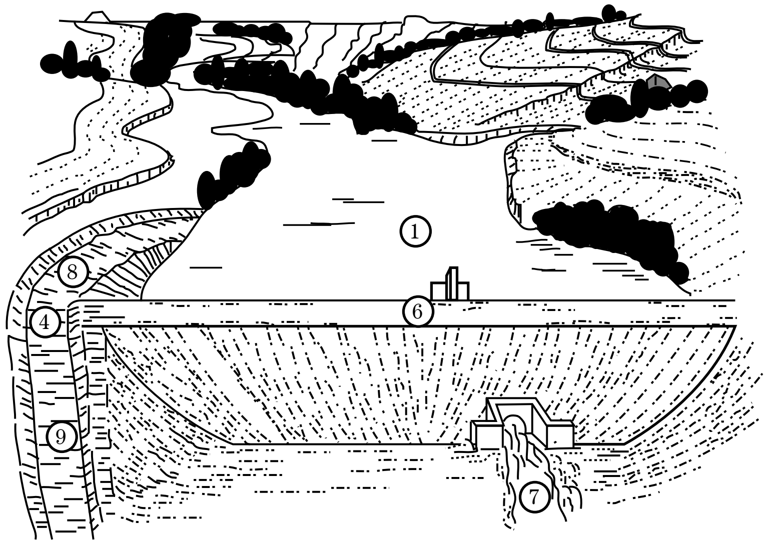
Rainfall—The program applies rainfall amounts for specified durations and temporal distributions uniformly over a (sub)watershed. You may furnish either actual or synthetic cumulative (mass curve) distributions. The program uses distributions based on a constant time increment. The size of time increment that best defines rainfall intensities will provide the more accurate hydrograph development. NRCS criteria (TR–60, NHCP–378) give the size, duration, and distribution of NRCS design rainfalls. The program defines only the standard NRCS 24-hour design storm and 6-hour rainfall distributions. You must determine and enter all others.

Runoff—The program develops a mass curve of runoff for each (sub)watershed. The runoff curve number (CN), rainfall volume, and rainfall distribution are the input variables needed to determine this mass curve. You determine CN's for each (sub)watershed based on soil, land use, and hydrologic condition information, as described in chapters 7, 8, and 9, NEH 630. Chapters 10 and 16, NEH 630, describe the procedure to develop the runoff mass curve from rainfall.

The program computes the runoff volume (Q) in inches from rainfall using the NRCS runoff equation outlined in chapter 10, NEH 630. The NRCS runoff equation assumes the initial abstraction equals 0.2 of the maximum retention ($I_a = 0.2S$). The program distributes the runoff volume over time by subtracting consecutive incremental Q values from the mass curve of runoff to obtain the incremental runoff volumes. Chapter 21, NEH 630 describes the standard NRCS 10-day principal spillway runoff distribution.

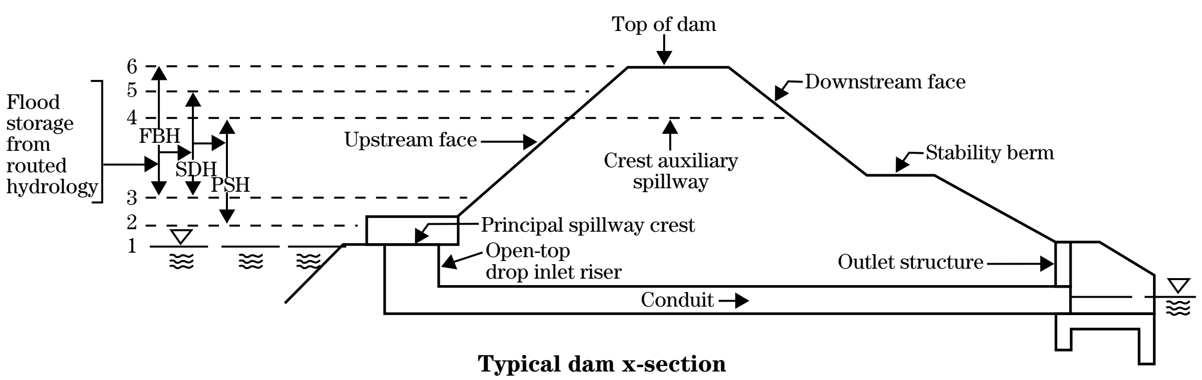
Hydrograph development—The program develops an incremental unit hydrograph for each (sub)watershed as shown in chapter 16, NEH 630. The program calculates the unit hydrograph time increment (ΔD) as a function of the time of concentration (T_c) and the rainfall distribution time increment. The program then adjusts the ΔD to provide a whole

Figure 2–1 DAMSITE terminology



1. Permanent pool & crest principal spillway
2. Sediment storage (submerged + aerated)
3. 10-day drawdown of PSH
4. Crest auxiliary spillway
5. Elevation of stability design flow
6. Top of dam
7. Tailwater elevation
8. Inlet channel auxiliary spillway
9. Exit channel auxiliary spillway

PSH = Principal spillway hydrograph
SDH = Stability design hydrograph
FBH = Freeboard hydrograph



Typical dam x-section

number of ΔD's to the peak of the unit hydrograph and to ensure that the number of ΔD's in the flood hydrograph base do not exceed the number of points limitation of the program.

The program determines coordinates of the incremental unit hydrograph for each ΔD using its ratio to the peak, the drainage area, and the incremental runoff volume (ΔQ) determined for each ΔD. The program determines the composite flood hydrograph for each (sub)watershed by summing the incremental hydrograph coordinates. The program stores the composite flood hydrograph values at times related to the specified number of hydrograph points. The peak flow value of the hydrograph is the maximum coordinate.

You may furnish the time of concentration (T_C) in one of three ways. You may compute T_C by the velocity method and enter the value as input, or the program will compute T_C using the Kirpich equation or the Lag equation. The velocity method is recommended and is in chapter 3, TR–55 (1986). Chapter 15, NEH 630 (1985) describes the Lag method. The Kirpich method is in NEH 630 editions prior to 1972.

Reservoir stage-storage—The program computes reservoir storage by the average surface area method assuming a linear relation between elevation-area points. If you give total volume-storage data, the program uses the storage directly.

Reservoir stage-discharge—You may enter discharge rating curves for the spillways or allow the program to compute them. The program determines principal spillway (PS) rating curves by standard hydraulic formulas described in chapters 5, 6, and 7 of NEH–5 for weir, orifice and pipe flow and for hood inlet configurations. The program assumes constant tailwater for pipe flow.

The program can develop auxiliary spillway (AS) rating curves using one of the four methods described.

Method 1—The WSPVRT method develops water surface profiles based on a full trapezoidal cross section using a combination of the direct step and standard step methods. The procedure uses the direct step method within reaches and the standard step method to establish conditions at reach nodes. The procedure provides for use of either the vegetal retardance curves of Agriculture Handbook 667 or user specified values of Manning's "n" in computing flow resistance. Conditions governing flow resistance are allowed to vary from reach to reach. Backwater computations begin with critical depth at the upstream end of the first supercritical reach. The program determines the location of the first supercritical reach for each discharge based on slope only; it does not consider reach length and the possible influence of downstream reaches. If no supercritical reach is present, computations begin with normal depth at the upstream end of the first reach above tailwater. Ratings are based on energy head at the reservoir end of the inlet channel.

Method 2—The frictionless side slope method develops water surface profiles based on discharge per foot (q) of bottom width (BW) assuming vertical frictionless side slopes, constant Manning's "n", and critical depth at the control section with an adjustment for the actual side slopes (z). Profiles start at critical depth at the downstream end of the crest section. The program adjusts the total discharge capacity of the auxiliary spillway (Q_{AS}) to the total flow area by the equation:

$$Q_{AS} = q\left[BW + z\left(\frac{q^{\frac{2}{3}}}{g^{\frac{1}{3}}}\right)\right]$$

where:
g = gravitational constant

Method 3—TRAPW develops water surface profiles based on an incremental forward projection procedure using the complete trapezoidal cross section with a given side slope ratio and a constant Manning's "n". Profiles start at critical depth at the downstream end of the crest section. The program divides the inlet channel length into 2000 reach increments for the water surface profile computation.

Method 4—The ASFILE method selects precomputed subcritical discharges per foot of bottom width (q) for given flat inlet channel lengths and retardances A to E with normal depths at the control section. These ratings were developed for small NCPS–378 dams from plots of the basic data used to compile the tables in chapter 11 of the NRCS Engineering Field Manual. The program determines the total discharge capacity of the auxiliary spillway (Q_{AS}) by the equation:

$$Q_{AS} = q\left(BW + zd\right)$$

where:
d = is the depth of flow in the spillway.

Auxiliary spillway rating methods–documentation—The Water Surface Profiles with Variable Retardance by Temple (WSPVRT) method, method 1, developed by Darrel Temple (ARS) uses established computational procedures documented in texts on open channel hydraulics. The FORTRAN source code contains comments for additional documentation of the procedure. The computational procedures for method 2 are from chapter 4, NEH–5 and Technical Release 39. Method 3 is derived from the SCS TRAP–W computer program Hydraulic Design of Trapezoidal Channels, 1979. The program is based on the gradually varying flow procedure in Open Channel Hydraulics by V.T. Chow (1959), chapter 9. Chapter 4 of NEH–5 gives the formulas used in method 4 for subcritical flow, and the relation between retardances and "n" values is from SCS Technical Publication Number 61 (1954). The WSPVRT procedure is recommended for vegetated spillways.

Reservoir routing—The program routes the composite flood hydrograph through a reservoir using the storage-indication method as described in chapter 17, NEH 630. The storage indication routing uses multiples of the hydrograph time increment (ΔD) and the elevation-discharge-storage data. NRCS criteria and input data establish the starting elevation for design routing. For simulation runs the starting elevation is at the principal spillway crest (permanent pool), unless you specify otherwise.

Earth spillway stability and integrity—You may evaluate the stability of the earth spillway exit channel for the stability design hydrograph using either the permissible velocity approach of TP–61 (1954) or the allowable erosionally effective stress approach of Agriculture Handbook 667. The program assumes normal depth in the exit channel for computation of both stress and velocity. You may compare output values of stress or velocities to allowable values, or may input allowable values and the program will compute corresponding spillway bottom widths.

Earth Spillway Design (1997) and Earth Spillway Erosion Model (1997) describe the integrity analysis of the earth spillway for the freeboard hydrograph based on a three phase erosion process. The phases are: (1) failure of vegetal cover, if any, and development of concentrated flow, (2) surface stress generated erosion resulting in the development of a headcut, and (3) the upstream advance of the headcut that may be accompanied by additional deepening. The developers calibrated the physically based relations describing each of these phases using data from actual auxiliary spillway flows. Integrity analysis will normally include all reaches between the spillway crest and the valley floor including natural hillslopes. The program terminates headcut advance computations when further upstream advance would result in lowering of the hydraulic control section. The program considers this condition to represent a breach of the spillway.

The program can analyze the effect of man-made barriers that stop the upstream advance of headcuts formed downstream of the barrier station. The headcut barrier station is used to estimate the potential depth of erosion if an effective barrier were placed in the spillway. This information may be used in design of an appropriate barrier. No actual analysis is made of any type of barrier or the forces that it would be required to withstand to be effective. The input of a barrier station has no influence on the computation of depth and advance of headcuts formed upstream of the barrier. This is equivalent to assuming that headcuts formed upstream of the barrier will successfully undermine or flank the barrier sufficiently to allow the flow to escape and erosion to continue.

The stability and integrity analysis procedures require detailed data on spillway cover conditions and materials. You have a great deal of flexibility with this data, and may be as general or as specific as the particular case requires. The engineer and geologist must work together to develop adequate input. Earth Spillway Design (1997), Earth Spillway Erosion Model (1997), and Field Procedures Guide for the Headcut Erodibility Index (2001) contain reference material for the various input parameters. The Headcut Erodibility Index Photo Reference (1994) provides assistance in determining the headcut erodibility index governing headcut advance for different geological materials. The SITES IDE help screens also provide references and assistance for input.

Reach routing—The program routes the composite flood hydrograph through a channel reach using the Muskingum-Cunge method (Chow, Maidment, and Mays, 1988; Maidment, ed., 1993; or Ponce, 1989), Modified Attenuation–Kinematic (Att-Kin) method described in Hydrology Note 2 (draft, 1994), or by the Convex method as described in chapter 17, NEH 630. The routing time interval is the hydrograph time increment (ΔD). You specify the routing reach length. You may enter the routing coefficients or direct the computer to compute them from cross section velocity (discharge/area) data.

Adding hydrographs—The program can add two composite flood hydrographs together at multiples of the hydrograph time increment (ΔD). If increments are not the same, the program adjusts the smaller hydrograph increment to the increment of the larger and then adds.

Organization

The program organizes input data and program execution under the executive control concept. You may enter data in almost any logical sequence using a series of control words that direct the program to store various parameters and impose various constraints on the design or simulation. For sites in series, the IDE organizes the data so as to allow the hydrographs to be stored in a stack using a last in-first out management approach.

This guide categorizes the 90 control words used in the DAMSITE control file as five major types to help you understand the organization of the required sequencing of input data.

- **Job control**—The program requires that SITES be the first record in the job sequence. The ENDJOB control word must be the last record pertaining to a specific site or to a system of structures. The ENDRUN control word denotes the end of input after the last of a series of job sequences.

- **Table data**—The program requires header lines starting with appropriate control words to identify the type of table data and an ENDTABLE control word to end the table. Tables may include structure area-capacity-discharge, centerline profile, rainfall, hydrograph, valley cross-section data, existing auxiliary spillway profile and geologic materials coordinates, geologic parameters of defined materials, profile template for the auxiliary spillway, and the surface conditions of the constructed auxiliary spillway by reaches. You must insert table data between the DAMSITE control word and the applicable execution control word.

- **Basic site**—The program uses these control words to enter watershed, site, hydrologic, and hydraulic information for a specific site. You must enter these between the DAMSITE control word and the applicable execution control word.

- **Execution**—Execution control words instruct the program that pertinent data are given in the data sequence for execution of a pass or alternative. Execution control words are in the form of GO,(type). Examples are GO,DESIGN, GO,REACH, and GO,ADDHYD.

- **Parameter**—NRCS design criteria are normally the bases for design input, but the program permits alteration of many of the parameters. Chapter 4 of this user guide gives a complete explanation of options available. The program establishes many standard or default conditions that remain in effect unless altered by you. Chapter 4 also explains these default parameters.

Figure 2–2 gives a simplified processing sequence for DAMSITE. It shows the general performance sequence for the major program functions.

The program first prints the input data set for a run as read and then edits for invalid characters, missing data, and unreasonably large and small values.

The program will not store outflow results beyond the point needed in performing computations unless you have assigned the results to a graphics file. The program develops, routes, and accumulates hydrographs internally without user control as to storage location. In normal runs the program order for hydrograph computations at each site is: principal spillway hydrograph, stability design hydrograph, and freeboard hydrograph. The program repeats this order for each alternative principal spillway or only the last two (stability design and freeboard hydrographs) for each alternative auxiliary spillway. After computations, the program prints the results and clears files, except when the results are retained for a system of structures. The program saves generated graphics files.

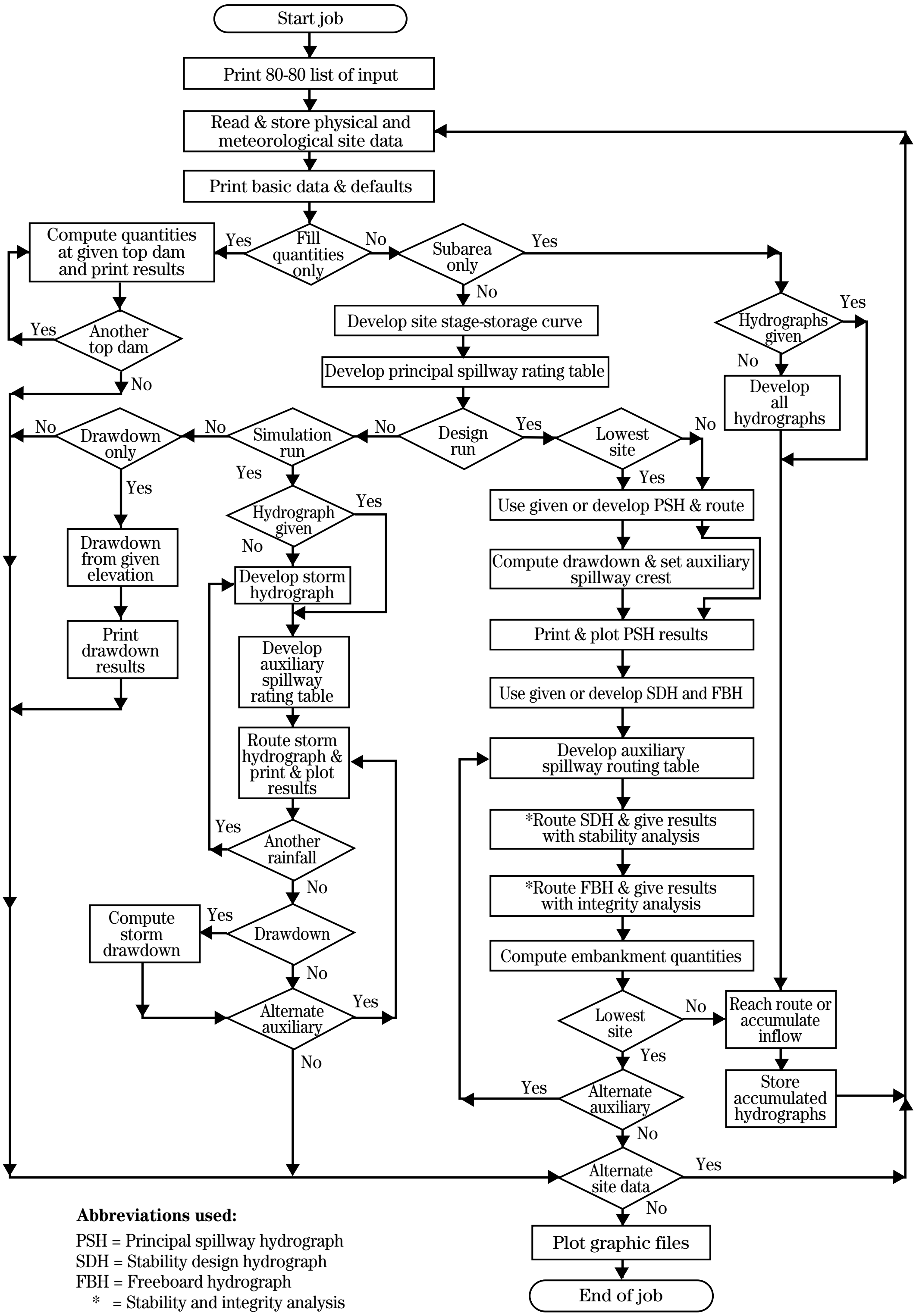
Capabilities and Limitations

This section describes the capabilities and explains the many features available in the DAMSITE portion of the SITES program. It also describes the program's limitations for the maximum allowable array sizes and other limiting factors.

The program does not limit the number of alternatives that you may consider for each site nor the number of sites for each job. Also, you may *batch* as many jobs as desired from any number of sources in a single computer run with each job being independent of the previous job's data. The program only holds in memory and processes input data for one structure at a time. You may input data for design and/or simulation runs. The design runs are based on NRCS design criteria.

You may give rainfall amounts for developing a single design storm or principal and stability design hydrographs or instruct the program to calculate the rainfall from two index storms (the 6-hour, 100-year and the 6-hour probable maximum precipitation point rainfall). A third option permits the input of runoff directly for the principal spillway, as well as the auxiliary spillway design hydrographs (provided you furnish a runoff distribution table).

Figure 2–2 Simplified processing sequence in DAMSITE



Abbreviations used:

PSH = Principal spillway hydrograph
SDH = Stability design hydrograph
FBH = Freeboard hydrograph
* = Stability and integrity analysis

The program can hold one defined rainfall distribution table of up to 300 coordinates per pass. You may use the defined rainfall distribution table plus the standard NRCS 24-hour design distributions defined by the program for design or simulation runs. The 6-hour AS design distribution used before 1996 is retained in the program.

The program develops all inflow hydrographs from unit hydrograph theory (chapter 16, NEH 630), but these may differ from corresponding dimensionless hydrographs in chapter 21, NEH 630 (1972). Differences are due to the grouping process required to produce the tables in chapter 21.

The program can store up to three user supplied inflow hydrographs in memory at one time. At the same time the program can hold in memory one user supplied dimensionless unit hydrograph of up to 100 coordinates.

The program uses a maximum of 5,000 points to define inflow hydrographs developed by the program or supplied by you for routing through the structure.

If not given by the input data, the program calculates reservoir storage volume from the site elevation-surface area relationship. The program defines this relationship by 2 to 20 points connected by straight-line segments. The program does not require the points to be at regular intervals. If a solution exceeds the range of the data, the program linearly extrapolates the first or last pair of points on the structure rating table as far as required and prints a warning message. The elevation-surface area input data should account for any significant encroachment upon reservoir storage by the structure embankment. You may approximate the amount of encroachment since the height of dam is usually not known when preparing the input. You may enter reservoir storage volume directly as a series of two to twenty points that the program will connect by straight line segments. This method of data handling for elevation-surface area input also applies if volumes are given.

A structure's discharge capacity consists of principal and auxiliary spillway flows, and the program combines the two to develop the total rating of the structure. The program does not consider downstream flow conditions in the analysis of principal spillway flow except for tailwater on the principal spillway outlet, which you supply and the program considers constant with time. The program can calculate the principal spillway (PS) capacity for round or rectangular closed-conduits of uniform cross section with optional single-stage hood inlets, open-top drop inlets, or covered drop inlets with maximum opening. The drop inlets may be single or two-stage. The program will not compute orifice flow for a single stage drop inlet. If these conditions will not adequately represent the stage-discharge characteristics of the principal spillway, you may give the desired stage-discharge relation. Up to 20 points are available to define the rating curve.

The WSPVRT procedure, using the actual cross section with variable retardance, is the default for computing water surface profiles for the auxiliary spillway (AS). The TRAPW method uses the actual cross section and fixed retardance and you select it with a control word switch. The frictionless side slope method uses a flat bottom channel with frictionless sides and uniform roughness coefficient with a side slope adjustment. The fourth method uses precomputed rating curves.

The precomputed stage-discharge relations of the auxiliary spillway are based on a constructed trapezoidal section. You can define up to 10 auxiliary spillway bottom profiles with a maximum of 7 coordinates each or use 22 auxiliary spillway centerline bottom profiles built into the program.

The default WSPVRT method uses the entire AS profile (inlet and exit channel) for its calculations and handles supercritical, critical, or subcritical flow in developing the auxiliary spillway ratings. The other methods in the program assume that the exit channel slope is steep enough for a control section to exist at the downstream end of the inlet channel.

For small structures, the program has predetermined stage-discharge relationships for all subcritical flow, flat inlet channels, and range of retardance factors. For larger structures, you may enter up to 20 points to define the total auxiliary spillway rating relation or 12 points at uniform stage increments above the crest to define the relation in discharge per foot of bottom width.

If desired, the program will compute the auxiliary spillway bottom width corresponding to a user specified velocity or effective tractive stress in the exit channel during passage of the stability design hydrograph. This feature is not available for the structures using National Handbook of Conservation Practices Standard 378 criteria designed with subcritical flow.

If desired, the program will determine the minimum crest elevation of the auxiliary spillway according to design criteria. The program will consider as many as five auxiliary spillway bottom widths and up to five auxiliary spillway crest elevations in each pass for a structure site. If you update the spillway (as part of a single set of input data), the program will consider an unlimited number of alternative auxiliary spillways in a single computer run.

The program can calculate volume of fill, area to seed, area of dam, maximum height and length of dam with each analysis. You may specify embankment top width, side slopes, wave action berm width and stability berm widths or use the program defaults. You may enter a maximum of 99 points to define the embankment centerline profile. The quantities based on the centerline profile and a flat bottom template cross-section are approximate and should only be used for comparisons between alternatives.

Structures in a system can be designed, considered to be in place for simulation runs, or be existing dams. The program uses a simple system of switches to handle routing of structures in series. This capability allows considerable flexibility in routing through systems of structures, subdividing watersheds, reach routing and adding hydrographs. The program can design only the most downstream structure of any system of structures in a single run. If upper sites are to be designed, they must be run as single structures one by one for design analysis. Their designed data can be entered as if for "existing" structures in the run describing the sites in series.

In routing through a system of structures or subareas, the total number of (sub)watersheds in the system is normally limited to those areas that can be set up for continuous accumulation of the hydrographs. If needed, use the SAVMOV procedure to save hydrographs for subsequent adding in complex systems. When the SITES IDE is used for the development of the control file for the DAMSITE routine, the control file is structured by the IDE for use of a last in-first out stack controlled by the SAVMOV procedure.

In the reach routing, the program allows up to 200 cross sections to represent reaches with up to 20 elevations permitted at each section.

Chapter 3 SITES Integrated Development Environment (SITES IDE)

This chapter describes the SITES Integrated Development Environment (IDE) used to manage the input and output for the DAMSITE routine described in the other sections of this guide. The SITES IDE is an interactive user interface that guides the user through development of input data (control) files, and assists in the display and interpretation of output from the DAMSITE computational routine. Context sensitive help is available from within the environment that reproduces much of the technical information provided in other chapters of this user guide. Data integrity checking is available from within the environment to assist in identifying incomplete or inconsistent input data. The IDE also provides tools for interactive management of input and output files. The IDE for SITES is designed to allow a user to conveniently examine the impact of flood or design changes on the performance of the downstream (design) structure. It is designed to take advantage of the unique features of the DAMSITE computational routine while operating in a Windows® environment. The software was developed using Visual Studio® 6.0 (Visual Basic® and Visual C++®) for operation under Windows® 98 SE or later operating systems.

SITES IDE Project

The highest level abstraction in SITES IDE is a project. A SITES IDE project is a directory that consists of related SITES IDE input files and corresponding output files generated by one or more simulation runs. A valid SITES IDE project must contain a hidden file, called an owner file. SITES IDE projects cannot be nested. These features are added to protect you from accidentally removing unrelated files.

SITES IDE Input/ Output files

- Owner File: a hidden owner text file to label the current directory as a valid SITES IDE project.
- Input Files: input control text files with the extension d2c. They are created with the Input Interface or by importing. Note: d2c stands for DAMS2 control.
- Output Files: text output files generated by SITES which have one of the 17 extensions: ddd, dec, dem, dg1, dg2, dg4, dg5, dg6, dhy, dis, dpr, drg, drr, dsm, dsp, dws, or out. These files are read by the IDE and used in the development of graphical and tabular display of simulation results.
- Summary Field Files: text files with extensions ide and ids used to control which fields are shown in the Summary Table.

Note: Users should not modify the input/output files directly, outside of the interface.

SITES IDE Modules

SITES IDE software consists of five main modules as shown in figure 3–1.

- **Top-Level Interface**—a Multiple-Document Interface (MDI) parent for the other four modules. The Top-Level Interface provides functions to create, open, or delete projects. Also, it monitors the synchronization among the other modules.

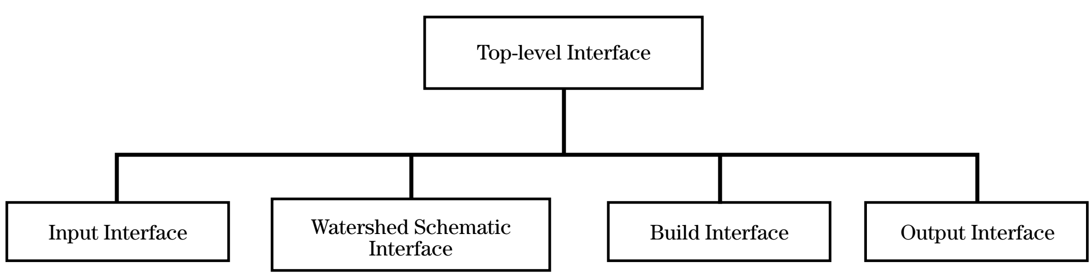
- **Input Interface**—an interface used to manage input control files. An input file can be created, imported, or opened by using this interface.

- **Watershed Schematic Interface**—an interface used to specify the topological relationships between watershed elements. This interface is also used to create and edit individual watershed elements.

- **Build Interface**—an interface used to invoke the simulator (damsite.exe) using a shell call in the background. The Build Interface also performs model integrity checking by calling an Integrity Checker (intcheck.exe), and parses output files generated by the simulator.

- **Output Interface**—an interface used to analyze the output files obtained from the Build Interface. It consists of six output windows to view the error list, summary table, summary graphs, and graphs or text for an individual watershed element.

Figure 3–1 SITES IDE interfaces

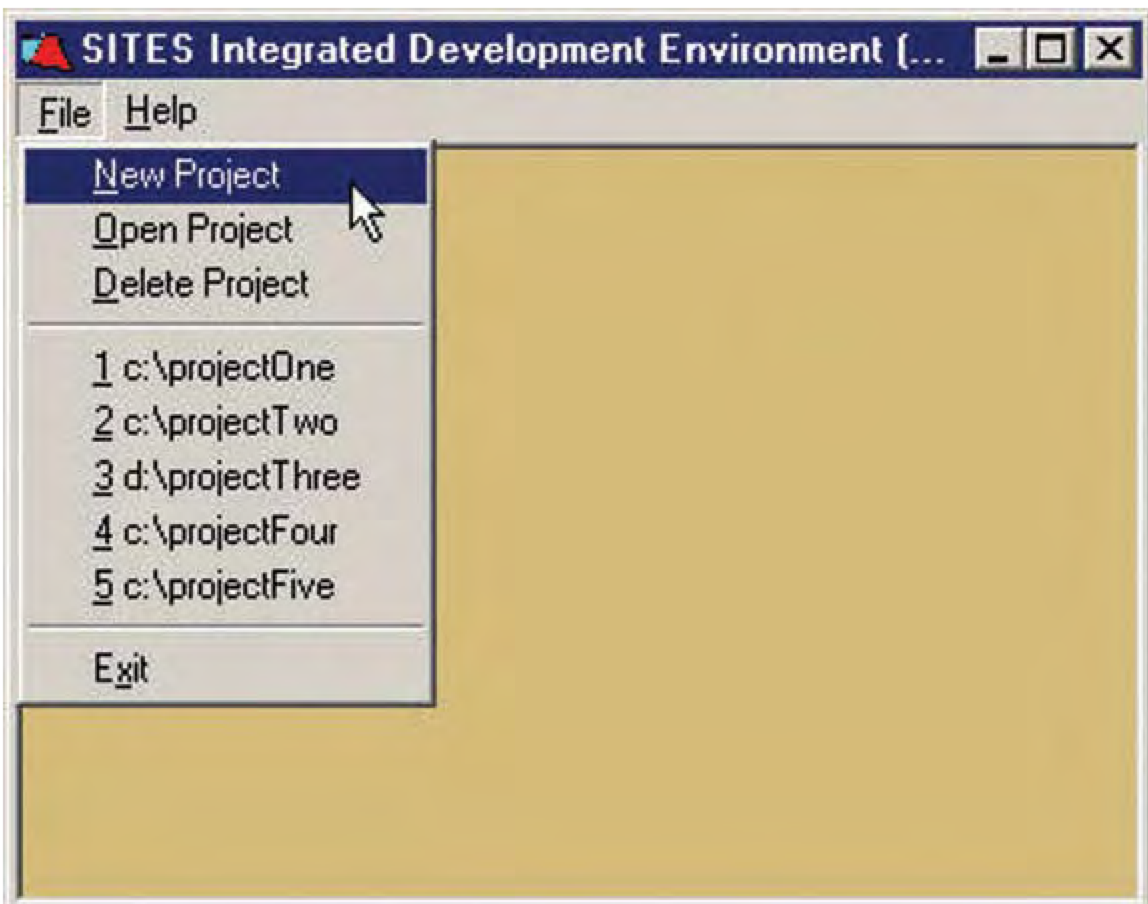


Top-Level Interface

The Top-Level Interface consists of one window as shown in figure 3–2.

When you execute the SITES IDE application, the Top-Level Interface allows you to manage SITES IDE projects. It provides a file menu to create new projects, open existing projects, or delete existing projects. It also maintains a history list of recently opened projects. When a project is created, the system puts a hidden file in the project's directory to identify it. At this level, several safety mechanisms are used to protect you. You are not allowed to open or delete an invalid project, or to create nested projects. The Top-Level Interface is the MDI parent that holds all of the other input and output interfaces. Whenever one of its MDI children is currently active, the Top-Level Interface menu bar will be filled with the child's menus. Click **Exit** from the File menu of the Input Interface to exit and return to the Top-Level Interface.

Figure 3–2 Top-Level Interface

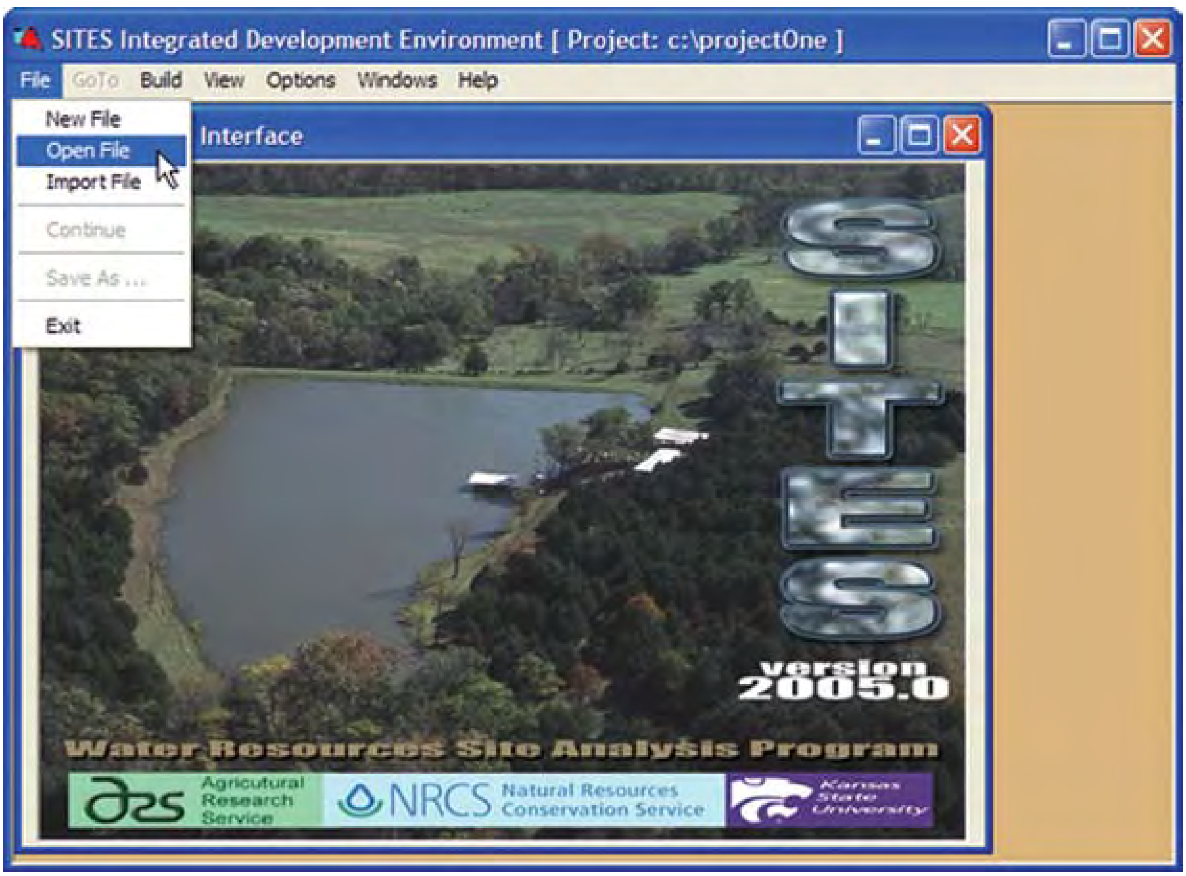


Input Interface

The Input Interface consists of the Home Input window and the Global Data Input window. All input windows allow you to easily edit SITES control (*.d2c) files step by step. They also provide protection and integrity checking mechanisms to help users create input files correctly. When the New Project or Open Project menu item is clicked from the File menu of the Top-Level Interface, the Home Input window shown in figure 3–3 is activated.

Through the Home Input window, you can open or import existing SITES control files to view, edit or build, or create a new SITES control file. From the Home Input window, you can also activate the Build Interface and/or the Output Interfaces.

Figure 3–3 Home input window

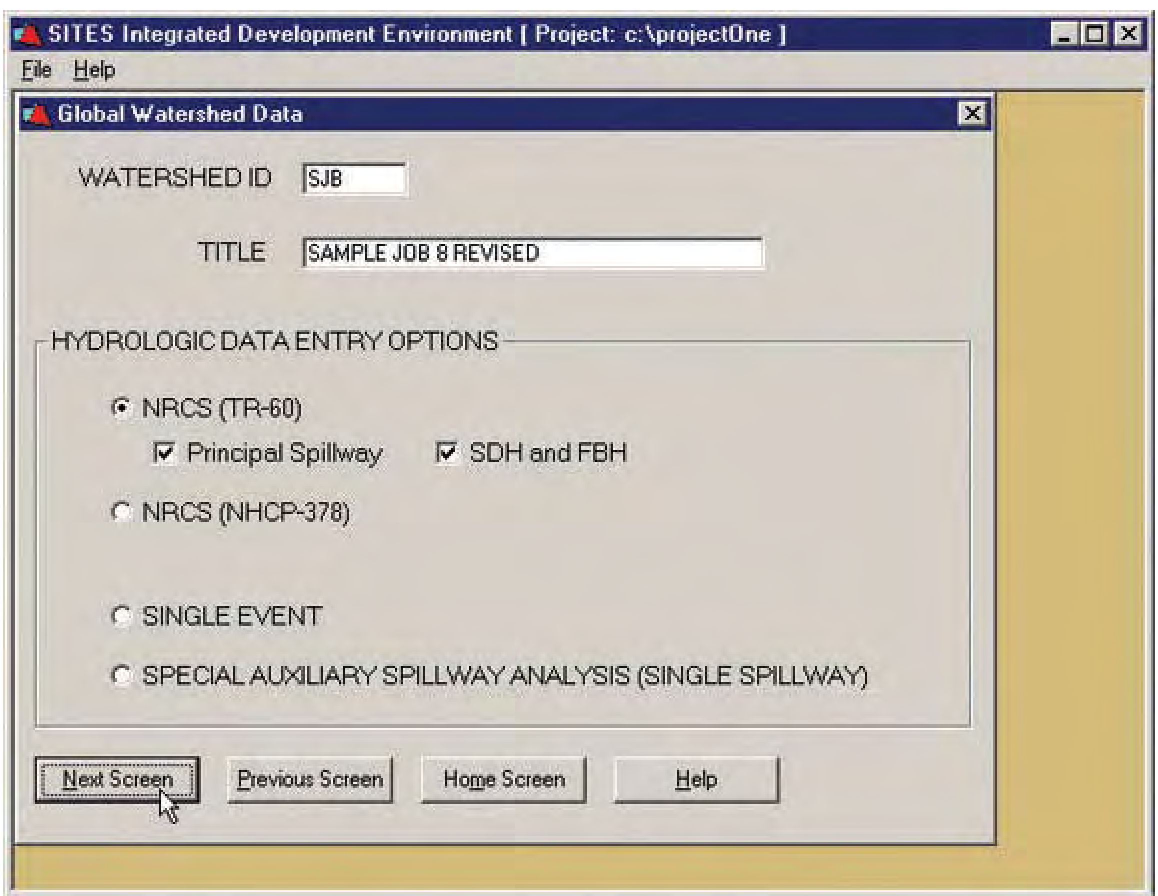


Global Watershed Data

The nature and scope of the resulting package can be seen by examining the global data input window. Options that impact all elements in the watershed are specified by using the Global Watershed Data Input window (fig. 3–4). The WATERSHED ID and TITLE fields shown on this window are used simply for identification and bookkeeping. Help windows are available for all fields to assist you in making appropriate selections for the system to be analyzed (normally a structure or series of structures with associated watersheds providing inflow).

The NRCS (TR–60) selection is used for design/analysis of dams using USDA, NRCS criteria and hydrology (USDA, NRCS, 2005). With this selection, up to three hydrographs, Principal Spillway (PSH), Stability Design (SDH), and Freeboard (FBH), are routed with a single execution of the computational program (simulator). Parameters such as the elevation of the top of dam, elevation of the auxiliary spillway crest, and width of the auxiliary spillway for the design site may be set by the program according to NRCS criteria. Other outputs for the design site may include estimated volume of fill in the dam and extent of predicted spillway erosion for the freeboard hydrograph.

Figure 3–4 Global Watershed Data window



The NRCS (NHCP 378) selection is used for the design of ponds using USDA, NRCS criteria and hydrology (USDA, NRCS, 1987). Input and output options are similar to those provided for the NRCS (TR–60) selection, but are slightly simplified at the expense of flexibility. Again, multiple hydrographs are routed simultaneously as appropriate for satisfaction of the criteria.

The single-event selection is used for simulation or analysis problems where routing of a single hydrograph is appropriate. Substantial flexibility for hydrograph development is provided as described later in this guide. The output may include the predicted extent of spillway erosion on the most downstream site (design site), as well as information related to the routing of the hydrograph through the system.

The selection of special auxiliary spillway analysis (single site) is provided to allow users of other flood routing software to evaluate spillway erosion based on the spillway flow predicted by that software. Input is limited to the information required to describe a single earth spillway and the hydrograph passing through that spillway. Output is related only to the performance of that spillway.

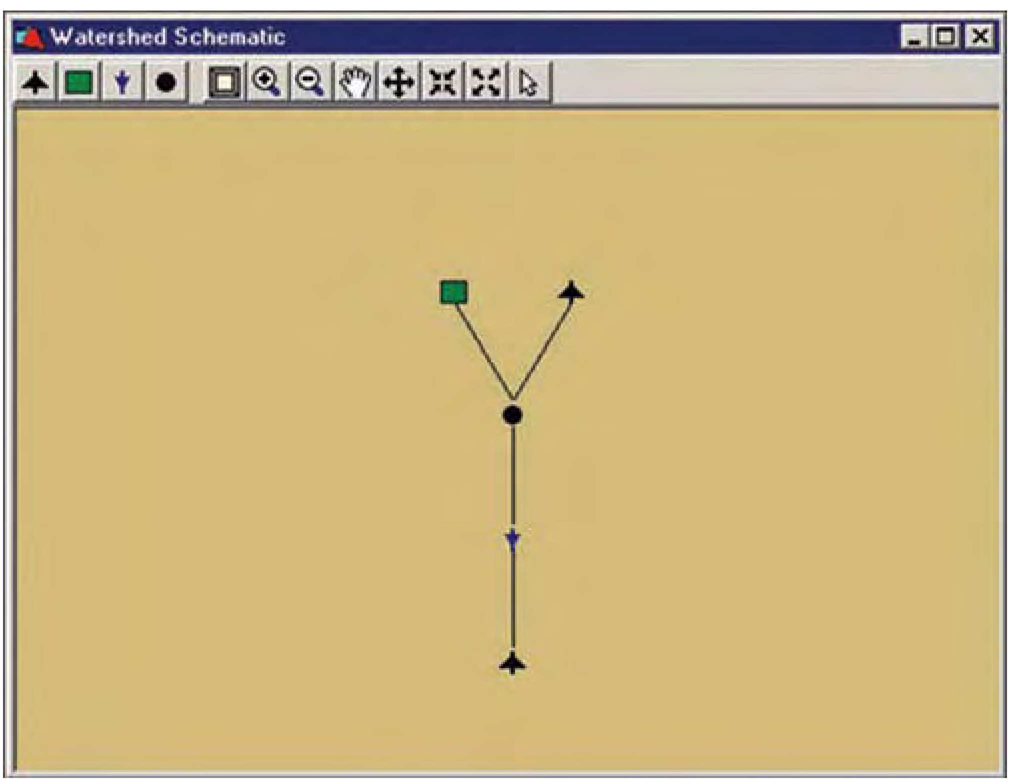
Watershed schematic interface

The relationships between elements in the watershed are described using the Watershed Schematic Interface illustrated in figure 3–5. Using this interface, you develop a schematic of the system to be analyzed. That schematic is then used by the IDE to guide you through the required input windows for each element of the system.

The Watershed Schematic is used to describe relationships between watershed elements. Four elements are used in the construction of the watershed schematic. The available elements are structure, reach, junction (bifurcation) point, and subwatershed. To add an element to the model, you must first select an element (by clicking on an element icon, if this is not the first element), and specify which type of element should be added upstream (or downstream) from the selected element. Elements can be selected by clicking on an element icon in the schematic.

Elements can be edited by double clicking on an **element icon** (or by selecting **Edit Element** from the menu). Each of these elements has its own set of data input windows that are accessed separately for data input. After routing of the hydrograph(s) by the simulator, the outflow hydrograph(s) and SITES control file for each element may be viewed along with a limited amount of output that is associated with each element.

Figure 3–5 Example watershed schematic containing all available elements



The structure element has associated with it a watershed area, so that the simplest system is a single structure. Subwatersheds, whether separate or associated with a structure, may be represented by their characteristics and rainfall amount and distribution, or by an appropriate set of hydrographs. Stream channel reaches may be described by routing coefficients or by a representative cross section. Therefore, substantial flexibility is provided for representation of complex watersheds. A junction point is required only when the ability to view hydrograph(s) at an intermediate point in the system is desired.

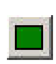
Edit element

Input windows are organized to give a logical input order. Each input window has a **Next** and **Previous** command button to move control to the next and previous window, respectively. The **Schematic** command button on each input window also lets you return control to the Watershed Schematic window directly. Entries for each newly loaded window are added as necessary. You can jump directly to a particular window by right clicking on the mouse in the background and selecting the window from the GoTo menu. Windows listed in the GoTo menu are organized in alphabetic order.

After an element has been created or edited, you are returned to the Watershed Schematic window. You can view modifications that were made to the element by selecting **View Sites Control File**. It is important to understand that changes made to an element are only stored in memory and must be saved to a file by jumping to the Home Input window and selecting **Save As** from the File menu. Changes can be saved incrementally (after each element is edited) or all at once (after all elements have been edited).

Watershed elements

1.  STR: STRUCTURE. If this item is selected alone, the input is that required for a single structure. The structure may be connected to another upstream element via a reach. The inflow hydrograph for the reach comes from that upstream element. The watershed outflow is added to the reach outflow to generate the inflow hydrograph to the structure.

2.  WSD: SUBWATERSHED. This element is usually the most upstream element of a branch with only a downstream connecting node.

   When placed in series with other elements (upstream connecting node), the hydrograph from the upstream element(s) are simply added to the hydrograph associated with the subwatershed to obtain the outflow hydrograph. This element requires a connection to a downstream node.

3.  RCH: REACH. The inflow hydrograph to a reach is provided from the upstream element(s). The outflow from the element is obtained by routing the inflow hydrograph through the reach. Connection of an element at the upstream node is required. Connection at

the downstream node is normal; however, if only hydrograph output is requested, then a reach may be the most downstream element.

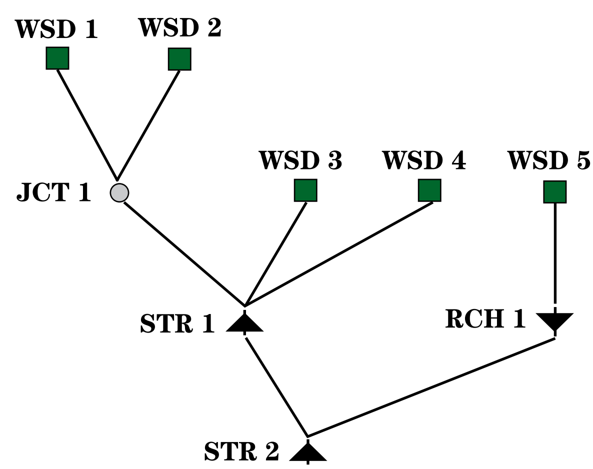
4.  JCT: JUNCTION (BIFURCATION) POINT. This element simply indicates a system branch. It generally has two or more upstream nodes and a downstream node. Junction points may be connected to form as many branches as desired. The inflow hydrographs from the upstream elements are added together to obtain the hydrograph at the downstream node. The input window associated with a junction point gathers labeling information only. That is, it simply provides an entry to view output hydrographs.

The above four elements must be combined such that there is only one element with no downstream element. The most downstream element will normally be the structure on which design or analyses is to be performed. Summary output is focused on this downstream structure in typical program application. However, it is possible to let an element other than a structure terminate the system. In this case, the only output will be a hydrograph at that element's downstream node.

The control file is constructed by performing a post-order traversal of the tree (watershed schematic). For the schematic shown in figure 3–6, this order is WSD1, WSD2, JCT1, WSD3, WSD4, STR1, WSD5, RCH 1, STR2. Elements are processed one-by-one from the most upstream nodes to the most downstream node by using a stack to store intermediate results. The stack operation is described in chapter 4 in conjunction with complex series routing and the use of the SAVMOV command.

In contrast to the processing order, the tree is generally constructed from the most downstream element upward when using the Watershed Schematic interface. Start at the most downstream element, and build the tree from its root. In this way, new elements may be added simply by specifying the downstream element (parent) and the element to be added (child). Also, the tree can be automatically generated from any input control (*.d2c) file.

Figure 3–6 Example watershed schematic (tree)



Build Interface

The Build Interface is used to invoke two different Fortran programs: the SITES Simulator (compiled as damsite.exe) and the SITES Integrity Checker (compiled as intcheck.exe). These programs run as background processes. However, before invoking the simulator, you should run the model integrity checker to test the validity of the input data set. The model integrity checker will generate a list of errors and allow you to jump directly back to the input window on which the integrity constraint violation occurred. After the simulator is activated, the SITES IDE application waits until the external process is finished. This mechanism helps to synchronize between the Build Interface and other interfaces. You can choose to build one input file or build all input files in the currently opened SITES project. If any output windows are active, after the build has finished successfully, the system will automatically update those windows.

Output Interface

The Output Interface displays the results after the Build Interface has invoked the SITES simulator (damsite.exe) to generate all output files. Using this interface, you can visually display hydraulic and hydrologic data to help in the design and analysis of dams. The Output Interface not only provides a complete set of graphs for a single run, it also draws summary graphs for comparing several runs. If you want to view the output files, you can do so by activating a built-in editor.

Since, as previously noted, the purpose of the SITES software is the design/analysis of a structure, the majority of the output is associated with the downstream (design) structure. The IDE allows any of the input data to be easily changed and the impact of the change to be evaluated by viewing the results of the analyses in a single table. This Summary Table can be customized through the selection of variables displayed from an extensive list containing both input and computed parameters. Each line in the resulting table represents a distinct data set with associated computations and output. More detailed output associated with any line in the table can be viewed in either text or graphical form. An example of the graphical output is shown in figure 3–7.

Standard features, such as print and zoom for the graphics and print and search for the text, are available along with help to assist in interpreting the output. The net result is an environment that may be conveniently used for comparison of design alternatives and documentation of performance predictions.

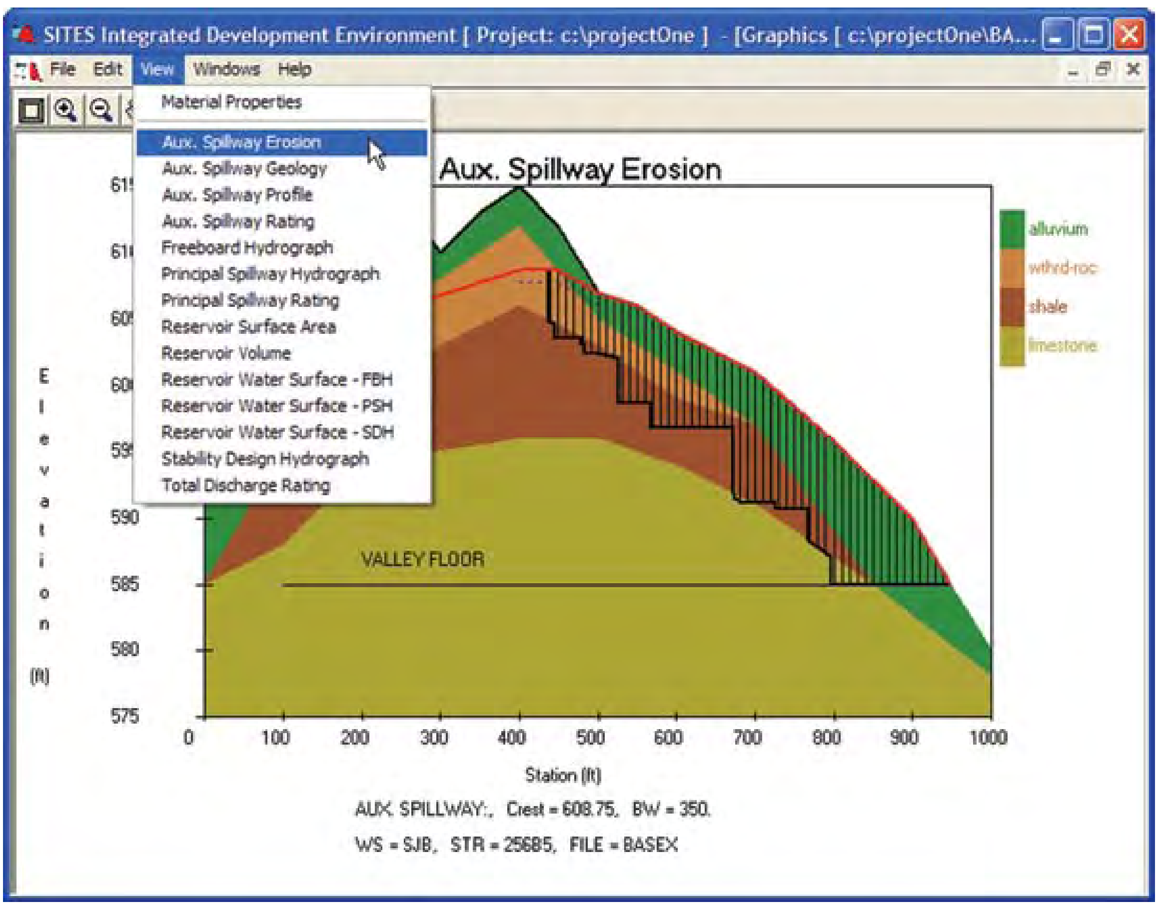
Summary Table

If the Summary Table item is clicked from the View menu of the Home Input window, the Summary Table window is displayed. This window maintains a summary table that builds one entry for each input file in the current SITES project directory if this file has been built by running the Build Interface. The table has 50 fields (columns) by default. You can choose the fields and their order in the table through the menu item Specify Summary Fields in the Options menu of the Home Input window. All summary field configuration information is stored in the Summary.ide file in the current SITES project directory. The Summary.ide file is created with the default fields and order when a new SITES project is created. If you choose to delete the output files for a given input file, the corresponding entry will be removed from the table. You can also choose to delete output files for all input files in the current project directory. There are several protection mechanisms to enable or disable the command buttons and menu items in the Summary Table window.

Summary Graphics

The Summary Graphics window is useful to compare several runs. It allows you to view any summary table fields for all files in a scatter or line plot. If you click the Summary Graphics button from the Summary Table window, a window is displayed to let you choose two different fields as X-coordinate and Y-coordinate respectively for the summary graph display in the Summary Graphics Window. There are two kinds of summary graphs: Line Graphs and Scatter Graphs. You can choose to view one of them by clicking the corresponding buttons in the Summary Graphics window. You can also change the coordinate fields at any time. If the user selects fields that have no valid corresponding data, the summary graph is simply not drawn.

Figure 3–7 Example Graphical Output window from SITES IDE

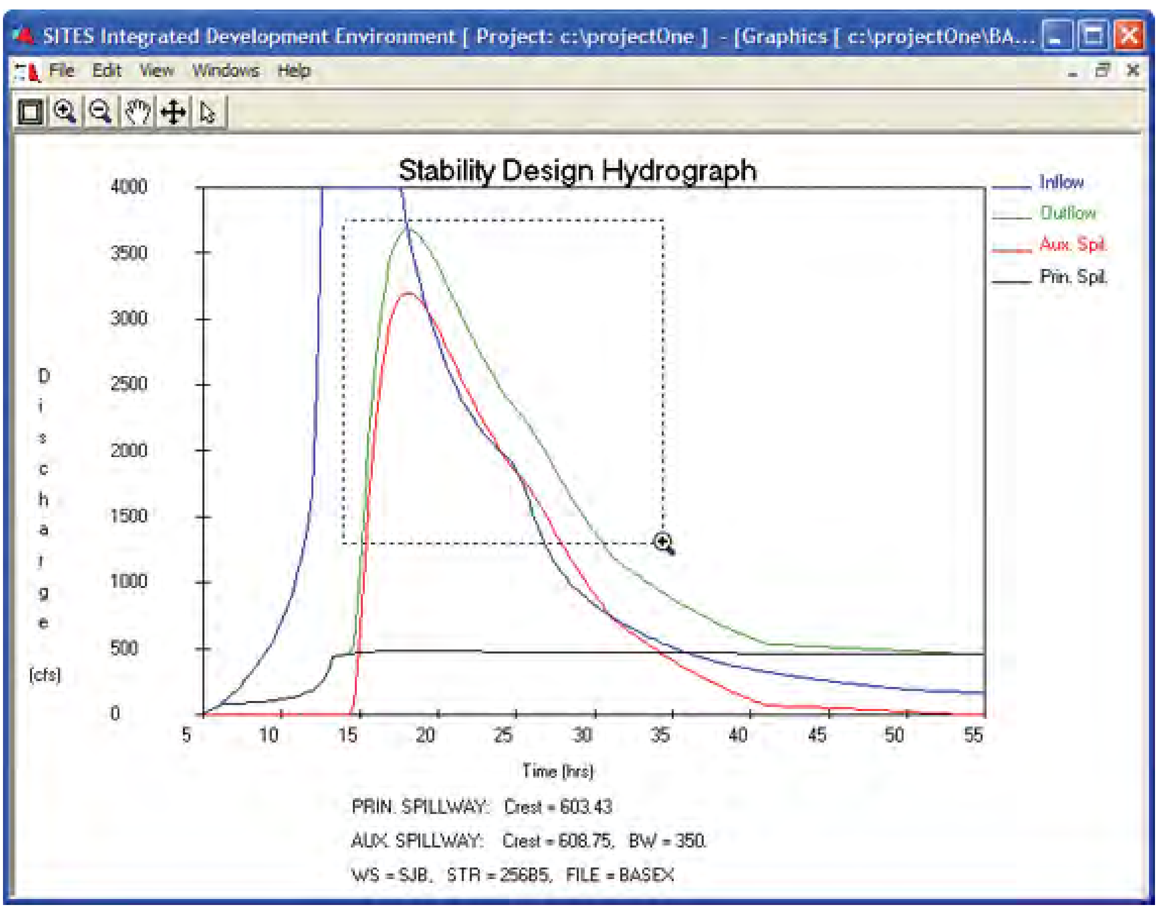


View Graphs

The View Graphs Interface is the most complicated single window in the SITES IDE application. It consists of eighteen tabs, each containing a single graph. The View Graphs command button and its corresponding View Graphs menu entry are only available when one row is highlighted in the Summary Table. The View Graphs window provides Zoom In, Restore, and Pan functions to focus the view on a particular part of each graph (fig. 3–8). It also allows you to view the value of any specific point on the graph.

If the highlighted row in the table of the Summary Table window is changed, thereby changing the file for which graphics are applicable, the Graphics Window will unload itself automatically. Returning to the Graphics Window can take several seconds to check which graphs should be enabled and to draw the available graphs.

Figure 3–8 Zoom-In option



View Text

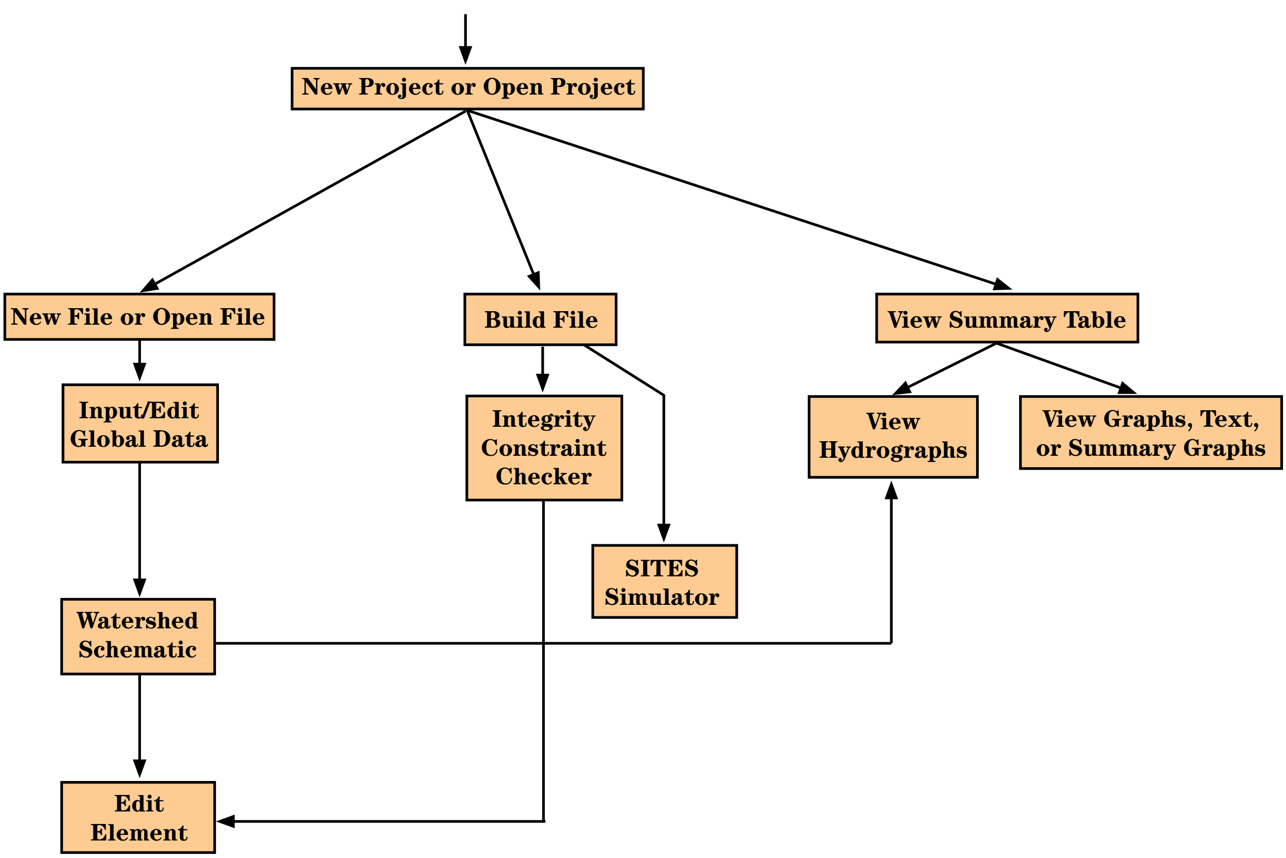
The SITES IDE application also provides a simple text editor for viewing text output files. You can only view the output; you cannot edit the output files. The file shown in the window changes depending on which file is selected in the Summary Table. Files are selected by highlighting a row in the Summary Table.

A flexible search mechanism is implemented in the View Text window. The Find window is displayed if you click on the **Find** option in the Edit menu. Several built-in phrases, which are frequently searched, are available in a pull-down menu. You can also enter a different search string to perform a new search.

View Hydrographs

The View Hydrographs Interface allows you to display hydrographs for all hydrologic elements in a given run. Hydrographs for the currently open file (current run) are available through this interface. You are allowed to specify which hydrograph is to be displayed by selecting the element in the Topological Graph Interface, or by selecting the element in the Hydrologic Element Table. Depending on the type of run, up to three different hydrographs may be displayed. Figure 3–9 shows a graphical description of the typical design cycle from the user's perspective.

Figure 3–9 Graphical description of the typical design cycle from the user's perspective



Chapter 4

Control File for DAMSITE Input

When using the IDE for data management, it is not necessary for the user to become familiar with the control words in this chapter or their format since data are managed interactively by the interface. Each data record has a maximum of 80 columns. The SITES DAMSITE program recognizes 90 control words that initiate data storage or set switches to override program defined criteria or procedures. Enter any control word or alphabetical data in upper case. Most users will seldom need many of these control words because most are for special situations. The SITES DAMSITE program has default values for many parameters. When they are inappropriate, you may change these values using the applicable control words.

The format of control word records is as follows:

Columns 1–10	The control word—enter control words exactly as shown on data input forms, but you may imbed blanks to improve readability. The program only reads the first five characters.
Columns 11–70 by 10 column fields	Data fields—decimal points are optional in the data fields, except for decimal fractions. If the decimal point is omitted, the program assumes that it follows the last digit in a field.
Columns 71–80	Record Identification—use to number the data record or otherwise identify it. These columns do not effect program execution. Use is optional.

The only exceptions to the above control word format are records that form the body of table data between the table header record and the ENDTABLE record. You must input these data records in specific sequences; therefore, the control word is not repeated. Otherwise, the format is the same as for columns 11 to 80.

Appendix E contains an alphabetical listing of the control words and a short description of their function. It also lists section and page where a detailed explanation of the control word is located.

This chapter gives detailed instructions on preparation of input records. The control word instructions are grouped into five sections based on their use. These groups are:

- Typical Runs for Single Structures (Design and Simulation)
- Typical Runs for Systems of Structures and Subwatersheds
- Alternative Input Possibilities
- Changes to Program Defined Input
- Changes to Program Defined Criteria

The detailed instructions for the control words give the purpose, use, relation to other control words, and data field requirements for columns 11 to 70.

The data fields are designated by columns, value, and type of characters. The following convention shows the type of characters:

A	=	Alphanumeric (letters or numeric) data that may appear in any location within specified columns.
N	=	Numeric data that may appear in any location within specified columns and may include special characters such as decimal points and plus or minus signs. Commas are not allowed.
I	=	Integer numbers (no decimal points) that may occur in any location within specified columns.
I_x	=	Integer numbers (no decimal points) that must occur in a fixed right justified position.
e	=	Essential data for use of control word. Program prints error message and normally terminates job execution if user omits this data.
–	=	Negative, negative data are required.
(–)	=	Negative, negative data are allowed.

Appendix F has blank input worksheets for typical design and simulation runs as well as tabular input worksheets.

The 1994 and later versions of the program may use different defaults than earlier versions of the program. To run old data sets, adding data or using the N option on the GO control word (see GO,DESIGN) may be necessary. Reproduction of previous program output may also require the use of OFFWSPVRT.

Table 4–1 lists the input required to obtain the special output files that the program can generate.

Table 4–1 Input options to obtain program generated special output files

Type data	Name [1/] prefix.ext	Program option [2/]	Graphic option [3/]	File description
		Transport files		
Hydrograph		I, O, B	–	HYD or READHYD tables Inflow & Outflow data
and/or	"prefix".DEC			
Structure ratings		R or T	–	STRUCTURE or STRUCT tables
Auxiliary spillway coordinates	"prefix".DSP	–	– [4/]	ASSPRFL, ASSURFACE, and associated ASDATA tables
		Graphic files		
Summary	"prefix".DSM	–	S	Compressed summary data
Summary	"prefix".DIS	–	I [5/]	Provides information for use by the IDE in creating the summary table
Text output	Oreference#.TOU	–	I	Contains portion of text output associated with the element referred to by the reference number
Structure ratings	"prefix".DRG	L	L, I	Compressed rating table data
Hydrographs	"prefix".DHY	P	P, I	Tabulated hydrograph, AS flow duration and velocity
Hydrograph	Hreference#.PHY	–	I	Hydrograph upstream of the element which is referred to by the reference number. It is used in plotting hydrographs from the IDE schematic.
Embankment	"prefix".DEM	E	E, I	CLPROFILE, template and quantity data
Auxiliary Spillway	"prefix".DGX [6/]	H	I	Stability procedure
Auxiliary Spillway	"prefix".DGX [6/]	U	I	Integrity procedure
Auxiliary Spillway	"prefix".DGX [6/]	–	I	Both stability and integrity procedures

Note: Other graphic files are not operational.

1/ Uses "prefix" from input or output file name, or user's choice.
2/ Option required in col. 11–20 of the GO, control word.
3/ Option required in col. 11–20 of GRAPHICS control word.
4/ Switch required in col. 51-60 of ASINSURF control word.
5/ Files generated by the graphics I are used by the IDE in generating output display.
6/ The DGX output files are DG1, DG2, DG4, DG5, and DG6. DG3 is not used.

Typical Runs for Single Structures

This section contains the control words commonly used to perform a variety of design and simulation program runs. Each control word has a brief description of its function.

Control word	Function of record	Page
SITES	Indicates beginning of job.	4–77
STRUCTURE	Loads structure elevation–surface area data table.	4–79
WSDATA	Enters design criteria and data for watershed area.	4–82
PDIRECT	Enters point design rainfall data.	4–62
POOLDATA*	Enters principal spillway crest, sediment storage, and valley floor information.	4–65
PSDATA	Specifies principal spillway conduit data.	4–67
PSINLET	Specifies data for a principal spillway drop inlet riser.	4–69
ASCOORD**	Defines surfaces of geologic materials in auxiliary spillway profile by x,y coordinates.	4–12
ASMATERIAL**	Describes geologic material parameters for each material identified in the ASCOORD table.	4–39
ASDATA*	Contains additional information for the auxiliary spillway.	4–18
ASCREST	Establishes auxiliary spillway crest elevation(s) for the spillway template.	4–16
ASSPRFL**	Describes the entire auxiliary spillway profile by x,y coordinates.	4–42
ASSURFACE**	Describes the surface parameters of the auxiliary spillway by x,y coordinates when the spillway location is specified by x,y coordinates.	4–44
ASINLET*	Provides inlet profile for the auxiliary spillway channel template.	4–32
ASINSURF**	Describes surface parameters of the auxiliary spillway inlet channel template.	4–37
ASEXIT**	Provides parameters characterizing the auxiliary spillway exit channel template.	4–26
ASEXSURF**	Describes surface parameters of the auxiliary spillway exit channel template.	4–28
BTMWIDTH*	Establishes auxiliary spillway bottom width(s).	4–51

Control Word	Function of record	Page
GO,DESIGN*	Initiates the design run.	4–58
STORM	Allows entry of specific data for a given storm.	4–106
RAINTABLE	Enters a specific rainfall distribution.	4–74
GO,RAINS*	Initiates a run using a series of rainfall amounts.	4–93
GO,STORM*	Initiates a run using a selected storm event.	4–96
HYD	Enters table of inflow hydrograph coordinates.	4–100
GO,HYD*	Initiates a run using an input inflow hydrograph.	4–90
GO,TDD	Initiates drawdown computations from a given elevation.	4–99
CLPROFILE	Enters coordinates of the embankment centerline profile.	4–53
GO,EMB	Initiates embankment quantity computations for given top of dam elevations.	4–89
ENDJOB	Signifies end of job.	4–56
ENDRUN	Ends the computer run.	4–56

* Control words used with older versions of the program (before 1994) with additional field entries or options for earth spillway erosion technology input.

** Control words introduced for earth spillway erosion technology data entry (1994).

You may substitute or add alternative control words to some of the control words shown to perform similar functions.

The program operates in the following sequence for a design run:

1. Read input data through ENDJOB record and echo the data to output.
2. Compute stage-storage relationship and calculate the spillway system rating curves.
3. Develop design inflow hydrographs.
4. Route the principal spillway storm to determine the required floodwater detention storage.
5. Compute drawdown time.
6. Establish minimum auxiliary spillway crest elevation.
7. Route stability design hydrograph to analyze stability of the auxiliary spillway exit channel.
8. Route freeboard hydrograph to analyze structural integrity of the spillway and to establish top of dam elevation.
9. Compute embankment yardage and other related quantities if CLPROFILE is entered.

10. Repeat stability design and freeboard hydrograph routings using any other specified bottom widths, permissible exit channel velocities or effective tractive stresses, or auxiliary spillway crest elevations.

The program automatically runs water surface profiles with varying roughness to provide the auxiliary spillway rating curve. The program provides control words or options to run DAMSITE with previous (prior to 1994) criteria and procedures using a constant spillway roughness.

For NHCP–378 criteria dams, you may select only one design hydrograph (freeboard–step 8), two design hydrographs (principal spillway and freeboard–steps 4 and 8), or all three hydrographs (principal spillway, stability design, and freeboard). You determine which hydrographs the program will use by the data input on the PDIRECT record. The NHCP–378 drawdown time is based on the design hydrograph (freeboard–step 8).

Appendix C, sample jobs 1 and 2 illustrate the input for normal design runs. Sample job 1 is a design run under TR–60 criteria. Sample job 2 is a design run under NHCP–378 criteria using principal spillway and design (freeboard) hydrographs. The output files for all sample jobs are included on the program compact disk.

Appendix F contains blank worksheets for use in preparing input for typical design runs and cases A through F.

The following paragraphs discuss several different types of runs. Table 4–2 indicates which control words are needed for several typical input alternatives called cases A through F that will give stability and integrity analyses for the auxiliary spillway. The Xs in a column for a case show which control words are needed for that case run. The table shows the normal order of entry for each case. Separate sections on design and simulation control words provide detailed descriptions of the control words and their input requirements.

Table 4–2 Examples of control words needed for various cases

Case A Determine principal spillway rating and auxiliary spillway crest elevation only.
Case B Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with auxiliary spillway crest elevation known.
Case C Design auxiliary spillway using a known spillway profile (ASSPRFL).
Case D Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with auxiliary spillway crest elevation unknown.
Case E Analyze existing auxiliary spillway for design conditions.
Case F Analyze existing auxiliary spillway for a given storm.

Control word	**Case example**					
	Case A	**Case B**	**Case C**	**Case D**	**Case E**	**Case F**
SITES	X	X	X	X	X	X
STRUCTURE	X	X	X	X	X	X
WSDATA	X	X	X	X	X	X
PDIRECT	X 1/	X	X	X 1/	X	
POOLDATA	X	X	X	X	X	X
PSDATA 2/	X	X	X	X	X	X
PSINLET 2/	X	X	X	X	X	X
ASDATA		X	X	X	X	X
ASCREST		X				
BTMWIDTH		X	X	X	X	X
ASCOORD		X	X	X	X	X
ASMATERIAL		X	X	X	X	X
ASSURFACE			X		X	X
ASSPRFL			X			
ASINLET		X		X		
ASEXIT		X		X		
ASINSURF		X		X		
ASEXSURF		X		X		
GO,DESIGN	X	X	X	X	X	
STORM						X
RAINTABLE						X
GO,STORM						X
ENDJOB	X	X	X	X	X	X
ENDRUN	X	X	X	X	X	X

1/ QDIRECT may be required by criteria for development of the principal spillway hydrograph.
2/ PSDATA and PSINLET are not required when the STRUCTURE table gives the principal spillway rating.

Typical design runs using GO,DESIGN

Use cases A through E as guides for runs for either TR–60 or National Handbook of Conservation Practices 378 (NHCP–378) criteria structures. A switch on the GO,DESIGN record activates the NHCP–378 criteria. You may identify on the ASDATA control word a precomputed auxiliary spillway rating based on subcritical flow for NHCP–378 dams.

Case A—Determine principal spillway rating and auxiliary spillway crest elevation only
Case A is a run to compute the principal spillway rating and the auxiliary spillway crest elevation.

The control words in the Case A column represent the minimum data required to produce a Case A run. If any one of these records is missing, some required basic data are not available. Running this case requires an N option in col. 11–20 of the GO,DESIGN control word.

Case B—Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with auxiliary spillway crest elevation known
Case B is a design run analyzing stability and integrity for a spillway using a profile template when the crest elevation is known. ASINLET and ASEXIT are paired to describe a floating spillway profile template. ASINSURF and ASEXSURF describe the spillway surface conditions. The uppermost material surfaces of the ASCOORD tables define the natural ground surface. The horizontal position of the spillway is specified with ASDATA. The crest elevation is specified with ASCREST.

You would typically run this case after a Case A run.

Case C—Design auxiliary spillway using a known spillway profile (ASSPRFL)
Case C is a run analyzing stability and integrity for a spillway where all coordinates of the profile are known. The ASSPRFL coordinates define the spillway profile. These coordinates may or may not coincide with portions of the natural ground surface defined by ASCOORD. The program requires ASSPRFL to define a spillway exit channel with multiple slopes. When ASSPRFL is used, ASSURFACE is used to describe the spillway surface conditions.

You would typically run this case to analyze complex surface conditions.

Case D—Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with auxiliary crest elevation unknown
Case D is a design run analyzing stability and integrity for an auxiliary spillway when its crest elevation is not known. The uppermost surfaces of the ASCOORD tables define the natural ground. ASINLET and ASEXIT are paired to describe a floating spillway profile template. When a template is used, ASINSURF and ASEXSURF are used to describe the spillway surface conditions. The horizontal position of the spillway is specified with ASDATA. The crest elevation is computed from routing the principal spillway hydrograph using design criteria.

You would typically run this case at the beginning of the design process instead of Case A and Case B runs.

Case E—Analyze existing auxiliary spillway for design conditions
Case E is a run using design storms to analyze stability and integrity for an existing or already designed auxiliary spillway. In this case, the uppermost surfaces described by the ASCOORD tables are the existing spillway ground surface. ASSURFACE describes spillway surface conditions along the profile.

Case F—Analyze existing auxiliary spillway for a given storm
Case F is a simulation run, routing an actual storm event through an existing spillway or a previously designed structure. If elevation-volume data and principal and auxiliary spillway ratings are available for the structures studied in simulation runs, you may shorten the control word list by using the STRUCTURE table to input volumes and spillway ratings. If this is done, you may omit the PSDATA, PSINLET, and ASDATA control words. The ASCOORD, ASMATERIAL, ASSURFACE and BTMWIDTH data are still required for the auxiliary spillway stability and integrity analyses.

Typical simulation runs using GO,STORM

The program operates in the following general sequence for a GO,STORM simulation run:

1. Read input data through the ENDJOB record and echo the data to output.
2. Compute stage-storage relationship and rate the spillway system if not input as STRUCTURE data.
3. Develop the storm inflow hydrograph.
4. Route storm hydrograph to analyze functioning of the structure including the stability and integrity procedures.
5. Repeat, as needed, storm routing using other auxiliary spillway crest elevations or specified bottom widths.

You may enter alternative control words to obtain many of the functions used in simulation runs.

In appendix C, sample job 3 illustrates the input for a typical simulation run. Appendix F contains blank worksheets for case F for use in preparing input for a typical simulation run.

Other types of runs

In addition to the GO,DESIGN and GO,STORM control words, four other GO, control words trigger more specialized options.

Simulation with series of rainfalls
GO,RAINS is a specialized version of the GO,STORM control word. It enables you to develop and route a series of storm rainfalls. The required input data and order of computations is essentially the same as that for GO,STORM except that a series of rainfall amounts are input with the GO,RAINS control word. To use GO,RAINS, replace GO,STORM with GO,RAINS in the control word list. STORM and RAINTABLE are not needed if using the default or preloaded design storm distributions.

Inflow hydrograph given
GO,HYD is another specialized control word used for simulation or design runs. Using GO,HYD, you may enter a hydrograph(s) for flood routing through a structure.

When using GO,HYD in a simulation run, enter only one HYD table. For design runs using GO,DESIGN, enter up to three HYD tables representing the principal, stability, and freeboard design inflow hydrographs.

The GO,HYD control word may also be used with the spillway ratings computed by the program. The control words are similar to the ones listed under GO,STORM except the RAINTABLE is eliminated and STORM and GO,STORM are replaced by the HYD and GO,HYD control words. Enter all essential data on the WSDATA record if not entered on the HYD table header record.

Sample job 4 in appendix C illustrates the input for a typical GO,HYD application.

Drawdown computations only
GO,TDD is a specialized control word to initiate drawdown computations from a given elevation. The program does not consider inflow in the drawdown computations.

Sample job 7 in appendix C illustrates the input for a typical GO,TDD application.

Embankment computations only
GO,EMB is a specialized control word to initiate a series of embankment quantity computations for a series of top of dam elevations.

In appendix C, sample job 8 illustrates input for a typical GO,EMB application to develop an embankment yardage versus top of dam elevation relationship.

Control words for typical design runs

Control words for typical design runs are listed below in alphabetical order. The function and location of control words for typical design runs are listed right after the table of contents. Appendix E also contains these control words with a brief description of their functions.

ASCOORD

ASCOORD—A set of tables of x,y coordinates that define the top surfaces of geologic materials along the centerline of the auxiliary spillway. Coordinates for the surfaces must relate to the same datum and stationing system (increasing from left to right in the downstream direction). The program will accept a maximum of 10 material surfaces, each of which must be described in an ASMATERIAL table. Each ASCOORD table defines the top surface of one material and the corresponding ASMATERIAL table entry defines the physical properties of the material. The exposed material/materials in the ASCOORD tables define the natural ground or an existing auxiliary spillway surface.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Material number	Ie	Consecutive integer from 1 to 10 used to cross reference material properties. See ASMATERIAL. Material number refers to the material whose surface is defined by the coordinates (fig. 4–1).
Col. 21–30	Material description	A	Enter the geologic material description, such as topsoil, CL, SM, or limestone. Program uses this description for graphics labels.
Col. 31–40	AS Surface?	A	**Y or Yes**: The exposed materials define an auxiliary spillway and its flow path that either exists or was previously designed. **N or No** (default): The exposed materials define the natural ground surface.

Notes:
1. A **Y** response in col. 31–40 requires the use of profile reference numbers 41–50 in control words ASDATA and ASSURFACE. A **N** response requires you to define the spillway surface by other control words (see ASDATA, ASINLET, ASEXIT, ASSPRFL).
2. Only material 1 needs an entry in col. 31–40 even though multiple materials exposed at the surface may define the ground surface (natural ground or constructed spillway, fig. 4–1).

Data field	Value	Type	Description
Col. 41–50	Barrier station	N(-)	Station of a barrier placed across the auxiliary spillway (see note 12).
Col. 51–70	User label	A	Available for user to record additional information about the material.

ASCOORD (continued)

Data field	Value	Type	Description
Data Records 2–8			
Col. 11–70 by 10 col. fields	X,Y coordinate pairs	Ne(–)	Coordinates are x,y pairs for station (distance) and elevation of the centerline profile of a material surface. Stations increase from left to right in the downstream direction. The minimum number of coordinate pairs is 2. Use only as many as needed, with a maximum of 21 points per material.

Notes (continued):

3. While material surfaces are usually defined along the centerline of the spillway, the coordinates should reflect the most erodible materials within the auxiliary spillway flow path.
4. Profile stationing must extend from the entrance of the auxiliary spillway inlet channel to the point where flow reaches the valley floor or to the elevation associated with the anticipated depth of erosion. Define the upper material surface through the spillway inlet because the water surface profile procedures terminate at the most upstream point entered.
5. The integrity procedure uses only the materials from the upstream edge of the auxiliary spillway crest downstream to the valley floor.
6. Enter material numbers consecutively – 1,2,3, etc. with no repeated numbers. The recommended approach is to work from the top surface downward to the valley floor. Enter all ASCOORD tables before the GO, control word that uses them.
7. Junction points between material surfaces must have the same coordinates in both material surfaces defined in the ASCOORD tables (fig. 4–1). The exposed materials must describe a continuous ground surface. If coordinates at a junction between two unexposed material surfaces do not agree, the program assumes a vertical drop from one material surface to the other as the tie-in.
8. Enter each material surface with increasing x coordinate values. The program gives an error message if x coordinates do not continually increase for a given surface.
9. A warning occurs if any two consecutive material surface points are apart by more than 50 feet in elevation or 5,000 feet horizontally.
10. The ASMATERIAL table must define the parameters for each material given in the ASCOORD tables.
11. The ASCOORD table must end with an ENDTABLE record.
12. The headcut barrier station is the hortizontal location of a manmade barrier capable of stopping the advance of any headcut formed downstream of that station. Downcutting at the base of the headcut is assumed to continue. The headcut barrier station is used to estimate the potential depth of erosion if an effective barrier was placed in the spillway. This information may be used in design of an ap-

ASCOORD (continued)

propriate barrier. The input of a barrier has NO influence on the computation of depth and advance of headcuts formed upstream of the barrier station. This is equivalent to assuming that headcuts formed upstream of the barrier will successfully undermine or flank the barrier sufficiently to allow the flow to escape and erosion to continue. No actual analysis is made of any type of barrier or the forces that it would be required to withstand to be effective.

Example 4–1 ASCOORD—The ASCOORD table from sample job 1 describes the surface of the first geologic material which is an alluvium. The N in col. 31–40 of the ASCOORD record indicates that this surface is natural ground and is not an existing or previously designed auxiliary spillway.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

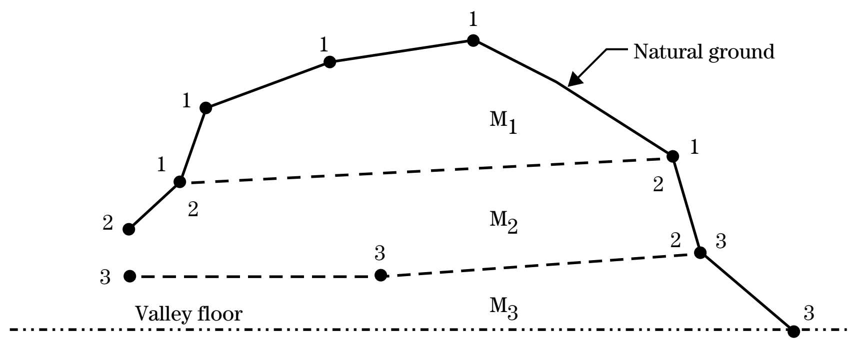
AUXILIARY SPILLWAY COORDINATES

9-05

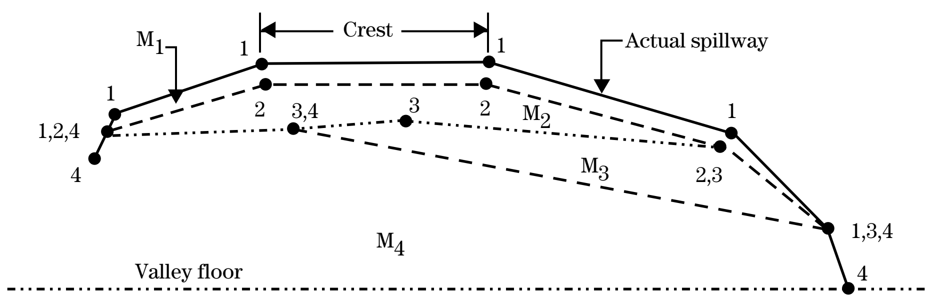
STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Material No.	Material Description	Aux. Surface ? (Y or N)	Barrier Station	User Label		Record Identification
ASCOORD	1	Alluvium	N				
Control Word	Enter successive coordinates left to right						Record Identification
	Station–feet	Elevation–feet	Station–feet	Elevation–feet	Station–feet	Elevation–feet	
(maximum of 7 data records)	0	595	100	603	200	608	
	250	613	275	612	300	610	
	350	613	400	615	450	612	
	500	607	550	606	600	604	
	700	601	800	595.7	900	590	
	950	585	1000	580			
ENDTABLE							

Figure 4–1 ASCOORD points and material surfaces. In A, the natural ground is the exposed surface. In B, the exposed surface is a spillway that has topsoil and natural ground upstream and downstream of the spillway.



(A)



(B)

Material surface 1 points are indicated by 1; material surface 2 points by 2; etc.

ASCREST

ASCREST—Allows you to specify the auxiliary spillway crest elevations to be considered with a spillway template when routing hydrographs. ASCREST is not used with ASSPRFL or with a Y in columns 31–40 of ASCOORD, which already include the crest elevation in the surface coordinates.

Data field	Value	Type	Description
Col. 11–20	Units	A	Indicates the units of the data in col. 21–70. Insert the word: ELEV–for elevation in feet, or FEET–for stage in feet, or AC-FT–for volume in acre-feet. If left blank, ELEV is assumed.
Col. 21–30	Blank or AS crest	N	Leave blank to instruct the program to route the principal spillway hydrograph to get the minimum auxiliary spillway crest. Otherwise, elevation in feet or volume in acre-feet (as in col. 31–70).
Col. 31–70 by 10 col. fields	Alternative AS crest	N	Alternative auxiliary spillway crest data. Option: 1 The elevation in feet of the crest of the auxiliary spillway. 2 The stage in feet to set the crest above the crest of the auxiliary spillway established by routing the PSH or the crest given in col. 21–30. 3 The volume of floodwater detention storage in acre-feet between the crests of the principal and auxiliary spillways. 4 Leave blank if running no alternatives. Use only one option type per record.

Notes:

1. You may mix the above options by following with additional consecutive ASCREST records with the appropriate units in col. 11–20. The program allows the specification of a maximum of 5 crests for each pass.
2. If entering a second or third ASCREST record, enter data in col. 21–30 of these records. Only the first ASCREST record needs a blank col. 21–30 to route the principal spillway hydrograph.

ASCREST (continued)

Data field	Value	Type	Description
			3. If col. 21–30 of the first ASCREST record is not left blank, and an elevation or volume is inserted, the program will not develop or route the principal spillway hydrograph. Exceptions are upper sites in series where the site type is 2 on the WSDATA record.
			4. The program allows only one ASCREST for an upper site in series; enter the value in col. 21–30.
			5. When using the ASCREST control word with a known auxiliary spillway profile entered by ASSPRFL or ASCOORD tables (Y in col. 31–40), the program uses only the crest elevation that matches the known crest elevation and ignores all other crest elevations.

Example 4–2 ASCREST—The ASCREST record in sample job 10 instructs the program to set the crest at 467.0 for Site A

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Units for Data in Col. 21 – 70	Leave Blank to Set Crest by Routing PSH	Alternative AS Crests				Record Identification
ASCREST							

ASCREST	ELEV.	467.0					

ASDATA

ASDATA—Describes the auxiliary spillway inlet, level crest, and exit channel. The program requires ASDATA to provide data for water surface profile and velocity computations, as well as stability and integrity designs even if given a discharge rating.

Data field	Value	Type	Description
Col. 11–12	Profile reference number	Ie	Reference number between 1 and 50 for auxiliary spillway profile type. This number must match that on other AS input records (note 1). Enter 30 when designing NHCP–378 structures using retardance class and precomputed ratings. See table 4–3 for program defined profile reference numbers. The reference number must be 41–50 if col. 31–40 of ASCOORD contains a "Y" or if ASSPRFL is used to describe the spillway profile.

Notes:

1. The profile reference number is the tie between the different control words describing a spillway:
   - For an existing spillway defined by ASCOORD tables, the profile reference number on ASDATA must match that on ASSURFACE.
   - A design run for a spillway with a fixed crest and profile defined by the ASSPRFL table must have matching profile reference numbers for ASDATA, ASSPRFL, and ASSURFACE.
   - Trials with a spillway template defined by inlet and exit profiles require matching profile reference numbers for ASDATA, ASINLET, ASEXIT, ASINSURF, and ASEXSURF if used.
   - When using ASRATING, the profile reference number must match that of ASDATA for retrieval.
2. If examining several spillway configurations, you may stack control words describing each configuration that have appropriate profile reference numbers in separate program passes or may change control words in subsequent runs.

Standard input: profile reference number is 1 to 29 or 41 to 50. (If profile reference number is 30, see alternative input, ASDATA.)

Col. 13	Retardance	A	The Retardance (A, B, C, D, or E) as related to a Vegetal Retardance Curve Index C_I (table 3.2, AH–667). Any other flow resistance entry will override this entry. See note 5.

ASDATA (continued)

Data field	Value	Type	Description
Col. 14–20	Tie-in station d/s crest	N	Station of downstream edge of crest in ASCOORD stationing system. Required with spillway profile template to tie given distances to stationing.
Col. 21–30	Inlet length	N	The inlet channel length in feet, including the level crest length. The program requires an inlet length if using a spillway profile template without ASCOORD tables.

Notes (continued):

3. The inlet length determines the upstream end of the water surface profile computations if:
   - The length is shorter than the table 4–3 maximum length for the profile reference number.
   - The length is shorter than the ASINLET maximum distance.
4. If using ASCOORD tables, the program determines the inlet length from the ground surface defined by these tables. The program performs water surface profile computations to the most upstream point in the ASCOORD tables. If a spillway template is used, the program computes the point of intersection of the inlet template with natural ground as appropriate.

Data field	Value	Type	Description
Col. 31–40	Inlet channel Manning's "n" or C_I	N	Options for inlet channel flow resistance used in water surface profile computations: • "n" – If value is less than 1, the program assumes Manning's "n" for the entire inlet for all procedures. • C_I – If value is greater than or equal to 1, the program assumes Vegetal Retardance Curve Index (C_I) for the entire inlet channel. This is only usable in the WSPVRT water surface profile procedure. • Leave blank, if C_I or "n" are entered on the other control word options.

ASDATA (continued)

Data field	Value	Type	Description
			Notes (continued): 5. The program follows a hierarchy in using flow resistance coefficients ("n" or C_I) entered on various control words. Detailed data overrides simplified data in the following order: • Reach values in the ASSURFACE table (most detailed). • Values in ASINSURF and ASEXSURF tables. • Separate inlet and/or exit channel values on ASDATA. • Single value (C_I only) for the entire spillway based on retardance, col. 13 of ASDATA (most simplified). • If no "n" or C_I values are given, the default "n" is 0.04.
Col. 41–50	Side slope ratio	Ne	The average AS side slope ratio (horizontal divided by vertical) along the spillway from inlet to exit. The average AS side slope of multichannel situations is the average of the AS side slope ratios of the individual channels. Zero is permissible for rectangular channels.
			Notes (continued): 6. If the spillway side slopes vary considerably and the interest is in a particular portion of the spillway, give added weight to the average side slope ratio in that portion. For instance, if you are especially interested in exit channel velocities, give added weight to the average side slope ratio in the exit channel.
Col. 51–60	Exit channel, Manning's "n" or C_I	N	Options for exit channel flow resistance used in all exit channel velocity computations: • "n" – If value less than 1, the program assumes Manning's "n" for the entire exit channel. • C_I – If value is greater than or equal to 1, the program assumes C_I for the entire exit channel. • Leave blank, if C_I or "n" are entered on the other control word options. See note 5.

ASDATA (continued)

Data field	Value	Type	Description
Col. 61–70	Exit channel slope	N	Options for exit channel slope: • % – If the value is greater than or equal to 1. • ft/ft – If the value is less than 1. • Leave blank if exit channel slope is defined by ASCOORD, ASSPRFL or ASEXIT. See note 7.

Notes (continued):

7. If you do not enter an exit channel slope, then:
   - With a stability or integrity analysis, the program assumes a 4 percent slope.
   - With a design run and an exit velocity analysis only, the program assumes the slope as the critical slope computed for a flow of 25 percent of the spillway maximum discharge during the passage of the FBH. To specify the SDH, see OLDTR60.
   - With a given AS rating in the STRUCTURE table, the program makes no exit velocity computations.

Alternative input if profile reference number is 30:

Data field	Value	Type	Description
Col. 13	Retardance class	Ae	Enter retardance class (A, B, C, D, or E). See Engineering Field Handbook, chapter 7.
Col. 14–20	Crest length	Ne	Enter level crest length (025, 050, 100, or 200 feet) beginning in col. 14.

Notes (continued):

8. The program left justifies the data in col. 11–20 (which includes the profile reference number) and forms a 6 character ID symbol for searching the current ASFILE for a subcritical stage discharge record with the same ID symbol. The ASFILE provided with the program is only valid for sites with A1 and S class codes.

Data field	Value	Type	Description
Col. 21–30	–	–	Leave blank, inlet predetermined.
Col. 31–40	–	–	Leave blank, ratings precomputed.
Col. 41–50	Side slope ratio	Ne	The average AS side slope ratio (horizontal divided by vertical) along the spillway from inlet to exit. If the spillway side slopes vary considerably see note 6.

ASDATA (continued)

Data field	Value	Type	Description
Col. 51–60	Exit channel Manning's "n" or C_I	N	Options for flow resistance coefficients used in exit channel stage-discharge-velocity relationships: • "n" – If value less than 1, the program assumes Manning's "n" for entire exit channel. • C_I – If value is greater than or equal to 1, the program assumes C_I for the entire exit channel. • Leave blank if C_I or "n" are entered on other control word options. See note 5.
Col. 61–70	Exit channel slope	N	Options for exit channel slope: • % – If the value is greater than or equal to 1. • ft/ft – If the value is less than 1. • Leave blank if exit channel slope is defined by ASCOORD, ASSPRFL, or ASEXIT. See note 11.

Notes (continued):

(Note 9 applies only to profile 30.)

9. Minimum slope with reference number 30 is 1.0 percent, and it must be less than critical slope. The program needs the exit channel slope for exit channel velocity computations.

(Notes 10 and 11 apply to all profile reference numbers 1–30 and 41–50.)

10. The program assumes normal depth and uniform flow conditions in solving for exit channel velocities.
11. You may enter or instruct the program to compute the auxiliary spillway stage-discharge relation. When the program computes the stage-discharge relation, you may enter the needed spillway information using a combination of control words. The program requires the ASDATA and BTMWIDTH records for velocity, stability, and/or integrity computations in all the combinations listed below. The combinations first listed have precedence over those listed later based on the assumed precision of the rating. ASDATA requirements for given ratings are the link to the exit channel data and side slope ratio.
    The priority of use of given ratings follows:
    - STRUCTURE table data with auxiliary spillway discharges given in cubic feet per second.
    - ASRATING, discharges per foot of bottom width based on even increments of stage.
    - ASFILE option includes user defined rating curves or precomputed ratings for profile reference number 30 spillways (current ASFILE).

ASDATA (continued)

Data field	Value	Type	Description

Notes (continued):
The hierarchy continues with computed ratings. The ASDATA record provides the side slope ratio and links to flow resistance coefficients and to inlet and exit channel configurations. Detailed inlet and exit channel information override given slope data for use in water surface profile computations in the following order:

- ASCOORD coordinates defining an existing spillway.
- ASSPRFL coordinates defining a proposed spillway.
- ASINLET points defining a floating inlet channel or a computed inlet slope passing through a fixed x,y point.
- ASEXIT record with a computed exit slope passing through a fixed x,y point.
- ASDATA record with the profile reference number 1–29 defining a predefined inlet channel.
- ASDATA record with exit slope entered in col. 61–70.
- If you do not enter exit channel data, the program uses a default exit slope. See note 7.

Example 4–3 ASDATA—The ASDATA control word from sample job 1 tells the program to use profile reference number 41. This profile (table 4–3) has a 50 foot level section and a 1,000-foot, 1.0 percent sloping inlet section. The tie-in station at the downstream edge of the crest is at 450 feet, which is in the same stationing system as the ASCOORD tables. The auxiliary spillway side slope ratio is 2.5 and the exit channel slope is 3.5 percent.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
		Inlet Channel			Exit Channel		
Control Word	1–Profile Ref. No. 2–Retardance * 3–Tie–in Station	Length–feet	Manning's "n" or C_I	Side Slope Ratio	Manning's "n" or C_I	Slope ft/ft or %	Record Identification
ASDATA	1 2 3						
ASDATA	41 450			.25		.035	

* If Columns 11-12 = 30: Columns 14-20 define a predetermined inlet length and Columns 21-40 are left blank. Then Columns 11-20 form the 378 ASFILE ID Symbol.

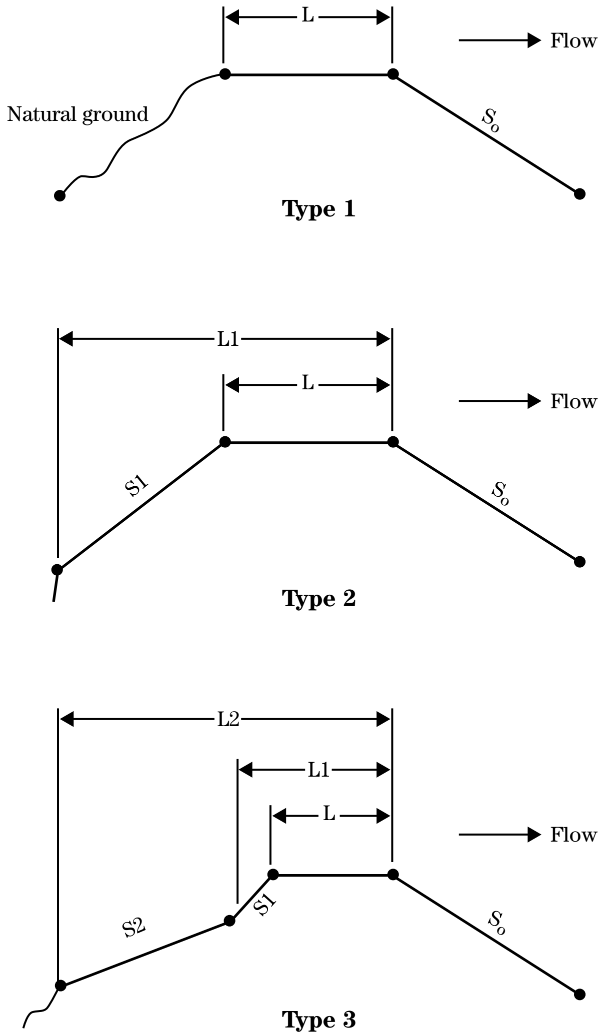
Table 4–3 Auxiliary spillway channel bottom profile reference numbers defined by the program

Profile reference number	Profile type (fig. 4–2)	Level sec. length (L) (feet)	Inlet channel–Accumulative length: Length (L1) (feet)	Slope (S1) (percent)	Length (L2) (feet)	Slope (S2) (percent)
1	1	1,000	–	–	–	–
2	2	30	1,030	–2	–	–
3	2	30	1,030	–3	–	–
4	2	30	1,030	–4	–	–
5	2	30	1,030	–5	–	–
6	2	50	1,050	–2	–	–
7	2	50	1,050	–3	–	–
8	2	50	1,050	–4	–	–
9	2	50	1,050	–5	–	–
10	3	30	50	–10	1,050	–1
11	3	30	60	–10	1,060	–1
12	3	30	70	–10	1,070	–1
13	3	30	80	–10	1,080	–1
14	3	50	70	–10	1,070	–1
15	3	50	80	–10	1,180	–1
16	3	50	90	–10	1,190	–1
17	3	50	100	–10	1,100	–1
23	2	100	1,100	–2	–	–
24	2	100	1,100	–4	–	–
27	2	50	1,050	–0.4	–	–
28	2	50	1,050	–1.0	–	–
29	2	50	1,050	–1.5	–	–

Notes:
1 to 29—Profile defined by program can be accessed by ASDATA. The inlet length entered by ASDATA will control if shorter than that in this table.
30—Used by ASFILE discharge ratings – subcritical flow w/retardance, profile type 1 with L =25 ft, 50 ft, 100 ft, and 200 ft.
31 to 40—Reserved.
41 to 50—Available for user defined data – see ASINLET and ASRATING.

The table was developed from two sources, ES124 (1960) and TR35 (1967), which contained some duplication. The following pairs of profile numbers were duplicates: 1 and 18, 2 and 19, 4 and 20, 6 and 21, 8 and 22, 14 and 25, and 16 and 26.

Figure 4–2 Auxiliary spillway profile types listed in table 4–3



Legend

L=Level section
L1, L2=Inlet lengths
S1, S2=Inlet channel slopes
S_o=Exit slope

ASEXIT

ASEXIT—Provides data for the auxiliary spillway exit channel when using ASINLET, ASDATA, or both, to describe the inlet channel template. Use ASEXSURF with ASEXIT to describe the surface conditions in the exit channel. ASEXIT allows only a single exit channel slope. For more complex spillway surfaces, use ASSPRFL to describe the total spillway profile. Do not use ASEXIT with ASSPRFL or when ASCOORD indicates an existing spillway with a Y.

Data field	Value	Type	Description
Col. 11–20	Profile reference number	Ie	Profile reference number (1–29 or 41–50) for an auxiliary spillway profile type. This number must match that on ASDATA and ASINLET (if used). Enter 30 when designing NHCP–378 structures using predefined ratings. See table 4–3 for other program defined reference numbers.
Col. 21–30	Allow exit channel fill to valley floor?	A	Y tells program to extend the exit channel to the valley floor using fill if necessary. An N or blank terminates the constructed exit channel at the intersection with the natural surface (fig. 4–3).
Col. 31–40	Topsoil fill depth (ft)	N	Auxiliary spillway topsoil fill depth in feet. Default is 0.0.

Notes:
1. The topsoil fill covers the spillway from the inlet to the computed intersection with the natural surface when exit channel fill is not specified and to the valley floor when exit channel fill is specified.

Data field	Value	Type	Description
Col. 41–50	Station of fixed exit coordinate	N	Station (ft) for point on exit channel profile used to determine slope from downstream edge of crest. Use the ASCOORD stationing system.
Col. 51–60	Elevation of fixed exit coordinate	N	Elevation (ft) for point on exit channel profile used to determine slope from downstream edge of crest. Elevation must be greater than or equal to the valley floor elevation (fig. 4–3).

Notes (continued):
2. Exit channel can be defined with a slope or a fixed end coordinate. You can choose to allow fill to the valley floor (Y in col. 21–30) or not (N or blank in col. 21–30) in either case.

ASEXIT (continued)

Data field	Value	Type	Description
	3. If ASEXIT defines an exit slope with a fixed coordinate point, that slope will override an exit slope given on the ASDATA record. Use the fixed point to avoid excavating rock or other erosion resistant material.		
Col. 61–70	Length of constructed exit channel	N	Use to establish exit channel length in feet when giving no ASCOORD data. Default is 100 feet.

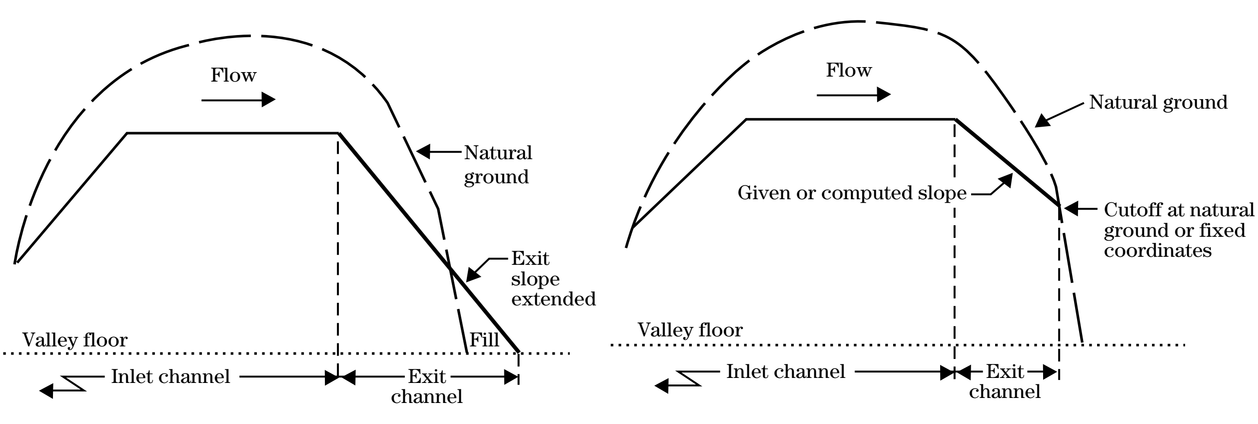
Notes (continued):

4. Use ASEXIT in combination with ASINLET or with an inlet defined using ASDATA. The program requires a tie-in station entry on ASDATA. An entry of N on ASCOORD table (for material number 1) is also implied.
5. Use ASEXSURF to describe surface conditions for the exit channel when giving the exit channel slope by ASEXIT or ASDATA.

Example 4–4 ASEXIT—This ASEXIT control word from sample job 1 directs the program to use profile reference number 41 indicating that the user will provide data defining the profile. The exit channel terminates at the natural surface and has a topsoil layer of 1.0 foot. The sample job 1 ASDATA record shows an exit channel slope of 3.5 percent.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Profile Reference No.	Fill to Valley Floor? Y or N	Topsoil Fill Depth (ft)	X Station Fixed Point (ft)	Y Elevation Fixed Point (ft)	Length Constructed Exit channel (ft)	Record Identification
ASEXIT							
ASEXIT	41	N	1.0				

Figure 4–3 Auxiliary spillway exit channel profile



(a) Exit channel defined by slope and extended to valley floor with fill

(b) Exit channel defined by fixed coordinates and cut off at natural ground with no fill

ASEXSURF

ASEXSURF—Table for describing the surface parameters for the design of a constructed auxiliary spillway exit channel and the natural ground downstream of the end of the exit channel. Use only for spillway templates defined by ASEXIT or an exit channel slope entered on ASDATA.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Profile reference number	Ie	Profile reference number (1–29 or 41–50) for an auxiliary spillway profile type. This number must match that on ASDATA and ASINLET, and on ASEXIT, or ASRATING if used. See table 4–3 for program defined profile reference numbers.
Col. 21–30	Label CI or N	A	Label CI for Vegetal Retardance Curve Index (C_I) or N for Manning's "n," whichever is given in columns 31–50.
Col. 31–40	C_I or "n"	N	Value of C_I or "n" for the designed constructed exit channel. See Agricultural Handbook (AH) 667, and note 1 below. Options: • If value is <1, the program accepts the value as Manning's "n." • If value is $\geq$1, the program accepts the value as C_I. • Leave blank if entered on ASDATA as retardance in col. 13 or C_I or "n" in col. 51–60.
Col. 41–50	C_I or "n"	N	Value of C_I or "n" for the natural ground downstream of the exit channel. See option descriptions for columns 31–40.

Notes:

1. The program needs the C_I or "n" values for rating curve development, exit channel velocity, stability, and integrity computations. However, for simplicity for NHCP–378 structures, enter C_I or "n" in ASDATA (col. 51–60) when an integrity analysis is not needed. For small 378 sites, represent the entire spillway by the retardance relation on ASDATA (col. 13). See ASDATA, note 5. If you enter no C_I or "n" value, the program uses the default "n" value of 0.04.

ASEXSURF (continued)

Data field	Value	Type	Description
Data Record 2			
Col. 21–30	Label CF	A	Label CF for Vegetal Cover Factor (C_F) given in columns 31–50.
Col. 31–40	C_F	N	Value of C_F for the constructed exit channel.
Col. 41–50	C_F	N	Value of C_F for the natural ground downstream of the exit channel.

Notes (continued):
2. Vegetal Cover Factor (C_F) varies between 0.0 and 0.9. The default is 0.0 for nonvegetated surfaces. See AH 667.
3. The Vegetal Cover Factor (C_F) impacts results only when using a Maintenance Code of one.

Data field	Value	Type	Description
Data Record 3			
Col. 21–30	Label MC	A	Label MC for Maintenance Code given in columns 31–50.
Col. 31–40	MC	I	MC value for the constructed exit channel.
Col. 41–50	MC	I	MC value for the natural ground downstream of the exit channel.

Notes (continued):
4. Maintenance Code is entered as an integer (1, 2, or 3). (See ASSURFACE col. 51–60 for definitions.) Default value is 3.
5. When performing integrity calculations with GO,DESIGN, the program uses a minimum MC of 2 as a design default. You may override this design default in simulation runs by using the MC switch (col. 41–50) on GO,STORM or GO,HYD. When doing stability analyses with GO,DESIGN, the program uses the actual input MC value of 1, 2, or 3.

Data field	Value	Type	Description
Data Record 4			
Col. 21–30	Label RD	A	Label RD for potential rooting depth given in columns 31–50.
Col. 31–40	RD	N	RD value for the constructed exit channel.
Col. 41–50	RD	N	RD value for the natural ground downstream of the exit channel.

ASEXSURF (continued)

Data field	Value	Type	Description

Notes (continued):

6. The protective value of vegetation is sensitive to rooting depths less than approximately 1 foot because of sod stripping. When rooting depth exceeds about 1.5 feet, variation in rooting depth will have only minor impact on stability and integrity results.

Data Record 5 (optional if D_{75} is blank or zero, see note 13)

Data field	Value	Type	Description
Col. 21–30	Label D75	A	Label D_{75} for Representative Diameter of topsoil material in the constructed exit channel given in columns 31–40.
Col. 31–40	D_{75}	N	Diameter in inches (D_{75}) of topsoil material in the constructed exit channel. (Conversion: millimeters to inches: mm/25.4 = inches.)

Notes (continued):

7. Entries for Data Record 5 apply only to stability analyses when $D_{75} > 0.05$ inches (coarse material).
8. The data records must be in the order shown for the program to interpret them correctly.
9. Label fields are optional. Use these fields to make input files more readable and reduce input errors.
10. The break between the designed constructed exit channel and the natural ground is at the intersection of the exit channel with the natural ground defined by the ASCOORD tables.
11. When you want the exit channel to reach the valley floor with cut or fill (Y on ASEXIT), natural ground parameters are not required.
12. When using ASSPRFL or a Y on the first ASCOORD table, use the ASSURFACE table to enter surface condition data. The ASSURFACE or ASINSURF and ASEXSURF forms of entry are mutually exclusive. Stability and integrity analyses allow entry of surface conditions by only one of these forms at a time in a pass. See ASDATA note 5 for hierarchy.
13. The table must end with an ENDTABLE record following data record 4 if omitting data record 5.

Example 4–5 ASEXSURF—The ASEXSURF table from sample job 1 describes the spillway surface conditions for the exit channel. C_I is used instead of Manning's "n" for the roughness parameter.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

EXIT CHANNEL SURFACE

3-95

STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word (record 1)	Profile Reference No.	Label "n" or C_I	Const. Exit Channel "n" or C_I	Natural Ground "n" or C_I			Record Identification
ASEXSURF	41		5.6	5.6			
(record 2)		Label C_F	Const. Exit Channel C_F	Natural Ground C_F			
			0.9	0.9			
(record 3)		Label MC	Const. Exit Channel MC	Natural Ground MC			
			1	3			
(record 4)		Label RD	Const. Exit Channel RD	Natural Ground RD			
			1	1			
(record 5)		Label D75	Const. Exit Channel D75*				
			.008				
ENDTABLE	(use if record 5 is omitted)						

select one

* Conversion millimeters to inches: Divide mm by 25.4

ASINLET

ASINLET—Defines the auxiliary spillway inlet channel profile template. The inlet channel includes the level crest length. ASINLET replaces the old (prior to 1994) control word ESPROFILE, but the latter can still be used for option 1. For program defined inlet templates (numbers 1–29 in table 4–3) ASINLET is not required.

ASINLET has two options: in one you can define a floating inlet template and the other a fixed point that may or may not have a program defined inlet template.

Notes:
1. The ASINLET control word provides template data for all the available water surface profile procedures (WSPVRT, frictionless side slope, and TRAPW). WSPVRT also requires a user defined exit channel (see ASDATA and ASEXIT).
2. Use ASINSURF or ASDATA with ASINLET to describe the surface conditions in the inlet channel. Pair ASINLET with ASEXIT or the ASDATA exit slope to describe the complete profile of the floating auxiliary spillway template.

Option 1

Option 1–User defined inlet template: A user defined spillway profile inlet table that has a profile reference number 41–50. This option corresponds to the use of ESPROFILE in pre-1994 versions of the program.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Profile reference number	Ie	The profile reference number must be from 41 to 50. You may define and store a maximum of 9 profiles at one time. This profile reference number must match the number in col. 11–12 of the ASDATA record for retrieval.
Col. 21–60 by 10 col. fields	Distances and depths in feet	Ne	Distance-depth pairs of the centerline profile template in the order: distance for point 2, depth for point 2, distance for point 3, depth for point 3. See figure 4–4.
Data Records (2 and 3)			
Col. 21–60 10 col. fields	Distances and depths in feet	N	Same as Data Record 1 except data are for points 4 and 5 and points 6 and 7, if needed. End input with an ENDTABLE record.

Notes (continued):
3. You may describe the inlet profile template with a minimum of two or a maximum of seven distance-depth pairs. The program sets the first point at the downstream end of the level section with the distance-depth pair (0,0). Define

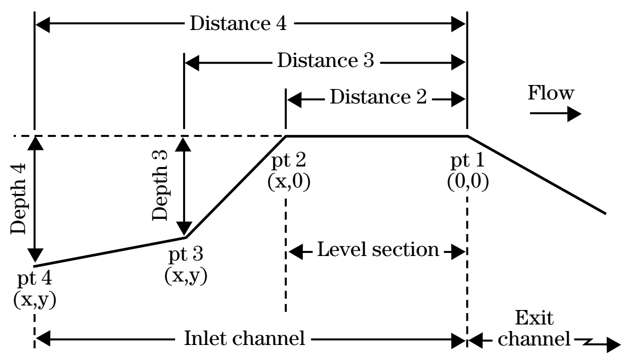
ASINLET (continued)

the remainder of the points by distance upstream from the downstream end of the spillway level section and the corresponding depth below the crest.

4. Point 1 (0,0) in figure 4–4 will correspond to the tie-in station (col. 14–20 of ASDATA).
5. End the profile template with an ENDTABLE record.
6. The old data entry format using the control word ESPROFILE utilizes the same form of profile entry except that the control word is repeated for each record and an ENDTABLE record is not used. Old data sets using this form will still be interpreted properly.
7. The user may use ASINLET Option 1, followed by ASINLET Option 2 to describe a spillway. The order Option 1–Option 2 must be followed.

Figure 4–4 illustrates an auxiliary spillway inlet profile defined by four points. Points 2, 3, and 4 require two data records.

Figure 4–4 Option 1: Auxiliary spillway inlet profile



Example 4–6 ASINLET (option 1)—The ASINLET from sample job 1 uses three points to define the inlet-defined profile reference number 41. This user defined inlet template ties into data in the ASCOORD tables at station 450, given in columns 14–20 of ASDATA.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Reference No 41 – 50	AS profile coordinates in feet (up to 3 records) Distance Pts. 2,4,6	Depth Pts. 2,4,6	Distance Pts. 3,5,7	Depth Pts. 3,5,7		Record Identification
ASINLET							
ENDTABLE							

ASINLET	41	0.0	0.0	50.	0.0		
		1000	10				
—		—	—	—	—		
ENDTABLE							

ASINLET (continued)

Option 2

Option 2—Inlet template passing through fixed coordinate point. This option may be used alone with the crest length specified on this record, or in combination with another spillway template.

Data field	Value	Type	Description
Col. 11–20	Profile reference number	Ie	A profile reference number from 1 to 29 or from 41 to 50. This number must correspond to that on the ASDATA and related records. Do not use profile reference number 30.

Notes (continued):

8. When option 2 is used alone (fixed point with crest length specified), use a profile reference number in the range 41–50.
9. When this option is used in combination with a user defined inlet template (option 1, reference number 41–50), the records defining the template must appear ahead of this record with the fixed point and the template must end with an ENDTABLE record.

Data field	Value	Type	Description
Col. 21–30	Station of fixed inlet coordinate	N	Station in feet for fixed point used to determine inlet channel slope. Use the ASCOORD stationing system.
Col. 31–40	Elevation of fixed inlet coordinate	N	Elevation in feet for fixed point used to determine inlet channel slope.

Notes (continued):

10. For the program to use the fixed inlet coordinate during computations, the specified fixed point must be lower than the spillway crest elevation and upstream of the upstream end of the crest section.
11. The fixed point determines the most upstream slope of the inlet template. When used in combination with a multiple slope inlet template (option 1 or profile reference numbers 1–29), the profile connects the fixed point to the nearest point on the template that is both above and downstream of the fixed point (fig. 4–5).

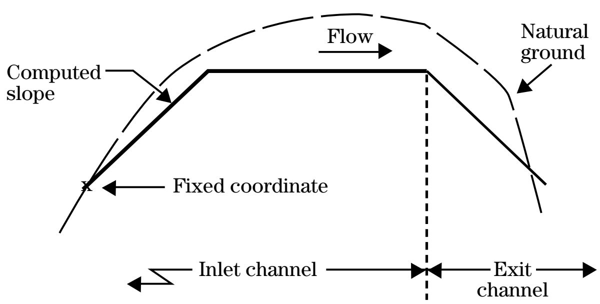
Data field	Value	Type	Description
Col. 41–50	Length AS crest (ft)	N	Program uses length of AS crest in feet when profile reference number is 41–50. The default length is 30 feet (TR–60). Leave blank if option 2 is used in combination with an inlet template.

Notes (continued):

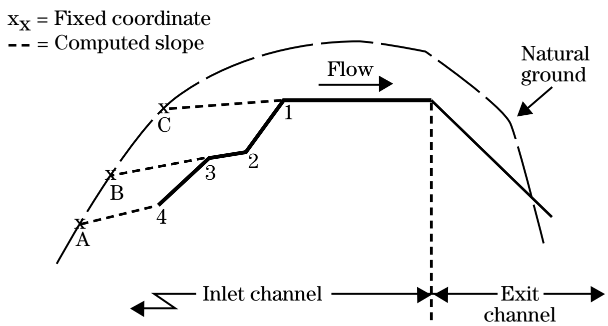
12. Use the fixed point to avoid excavating rock or other erosion resistant material. The fixed point may be anywhere on the desired inlet slope or its projection.
13. No ENDTABLE record is required with option 2.

Figure 4–5 Auxiliary spillway inlet profiles with the fixed point option

Option 2: Alternative 1, auxiliary spillway inlet profile and fixed coordinate, one slope upstream of level crest section.



Option 2: Alternative 2, auxiliary inlet channel profile and fixed coordinate, multiple slopes for inlet channel with x_A, x_B, x_C, possible fixed coordinate locations.



Example 4–7 ASINLET (Option 2, Alternative 1)—The ASINLET control word from sample job 5 with profile reference number 41 locates the fixed point (100, 603) for a single inlet slope. The user provides an inlet template so col. 41–50 are blank.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word	Reference No 1 – 29 41 – 50	X Station, ft Fixed Point	Y Elevation, ft Fixed Point	Length, ft AS Crest			Record Identification
ASINLET							
ASINLET	41	100	603				

ASINSURF

ASINSURF—Describes the vegetal retardance curve index (flow resistance) surface parameter for the auxiliary spillway inlet channel and the natural ground upstream of the entrance of the inlet channel. The inlet channel includes the level crest. Use only with the ASINLET or ASDATA control words.

Data field	Value	Type	Description
Col. 11–20	Profile reference number	Ie	Profile reference number (1–29 or 41–50). This number must match that on ASDATA and ASINLET, ASEXIT, or ASRATING if used. See table 4–3 for program defined profile reference numbers.
Col. 21–30	Label CI or N	A	Label CI for Vegetal Retardance Curve Index (C_I) or N for Manning's "n," whichever is given in columns 31–50.
Col. 31–40	C_I or "n"	N	Value of C_I or "n" for the designed constructed inlet channel. See AH 667 and note 1. Options: • If value is <1, the program accepts the value as Manning's "n." • If value is ≥1, the program accepts the value as C_I. • Leave blank if entered on ASDATA as retardance in col. 13 or C_I or "n" in col. 31–40.
Col. 41–50	C_I or "n"	N	Value of C_I or "n" for the natural ground upstream of the inlet channel. See option descriptions for col. 31–40.

Notes:

1. The program needs C_I or "n" values in the inlet channel for rating curve development and integrity analyses in the level crest. To simplify NHCP–378 structures, enter C_I or "n" in ASDATA (col. 31–40) when an integrity analysis is not needed. For small 378 sites represent the entire spillway by the retardance relation on ASDATA (col. 13). See ASDATA, note 5. If you enter no C_I or "n" value, the program uses the default "n" value of 0.04.

ASINSURF (continued)

Data field	Value	Type	Description
Col. 51–60	Switch to generate tables	I	Switch for program to generate ASSPRFL and ASSURFACE tables from present pass for input in future runs. **0 or blank**: no tables generated (default) **1**: generate new tables

Notes (continued):

2. The break between the designed constructed inlet channel and the natural ground is at the intersection of the inlet channel with the natural ground defined by the ASCOORD tables.
3. When using ASSPRFL or a Y on the first ASCOORD table, use the ASSURFACE table to enter surface condition data. The ASSURFACE or ASINSURF and ASEXSURF forms of entry are mutually exclusive. Stability and integrity analyses allow entry of surface conditions by only one of these forms at a time in a pass. See ASDATA note 5 for hierarchy.
4. If you request ASSPRFL and ASSURFACE tables, the program writes them, along with an associated ASDATA and comments, to a file named with the base name of the standard output file and the extension .DSP. Multiple tables may be generated during a run. You must extract the appropriate tables from the file, modify them as desired, and replace ASINLET, ASEXIT, ASINSURF, ASEXSURF and ASDATA in the original data file. The program will overwrite the output .DSP file in subsequent runs with the same base output file name.
5. An ENDTABLE is not required.

Example 4–8 ASINSURF—This ASINSURF control word for sample job 1 gives the C_I values for the inlet channel.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Profile Reference No.	Label "n" or C_I	Const. Inlet Channel "n" or C_I	Natural Ground "n" or C_I	Switch for Tables ASSPRFL & ASSURFACE	Reserved	Record Identification
ASINSURF							

ASINSURF	41		4.9	4.9			

ASMATERIAL

ASMATERIAL—Table for describing materials defined in the ASCOORD tables with each material being one record in the table. Also provides for additional materials for (1) topsoil fill and for (2) general fill material if different from other defined materials. Do not use these additional materials when the surface defines an existing auxiliary spillway profile.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Topsoil fill material number	I	The topsoil fill material number may be the same as one of the ASCOORD material numbers. If the topsoil fill material is not identified in the ASCOORD tables as an in-place material, make it material number 11 for the purpose of entering the topsoil fill material parameters in the ASMATERIAL table. If you do not enter parameters and specify a nonzero topsoil depth, the program uses default parameters (see note 5).
Col. 21–30	General fill material number	I	The general fill material number may be the same as one of the ASCOORD material numbers. If the fill material is not identified as an in-place material in the ASCOORD tables, make it material 12 for the purpose of entering the fill material parameters in the ASMATERIAL table. The default, if blank, is material 1.
Col. 31–40	Blank	–	Reserved for future use.
Col. 41–70	User label	A	Identifies materials described in the table by location or any other data that you may find useful.
Data Records 2–13			
Col. 11–20	Material number	Ie	The material number (1–10) cross-references materials between the ASCOORD table and the ASMATERIAL table. The material number may also be 11 for topsoil fill and 12 for general fill material.

ASMATERIAL (continued)

Data field	Value	Type	Description
	Notes: 1. Material numbers must correspond to each ASCOORD table material number. ASCOORD associated material numbers are integers from 1 to 10.		
Col. 21–30	Plasticity Index I_w	N	Plasticity index of the material, assumed typical of entire layer. Use for soils only.
Col. 31–40	Representative diameter d_{75}	Ne	Representative diameter of material in inches. (Conversion millimeters to inches: mm/25.4 = inches.)
Col. 41–50	Percent clay or	N	Percent clay of the material (less than .00008 inches or .002 mm); use for soil only.
	Detachment Rate Coef	–N	Detachment rate coefficient (ft/hr)/(lb/ft^2) preceded by a minus sign.
Col. 51–60	Dry bulk density γ_d	Ne	Dry bulk density of the material in lb/ft^3. (Conversion gm/cc to #/ft^3: 62.428 x gm/cc = #/ft^3)
Col. 61–70	Headcut Index K_h	Ne	Headcut erodibility index for the material.

Notes (continued):

2. If considered in design, enter the topsoil fill number in col. 11–20 of the header record. If the topsoil fill material, for example, is the same as material 1, enter 1 in col. 11–20. Define the topsoil depth in ASSPRFL or ASEXIT control record.
3. If allowing general fill (design auxiliary spillway surface is above the natural ground surface), enter the fill material number in col. 21–30 of the header record. The number may be one of the ASCOORD material numbers (1–10). If it is an additional material, number it 12 and enter the fill material parameters in the ASMATERIAL table. If left blank, the program will use material 1 as default.

Data field	Value	Type	Description

ASMATERIAL (continued)

4. The program gives a warning or error if a given parameter is outside the following ranges:
   I_w : cohesive materials, $0 < I_w \leq 1000$
   noncohesive materials and rock, $I_w = 0$
   d_{75} : all soils, $0 < d_{75} < 12$;
   rock, $d_{75} < \infty$
   % clay (less than .00008 inches or .002 mm):
   all soils, 0% < % clay <100%;
   rock and sand, % clay = 0
   γ_d : all soils, $75 \leq \gamma_d \leq 135$;
   rock, $120 \leq \gamma_d \leq 350$
   K_h : all soils, $0.001 \leq K_h < 10$
   rock, $K_h \leq 100{,}000$

5. If you do not input topsoil fill material parameters, the program assumes the following default values:
   I_w = 0.0, equivalent to nonplastic sand
   d_{75} = 0.05 inches
   % clay = 0.0, equivalent to nonplastic sand
   γ_d = 100 #/ft^3
   K_h = 0.05

6. The table must end with an ENDTABLE record.

Example 4–9 ASMATERIAL—The ASMATERIAL table from sample job 5 describes the physical parameters for each of the four materials located by the ASCOORD tables in the data set.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY MATERIAL

2-95

STRUCTURE ID ____ PREPARED BY ____ DATE ____ PAGE ____
JOB ____ CHECKED BY ____ DATE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Topsoil Fill Material No.	General Fill Material No.		User Label			Record Identification
ASMATERIAL	1						
Control Word	Material No.	Plasticity Index	Rep. Diameter in *	Percent Clay or - Det. Rate Coef.	Dry Bulk Density #/cf **	Head Cut Index	Record Identification
(maximum of 12 data records)	1	12	.008	20	110	.07	
	2	0	2	0	120	.4	
	3	0	7	0	130	7	
	4	0	18	0	160	200	
ENDTABLE							

* Conversion millimeters to inches: mm/25.4 = inches
** Conversion gm/cc to #/cf: 62.428 x gm/cc = #/ft^3

ASSPRFL

ASSPRFL—Table of coordinates for the total auxiliary spillway profile (inlet, crest, and exit). If ASCOORD does not define the spillway surface, use ASSPRFL to define more complex spillway surfaces after the auxiliary spillway configuration and location have been tentatively established. The ASSURFACE table is required for defining surface parameters when using ASSPRFL to define coordinates. Stationing and elevation have the same base as ASCOORD tables.

Data field	Value	Type	Description
Data Record 1			
Col. 11–12	Profile reference number	Ie	Reference number between 41 and 50 for an auxiliary spillway bottom profile. This number must match that on ASDATA and ASSURFACE.
Col. 21–30	Topsoil fill depth (ft)	N	Auxiliary spillway topsoil fill depth in feet. Default is 0.0.
Col. 31–40	Blank	–	–
Col. 41–70	User label	A	Label for identification of spillway profile.

Notes:
1. When using ASSPRFL with a topsoil fill depth greater than 0.0, the program assumes topsoil from the inlet to the end of the constructed exit channel station given on ASSURFACE.

Data field	Value	Type	Description
Data Records 2–8			
Col. 11–70 by 10 col. fields	X and Y co–ordinate pairs	Ne (–)	Coordinates (X, Y pairs in order) for station and elevation of the auxiliary spillway profile. Stations increase from left to right in downstream direction. Use only as many pairs as are needed to describe the entire spillway surface, with a maximum of 21 points (seven records). The last record may contain less than 3 points.

Notes (continued):
2. Describe the entire spillway profile from the upstream end of the inlet to valley floor. The program will compute areas of fill and/or cut from the ASCOORD surface to the ASSPRFL surface.
3. The program can generate ASSPRFL and ASSURFACE tables for use in future runs when you tentatively establish the location of the spillway surface using ASINLET and ASEXIT templates. (see ASINSURF, col. 51–60).

ASSPRFL (continued)

Data field	Value	Type	Description

4. Use of ASSPRFL implies an N entry in ASCOORD (col. 31– 40) and use of ASSURFACE to describe spillway surface conditions. Because you enter the spillway profile in coordinates having the same origin as used in ASCOORD, a tie station entry on ASDATA is not required.
5. An ASSPRFL defined exit channel slope overrides an ASDATA exit channel slope.
6. An ASSPRFL defined inlet channel profile overrides ASDATA inlet information.
7. Do not use ASINLET and ASEXIT with ASSPRFL.
8. The ASSPRFL table must terminate with an ENDTABLE.

Example 4–10 ASSPRFL—This ASSPRFL table is from sample job 6. The table gives the coordinates for the fixed auxiliary spillway surface.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY SURFACE PROFILE

2-95

STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Profile Reference No. 41–50	Topsoil Fill Depth, ft		User Label			Record Identification
ASSPRFL	41	1					
Control Word	Enter successive coordinates left to right						Record Identification
	Station–feet	Elevation–feet	Station–feet	Elevation–feet	Station–feet	Elevation–feet	
(maximum of 7 data records)	0.0	595.00	100.0	603.00	155.9	605.79	
	400.0	608.36	450.0	608.36	604.0	601.00	
	777.0	596.92	800.0	595.70	900.0	590.00	
	950.0	585.00					
ENDTABLE							

ASSURFACE

ASSURFACE—Table for describing the surface conditions of the auxiliary spillway profile from the inlet to valley floor by reaches using x coordinates. Use ASSURFACE in conjunction with ASSPRFL or with an existing auxiliary spillway (Y in col. 31 on the first ASCOORD table, see note 2). Each record in the table describes a continuous "reach" of the spillway with constant surface conditions (see note 1).

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Profile reference number	Ie	Reference number between 41 and 50 for an auxiliary spillway channel bottom profile. This number must match that on ASDATA and ASSPRFL if used.
Col. 21–30	D/S End constructed exit channel station	Ne	Station in feet at the downstream end of constructed exit channel. Use the ASCOORD stationing system. The program analyzes stability for reaches between the crest and this station.
Col. 31–40	Diameter surface material d_{75}	N	Representative diameter (d_{75}) in inches for the auxiliary spillway surface material. Used in stability analysis when d_{75} is a coarse material greater than 0.05 inch in diameter. Conversion millimeters to inches: mm/25.4 = inches.
Col. 51–70	User label	A	Label for identification of surface data.
Data Records 2–21	(First enter the most upstream reach. Enter the last reach as one which extends to the valley floor.)		
Col. 11–20	Beginning of reach station	Ne	The station (x coordinate) in feet at the start of the reach.
Col. 21–30	Ending of reach station	N	The station in feet at the end of the reach. The default for the last reach is the last downstream coordinate.

ASSURFACE (continued)

Data field	Value	Type	Description

Notes:

1. Reaches start at the upper end of the surface defined by ASCOORD. Successive reaches continue downstream to the valley floor. Reaches may include all or parts of the constructed inlet channel, the constructed exit channel, and/or the natural ground along the flow path. Individual reaches do not have to match those defined by the spillway profile coordinates. The stationing system is that used with ASCOORD and ASSPRFL.
2. The program requires at least 1 reach and allows a maximum of 20 reaches. Use only the number of reaches required to describe variations in surface conditions. The required total number of ASSURFACE reaches depends on the uniformity of surface conditions through the auxiliary spillway and on the natural surface along the flow path.
3. See figure 4–7 for example reach designations.

Data field	Value	Type	Description
Col. 31–40	Vegetal Retardance Curve Index (C_I) or Manning's "n"	N	Vegetal Retardance Curve Index (C_I) or Manning's "n" for the reach. If less than 1, the program assumes the value is a Manning's "n" value and if greater than or equal to 1, the program assumes the value is a retardance curve index.

Notes (continued):

4. If C_I is zero or blank, the program uses the constant "n" or C_I values for the inlet and exit channels from ASDATA if given. You may enter flow resistance for small 378 sites for the entire spillway by the retardance class on ASDATA (see ASDATA, note 5 for hierarchy). If you enter no C_I or "n" value, the default n is 0.04.

Data field	Value	Type	Description
Col. 41–50	Vegetal Cover factor (C_F)	N	Vegetal cover factor (C_F) for the reach: $0.0 \leq C_F \leq 0.9$. Default is zero for nonvegetated surfaces. See AH 667.

Notes (continued):

5. The vegetal cover factor (C_F) impacts results only when using a maintenance code of one.

ASSURFACE (continued)

Data field	Value	Type	Description
Col. 51–60	Maintenance code (MC)	I	Maintenance code (MC) for the reach. Enter as integer with MC = 1, 2, or 3 where: **1** = good maintenance, uniform cover conditions **2** = average maintenance, minor discontinuities perpendicular to flow **3** = poor maintenance, major discontinuities parallel to flow Default value is 3.

Notes (continued):

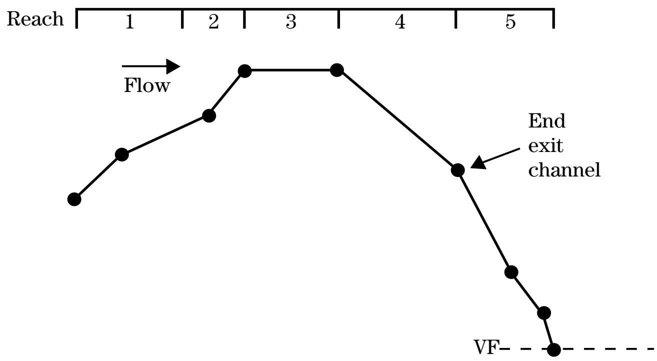
6. When performing integrity calculations with GO,DESIGN, the program uses a minimum MC of 2 as a design default. You may override this design default for simulation runs using the MC switch (col. 41–50) on GO,HYD or GO,STORM. When doing stability analyses with GO,DESIGN, the program uses the actual input MC value of 1, 2, or 3.

Data field	Value	Type	Description
Col. 61–70	Potential rooting depth	N	The potential rooting depth in feet. Program uses this entry to determine if stripping of the vegetation occurs.

Notes (continued):

7. The protective value of vegetation is sensitive to rooting depths less than approximately 1 foot because of sod stripping. When rooting depths exceed about 1.5 feet, variation in rooting depth will have only minor impact on stability and integrity results.
8. If you enter Manning's "n" and C_F = 0, the program assumes nonvegetated conditions and provides warnings accordingly. The rooting depth field should be left blank for nonvegetated reaches.
9. ASSURFACE implies either Y on ASCOORD or use of ASSPRFL. When using ASINLET, ASEXIT, or both, enter surface information through ASINSURF and ASEXSURF. These forms of surface condition data entry are mutually exclusive. Stability and integrity analyses allow entry of surface conditions by only one of these forms at a time in a pass. See ASDATA note 5 for hierarchy of data entry.
10. The program can generate the ASSURFACE and ASSPRFL tables when you tentatively establish the location of the surface using a floating spillway template defined by ASDATA, ASINLET, and ASEXIT (see ASINSURF, col. 51–60).
11. The table must end with an ENDTABLE record.

Figure 4–6 Example of reach configuration



Example 4–11 ASSURFACE—This ASSURFACE table from sample job 3 describes the surface of an existing auxiliary spillway defined in the ASCOORD tables.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY SURFACE 2-95

STRUCTURE ID ________ PREPARED BY ________ DATE ________ PAGE ________
JOB ________ CHECKED BY ________ DATE ________ OF ________

1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Control Word	Profile Reference No. 41–50	D/S End Exit Channel Station – ft	D_{75} Surface Material in	Reserved	User Label		Record Identification
ASSURFACE	41	808	0.008				
Control Word	Reach Begin Station ft	Reach End Station ft	C_I	C_F	MC	Rooting Depth ft	Record Identification
(maximum of 20 data records)	0	450	4.9	0.9	1	1	
	450	808	5.6	0.9	1	1	
	808	950	5.6	0.9	3	1	
ENDTABLE							

BASEFLOW

BASEFLOW—Control word to enter baseflow values used with NRCS design hydrographs (GO,DESIGN) when routing the principal spillway hydrograph. Once entered, the program uses these values with the principal, stability design, and freeboard hydrographs. Figure 4–7 illustrates how constant baseflow may be used in relation to quick return flow (QRF).

Data field	Value	Type	Description
Col. 11–20	Initial elev.	N	An initial elevation if routing is to start higher than the total sediment storage elevation. Initial elevations may account for "significant baseflow" (as defined in TR–60) or the water surface level of a previous storm event. The initial elevation should be below the crest of the auxiliary spillway for consistent results.

Notes:
1. The elevation to start routing the stability design and freeboard hydrographs may also be controlled by the elevation reached after the design drawdown time or, when the PSH is not routed, by the start routing elevation (col. 61–70) on GO,DESIGN.
2. For an upper site in series, the initial elevation may be a 10-day drawdown elevation from a previous design run on the site.

Data field	Value	Type	Description
Col. 21–30	Constant baseflow	N	Baseflow in csm that is added to the base of each hydrograph (see note 3 and fig. 4–1). The baseflow should not exceed the maximum outflow capacity of the principal spillway at the crest of the auxiliary spillway.

Notes (continued):
3. When a hydrograph is developed from rainfall (PDIRECT or P100,PMP), the program adds the baseflow to the base of the entire hydrograph. When developed from runoff (QDIRECT), the program increases all hydrograph discharge values less than baseflow to baseflow. In both cases, the recession or tail of the PSH may be controlled by the QRF csm (see WSDATA) if higher than baseflow. In the computation of drawdown time or remaining storage, the elevation sustained by constant baseflow is the base elevation in the flood pool where computations stop.

BASEFLOW (continued)

Data field	Value	Type	Description

Notes (continued):

4. The initial elevation (col. 11–20) is not associated with the constant baseflow. When a hydrograph containing baseflow is storage routed, the pool elevation will immediately rise to the constant baseflow (outflow) elevation. Because the initial elevation is a starting elevation for routing, if it is higher than the associated outflow elevation for a constant baseflow, the pool elevation will drop until inflow equals outflow. If the initial elevation is lower than the baseflow elevation, it is ignored.
5. The program interpolates the constant baseflow discharge and the discharge associated with the starting elevation from the principal spillway rating before the routing of the design principal spillway hydrograph. If the discharges are actually above the auxiliary spillway crest, the program uses the combined (PS & AS) rating for the other design hydrographs. Use the plot option to understand and verify the operation of these baseflow values in complex situations.
6. An entry of baseflow on the STORM record will override an entry of baseflow from the BASEFLOW record.

Data field	Value	Type	Description
Col. 31–40	Initial volume below PS crest	N	Volume in acre-feet below the crest of the principal spillway, used to establish a pre-storm starting level. The program subtracts the initial or extra volume from the inflow hydrograph before flood routing.

Notes (continued):

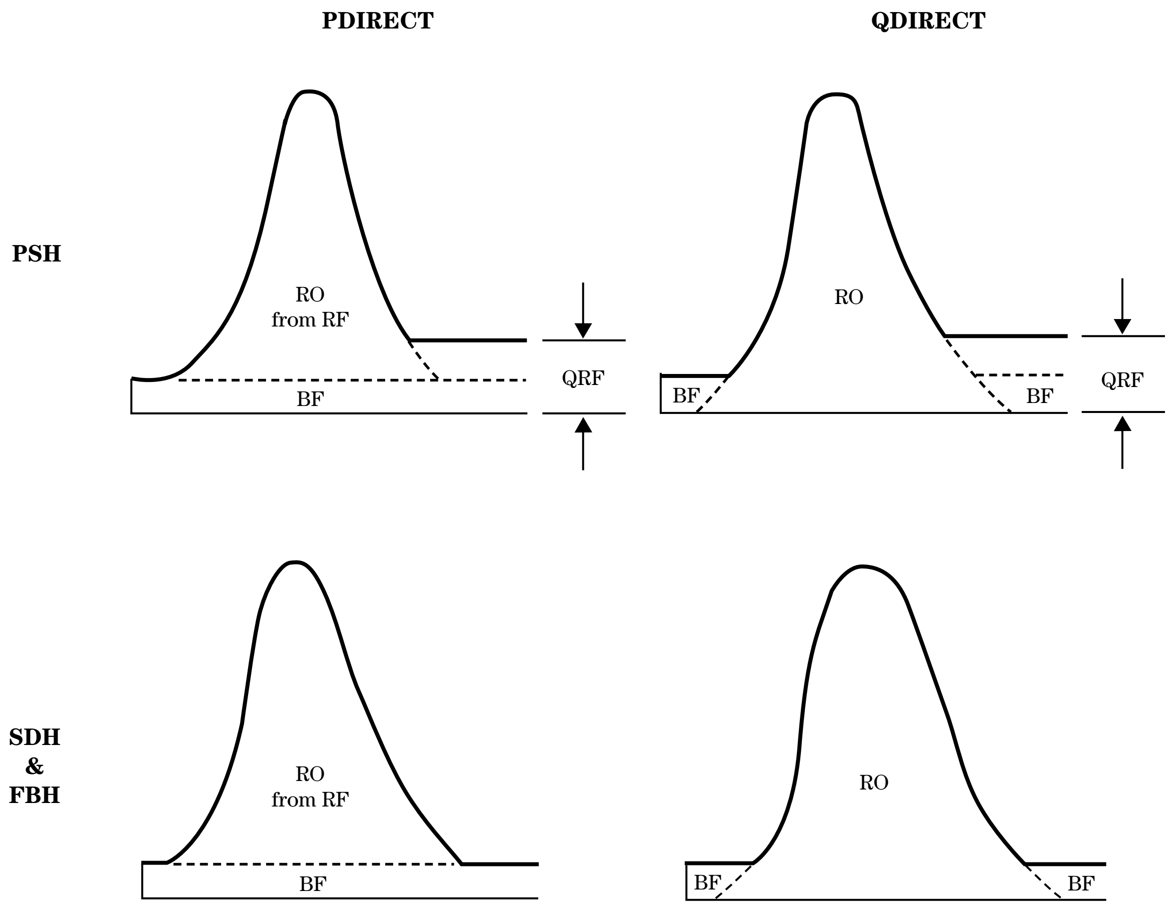
7. The actual volume subtracted from the inflow hydrograph is usually less than the initial volume requested. The program sums the hydrograph volume by time increments until the initial volume is equaled or exceeded. When the initial volume is exceeded, the actual volume subtracted is that at the preceding time increment.

Example 4–12 BASEFLOW—This BASEFLOW record instructs the program to add a constant baseflow of 2 csm to the base of the uncontrolled area design hydrographs and to start routings at the initial elevation of 281.5 feet at the lower site (Site C) in sample job 10.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Initial Elevation Feet	Baseflow csm	Initial Volume Below PS Crest Acre – Feet				Record Identification
BASEFLOW							

BASEFLOW	281.5	2.0					

Figure 4–7 Inflow design hydrographs with baseflow and QRF



BTMWIDTH

BTMWIDTH—Allows you to specify auxiliary spillway bottom widths, exit channel velocities, or effective tractive stress values considered for a run. The program requires a BTMWIDTH control word whenever routing through an auxiliary spillway.

Data field	Value	Type	Description
Col. 11–20	Units	Ae	Indicates the type of data in col 21–70. Insert the word: FEET–for option (1) below, VELOCITY–for option (2), or STRESS – for option (3).
Col. 21–70 by 10 col. fields	BW or exit velocity or effective tractive stress	Ne	Options (the program requires a value in col. 21–30): 1 The bottom width in feet of the auxiliary spillway. 2 The maximum allowable velocity in feet per second in the AS exit channel during passage of the SDH storm. The program will determine the associated bottom width. (See BWDATA for parameters.) 3 The effective tractive stress (lb/ft^2) in the AS exit channel during passage of the SDH storm. The program will determine the associated bottom width. (See BWDATA for parameters.)

Notes:

1. For a GO,DESIGN run, you may mix the above options by entering additional BTMWIDTH records with the appropriate words in col. 11–20. The BTMWIDTH records must be consecutive in the data set. A maximum of three BTMWIDTH records may be specified for each pass.
2. For GO,STORM, GO,RAINS, or GO,HYD, the program allows only one BTMWIDTH record with up to five values of bottom width per pass. The program does not permit exit velocity or effective tractive stress options.
3. The program does not permit exit channel velocity and effective tractive stress options for NHCP–378 runs with subcritical flow (profile reference number 30 with retardance given).
4. The program allows only one bottom width with an upper site(s). It must be in feet and entered in col. 21–30. The program does not allow the velocity option or the effective tractive stress option for an upper site(s).

BTMWIDTH (continued)

Data field	Value	Type	Description

Notes: (continued)

5. When using the exit velocity or effective tractive stress options, the precision controls on the BWDATA control word dictate the number of bottom width iterations.
6. The program will accept effective stress values from a minimum of 0.01 pound per square foot to a maximum of 15 pounds per square foot. Typical values for soil materials range from 0.02 to 0.05 pound per square foot. Aids for determining effective stress may be found in USDA Agriculture Handbook 667. A warning is given if the values are greater than 0.5 pound per square foot or if d_{75} (surface material particle diameter in inches) is used and the values are greater than 0.6 times d_{75}. This limits the maximum d_{75} to 25 inches.

Example 4–13 BTMWIDTH—This example BTMWIDTH record instructs the program to use an auxiliary spillway bottom width of 100 feet for the trials in sample job 1.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Units for data in Col. 21-70	Alternate Control Section Bottom Widths, Exit Channel Velocities or Effective Tractive Stresses					Record Identification
BTMWIDTH							

BTMWIDTH	FEET	100					

CLPROFILE

CLPROFILE—Allows you to enter the coordinates of the profile along the centerline of the dam for the computation of embankment quantities.

Data field	Value	Type	Description
Data Record 1			
Col. 21–30	Adj.	N(–)	The elevation adjustment factor is an optional factor that is added to all elevations along the entered profile. If an allowance for stripping is desired, a negative value should be entered for the adjustment factor. To allow for fill, enter a positive value.
Col. 31–70	Title	A	The title or description of the profile.
Data Records 2–34			
Col. 11–70 by 10 col. fields	Coord.	N(–)	Coordinates of the centerline profile in order. Distance for point 1, elevation for point 1, distance for point 2, elevation for point 2, etc., in algebraically increasing order with respect to distance.

Notes:
1. Use only the number of data records needed; maximum is 33 records. The last record may contain less than 3 points.
2. The program requires CLPROFILE table termination using an ENDTABLE.
3. Use the CLPROFILE table only when wanting the program to calculate embankment quantities (volume of fill, etc.). CLPROFILE is not needed for runs when you are only interested in hydrologic proportioning of the site or for simulation runs on a designed or constructed dam. See TEMPLATE, STABERM, and CROWN control words for program defaults related to the cross section of the embankment used in computing quantities.
4. The program uses the low point in the CLPROFILE table to compute the effective height of dam, a factor in checking the dam classification. Enter the low point on the POOLDATA (col. 57–60) record if not using CLPROFILE.

Example 4–14 CLPROFILE—The data in this example represent the centerline profile of the dam in sample job 1, starting 1,180 feet to the negative side of center at 625 feet in elevation. The elevation adjustment factor is zero. Sample job 7 illustrates the use of a negative elevation adjustment factor of 0.5 feet.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

EMBANKMENT CENTERLINE

2-95

STRUCTURE ID ________ PREPARED BY ________ DATE ________ PAGE ________
JOB ________ CHECKED BY ________ DATE ________ OF ________

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Elevation Adjustment factor – feet	Label				Record Identification
CLPROFILE		–0	Structure 156B4, sample job 1				
Control Word	Enter successive coordinates left to right						Record Identification
	Distance–feet	Elevation–feet	Distance–feet	Elevation–feet	Distance–feet	Elevation–feet	
(maximum of 33 data records)	–1180	625	–1000	618	–750	609	
	–500	601.5	–280	595	–150	591	
	–50	589	200	588	600	589	
	620	579	670	581	690	588	
	1110	590	1360	596	1600	607	
	1870	613	2010	617			
ENDTABLE							

COMMENT or *

COMMENT or *—Causes the program to print a comment. The program prints the text at the top of a new page for each pass. The program considers any text immediately following comment lines as a continuation and prints it on the same page.

Data field	Value	Type	Description
Col. 11–70	Text	A	Text of comment to be printed.

Note:
Comments consist of any alphabetic or numeric characters. Group comments together in the input as much as possible to save on pages of output since each new group of comments will generate another page of output.

Example 4–15 COMMENT or *—All the sample jobs contain comments to explain the runs. Sample job 1 illustrates the use of comments with two passes. Each set of comments occupies a separate page of output.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Text of Comment						Record Identification
COMMENT							

COMMENT	Trial No. 1, using 36 inch pipe, single stage inlet principal	

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Text of Comment						Record Identification
*							

*	Spillway and 50 feet auxiliary spillway crest	

ENDJOB

ENDJOB—Terminates the processing of a job and prepares for the next job. Do not use ENDJOB between alternatives run on the same site. The program prints a job summary indicating the number of structures analyzed, the number of hydrographs routed, and the number of trial routings.

The ENDJOB control word also triggers a listing of the number of input errors, warnings, and messages.

Example 4–16 ENDJOB

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
ENDJOB							

ENDRUN

ENDRUN—Terminates the execution of the program after a single job or series of jobs. Use an ENDRUN control word as the last record of any DAMSITE data file.

Example 4–17 ENDRUN

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
ENDRUN							

ENDTABLE

ENDTABLE—This control word must follow the last data record of tabular data (ASCOORD, ASEXSURF, ASINLET (option 1 only), ASMATERIAL, ASSURFACE, STRUCTURE, RAINTABLE, HYD, DIMHYD, XSECTN, and CLPROFILE tables).

Example 4–18 ENDTABLE

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word							Record Identification
ENDTABLE							

9ENDTBL

9ENDTBL—This is a legacy control word and is not supported in SITES 2005. It must follow the last data record of tabular data entered by the 2XSECTN or 7READHD control words. The NRCS WSP2 program (NEH, part 630, chapter 31, 1993) generates the cross section data (2XSECTN) in the TR–20 input format. The NRCS TR–20 program generates the hydrograph data (7READHD).

Example 4–19 9ENDTBL

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word							Record Identification
9 ENDTBL							

GO,DESIGN

GO,DESIGN—Initiates a design run of the input data to this point. The program reviews the input data and checks for errors and, if it detects no fatal errors, begins computations.

Data field	Value	Type	Description
Col. 11–20	Code letter for program options	A	Code letter indicating options in addition to the program standards. Select up to 10 options; see note 1. Run control options (see note 2): **H** – Stability procedure only. **U** – Integrity procedure only. **N** – Neither stability nor integrity analysis. **Q** – Routing only, no auxiliary spillway analysis **E** – Volume of fill and other embankment quantity calculations. List options: **A** – Coefficients, parameters, dimensionless unit hydrograph, and all program default rainfall distribution tables. **C** – Same as option A except includes only the rainfall distribution used in the computational pass. **L** – Elevation-discharge-storage rating tables. Also see V. **P** – Character plot of inflow and outflow hydrographs with hydrograph and flood routing data. **V** – Auxiliary spillway surface condition parameters by reach. Automatic with L option when doing integrity or stability analysis, or both. Generate file options: **I** – File of inflow hydrograph coordinates in 10 col. fields. **O** – File of outflow hydrograph coordinates in 10 col. fields. **B** – File of hydrograph coordinates in 12 col. fields for TR–20, used in combination with options I and O.

GO,DESIGN (continued)

Data field	Value	Type	Description
			R – File of rating tables in 10 col. fields. **T** – File of rating tables in 12 col. fields for TR–20.

Notes:
1. Select nonconflicting options. For example, only select one option from the following groups: H, U, Q, or N; A or C; L or V.
2. Unless you enter an H, U, Q, or N in columns 11–20, the program uses both the stability and integrity procedures.
3. For null structures (Site Type = 1 in col. 16 of WSDATA control), only the C and inflow hydrograph (I and B) program options apply.
4. The Q option should be used only when the auxiliary spillway rating is given in the structure table.

Data field	Value	Type	Description
Col. 21–25	AS raintable ID	A	Enter the identification (ID) name of the rainfall distribution to be used for SDH and FBH development. The ID must be identical to that in col. 11–15 of RAINTABLE for retrieval if the distribution is not loaded in the program. See note 6.
Col. 26–30	Multiple design pass switch	A	Enter M if the program is to make multiple design passes at a lower site in a system of structures or subareas. The program will save the total accumulated hydrograph for the next GO,DESIGN or GO,STORM pass at the lower site.
Col. 31–40	AS rainfall duration	N	The rainfall duration in hours (24 or greater) used in SDH and FBH development. Required if col. 21–30 of RAINTABLE is blank or 1 (see note 7). Default is 6 hours if col. 21–25 of GO,DESIGN is blank if the DAMSITE routine is used without the IDE. The IDE uses 24 hours as its default.
Col. 41–45	PS raintable ID	A	Leave blank to use the standard NRCS 10-day PSH storm distribution or enter the identification (ID) name of the rainfall distribution to be used for PSH development if different from the 10-day distribution. Must be identical to col. 11–15 of RAINTABLE for retrieval. See note 6.

GO,DESIGN (continued)

Data field	Value	Type	Description
Col. 46–50	NHCP–378 switch	I	Enter number **378** to initialize criteria for use with small dams. Enter the standard NRCS 24-hour storm distribution of appropriate type by the RAINTABLE control word. For exceptions, see note 6. Use of the ASFILE (pre-computed auxiliary spillway rating for subcritical flows) is optional.

Notes: (continued)

5. Apply NHCP–378 criteria only to sites with A1 or S class codes. See section 520.20 to .24, NRCS Engineering Manual, for discussion of structure design classes. Enter the design class code in col. 12–13 of the WSDATA control word.
6. The program contains the standard NRCS 24-hour, type I, IA, II, and III storm distributions. Their use requires no RAINTABLE and is directed by using TYPE1, TP–1A, TYPE2, or TYPE3 in RAINTABLE ID fields (col. 21–25 and/or col. 41–45). The NRCS 6-hour distribution is also contained in the program and is the default if the RAINTABLE ID fields are left blank.

Data field	Value	Type	Description
Col. 51–60	PS rainfall duration	N	The rainfall duration in hours used in PSH development. Required if user enters Raintable ID in col. 41–45 of GO,DESIGN. If ID is blank or not matched for retrieval, program will default to the standard NRCS PSH 10-day distribution.

Notes: (continued)

7. Default is duration from GO,DESIGN if RAINTABLE duration is blank or one (1). If RAINTABLE duration is greater than one (1), the RAINTABLE duration overrides the GO,DESIGN duration.

Data field	Value	Type	Description
Col. 61–70	Elev. start routing (PSH (not routed)	N	The water surface elevation in feet at the start of rainfall when the PSH is not routed. If left blank for single sites and the PSH is not routed, SDH and FBH routings will normally default to a routing start at the maximum elevation determined from the crest elevation on the POOLDATA control word, or sediment elevation on the POOLDATA control word, or the elevation associated with the baseflow. This col. 61–70 entry is required for upper sites in a system of structures when the PSH is not routed. This entry is also required for single-site 378 runs when the PSH is not routed. It is good practice to enter

Data field	Value	Type	Description
			the proper start elevation in col. 61–70 when **not** routing the PSH. Leave blank if the PSH is routed.

GO,DESIGN (continued)

Notes: (continued)

8. Use GO,DESIGN also to enter single or multiple design hydrographs loaded by the HYD control word into a single site or system of structures or subareas. A given design hydrograph will override the design rainfall or runoff procedure for generating that hydrograph. Thus, the rainfall/runoff data may be left blank for that hydrograph.

Example 4–20 GO,DESIGN—This GO,DESIGN, used in sample job 2, requests elevation-discharge rating tables, with neither stability or integrity analyses run (N), and uses the program defined rainfall table TYPE2 for both the principal and auxiliary spillway rainfall distributions that have a 24-hour storm duration. The NHCP–378 switch is on and the elevation at which the FBH routings will start is left blank; therefore, it is dependent on the PSH drawdown criteria. Sample job 1 illustrates more program options.

1 – 10	11 – 20	21 – 25	26 – 30	31 – 40	41 – 45	46 – 50	51 – 60	61 – 70	71 – 80
Control Word	Program Options	AS Raintable ID	Multiple Pass Switch	SDH & FBH Storm Duration Hours	PS Raintable ID	378 Criteria Switch	PSH Storm Duration Hours	Start Routing Elev. If PSH not Routed	Record Identification
GO. DESIGN									
GO. DESIGN	LN	TYPE 2		24	TYPE 2	378	24		

PDIRECT

PDIRECT—Enters the design point rainfall amounts for design runs. If areal corrections have already been applied to the rainfall, see note 2. The program makes no duration corrections to design rainfall amounts when using PDIRECT, see note 3. If entering runoff volumes for the principal spillway hydrograph, see note 4.

Data field	Value	Type	Description
Col. 11–20	C_i	N	Climatic index, see chapter 21, NEH 4. Used to determine minimum quick return flow if greater than 1.0 and transmission loss if less than 1.0 for the PSH. Area weighted values less than 0.4 may be appropriate for upstream sites. The program default is 1.0. For an NHCP–378 structure, set to 1.0 or leave blank. For upper sites or subareas in series, set C_i equal to or less than 1.0.

Notes:

1. Minimum quick return flow (table 2–4, TR–60) and transmission loss (table 21.3, chapter 21, NEH 4) procedures apply only to the design PSH and not to the SDH, FBH, or storm hydrographs.

Data field	Value	Type	Description
Col. 21–30	P_{1D}	N	The 1-day PSH point rainfall in inches. User may leave blank for NHCP–378 structures if not a part of local criteria. Also, leave blank if entering PSH runoff (see note 3).
Col. 31–40	P_{10D}	N	The 10-day PSH point rainfall in inches. Leave blank for NHCP–378 structures or if entering PSH runoff. The P_{10D} value must be equal to or greater than the P_{1D} value in the previous data field. (See note 3).
Col. 41–50	P_{SDH}	N	The SDH point rainfall in inches for the duration specified by RAINTABLE or GO,DESIGN. If you do not specify duration, the program assumes 6 hours. If the time of concentration is greater than 6 hours, you must enter the correct rainfall volume. You may leave this field blank for NHCP–378 structures if not part of local criteria.

PDIRECT (continued)

Data field	Value	Type	Description
Col. 51–60	P_{FBH} or NHCP–378 Design Storm	Ne	The FBH point rainfall in inches. The duration applicable to the SDH also applies here. This is the design storm for a NHCP–378 structure.
Col. 61–70	P100–10D	N	The 100-year, 10-day point rainfall in inches. The program uses this value to check if the 10-day curve number reduction applies (see note 10). The reduction applies if the 10-day point rainfall (col. 31–40) exceeds 6 inches, or if the 100-year, 10-day point rainfall equals or exceeds 6 inches. If both point rainfalls are less, or if the structure is an NHCP–378 structure, the program uses the 1-day input curve number without a reduction, and this field (col. 61–70) may be left blank.

Notes: (continued)

2. The program will apply NRCS standard areal corrections for Climate Area Zones 1, 2, and 3 (col. 11, WSDATA) to all PS and AS point rainfall values in col. 21 to 60 (see TR–60 chapter 2); however, it will not make corrections below 10 mi^2 of drainage area. If rainfall values already include an areal correction for Zones 1, 2, and 3, use an AREACRCT control word with Climate Zone 4 and correction factors of 1.0 to prevent further correction. When col. 11, WSDATA control word, equals 0 or blank, the program does not apply areal corrections to the P_{SDH} and P_{FBH}. The program, however, still applies correction factors to P_{1D} and P_{10D}.
3. The program makes no storm duration corrections to PDIRECT rainfall amounts when the T_c exceeds 6 hours. See TR–60/NEH 630, chapter 21 for recommended duration corrections. See the P100,PMP control word if corrections by the program are desired.
4. Use QDIRECT to enter runoff in place of precipitation for the PSH. In this case, leave PDIRECT values blank in col. 21–40 and 61–70 and include a QDIRECT control word with the applicable PSH data. Do not mix rainfall and runoff for the development of the PSH. See QDIRECT for auxiliary spillway design hydrographs (SDH and FBH) based on runoff.
5. PDIRECT, P100,PMP or QDIRECT data are relevant only for design runs, not simulation runs.
6. For a PSH only run, leave col. 41–50 and 51–60 blank.

PDIRECT (continued)

Data field	Value	Type	Description

Notes: (continued)

7. When the NHCP–378 switch (col. 46–50) of GO,DESIGN is on, enter only the design storm (FBH) rainfall. However, you may enter the PSH (P_{1D}) and SDH rainfalls if called for by state or local criteria. The NHCP–378 drawdown criteria applies to the design (FBH) storm. If you enter the PSH rainfall, the output will also include the TR–60 drawdown procedure.
8. The program adds quick return flow to the recession or tail of the combined PS hydrograph developed from PDIRECT only at the site being designed. See figure 4–7 for relationship of quick return flow to baseflow.
9. For design runs in watersheds with subareas or sites in series, make separate comparison runs of PDIRECT and QDIRECT. The program does not accept mixed runs.
10. The 10-day curve number reduction adjustment in chapter 2, TR–60, applies only when the 100-year, 10-day point rainfall equals or exceeds 6 inches and the structure does not use NHCP–378 criteria. If the 10-day PSH point rainfall (col 31–40) is greater than 6 inches, it is assumed the 100-year, 10-day point rainfall will be the same or greater, and col. 61–70 may be left blank.

Example 4–22 PDIRECT—This example PDIRECT record is input for sample job 1, a typical TR–60 design run. The structure in sample job 1 has a climatic index of 1.32. Develop the principal spillway hydrograph with 1-day rainfall of 5.8 inches and 10-day rainfall of 10.2 inches. Base the stability design hydrograph on 11.4 inches of rainfall and the freeboard hydrograph on 18.1 inches. The 100-year, 10-day rainfall is 11.0 inches, which means the 10-day runoff curve number correction applies for this significant hazard site. These are all point rainfalls. Because the site is less than 10 square miles and the climatic index is greater than 1.0, the program does not adjust the rainfall values in sample job 1.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Climate Index (378 leave Blank)	PSH 1–Day Rainfall Inches	PSH 10–Day Rainfall Inches	SDH Rainfall Inches	FBH Rainfall–inches (378 Design Storm)	100–Yr. 10–Day Rainfall–inches (378 Leave Blank)	Record Identification
PDIRECT							

PDIRECT	1.32	5.8	10.2	11.40	18.10		

POOLDATA

POOLDATA—Enters the reservoir storage pool information for a structure and minimum dam and valley floor elevations.

Data field	Value	Type	Description
Col. 11–20	Unit	Ae	Indicates the units of the data in col. 21–50. Enter the word: **ELEV**—for elevation option (1) **INCHES**—for watershed inches option (2) (see note 3 for limitations) **AC–FT—**for acre-feet option (3).
Col. 21–30	Perm. pool	N	Permanent pool: 1 Elevation in feet. 2 Volume in watershed inches. 3 Volume in acre-feet. 4 Leave blank for dry dams. This option sets the elevation of a wave action berm used in computing quantities.
Col. 31–40	Crest PS (low stage)	Ne	Crest of the principal spillway: 1 Elevation in feet. 2 Volume in watershed inches below crest. 3 Volume in acre-feet below the crest. For a two-stage riser, this is the crest of the orifice.

Notes:
1. The crest of the principal spillway must be higher than the tailwater elevation (col. 61–70 on the PSDATA control word) to avoid negative head.

Data field	Value	Type	Description
Col. 41–50	Flood pool sediment storage	N	Flood pool (aerated) sediment storage: 1 Elevation in feet to which sediment may accumulate above the PS crest during the reservoir design life, 2 Volume in watershed inches between the principal and auxiliary spillway crests allocated to sediment deposition above the PS crest. 3 Same as 2 above except volume is acre-feet. 4 Leave blank if not applicable. The flood pool sediment determines the available storage.

POOLDATA (continued)

Data field	Value	Type	Description
	Notes: (continued) 2. Program does not accept mixing of unit options 1, 2, and 3 in columns 21–50 on the POOLDATA line. 3. The INCH option only applies to the drainage area on the WSDATA control word, not total drainage area of a system of sites and subwatersheds. 4. Normally the crest of the principal spillway is at the top of the submerged sediment pool. Columns 41–50 are set up to take care of additional aerated sediment storage in the flood pool.		
Col. 51–60	Min. elev. dam C/L	N	Minimum elevation on profile along the centerline of dam. Leave blank if CLPROFILE table is entered. Used to calculate effective height of dam for checking dam classification.
Col. 61–70	Valley floor elevation	Ne	Elevation of the valley floor at the end of the auxiliary spillway exit channel or the lowest elevation at which erosion is expected to occur. Program requires this value when making integrity and stability calculations. It is also required when using the WSPVRT water surface profile procedure to develop the auxiliary spillway rating curve.
	Notes: (continued) 5. The POOLDATA record contains necessary data for structure routing with design and simulation runs.		

Example 4–23 POOLDATA—The structure in sample job 1 has the principal spillway crest and permanent pool set at 2,600 acre-feet of storage (option 3). There are 30 acre-feet of aerated sediment planned in the flood pool between the principal and auxiliary spillway crests. The low point in the dam is not given since the CLPROFILE table is input. If entered here, the low point would be 579.0. The valley floor elevation is 585.0.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Units for Data in Col. 21 – 50	Permanent Pool	Crest Principal Spillway	Flood Pool Sediment	Lowest Elevation of Profile Along Centerline Dam	Valley Floor Elevation	Record Identification
POOLDATA							
POOLDATA	AC-FT	2600	2600	30		585	

PSDATA

PSDATA—Enters principal spillway conduit hydraulic parameters used to compute a principal spillway elevation-discharge rating. Use PSDATA with a PSINLET or PSHOOD record to describe the inlet conditions. Inlet configurations should conform to standard NRCS inlet design practices. For nonstandard inlets, see note 3.

Data field	Value	Type	Description
Col. 11–20	Number conduits	N	The number of principal spillway closed conduits. Leave blank or enter zero for orifice controlled principal spillway flow for single stage culvert type installations. For the orifice to control, give the orifice size on the PSINLET record.
Col. 21–30	Conduit length	N	The length of the principal spillway conduit(s) in feet for evaluating friction losses.

Notes:
1. If you enter PSHOOD to describe a hooded inlet, the PSDATA record pertaining to that inlet configuration should have the conduit length entry blank (col. 21–30). The PSHOOD record contains length entry data.

Data field	Value	Type	Description
Col. 31–40	Dia. or width	Ne	Enter either: 1 Diameter of circular principal spillway conduit in inches or 2 Width of rectangular conduit in feet.

Notes: (continued)
2. Minimum pipe diameter is 10 inches. You may change the minimum with the MINDISCH control word.

Data field	Value	Type	Description
Col. 41–50	Conduit height	N	Enter either: 1 Blank for circular conduit or 2 Height of rectangular conduit in feet.
Col. 51–60	Conduit "n"	Ne	Manning's roughness coefficient for evaluating closed conduit friction losses. "n" must be greater than zero and equal to or less than 0.1.
Col. 61–70	HGL outlet (tailwater)	Ne	The elevation in feet of the hydraulic grade line at the principal spillway outlet. The program uses this value as a constant tailwater elevation in rating the principal spillway system.

PSDATA (continued)

Data field	Value	Type	Description

Notes: (continued)

3. PSDATA is not needed if you enter the principal spillway rating for the spillway systems in the STRUCTURE data. If both are entered, the STRUCTURE rating has precedence. The program uses PSDATA and PSINLET or PSHOOD with design and simulation runs if the rating is not given in the STRUCTURE table.
4. Program assumes free flow at the inlet, and it does not consider submerged orifice flow conditions. If this condition exists, enter the computed principal spillway rating in the STRUCTURE data.
5. Program does not use negative heads in hydraulic computations. Negative heads are usually the result of high tailwater.
6. Using PSDATA with PSHOOD limits the number of pipes to 1 in versions of the program prior to December 1999. If it is necessary to model more than one hood inlet for a structure, calculate the rating for a single hood inlet and either multiply it or add ratings to obtain a total rating. Enter the total rating as part of the STRUCTURE table.

Example 4–24 PSDATA—This example PSDATA record is for sample job 1. The principal spillway is a 36-inch diameter conduit (pipe), 250 feet long with an "n" of 0.013 and a tailwater elevation of 584.0.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Number of Conduits	Length of Conduit – feet	Diameter – inches or Box Width – feet	& Height – feet	Manning's "n" for Conduit	Hydraulic Gradient Elev. at Outlet	Record Identification
PSDATA							

PSDATA	1	250	36		0.013	584	

PSINLET

PSINLET—Enters principal spillway inlet parameters used to compute the principal spillway elevation-discharge rating for a drop inlet riser or orifice flow control at the pipe inlet. Use in conjunction with conduit data on PSDATA.

Data field	Value	Type	Description
Col. 11–20	Unit	A	Units of the high stage crest data in col. 41–50. Options: Leave blank for single stage drop inlets. Enter: **ELEV**–for elevation in feet. **INCHES**–For volume in watershed inches. The program uses the WSDATA drainage area to compute the volume in acre-feet. **AC–FT**–For volume in acre-feet.
Col. 21–30	K_e	Ne	A coefficient for evaluating total energy losses in the drop inlet to just through the entrance of the principal spillway conduit. This coefficient multiplied by the velocity head in the conduit is the inlet loss. The program does not check for orifice control at the entrance to the riser. See NRCS Design Note 8 for coefficient values. The value of K_e will usually range from 0.7 to 1.0.
Col. 31–40	Weir length	Ne	Weir length of the drop inlet principal spillway in feet. Single stage weir length, if col. 41–50 is blank. Second (high) stage weir length, if col. 41–50 has a value.

Notes:

1. NRCS recommends a minimum size drop inlet riser and weir to avoid orifice control at the inlet and to operate at minimum head without excessive surging, noise, vibration, or vortex action. The NRCS standard interior riser area is D by 3D if rectangular and about 1.5D if circular, where D is the width or diameter of the conduit. For a standard single stage open riser, the minimum weir length is about 8D minus the anti-vortex wall. The standard NRCS covered riser weir length is 6D.

PSINLET (continued)

Data field	Value	Type	Description
Col. 41–50	High stage crest options	N	The high stage crest of two stage inlets. Options (see col. 11–20 for units): • Leave blank for single stage drop inlets. • Elevation of high stage crest. • Volume floodwater detention between high and low stage crests or at sediment elevation pool if higher. • Elevation of PS crest for single stage orifice control (see note 2).
Col. 51–60	Orifice height (low stage)	N	Height options: • Leave blank for single stage inlets. • Height in feet of rectangular low stage orifice of two-stage inlet. • Height in feet for single stage orifice control (see note 2).
Col. 61–70	Orifice width (low stage)	N	Width options: • Leave blank for single stage inlets. • Total width in feet of rectangular low-stage orifice(s). • Total width in feet for single stage orifice control (see note 2).

Notes (continued):

2. For single stage orifice controlled principal spillways such as:
   - culverts–place 0 in col. 11–20 of PSDATA or leave blank and set high stage crest at the permanent pool and/or culvert invert elevation and use the orifice height and width to define the size of culvert.
   - drop inlets–place 0 in col. 11–20 of PSDATA or leave blank and set high stage crest at crest of the principal spillway and use the orifice height and width to define the size of the inlet.

   You must enter the other required information on PSDATA and PSINLET, but the program does not use it.
3. For two-stage drop inlets, the orifice height must not extend above the high stage weir crest.
4. The program does not use the PSINLET and PSDATA records if you enter the principal spillway rating in the STRUCTURE table. It uses PSINLET and PSDATA with design and simulation runs if this rating is not given in the STRUCTURE table.
5. For hood inlet computations, see PSHOOD.
6. PSCOEFFS can be used to change the default values of the orifice and weir flow coefficients, or the rectangular conduit fillet size (default 6").

Example 4–25 PSINLET—This example PSINLET record is for sample job 1. The principal spillway is single stage with an entrance loss coefficient of 1.0 and a weir length of 18 feet. Sample job 9 illustrates examples of a two-stage structure (site A) and culvert structure (site B).

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Units for High Stage Crest in Col. 41–50	Conduit Entrance Loss Coeff. K_e	Single or High Stage Drop Inlet Weir Length – feet	Crest of High Stage	Low Stage Orifice Height – feet	Low Stage Orifice Width – feet	Record Identification
PSINLET							

PSINLET		1.0	18				

QDIRECT

QDIRECT—Enters the design runoff amounts that include any baseflow and may include subsurface discharge and snow or ice melt at the site for design runs. The program develops the runoff distribution for the 10-day principal spillway hydrograph used for TR–60 structures. You must enter all other duration runoff distributions using the RAINTABLE control word (see note 8 under RAINTABLE).

Data field	**Value**	**Type**	**Description**
Col. 21–30	Q_{1D}	Ne	The 1-day PSH design runoff in inches for TR–60 structures, used in developing the 10-day runoff distribution. For an NHCP–378 structure, the PSH raintable distribution ID on GO,DESIGN should be for the distribution of runoff.
Col. 31–40	Q_{10D}	Ne	The 10-day PSH design runoff in inches. Leave blank if col. 21–30 is used for NHCP–378 structures.

Notes:

1. The 10-day PSH storm distribution used in design of a TR–60 criteria structure is a program defined runoff distribution based on the Q_{1D} and Q_{10D} runoff amounts. The NRCS 24-hour design storm distributions (Type 2, etc.) are based on rainfall data. In practice, these 1-day distributions are generally assumed to be adequate for NHCP–378 designs using runoff with a curve number of 100.

Data field	**Value**	**Type**	**Description**
Col. 41–50	Q_{SDH}	N	The SDH design runoff in inches for the duration specified by RAINTABLE and GO,DESIGN. The raintable distribution is the distribution of the runoff and not the rainfall. Leave blank for NHCP–378 structures if not part of local criteria.
Col. 51–60	Q_{FBH}	N	The FBH design runoff in inches for the duration and runoff distribution used above for the SDH. The FBH is the design storm for NHCP–378 structures.

Notes (continued):

2. The program assumes that you applied all areal and volume corrections before entering QDIRECT values. You must enter quick return flow by WSDATA (col. 61–70) or by PDIRECT as climatic index (col. 11–20). See note 6 for this application.

QDIRECT (continued)

Data field	Value	Type	Description

Notes: (continued)

3. The runoff curve number is assumed to be 100 with QDIRECT. The actual curve number on WSDATA, although still required as a data entry, is only used with PDIRECT.
4. Enter NRCS design runoff input data for the PSH and rainfall input data for the SDH and FBH by using both a QDIRECT and a PDIRECT that have applicable data on each record. This avoids having to enter a nonstandard runoff distribution table based on the Runoff Curve Number (RCN) for the SDH and FBH. You must enter the actual RCN by WSDATA (col. 21–30) for use with PDIRECT.
5. QDIRECT, PDIRECT, or P100,PMP data are relevant only to design runs, not simulation runs.
6. The program only adds quick return flow to the recession or tail of the combined PS hydrograph developed from QDIRECT for the site being designed. See figure 4–7 for the relationship of quick return flow to baseflow.
7. For design runs in watersheds with subareas or sites in series, make separate comparison runs of PDIRECT and QDIRECT applied to the entire watershed. The program does not allow mixing of the two in a run of this type.

Example 4–26 QDIRECT—This example QDIRECT record is for sample job 1. The QDIRECT record instructs the program to develop the principal spillway hydrograph using runoff volumes of 3.60 inches for 1 day and 6.0 inches for 10 days for pass no. 2. The program develops the SDH and FBH from rainfall using the PDIRECT control word. You may also leave col. 41–60 blank for a PSH only run.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		PSH 1 – Day Runoff inches	PSH 10 – Day Runoff inches	SDH Runoff – inches (Use with Runoff Distribution Table)	FBH Runoff – inches (Use with Runoff Distribution Table)		Record Identification
QDIRECT							
QDIRECT		3.6	6.0				

RAINTABLE

RAINTABLE—Loads a rainfall (or runoff) distribution table to use for development of a nonstandard design or storm hydrograph. Only one RAINTABLE may be held in storage at a time. You may change the RAINTABLE for any site or subarea by adding a new RAINTABLE ahead of GO,DESIGN, GO,STORM, or GO,RAINS.

Data field	Value	Type	Description
Data Record 1			
Col. 11–15	Table ID	Ae	Raintable identification name. The program requires that this ID name be the same as col. 21–25 on GO,DESIGN, GO,STORM, or GO,RAINS or col. 41–45 on GO,DESIGN.
Col. 21–30	Duration	N	Duration of rainfall in hours. If blank or 1, the program assumes unit duration. Actual duration is specified by GO,DESIGN. If using GO,STORM or GO,RAINS, use the same duration as col. 31–40 on STORM.
Col. 31–70	Title	A	The title, date, and description of the storm.
Data Records 2–61			
Col. 21–70 by 10 col. fields	RF or (RO)	N	Accumulated rainfall amounts at equal time increments (any size). The rainfall does not have to start at zero and may be actual (inches) or dimensionless amounts. The program puts the table into dimensionless form. Because amounts are accumulated, they must not decrease with time. You may enter runoff values (see QDIRECT) instead of rainfall.

Notes:
1. Use only those data records needed. The program allows a maximum of 300 values.
2. Terminate RAINTABLE with ENDTABLE.
3. The program predefines a 6-hour rainfall distribution. Before 1996, this was the AS design distribution. Direct its use by leaving blank the storm identification name (col. 21–25) on GO,DESIGN, GO,STORM, or GO,RAINS.

Data field	Value	Type	Description

RAINTABLE (continued)

Notes: (continued)

4. The program also predefines the NRCS 24-hour Type I, IA, II, and III PS or AS design storm rainfall distributions. Direct their use by using TYPE1, TP–1A, TYPE2, or TYPE3 in the ID fields (col. 21–25 and/or col. 41–45 of GO,DESIGN or col. 21–25 of GO,STORM and GO,RAINS).
5. The program predefines the NRCS 10-day design storm runoff distribution. Direct its use for TR–60 designed structures by leaving the ID field (col. 41–45) blank on GO,DESIGN.
6. Use RAINTABLE to enter historical data for a simulation run or for design runs. For TR–60 criteria design runs, use it only to enter an auxiliary spillway design storm rainfall distribution (SDH & FBH). For NHCP–378 criteria design runs, use it to enter principal spillway and auxiliary spillway design storm rainfall distributions.
7. The RAINTABLE may contain actual rainfall in inches; however, when also using rainfall amounts entered on PDIRECT, GO,STORM, and GO,RAINS, the program uses the amounts on the latter records in the routings.
8. If using a runoff distribution, develop it from stream gage or similar information from the watershed being analyzed. The differences between the rainfall and runoff distribution are primarily due to the initial abstraction (interception, infiltration, and surface storage) that occurs at a decreasing rate with increased rainfall. Using a 100 curve number does not change a rainfall distribution to a true runoff distribution.

Example 4–27 RAINTABLE—The RAINTABLE is the Type II rainfall distribution with .25 hour increments. The 24-hour Type II design storm distribution actually pre-loaded into the program has a time increment of 0.1 hour.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CUMULATIVE RAINFALL TABLE

2-95

LOCATION ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20		21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
Control Word	Table ID		Duration hours	Label				Record Identification
RAINTABLE	225		24	24 Hr. Type 2 .25 Hr. Increment				
Control Word			Entry successive entries left to right with initial entry for time = 0					Record Identification
(maximum of 60 data records)			0.0	.002	.005	.008	.011	
			.014	.017	.020	.023	.026	
			.029	.032	.035	.038	.041	
			.044	.048	.052	.056	.060	
			.064	.068	.072	.076	.080	
			.085	.090	.095	.100	.105	
			.110	.115	.120	.126	.133	
			.140	.147	.155	.163	.172	
			.181	.191	.203	.218	.236	
			.257	.283	.387	.663	.707	
			.735	.758	.776	.791	.804	
			.815	.825	.834	.842	.849	
			.856	.863	.869	.875	.881	
			.887	.893	.898	.903	.908	
			.913	.918	.922	.926	.930	
			.934	.938	.942	.946	.950	
			.953	.956	.959	.962	.965	
			.968	.971	.974	.977	.980	
			.983	.986	.989	.992	.995	
			.998	1.000				
ENDTABLE								

SITES—Control word indicates the beginning of a job. At the beginning of a job, the program sets all variables and coefficients to program default values and initializes all hydrograph storage arrays to zero. Also, the SITES control word prepares the program to accept a list of the input data to the next ENDJOB control word. A job must start with the SITES control word; otherwise, a fatal error occurs.

Data field	Value	Type	Description
Col. 11–20	Program revision date	Ne	The program revision date which must match the revision date in the DAMSITE or SITES program that will process the data (see example 4–28). Older versions prior to version 98.1.1 have the program revision date in the format MM/DD/YY, eight characters including slashes. DAMSITE versions 98.1.1 and later have the format MM/DD/YYYY, 10 characters including slashes. This date is needed to ensure that you note changes in program input format between revisions. If the date is not matched, the program prints a list of input changes along with the correct revision date.
Col. 21–28	Watershed ID	A	Watershed identification name (eight characters maximum). The ID entry must begin in column 21. Used for page heading and graphics file. Name may consist of alphanumeric characters only. No special characters are allowed (periods, commas, etc.). If left blank, the default watershed ID is the input file name prefix.
Col. 29–30	Blank	—	—
Col. 31–60	Title	A	Title or description of the job. This job title appears on top of each labeled page of output. Program versions after March 2000 use column 31–60. Earlier program versions used columns 31–70.

SITES (continued)

Data field	Value	Type	Description
Col 61–70	System Drainage Area	N	Total system watershed drainage area in square miles generated by the IDE. This value is used in computation of rainfall areal corrections for sites in series runs and for computing channel losses in all runs where they are applied. Applies to versions of the program after March 2000.
Col 71	Case	A	The Design Structure Case value (used by the interface).
Col 72	Run Type	I	The Run Type defining the hydrographs to be routed. The values are 1—TR–60 Principal Spillway 2—TR–60 SDH and FBH only 3—TR–60 Prin. Spillway, SDH and FBH 4—NHCP–378 Design 5—NHCP–378 Design and Prin. Spillway 6—NHCP–378 Design + Secondary Design 7—Adds Prin. Spillway to #6 8—Single Event 9—Special Auxiliary Spillway Analysis

Note 1: If the input for a sites in series run is not generated by the IDE, the user must enter the system drainage area in columns 61–70.

Note 2: The values entered in columns 71 and 72 are optional. These fields are used in conjunction with the Integrated Development Environment (IDE) for I/O management. The Run Type and case values are generated automatically by the IDE from selections made on the input windows and used to assist in identification of required control words and data entry fields.

Example 4–28 SITES—The program prepares for the sample job 1 watershed data by zeroing out all hydrograph storage arrays and initializing the program defined default values. The total drainage area is 7.5 square miles.

1 – 10	11 – 20	21 – 30		31 – 40	41 – 50	51 – 60	61 – 70	71 – 80		
Control Word	Current Program Date	Watershed ID		Job Title			System Drainage Area	Case	Run Type	Record Identification
SITES										
SITES	01/01/2005	SJU1		SAMPLE JOB 1, TYPICAL DESIGN RUN			7.5	B	3	

STRUCTURE

STRUCTURE—Initiates loading of data describing a reservoir site. The program requires elevations and either surface areas or storage volumes. If areas are given and volumes left blank, the program will compute an elevation-storage curve. If volumes are given, the program will not use given surface areas for storage computations. You may give principal and auxiliary spillway ratings. If either or both are left blank, the program will compute their ratings based on your input of spillway parameters.

Data field	Value	Type	Description
Data Record 1			
Col. 11–15	Struc. ID	A	Structure identification for use in the summary table, page headings, and labeling output files. If left blank, the structure ID defaults to S 1, S 2, etc. based on the number of blank IDs in a run.
Col. 21–70	Struc. title	A	The title, description, and location of the structure. Used in output page headings and in labeling some output files.
Data Records 2–21			
Col. 21–30	Elev.	Ne	Elevation in feet corresponding to reservoir surface area, discharge, or volume on the same record. Program requires elevations in increasing order. Use only as many as required to adequately define the elevation-surface area or volume and discharge relationships as a series of straight line segments. The program will linearly extrapolate the last two points of the computed or given rating table if needed. If the elevation increment exceeds 20 feet, the program gives a warning.
Col. 31–40	Surface area	N	Reservoir surface area in acres corresponding to the elevation given in col. 21–30. Leave blank if you give storage volumes in col. 61–70. Program lists surface areas as zero in output if not given.

STRUCTURE (continued)

Data field	Value	Type	Description
Col. 41–50	PS discharge	N	Principal spillway discharge in cubic feet per second relating to the elevation in col. 21–30. Leave blank if program is to compute the principal spillway rating.

Notes:
1. If you give the PS rating, enter zero discharge at the first elevation and that elevation must agree with the PS crest on POOLDATA. This rating has precedence over PS ratings computed using PSDATA. Once entered in a STRUCTURE table, the program uses this PS rating in all subsequent passes until a new STRUCTURE table with or without a new PS rating is entered.

Data field	Value	Type	Description
Col. 51–60	AS discharge	N	Auxiliary spillway (AS) discharge in ft^3/s relating to the elevation in col. 21–30. The elevation and discharge relationship is for pool stages where velocity head is essentially zero. Leave blank if program is to compute the auxiliary spillway rating.

Notes: (continued)
2. If you enter AS discharges, the program still needs the ASDATA and BTMWIDTH control words.
3. The auxiliary spillway crest is set by the zero AS discharge entry that precedes the first non-zero AS discharge entry. This will override the crest set using the ASCREST control word.
4. The AS rating in the structure table takes precedence over computed AS ratings. In multiple pass runs, it operates the same as the PS rating (see note 1).

Data field	Value	Type	Description
Col. 61–70	Storage volume	N	Storage volume in acre-feet at the elevation in col. 21–30. Storage volume may be total available or corrected for sediment accumulation. If you want the program to compute storage volume from surface areas, enter only the storage volume for the elevation corresponding to zero discharge. The program recognizes the total storage volume data column only if the last (highest) elevation has a storage volume value.

Data field	Value	Type	Description

Notes: (continued)

5. The program allows a maximum of twenty data records to define the STRUCTURE data; only use as many as necessary.
6. The program gives error messages when any elevation, surface area, discharge, and volume data (except for zero values) do not increase in order.
7. The program does not allow negative STRUCTURE data.
8. Terminate the STRUCTURE table by using an ENDTABLE.

STRUCTURE (continued)

Example 4–29 STRUCTURE—This data represents the structure table in sample job 1 where you give only the elevation-surface data and the initial storage volume. The program will compute the discharges and the remaining storages. Sample job 3 illustrates a structure where the user gives all discharges and storage values.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STRUCTURE DATA

2-95

STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Struc. ID	Label					Record Identification
STRUCTURE	156B4	YOUR PROJECT NAME AND LOCATION					
Control Word		Elevation feet	Surface Area acres	Principal Spillway Rating cfs	Auxillary Spillway Rating cfs	Storage acre – feet	Record Identification
(maximum of 20 data records)		591	76.6			247.8	
		593	106.9				
		595	142.8				
		597	180.6				
		601	262.7				
		605	360.3				
		609	456.9				
		613	557.7				
		615	607.7				
ENDTABLE							

WSDATA

WSDATA—Enters the design criteria and data for the watershed area immediately above the structure or, if subdivided, for the subwatershed area.

Data field	Value	Type	Description
Col. 11	Climate area zone	I_xe	A number designating the climate area zone for the auxiliary spillway areal rainfall correction used in PS402 dams. **0 or blank** = when NWS references apply and areal corrections are accounted for, such as in HMR–51 (or other NWS sources) rainfall values. **1** = arid and semiarid climate **2** = humid and subhumid climate **3** = Pacific coastal climate **4** = user defined climate area or special case. Use AREACRCT with this zone. **5** = Areally corrected rainfall is entered for all hydrographs. All rainfall areal corrections are set to 1.0 Leave blank for NHCP–378 design.

Notes:

1. The program calculates areal rainfall correction factors for auxiliary spillway and freeboard design hydrographs according to TR–60 for drainage areas from 10 to 100 square miles for Climate Area Zones 1, 2, or 3. Program makes no corrections for drainage areas less than 10 square miles. Use AREACRCT when changing or suppressing areal corrections, for principal spillway rainfall values, for drainage areas greater than 100 square miles, or for other special cases.

Data field	Value	Type	Description
Col. 12–13	Design class code	Ae	The design class code refers to the hydrologic design criteria reflecting the hazard class from NRCS TR–60. The different classes are briefly defined as: **A** – Low hazard dams located in rural or agricultural areas where failure may damage farm buildings, agricultural land, or townships and country roads. Low hazard (class A) dams are further subdivided by the product of the effective dam height (ft) and the storage volume (acre-ft) as:

Data field	Value	Type	Description
			A1 – product less than 3,000; effective height <35 ft. Use this Design class for NHCP–378 structures. **A2** – product from 3,000 to 30,000. **A3** – product >30,000. The effective height of the dam is normally defined as the difference in elevation from the lowest point on the original cross section to the crest of the lowest uncontrolled open channel auxiliary spillway (see NRCS TR–60 for additional details). **B** – Significant hazard dams located in predominately rural or agricultural areas where failure may damage isolated homes, main highways or minor railroads, or cause interruption of use or service of relatively important public utilities. **C** – High hazard dams located where failure may cause loss of life, serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads. S – User defined or unspecified design class where it is inappropriate to use NRCS TR–60 criteria.

Notes: (continued)

2. Design class code A1 is reserved for low hazard dams where the height-storage product, as defined in TR–60, is less than 3,000 and where the effective height is less than 35 feet. Although not required in PS378, designation of design class code A1 will provide for an auxiliary spillway with minimum discharge capacity of 200 ft^3/s. The difference between class code A1 and all TR–60 classes is that in no case is the capacity of the auxiliary spillway to be less than 200 ft^3/s or

$$237\ (DA)^{0.493}$$

where:
DA = drainage area in square miles for a TR–60 structure

Use the MINDISCH control word to change the coefficient, exponent, and/or minimum allowable discharge capacity.

WSDATA (continued)

Data field	Value	Type	Description
Col. 14–15	Sub-watershed ID	A	Watershed ID for uncontrolled drainage area of site or subarea, especially useful for sites in series. The program uses it in the summary table and output headings and files. If left blank, the subwatershed ID defaults to A, B, C, etc., depending on the number of blank subwatershed IDs in a run.
Col. 16	Site type	I_x	A number designating the type of structure represented by this data: **1** = null site (dummy structure indicating potential structure location) subarea data only. **2** = existing site (actually built or assumed to have been built, usually an upper site in series) no design or simulation trials made and no AS graphics available. You must provide crest of auxiliary spillway. Leave blank for normal design and simulation runs.
Col. 18–19	AC for acres	A	Enter AC if drainage area is in acres. If blank, program assumes square miles.
Col. 21–30	Runoff curve no.	Ne	The NRCS runoff curve number for antecedent runoff condition II (chapters 7–10, NEH 4) must be between 40 and 98. If RCN is less than 40, program assumes 40.

Notes: (continued)
3. The program uses RCN of 100 when using QDIRECT to develop runoff hydrographs regardless of the runoff curve number entered in col. 21–30.

Data field	Value	Type	Description
Col. 31–40	Drainage area	Ne	The watershed area of the structure site or subarea. Program assumes units of square miles. If the drainage area is in acres, use AC in col. 18–19 above.

Notes: (continued)
4. Do not change Drainage Area in multiple passes at the design site with sites in series.

WSDATA (continued)

Data field	Value	Type	Description
Col. 41–50	T_C	Ne	The time of concentration of the watershed in hours (this is the recommended input);
	or		or
	Ws length	N	Watershed length in feet for calculating the time of concentration by the Kirpich or T_C-15.3 (Lag equation) methods.
Col. 51–60	–	–	Leave blank if giving time of concentration in hours in col. 41–50;
	or		or
	WS differ. in elev.	N	Watershed elevation difference in feet for calculating the time of concentration by the Kirpich method;
	or		or
	WS slope	N	Average watershed slope (%) for calculating the time of concentration by the T_C-15.3 control word (NEH 4, chapter 15).

Notes: (continued)

5. If col. 51–60 contains data, you need to specify which method the program will use to compute T_C by including the KIRPICH or T_C-15.3 control word in the data set. However, the default is T_C-15.3 method.
6. The program uses a minimum T_C of .05 hours.

Data field	Value	Type	Description
Col. 61–70	QRF (total DA)	N	The quick return flow in csm (cubic feet per second per square mile). The program compares this with quick return flow computed according to chapter 2, TR–60 based on the climatic index. The program uses the maximum. Leave blank for NHCP–378 sites. For sites in series, see note 8.

Notes: (continued)

7. When using QDIRECT, enter in col. 61–70 the flow from the quick return flow maps in chapter 2, TR–60, or from stream gage analysis, whichever is applicable.
8. For subdivided watersheds or sites in series, the program only adds quick return flow (QRF) to the tail of the combined principal spillway hydrograph at the most downstream site being designed. The program multiplies the total accumulated drainage area above the site being

WSDATA (continued)

Data field	Value	Type	Description
			Notes: (continued) designed by the QRF in csm. The csm value is the larger value from either col. 61–70 of the WSDATA record or col. 11–20 of the PDIRECT record. For the upstream sites or subarea, the program requires that the csm value on the WSDATA record be blank or zero and the Ci value on the PDIRECT record be less than or equal to 1.0.

Example 4–30 WSDATA—This example WSDATA record is for sample job 1. The watershed is in the humid climate area so the program will make areal corrections to the rainfall entered on PDIRECT. The runoff curve number is 82, the drainage area is 7.5 square miles, and the time of concentration is 2.57 hours. The given quick return flow is 2.67 csm.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word	1 – Climate Area 2 – Design Class 3 – Subws ID 4 – Site Type 5 – AC or DA Acres	Runoff Curve Number	Drainage Area square miles or acres	Tc – hours or Length WS – ft.	KIRPICH – – Elev. Diff. ft. TC–15.3 – – WS Slope %	Quick Return Flow – csm	Record Identification
WSDATA	1 2 3 4 5						

WSDATA	2 S WI	82	7.5	2.57		2.67	

Control words for typical simulation runs

Control word descriptions in this section are arranged in alphabetical order. The control words are also listed in appendix E and below.

GO,DRAW

GO,DRAW—Initiates drawdown computations from the maximum routed elevation previously determined by a GO,STORM, GO,RAINS or GO,HYD pass. The program includes inflow from the previous storm inflow hydrograph in the drawdown. The program computes drawdown time from the maximum storm elevation to the PS crest or to any higher control elevation.

Data field	Value	Type	Description
Col. 11–20	Hydro-graph type H	A	The letter H or number 9 sets hydrograph type code to 9. Required for use following a GO,HYD. If left blank, the program assumes the GO,DRAW follows a GO,STORM.

Notes:

1. Program assumes 10 days for the drawdown time limit and a ratio of 0.00 for floodwater storage remaining to total routed storage.
2. You may change the control elevations using the DDTESTS control word. If not changed, the drawdown will stop at the highest elevation of the PS crest, baseflow, or sediment storage elevation.
3. GO,DRAW must follow the GO,STORM, GO,RAINS or GO,HYD to which it applies. You may enter only DDTESTS, if needed, ahead of GO,DRAW.
4. For GO,DESIGN runs, the drawdown with continuing inflow is already built into the computations. For drawdown without inflow, you may enter GO,TDD.
5. Only one GO,DRAW should appear in a job. If additional storm and drawdown information is required, the data should be copied and run as a separate job.

Example 4–32 GO,DRAW—Sample job 9 uses GO,DRAW with an H in col. 11 to initiate drawdown calculations after a GO,HYD control word.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Type Inflow: H = Hyd blank = storm						Record Identification
GO,DRAW							

GO,DRAW	H						

GO,EMB

GO,EMB—Initiates computations of embankment quantities for a series of top of dam elevations. The program makes no hydrologic or hydraulic computations. You must enter the CLPROFILE table.

Data field	Value	Type	Description
Col. 11–20	D or DRYDAM	A	For dry dams, insert D or DRYDAM. This designates the wave action berm elevation in col. 51–60 as being on a dry dam. Otherwise, leave blank.
Col. 21–30	Min. Elev. top dam	N	Minimum elevation of the top of dam.
Col. 31–40	Max. Elev. top dam	N	Maximum elevation of the top of dam.
Col. 41–50	Elev. increment	N	Elevation increment to use between the minimum and maximum top of dam elevations for embankment quantity computations.
Col. 51–60	Elev. Berm	N	The elevation of the wave action berm. Leave blank if not using wave action berm.

Notes:
1. If considering only one top elevation, enter it in col. 21–30. In this case, user may leave col. 31–50 blank.
2. If the elevation increment is left blank, the program divides the difference between the minimum and maximum elevation by 5 to set the increment.
3. The TEMPLATE control word description lists the embankment default parameters. If you are not satisfied with the defaults, enter new values using the TEMPLATE and/or the STABERM control words.
4. The program does not allow program output options with GO,EMB. The embankment quantity listings are automatic output.

Example 4–33 GO,EMB—This example GO,EMB for sample job 8 instructs the program to compute embankment quantities at elevations 611, 613, and 615 with a wave action berm at elevation 603.5.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Enter If "DRY DAM"	Minimum Top Elevation	Maximum Top Elevation	Increment of Elevation – feet	Wave Berm Elevation		Record Identification
GO, EMB							

GO, EMB		611	615	2.0	603.5		

GO,HYD

GO,HYD—Initiates computations when routing through a structure a given storm inflow hydrograph whose coordinates were loaded by HYD or 7READHD or when adding a single null site (subarea) hydrograph to a system of structures and subareas.

Data field	Value	Type	Description
Col. 11–20	Code letter for program options	A	Code letter indicating options in addition to the program standards. Select up to 10 options; see note 1. Run control options (see note 2): **H** – Stability procedure only. **U** – Integrity procedure only. **N** – Neither stability nor integrity analysis. **Q** – Routing only, no auxiliary spillway analysis **S** – Principal spillway routing only, see note 3. List options: **A** – Coefficients, parameters, dimensionless unit hydrograph, and all program default rainfall distribution tables. **C** – Same as option A except includes only the rainfall distribution used in the computational pass. **L** – Elevation-discharge-storage rating tables. Also see V. **P** – Character plot of inflow and outflow hydrographs with hydrograph and flood routing data. **V** – Auxiliary spillway surface condition parameters by reach. Automatic with L option when doing integrity or stability analysis, or both. Generate file options: **I** – File of inflow hydrograph coordinates in 10 col. fields. **O** – File of outflow hydrograph coordinates in 10 col. fields. **B** – File of hydrograph coordinates in 12 col. fields for TR–20, used in combination with options I and O.

GO,HYD (continued)

Data field	Value	Type	Description
			R – File of rating tables in 10 col. fields. **T** – File of rating tables in 12 col. fields for TR–20.

Notes:
1. Select nonconflicting options. For example, only select one option from the following groups: H, U, Q, or N; A or C; L or V.
2. Unless you enter an H, U, Q, or N in columns 11–20, program uses both the stability and integrity procedures.
3. The Q option should be used only when the auxiliary spillway rating is given in the structure table.
4. If you enter the S program option, it must be the first option listed and col. 21–30 of the ASCREST control word must be blank.
5. Only the C and the I and B inflow hydrograph program options apply to null sites.

Data field	Value	Type	Description
Col. 26–30	Multiple design pass switch	A	Enter M to obtain multiple design passes at a lower site in a system of structures or subareas. This will save the total accumulated hydrograph for the next GO,DESIGN or GO,HYD pass at the lower site.
Col. 41–50	Minimum maintenance code (MC) switch	I	Options for minimum MC value: **1** – Sets minimum value of MC=1 for storm simulation run. **0 or blank** – Sets minimum value of MC= 2, the design default. Applies only to integrity analyses; stability analyses use the original maintenance code (MC=1 to 3).
Col. 61–70	Elev. Start routing	N	The water surface elevation in feet at the beginning of the storm HYD. Leave blank if the program is to begin routing at the principal spillway crest. When left blank, the program accounts for sediment above the crest (col. 41–50 of POOLDATA).

GO,HYD (continued)

Data field	Value	Type	Description
			Notes: (continued) 6. In a system of structures or subareas, the program uses GO,HYD only with a single storm hydrograph at any structure or subwatershed area (null site). You must enter GO,DESIGN for the program to route a set of design hydrographs (PSH, SDH, FBH) through the system of structures. 7. If you enter two hydrographs of the same type code (see HYD, col. 11–20) before the GO,HYD, the program will use the last one entered.

Example 4–34 GO,HYD—This GO,HYD is from sample job 4. You instruct the program to start routing the storm hydrograph (HYD) at the elevation 604.29, which is above the principal spillway crest, and do not request any options. The program option Q requests routing only without spillway analyses, and the option L requests elevation-discharge-storage rating tables in the output.

1 – 10	11 – 20	21 – 25	26 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
Control Word	Program Options		Multiple Pass Switch		Maintenance code Switch		Start Routing Elev. if not at PS Crest	Record Identification
GO, HYD								
GO, HYD	QL						604.29	

GO,RAINS—Initiates computations when you instruct the program to develop a series of storm hydrographs from a rainfall distribution and to flood route the STORM data.

GO,RAINS

Data field	Value	Type	Description
Col. 11–20	Code letter for program options	A	Code letter indicating options in addition to the program standards. Select up to 10 options; see note 1. Run control options (see note 2): **H** – Stability procedure only. **U** – Integrity procedure only. **N** – Neither stability nor integrity analysis. **S** – Principal spillway routing only, see note 3. List options: **A** – Coefficients, parameters, dimensionless unit hydrograph, and all program default rainfall distribution tables. **C** – Same as option A except includes only the rainfall distribution used in the computational pass. **L** – Elevation-discharge-storage rating tables (see also V). **P** – Character plot of inflow and outflow hydrographs with hydrograph and flood routing data. **V** – Auxiliary spillway surface condition parameters by reach. Automatic with L option when doing integrity or stability analysis, or both. Generate file options: **I** – File of inflow hydrograph coordinates in 10 col. fields. **O** – File of outflow hydrograph coordinates in 10 col. fields. **B** – File of hydrograph coordinates in 12 col. fields for TR–20, used in combination with options I and O. **R** – File of rating tables in 10 col. fields. **T** – File of rating tables in 12 col. fields for TR–20.

GO,RAINS (continued)

Data field	Value	Type	Description
	Notes: 1. Select nonconflicting options. For example, only select one option from the following groups: H, U, or N; A or C; L or V. 2. Unless you enter an H, U, or N in columns 11–20, the program uses both the stability and integrity procedures. 3. If the you enter the S program option, it must be the first option listed and col. 21–30 of the ASCREST control word must be blank. 4. Only the C and the I and B inflow hydrograph program options apply to null sites.		
Col. 21–25	Raintable ID	A	The identification (ID) name of the rainfall distribution to be used. The ID must be identical to col. 11–15 of RAINTABLE for retrieval or be one of the preloaded NRCS rainfall distributions.
	Notes (continued): 5. The program has preloaded standard NRCS 24-hour Type I, IA, II, and III rainfall distributions and requires no RAINTABLE. Direct their use by using TYPE1, TP–1A, TYPE2, or TYPE3 in the ID field (col. 21–25). Leave the ID field blank to use the 6-hour design storm distribution.		
Col. 26–30	Multiple design pass switch	A	Enter M to obtain multiple design passes at a lower site in a system of structures or subareas. This will save the total accumulated hydrograph for the next GO,DESIGN or GO,RAINS control pass at the lower site.
Col. 31–40	Min.RF	Ne	The minimum storm rainfall amount in inches.
Col. 41–50	Max.RF	Ne	The maximum storm rainfall amount in inches.
Col. 51–60	RF Increment	N	The rainfall increment in inches. The program will flood route all storm rainfall amounts obtained by incrementing between the minimum and maximum rainfalls. If blank, the program will divide the difference between the minimum and maximum by 5 to set the increment. A practical limit for the number of increments is 20.

GO,RAINS (continued)

Data field	Value	Type	Description
Col. 61–70	Elev. Start routing	N	The water surface elevation in feet at the beginning of storm rainfall. Leave blank if the routing is to begin at the principal spillway crest. The program accounts for sediment above the crest (col. 41–50 of POOLDATA) when left blank.

Notes: (continued)

6. In a system of structures or subareas, the program uses only the minimum storm rainfall (col. 31–40).

Example 4–35 GO,RAINS—This GO,RAINS record instructs the program to route storm hydrographs based on rainfall distribution table TYPE2 for 4, 6, and 8 inches of rainfall.

1 – 10	11 – 20	21 – 30		31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	12345	67890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Program Options	Raintable ID	Multiple Pass Switch	Minimum Rainfall inches	Maximum Rainfall inches	Rainfall Increment inches	Start Routing Elev. if not at PS Crest	Record Identification
GO, RAINS								

GO, RAINS		TYPE2		4.0	8.0	2.0		

GO,STORM

GO,STORM—Initiates computations when you instruct the program to develop a storm hydrograph from a rainfall distribution and to flood route the STORM data.

Data field	Value	Type	Description
Col. 11–20	Code letter for program options	A	Code letter indicating options in addition to the program standards. Select up to 10 options; see note 1. Run control options (see note 2): **H** – Stability procedure only. **U** – Integrity procedure only. **N** – Neither stability nor integrity analysis. **Q** – Routing only, no auxiliary spillway analysis **S** – Principal spillway routing only, see note 3. List options: **A** – Coefficients, parameters, dimensionless unit hydrograph, and all program default rainfall distribution tables. **C** – Same as option A except includes only the rainfall distribution used in the computational pass. **L** – Elevation-discharge-storage rating tables. Also see V. **P** – Character plot of inflow and outflow hydrographs with hydrograph and flood routing data. **V** – Auxiliary spillway surface condition parameters by reach. Automatic with L option when doing integrity or stability analysis, or both. Generate file options: **I** – File of inflow hydrograph coordinates in 10 col. fields. **O** – File of outflow hydrograph coordinates in 10 col. fields. **B** – File of hydrograph coordinates in 12 col. fields for TR–20, used in combination with options I & O. **R** – File of rating tables in 10 col. fields.

GO,STORM (continued)

Data field	Value	Type	Description
			T – File of rating tables in 12 col. fields for TR–20.

Notes:
1. Select nonconflicting options. For example, only select one option from the following groups: H, U, Q, or N; A or C; L or V.
2. Unless you enter an H, U, Q, or N in columns 11–20, the program uses both the stability and integrity procedures.
3. If you enter the S program option, it must be the first option listed and col. 21–39 of the ASCREST control word must be blank.
4. Only the C and the I and B inflow hydrograph program options apply to null sites.
5. The Q option should be used only when the auxiliary spillway rating is given in the structure table.

Data field	Value	Type	Description
Col. 21–25	Raintable ID	A	The identification (ID) name of the rainfall distribution to be used. The ID must be identical to col. 11–15 of RAINTABLE or be one of the preloaded NRCS rainfall distributions. Use STORM if the duration is not 6 hours.

Notes: (continued)

6. The program contains preloaded standard NRCS 6-hour storm and the 24-hour Type I, IA, II, and III rainfall distributions and requires no RAINTABLE. Direct their use by using TYPE1, TP–1A, TYPE2, or TYPE3 in the ID field (col. 21–25). Leave the ID field blank to use the 6-hour design storm distribution.

Data field	Value	Type	Description
Col. 26–30	Multiple design pass switch	A	Enter M to obtain multiple design passes at lower site in a system of structures or subareas. This will save the total accumulated hydrograph for the next GO,DESIGN or GO,STORM control pass at the lower site.
Col. 31–40	Storm RF	Ne	The storm rainfall amount in inches.
Col. 41–50	Minimum maintenance code (MC) switch	I	Options for minimum MC value: **1**—Sets minimum value of MC = 1 for a storm simulation run. **0 or blank**—Sets minimum value of MC = 2, the design default. Applies only to integrity analyses; stability analyses use the original maintenance code (MC = 1 to 3).

GO,STORM (continued)

Data field	Value	Type	Description
Col. 61–70	Elev. Start routing	N	The water surface elevation in feet at the beginning of storm rainfall. Leave blank if the program is to begin routing at the principal spillway crest. The program accounts for sediment above the crest (col. 41–50) of POOLDATA when left blank.

Notes: (continued)

7. The program routes all auxiliary spillway crests and bottom widths given by ASCREST and BTMWIDTH if you do not activate the S program option. If col. 21–30 of ASCREST is blank and the program has made a design run on the data, the last auxiliary spillway crest established by PSH criteria will automatically be carried over to this run.
8. You can not use GO,STORM to initiate the processing of design or storm hydrographs loaded by HYD.

Example 4–36 GO,STORM—This GO,STORM record for sample job 3 instructs the program to route the storm hydrograph based on the given rainfall table labeled TYPE2 and 7.2 inches of rainfall with a program option requesting rating tables. The maintenance code is set to the minimum value of 1. The routing of the storm will begin at elevation 604.24.

1 – 10	11 – 20	21 – 30		31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	12345	67890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Program Options	Storm Raintable ID	Multiple Pass Switch	Storm Rainfall inches	Maintenance Code Switch		Start Routing Elev. if not at PS Crest	Record Identification
GO, STORM								

GO, STORM	L	TYPE2		7.2	1		604.24	

GO,TDD

GO,TDD—Initiates a run to get the time of drawdown of a flood detention pool using the data loaded previously by STRUCTURE, PSDATA, PSINLET, and POOLDATA. The program computes drawdown time between start and end elevations. The program produces no other hydraulic, hydrologic, or embankment parameters.

Data field	Value	Type	Description
Col. 21–30	Elev. start	Ne	Elevation in feet at start of drawdown. The starting elevation must be greater than the ending elevation in the next field.
Col. 31–40	Elev. end	Ne	Elevation to end drawdown computations. See note 2.
Col. 41–50	BF	N	Baseflow or quick return flow in ft^3/s used in computations.

Notes:
1. Drawdown computations under GO,TDD assume no inflow is added during the time of drawdown other than baseflow or quick return flow.
2. Drawdown computations stop at the highest elevation of the following: PS crest, baseflow, QRF, sediment storage, or the end elevation in col. 31–40.
3. Program assumes 10 days for drawdown time limit (TR–60). The program assumes a ratio of 0.15 for floodwater storage remaining to total routed storage for TR–60 and a ratio of 0.0 for NHCP–378. Change these limits using DDTESTS.
4. The program automatically lists the principal spillway rating table; no other program options are available with GO,TDD.
5. See GO,DRAW for drawdown of storm detention pools.

Example 4–37 GO,TDD—Drawdown computations for sample job 7 start at elevation 607.73 and end at elevation 603.52. Baseflow is 34.6 cubic feet per second.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Start Drawdown Elevation	End Drawdown Elevation	Baseflow or QRF–cfs			Record Identification
GO, TDD							
GO, TDD		607.73	603.52	34.6			

HYD

HYD—Enters the coordinates of a hydrograph for the program to route through a single site by GO,HYD or to enter into a system of structures or subareas by GO,DESIGN. The program does not require WSDATA if you enter the drainage area and site type code here and the pass does not require computed hydrographs. Enter the TITLE control word before the HYD control word to identify subareas.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Hydrograph type code	A	Enter proper code (letter or number) to identify type of hydrograph: **S or 7 or 9** = Storm, use with GO,HYD **P or 1** = PSH, use with GO,DESIGN **A or 3** = SDH, use with GO,DESIGN **F or 5** = FBH, use with GO,DESIGN

Notes:
1. Leaving this field blank or entering any other hydrograph type code than the above codes will identify the hydrograph as a storm hydrograph. Table 4–4 in the Complex Series Routing Section refers to these hydrograph type code numbers as Hydrograph Storage Arrays.

Data field	Value	Type	Description
Col. 21–30	Drainage area	N	Enter drainage area (mi^2) associated with the hydrograph, if not given on WSDATA. Drainage area is essential input to the program.
Col. 31–70	Title	A	The description of the hydrograph used for identification in the program output.
Data Record 2			
Col. 11–20	Site type code	I	Enter if not given on WSDATA: **1** – null site (dummy structure indicating potential structure location); subarea data only. **2** – existing site or site assumed to have been built; no design or simulation trials made. Crest of AS must be provided. Leave blank for design or simulation runs.

HYD (continued)

Data field	Value	Type	Description
	Notes (continued): 2. The Site Type Code entered on HYD takes precedence over the Site Type Code entered on the WSDATA.		
Col. 21–30	Time increment	Ne	The time increment in hours defining the hydrograph.
Col. 31–40	Start time	N	The time in hours of the first hydrograph point that is greater than the cutoff value. The default cutoff value is 0.5 ft^3/s.

Data Records 3–102

Data field	Value	Type	Description
Col. 21–70 by 10 col. fields	Discharge	Ne	The discharge rate in cubic feet per second. Enter a maximum of 5 entries per record (500 total points), but use only those needed.

Notes: (continued)

3. End the HYD table with an ENDTABLE record.
4. Enter a set of design hydrographs (PSH, SDH, FBH) or a single storm hydrograph at the same location and instruct the program to route them through the system of structures or subareas. A given design hydrograph with the proper type code in col. 11–20 will replace the design rainfall or runoff procedure for generating that hydrograph. If two hydrographs of the same type at the same location are entered, the program uses the last one entered.

Example 4–38 HYD—This example HYD instructs the program to use this hydrograph table for its calculations. The hydrograph time increment is 0.637 hours. WSDATA contains the drainage area and the site type.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

INPUT HYDROGRAPH

9-05

HYDROGRAPH LOCATION ______ PREPARED BY ______ DATE ______ PAGE ______

JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Hydrograph Type Code	Drainage Area sq. mi. *	Label				Record Identification
HYD	S		Storm Hydrograph from Sample Job 1				
	Site Type Code *	Time Increment hours	Start time hours				Record Identification
		0.637					
		Enter successive entries left to right with first entry for starting time					Record Identification
1. maximum of 1000 data records 2. * only use if not given on WSDATA Control		0	0	0	0	0	
		0	0	7	29	73	
		132	203	282	367	464	
		596	769	997	1374	2969	
		8325	11971	10343	6764	4567	
		3221	2398	1876	1537	1315	
		1155	1018	920	834	767	
		720	687	662	639	570	
		405	230	118	61	31	
		16	8	4	2	0	
ENDTABLE							

7READHD

7READHD—This is a legacy control word not supported in SITES 2005. It enters the coordinates of a given hydrograph in the NRCS TR–20 (1992) format, so the program can route it through a single site by GO,HYD or enter it into a system of structures or subareas by GO,DESIGN. The program does not require the WSDATA if you enter the drainage area and site type code here and the pass does not require computed hydrographs.

Data field	Value	Type	Description
Data Record 1			
Col. 2	7	Ie	TR–20 data code number.
Col. 4–9	READHD	Ae	Table name.
Col. 11	8	I	Operation code number.
Col. 17	Hydrograph type code	I_xe	Enter proper Hydrograph Type Code number to identify type of inflow hydrograph: **7 or 9** = Storm, use GO,HYD **1** = PSH, use with GO,DESIGN **3** = SDH, use with GO,DESIGN **5** = FBH, use with GO,DESIGN
Col. 25	Site type code	I_x	Enter if not given on WSDATA: **1** – for Null Site only (subarea hydrograph) **2** – for existing site Leave blank for design or simulation runs.

Notes:
1. TR–20 requires col. 2–11 data fields on record 1, but DAMSITE requires only 7READHD in col. 1–10.
2. The hydrograph storage location, col. 17, may be 1 to 7 for TR–20, but DAMSITE requires one of the inflow hydrograph type code numbers shown.
3. TR–20 does not require the Site Type Code, but DAMSITE requires one of the codes if not blank.

Data Record 2

Col. 2	7	Ie	TR–20 data code number.
Col. 4–9	READHD	Ae	Table name.
Col. 11	9	I	Operation code number.

7READHD (continued)

Data field	Value	Type	Description
Col. 13–24	Starting Time	Ne	Starting time in hours from TR–20. SITES requires this value to be zero, and you may need to add appropriate zero or baseflow discharge data to the hydrograph.
Col. 25–26	Time Increment	Ne	The time increment in hours defining the hydrograph.
Col. 37–48	Drainage area	N	Enter drainage area in square miles associated with the hydrograph, if not given on WSDATA.
Col. 49–60	Baseflow	N	Baseflow in cubic feet per second included in TR–20 hydrograph. Use other methods in SITES to identify baseflow.

Notes: (continued)

4. TR–20 requires col. 2–11 data fields on record 2, but DAMSITE requires only 7READHD in col. 1–10.
5. TR–20 uses data in col. 13–24 for Starting Time and col. 49–60 for Baseflow, but DAMSITE ignores them so they are not shown here. If the starting time is not zero, the timing of the routed hydrograph will be in error because all DAMSITE hydrographs start at zero time.

Data Records 3–102

Col. 13–72 by 12 col. fields	Discharge	Ne	The discharge rate in cubic feet per second. You may enter a maximum of five discharges per line (500 total points). However, the limit for a hydrograph generated by TR–20 is 400 points. Fill out the last row of data only if the last point is at constant baseflow.

Notes: (continued)

6. Terminate the 7READHD table using an 9ENDTBL record.
7. Enter a set of design hydrographs (PSH, SDH, FBH) or a single storm hydrograph at the same location and instruct the program to route them through the system of structures or subareas. A given design hydrograph that has the proper type code in col. 11–20 will replace the design rainfall or runoff procedure for generating that hydrograph. If two hydrographs of the same type at the same location are entered, the program uses the last one entered.

Example 4–39 7READHD—A TR–20 (1992) computer program run produced this 7READHD table. SITES does not use certain fields used by the TR–20 program.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

READ DISCHARGE HYDROGRAPH

(TR–20 Format – 12 Column Data Fields) 2-95

HYDROGRAPH LOCATION ______ PREPARED BY ______ DATE ______ PAGE ______

JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 12			13 – 24	25 – 36	37 – 48	49 – 60	61 – 72	73 – 80
Data Code	Table Name	Opp. Code	Storage Location No. 1 to 7	SITES only site Type Code 1 = Null Site				Record Identification
7	READHD	8	3					
			Starting Time hours *	Time increment hours	Drainage Area square miles	Baseflow included cfs *		Record Identification
7	READHD	9	6.0	0.5	1.66	5.0		

Enter successive discharges left to right with first entry for starting time.
Fill last row of data with last entry of table. Include Baseflow if applicable.

Data Code	Notes	13 – 24	25 – 36	37 – 48	49 – 60	61 – 72	73 – 80
8	1. Maximum of 80 records (400 pts.) 2. Data Fields in Col. 13 to 72 require decimal points. 3. * TR–20 Data Fields in Col. 13 to 24 and 49 to 60 on the 7 READHD 9 record are not used in SITES.	5.0	9.0	20.0	98.0	582.0	
8		294.0	177.0	129.0	109.0	93.0	
8		83.0	73.0	67.0	63.0	59.0	
8		40.0	23.0	16.0	12.0	9.0	
8		8.0	7.0	7.0	6.0	6.0	
8		6.0	6.0	6.0	5.0	5.0	
8							
8							
8							
8							
8							
8							
8							
8							
9	ENDTBL	This record must be the last record of this table					

Note: For SITES, the table may contain up to 100 records or 500 points

STORM

STORM—Allows you to enter storm specific data that the program uses to develop an inflow hydrograph for a given storm. Use required with GO,STORM or GO,RAINS for simulation runs when hydrograph or watershed parameters are to be modified for the storm.

Data field	Value	Type	Description
Col. 21–30	Time increment	N	The time increment in hours of the inflow hydrograph if used with OLDHYD. If this value is blank, the program will calculate a time increment so that the last point is at the end of the hydrograph. When OLDHYD is not used, the program does not accept the time increment from the STORM control word. It uses the internally developed time increment.
Col. 31–40	Duration	N	The storm duration in hours, 24 hours or greater, with new criteria. Program default is 6 hours with old criteria.
Col. 41–50	RCN	N	The runoff curve number the program should use if different from that given in WSDATA. Must be between 40 and 100.
Col. 51–60	Tc	N	The time of concentration in hours if different from that defined by WSDATA.
Col. 61–70	BF	N	The baseflow in csm, if any, the program adds to direct runoff.

Notes:

1. Baseflow may also be entered using a BASEFLOW record. A value entered in columns 61–70 will take precedence over a value entered from a BASEFLOW record.

Example 4–40 STORM—This example STORM record is from sample job 3. It is based on 101 points, and has a 24-hour duration with zero baseflow. The time increment is computed by the program, and the WSDATA control word gives the CN and the T_C.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
		Inflow Hydrograph	Storm				
Control Word		Time Increment hours	Duration – hours	Curve Number	Tc – hours	Baseflow – csm	Record Identification
STORM							

STORM			24				

TITLE

TITLE—Provides an ID and title for a subwatershed hydrograph entered by the HYD control word. The program also uses the title as identification on the second line of the page heading when the run does not require a WSDATA record and a STRUCTURE table. If a hydrograph file is generated in the 10 column field HYD format with a WSDATA and a STRUCTURE table, the program will use the structure title in the page heading. TITLE will not work with a hydrograph entered with a 7READHD control word.

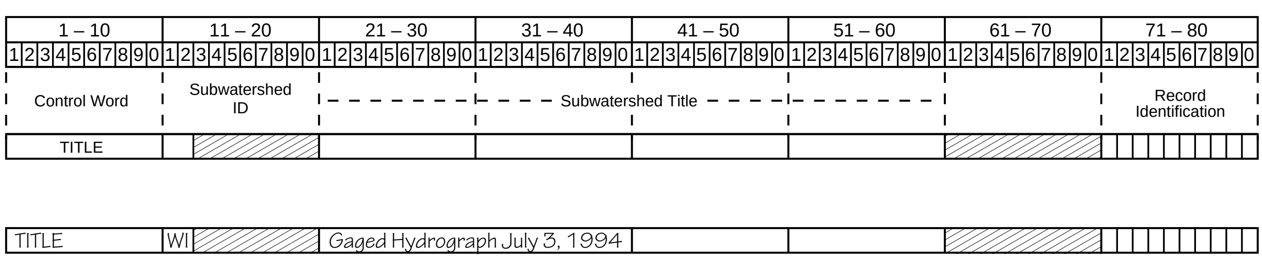
Data field	Value	Type	Description
Col. 11–12	Sub-watershed ID	A	Subwatershed ID, if no WSDATA record is entered. Used in summary table, output headings, and files.

Notes:
1. If you specify a Subwatershed ID in col. 14–15 of WSDATA, the program does not use the Subwatershed ID on the TITLE record.

Data field	Value	Type	Description
Col. 21–60	Sub-watershed title	A	The name, description, and location of the subwatershed represented by the HYD table.

Notes: (continued)
2. You should locate the TITLE associated with a particular HYD table before the GO,HYD or GO,DESIGN that will use that HYD table.

Example 4–41 TITLE—This TITLE record describes a hydrograph entered with the HYD table.



Typical Runs for Systems of Structures and Subwatersheds

This section contains additional control words commonly used to perform a variety of design and simulation functions involving a system of structures, subdivided watersheds, or both. The SITES program can handle any number of combinations of input data. The next sections illustrate three types of commonly encountered situations to show typical data required and the normal order of computations. This section on control words for systems provides detailed descriptions of the additional control words and their input requirements.

Two sites in series run

The following control words are required for the typical design of the lower site in a two sites in series design run. Unless noted, these control words were defined in the section Control Words for Typical Design Runs.

Control word	Function of record	Page
SITES	Indicates beginning of job, only use once.	4–77
STRUCTURE	Loads upper structure elevation, surface area, and volume data.	4–79
WSDATA	Enters design criteria and data for upper watershed. Site Type in col. 16 should be 2 for an existing site.	4–82
PDIRECT	Enters point design rainfall data.	4–62
AREACRCT*	Loads total watershed areal rainfall correction factors if needed.	4–156
POOLDATA	Enters principal spillway crest, sediment storage, and valley floor information for upper site.	4–65
PSDATA	Specifies principal spillway conduit data.	4–67
PSINLET	Specifies data for a principal spillway drop inlet riser.	4–69
ASDATA	Contains additional information for the auxiliary spillway.	4–18
ASCREST	Enters the auxiliary spillway crest.	4–16
BTMWIDTH	Enters the auxiliary spillway bottom width.	4–51
GO,DESIGN	Initiates the design run through upper structure.	4–58
XSECTN**	Loads cross section elevation-discharge-end area table.	4–128
GO,REACH**	Enters reach data and indicates reach routing. Operation control number (col. 11) is 2.	4–123

Control word	Function of record	Page
STRUCTURE	Loads lower structure elevation, surface area, and volume data.	4–79
WSDATA	Enters design criteria and data for uncontrolled lower watershed. Site Type is blank for design.	4–82
PDIRECT	Enters point design rainfall data.	4–62
AREACRCT*	Loads total watershed areal rainfall correction factors if needed	4–156
POOLDATA	Enters principal spillway crest, sediment storage, and valley floor information for lower site.	4–65
PSDATA	Specifies principal spillway conduit data.	4–67
PSINLET	Specifies data for a principal spillway drop inlet riser.	4–69
ASCOORD	Defines surfaces of geologic materials in auxiliary spillway profile by x,y coordinates.	4–12
ASMATERIAL	Describes geologic material parameters for each material identified in the ASCOORD tables.	4–39
ASDATA	Contains additional information for the auxiliary spillway.	4–18
ASCREST	Establishes auxiliary spillway crest elevation(s) for the spillway template.	4–16
ASINLET	Provides inlet profile for the auxiliary spillway channel template.	4–32
ASEXIT	Provides parameters characterizing the auxiliary spillway exit channel template.	4–26
ASEXSURF	Describes surface parameters of the auxiliary spillway exit channel template.	4–28
ASINSURF	Describes surface parameters of the auxiliary spillway inlet channel template	4–37
BTMWIDTH	Establishes auxiliary spillway bottom width(s).	4–51
GO,DESIGN	Initiates the design run for the lower site.	4–58
ENDJOB	Signifies end of this job.	4–56
ENDRUN	Ends the computer run.	4–56

* Changes to Program Defined Input section describes AREACRCT. When total watershed area is less than 10 square miles, the AREACRCT record is not needed.

** Additional control word description contained in this section.

The program can pass only one set of design hydrographs through the upper site to be combined with the uncontrolled area hydrographs of the lower site. Note, all the site and rainfall related control words are repeated for the lower site. The GO,REACH control word initializes these variables. Do not use the SITES control word ahead of the lower site since this would zero the storage arrays that contain the upper structure outflow hydrographs. Use alternative control words, described in the section, Alternative Input Possibilities, to replace or add control words to the above list. The STRUCTURE table gives the discharge rating curve for the upper site.

The program does the design computations for the two sites in series:

1. Read input data through the ENDJOB line and echo print to output.
2. Compute upper site stage-storage-discharge relationship by rating its spillway system.
3. Develop design inflow hydrographs for upper site.
4. Flood route hydrographs through the upper site spillway system to determine the outflow hydrographs.
5. Perform any stability and integrity analyses requested, but any effects are not carried downstream.
6. Reach route outflow hydrographs to lower site.
7. Develop design inflow hydrographs for uncontrolled watershed of lower site and add to reach routed hydrographs.
8. Compute lower site stage-storage-discharge relationship by rating its spillway system.
9. Flood route combined principal spillway hydrograph to determine the required flood water detention storage.
10. Compute drawdown time.
11. Establish minimum auxiliary spillway crest elevation.
12. Route combined stability design hydrograph to analyze stability of the auxiliary spillway exit channel.
13. Route combined freeboard hydrograph to analyze structural integrity of the spillway and establish top of dam.
14. Repeat auxiliary spillway and freeboard routing using any other specified bottom widths or auxiliary spillway crest elevations.

The program can also make simulation runs through sites in series. The program handles only one storm hydrograph per run in a system of structures. Enter control word lists for routing a specific storm event for both the upper and lower structures with the GO,STORM control word. See the subsection on typical simulation runs using GO,STORM.

In simulation runs use GO,HYD only with the upper site and GO,STORM for the lower site below the GO,HYD.

The GO,RAINS control word only uses the first storm rainfall at the upper site and the first storm rainfall at the lower site.

The specialized GO,TDD and GO,EMB options work at either site.

Subdivided watershed site run

A typical design run for a watershed divided into three subareas above a site (two subareas added, then routed through a reach to the site where the third subarea is added) might require the following group of control words:

Control word	Function of record	Page
SITES	Indicates beginning of job, only use once.	4–77
WSDATA	Enters design criteria and data for first subarea. Site Type in col. 16 should be 1 for a null site.	4–82
PDIRECT	Enters point design rainfall data.	4–62
AREACRCT*	Loads total watershed areal rainfall correction factors if needed.	4–156
GO,DESIGN	Initiates hydrograph development for 1st subarea.	4–58
GO,ADDHYD**	Moves hydrographs to accumu–lation storage arrays. Operation control number (col. 11) is 0.	4–121
WSDATA	Enters design criteria and data for 2nd subarea. Site Type in col. 16 should be 1 for a null site.	4–82
PDIRECT	Enters point design rainfall data.	4–62
AREACRCT*	Loads total watershed areal rainfall correction factors if needed.	4–156
GO,DESIGN	Initiates hydrograph development for second subarea.	4–58
GO,ADDHYD**	Accumulates hydrographs for subareas #1 and #2. Operation control number (col. 11) is 1.	4–121
GO,REACH**	Enters reach data and initiates reach routing. Operation control number (col. 11) is 2.	4–123
STRUCTURE	Loads structure elevation-surface area, etc. table.	4–79
WSDATA	Enters design criteria and data for third subarea above site. Site type in col. 16 should be blank or zero for design site.	4–82
PDIRECT	Enters point design rainfall data.	4–62
AREACRCT*	Loads total watershed areal rainfall correction factors if needed.	4–156

(Enter typical design run control words for a structure site. See subsection on typical design runs using GO,DESIGN.)

Subdivided watershed site run
(continued)

Control word	Function of record	Page
GO,DESIGN	Initiates design run with accumulated subareas.	4–58
ENDJOB	Signifies end of job.	4–56
ENDRUN	Ends the computer run.	4–56

* Described in Changes to Program Defined Input section.
** Additional control word descriptions contained in this section.

As with sites in series, the program develops only one set of design hydrographs for the upper subareas to be combined with the lower subarea hydrographs. The rainfall related control words are repeated for each subarea as the GO,ADDHYD control word initializes these variables.

The control words listed represent the minimum amount of data required for the subdivided watershed site design run. You may enter alternative control words or may add control words. It should be noted that if either or both of the upper subareas were actually structure sites, the same control word list would apply with the addition of the site data before the GO,DESIGN for each site.

The program does the computations for the subdivided watershed site as follows:
1. Read input data through the ENDJOB line and echo print to output.
2. Develop design inflow hydrographs for first subarea.
3. Store hydrographs in accumulation storage arrays.
4. Develop design inflow hydrographs for second subarea.
5. Add hydrographs in accumulation storage arrays.
6. Reach route accumulated hydrographs to site.
7. Develop design inflow hydrographs for third subarea and add to reach routed hydrographs.
8. Compute lower site stage-storage-discharge relationship by rating its spillway system.
9. Flood route combined principal spillway hydrograph to determine the required flood water detention storage.
10. Compute drawdown time.
11. Establish minimum auxiliary spillway crest elevation.
12. Route combined stability design hydrograph to analyze stability of the auxiliary spillway exit channel using effective tractive stress.
13. Route combined freeboard hydrograph to analyze structural integrity of the spillway and establish top of dam.
14. Repeat auxiliary spillway and freeboard routing using any other specified bottom widths or auxiliary spillway crest elevations.

Subdivided watershed site run
(continued)

You may do simulation runs through a system of subareas, but the program allows only one storm hydrograph per run. The control word list for development of the storm hydrograph from a specific storm event for an upper subarea follows:

Control word	Function of record	Page
SITES	Indicates beginning of job—only use once.	4–77
WSDATA	Enters data for watershed area. Type (col. 11) is 1.	4–82
STORM	Enters specific storm data.	4–106
RAINTABLE	Inputs the rainfall distribution.	4–74
GO,STORM	Initiates the simulation run.	4–96

Substitute this set of control words for both subareas #1 and #2 in the previous design control word list. Substitute the site data control words from the Typical Simulation Runs subsection using GO,STORM for the typical design run control words.

Enter the other GO, control words with limitations as expressed in the Two Sites in Series Run section.

Complex series routings

Make design runs involving combination of three or more sites and subareas utilizing the operation control number on the GO,ADDHYD and GO,REACH control word records. Design upper sites individually unless they are existing structures. Design the next lower downstream tier of sites in series as two sites in series or in small groups of sites. Design still lower downstream sites next, one tier at a time, treating all upper sites as already planned or existing structures until the design for the lowest site of interest in the system is complete.

You should make a schematic drawing of the system of sites and subareas as the first step in setting up a design run. In general the program permits only three locations or types of areas:

- sites or subareas directly on the main watercourse,
- sites or subareas on tributaries that may be added directly to the main watercourse, and
- sites or subareas on tributaries that can be routed to the main watercourse where they are accumulated with the other two types.

Route each subarea or site on the upper portion of a tributary individually to the main stem, unless using the SAVMOV control word.

Complex series routings with Integrated Development Environment

When complex series routings are done with the Integrated Development Environment (IDE), a stack is used to store hydrographs and the IDE tracks all the SAVMOV and ADDMOV operations automatically. Input data is ordered by the IDE (post order transversal) such that a last in/first out form may be used when moving hydrographs to and from the stack. The commands used in conjunction with the stack are given in table 4–4. If multiple hydrographs are being processed (PSH, SDH, FBH), all are moved with a single command (Temple and Neilsen, 2000). The label 101 is used to represent the stack as a storage location.

The operation control number (col. 11 of GO,ADDHYD or GO,REACH) associated with all subareas and sites on tributaries is *0*. It is also *0* for multiple subareas, sites, or reaches added at a common point on the main stem except for the last one added. The last one added must be a *1* or *2*. Whenever the next downstream operation is a REACH on a tributary or main stem, the operation control number is *1*. For main stem subareas and sites, when it is the only or last operation above a downstream site, it is *2*. The uncontrolled area associated with the downstream site (WSDATA) is added only when the operations control number is *2*.

Sample job 5 in appendix C illustrates a complex series routing easily handled by the program. The program reach routes and adds all sites and subareas or directly adds these hydrographs to the main stem without having to route more than one area through the same reach. Sample job 5 illustrates a series routing using the SITES IDE for managing data input. Complex watersheds are easily handled through the IDE.

Table 4–4 Complex series routing with the IDE

Command			Resulting action
SAVMOV	0	101	Places zeroes on top of stack. Command precedes elements having no inflow from upstream. Note that the label 0 denotes numeric zero rather than a source storage location.
SAVMOV	101	1 or 2	Moves top of stack to the appropriate registers. Top of stack at this point represents inflow to the following element. Command immediately precedes data for this following element. The label 1 indicates the destination register(s) appropriate for a watershed or structure element. 2 indicates the destination register(s) appropriate for a reach element.
SAVMOV	2	101	Moves outflow for the element from the appropriate registers to the top of the stack. Command always follows data for an element.
ADDMOV			Adds the hydrograph on the top of the stack to that immediately below it on the stack and places the result on the top of the stack. The stack height is reduced by one. Command used at points in the data where branches come together.

Complex series routings (continued)

Figure 4–8 shows various combinations of areas (these can be sites or subareas) and the required operation control numbers.

Tables 4–5 and 4–6 are included to provide an understanding of how the program stores and moves hydrographs internally. This information is helpful when developing a schematic for the more complex series routings.

Table 4–5, Hydrograph storage arrays, describes the 15 internal storage locations. Locations 1, 3, 5, 7, and 9 always store inflow hydrographs, each developed for a specific purpose. Locations 2, 4, 6, and 8 store hydrographs which also become inflow hydrographs to reach routings. Locations 10, 11, and 12 store outflow hydrographs from reach routings. Locations 13, 14, and 15 are the accumulation storages for adding to saved hydrographs. You must route the watershed in such a manner as to always save the resulting hydrographs in these accumulation storages.

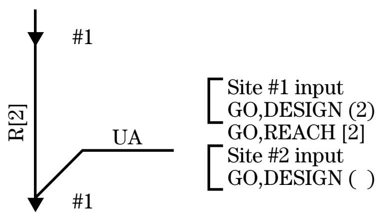
Table 4–6, Internal hydrograph procedures, displays the relation between the site type on the WSDATA control word record, the operations control number on the GO,ADDHYD and GO,REACH record, and the hydrograph storage arrays in table 4–5. The arrows indicate the internal direction of flow in the program from inflow hydrographs to temporary storage of the outflow hydrograph to final or alternate storage of the outflow hydrograph.

Verify that the areas are accumulating by checking the output for the accumulated drainage area of the total system. The accumulated drainage area shown on laterals include the drainage area of the entire system above that lateral. Zero peaked hydrographs and accumulations are not printed in the output where one of the individual hydrographs is a zero peaked hydrograph. If more detailed hydrograph data are desired, the TESTLIST option gives the inflow and outflow hydrograph coordinates along with the computed time increment.

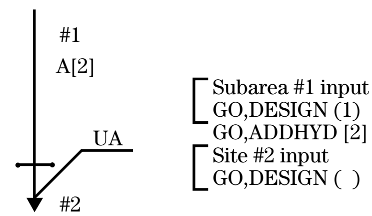
Baseflow will accumulate each time it is entered at a dam site or subarea. The accumulated amount is included in hydrographs routed through downstream reaches and structure sites. Quick return flow is only added at the lower site being designed.

The Modified Att-Kin routing coefficient "C" is computed by DAMSITE, and is not a user entered value. If the Modified Att-Kin routing coefficient "C" is equal to 1.0, the hydrograph is not routed through the reach, but is transferred through the reach with no change in discharge or time. This can occur either if the reach length is short or the time interval for the routing is long. This condition can occur frequently when routing principal spillway outflow hydrographs. When 10-day storms are routed, the time interval can be 1 hour or more. With this long a time interval, the "C" value can equal 1.0. For example, if the time interval is 1.0 hour, and if the travel time through the reach is 0.5 hour or less, then "C" equals 1.0 and the outflow hydrograph is assumed to be the same as the inflow hydrograph. Principal spillway outflow hydrographs are generally of long duration and have no sharply defined peak. These hydrographs

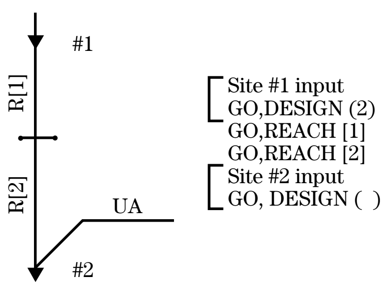
Figure 4–8 Typical combinations of systems of sites and subwatersheds



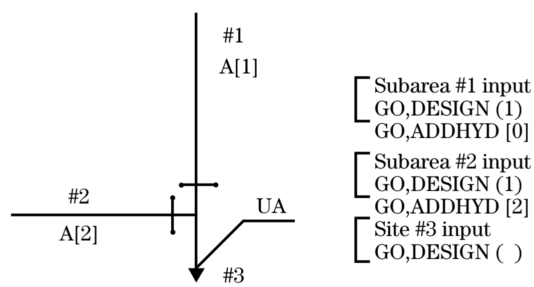
(a) 2 Sites: with one reach



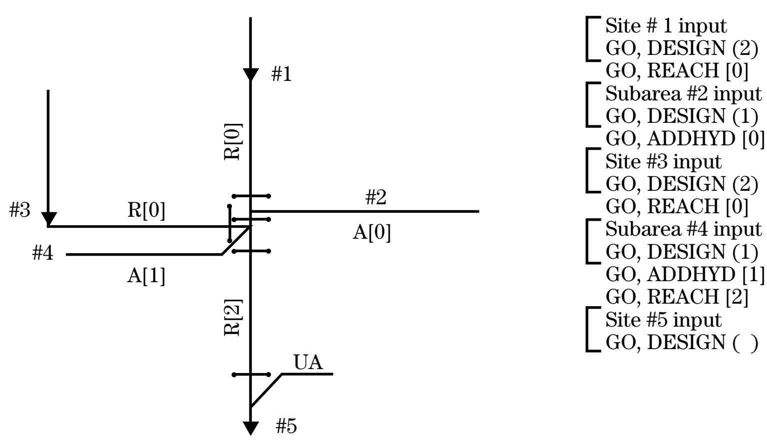
(b) 1 Site: subarea and uncontrolled area added



(c) 2 Sites: with 2 reaches



(d) 1 Site: 2 subareas and uncontrolled area added



(e) 3 Sites; 3 reaches, and 3 uncontrolled intervening areas

Legend

#1 = Site or subarea number (upper areas can be interchangeable)
(2) = Site type preceded by GO,DESIGN (1 = Null, 2 = Existing, Blank = design run)
[2] = Operation Control Number preceded by GO,ADDHYD or GO,REACH (A or R)
UA = Uncontrolled area of lower site being designed
▼ = Location of structure site

Table 4–5 Hydrograph storage arrays

Location no.	Description
1	Stores the principal spillway inflow hydrograph to a site.
2	Stores the principal spillway outflow hydrograph that becomes the inflow hydrograph for reach routing. Also stores the GO,STORM, GO,RAINS, and GO,HYD outflow hydrograph.
3	Stores the stability design inflow hydrograph to a site.
4	Stores the stability design outflow hydrograph that becomes the inflow hydrograph for reach routing.
5	Stores the freeboard inflow hydrograph to a site.
6	Stores the freeboard outflow hydrograph that becomes the inflow hydrograph for reach routing.
7	Stores the inflow hydrograph to a site developed by GO,STORM or GO,RAINS.
8	Temporarily stores the outflow hydrograph for all routings through a site. For sites in series the hydrographs are moved from 8 to 2, 4, 6, etc.
9	Stores the inflow hydrograph for the control word HYD and is used in a GO,HYD run.
10	Stores the principal spillway output hydrograph after reach routing. Also stores hydrographs for GO,STORM, GO,RAINS, and GO,HYD after reach routing.
11	Stores the stability design output hydrograph after reach routing.
12	Stores the freeboard output hydrograph after reach routing.
13	Stores the accumulated principal spillway hydrograph.
14	Stores the accumulated stability design hydrograph.
15	Stores the accumulated freeboard hydrograph.

Note: The program reserves only one set of storage locations for accumulation. You must route the watershed in such a manner as to always save the resulting hydrograph in 13, 14, or 15. Do this with GO,ADDHYD. Storage in 13, 14, and 15 permits the other arrays to hold data from other tributaries.

Table 4–6 Internal hydrograph procedures

Control word **(Operation control no.)** **Procedure** [1/]	**GO,DESIGN** **- - - -** [2/] **Inflow/Reach/Add**	**GO,REACH** **(0 or 2)** **Reach/Add/Accum**	**GO,REACH** **(1)** **Reach/Temp/Reach**	**GO,ADDHYD** **(0 or 2)** **Add/Accum**	**GO,ADDHYD** **(1)** **Add/Temp/Reach**
Hydrograph types	- - - - - - - - - - - - - - - - - - - -Hydrograph storage array locations - - - - - - - - - - - - - - - - - -				
PSH	1 → 2 & 10	2 → 10 → 13	2 → 10 → 2	10 → 13	10 → 13 → 2
STORM	7 → 2 & 10	2 → 10 → 13	2 → 10 → 2	10 → 13	10 → 13 → 2
HYD	9 → 2 & 10	2 → 10 → 13	2 → 10 → 2	10 → 13	10 → 13 → 2
SDH	3 → 4 & 11	4 → 11 → 14	4 → 11 → 4	11 → 14	11 → 14 → 4
FBH	5 → 6 & 12 [3/]	6 → 12 → 15	6 → 12 → 6	12 → 15	12 → 15 → 6

1/ Procedures are:

Inflow	=	Development of inflow hydrograph and routing it through a structure.
Reach	=	Routing a hydrograph through a reach.
Add	=	Positioning a hydrograph to be added to the accumulation arrays.
Accum	=	Accumulated hydrograph after addition.
Temp	=	Temporary storage array, the hydrograph is not retained.
→	=	Internal movement of the hydrograph, shown by storage locations for each procedure and operation control numbers by hydrograph type.

Hydrographs must be in 2, 4, and 6 to route through a reach; 10, 11, and 12 to add; and 13, 14, and 15 to accumulate.

2/ If operation control number = 2 on a GO,ADDHYD or GO,REACH immediately above a GO,DESIGN, uncontrolled area inflows are automatically added to 13, 14, and 15.

3/ Example: Using GO,DESIGN, the program develops the freeboard hydrograph in storage array 5. The program routes the FBH through the structure and stores the outflow hydrograph in 6, which is the proper storage location to initiate a reach routine. The program also stores the outflow hydrograph in 12, however, ready for accumulation in 15 if no reach routing follows.

Complex series routings (continued)

generally do not show any routing effect especially for a relatively long time interval. The warnings related to "C"=1.0 can be ignored in cases like this.

In some cases, you may find it desirable to use the NRCS TR–20, Computer Program for Project Formulation to develop tributary hydrographs. Enter these hydrographs using HYD with GO,DESIGN or GO,HYD. However, the program allows routing only one simulation storm in the system at a time with the GO,HYD control word.

Control words for systems

Control word descriptions in this section are arranged in alphabetical order on the following pages. They are also indexed in appendix E.

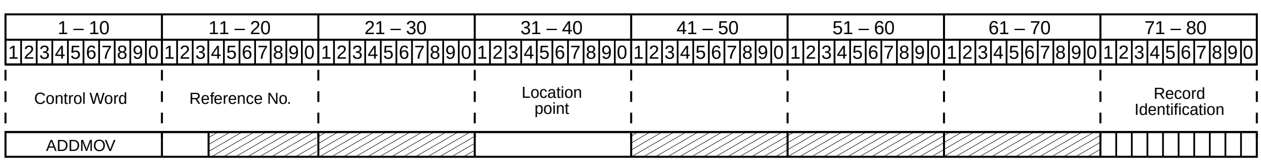
ADDMOV

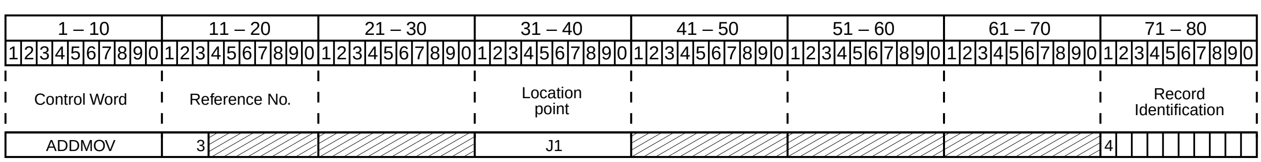
ADDMOV—Provides the means to add hydrographs at a bifurcation or junction point (also called a node) in the watershed where two elements come together when an ordered form of data input is used in conjunction with the stack storage of hydrographs. ADDMOV is used primarily in the SITES IDE where the data ordering and hydrograph management is performed by the IDE. Use of the stack (referred to as register 101) allows very complex watersheds to be analyzed systematically.

Data field	Value	Type	Description
Col. 11–13	1–199	N	Reference number of the bifurcation where watershed elements come together and the hydrographs are to be added.
Col. 31–40	Location Point	A	Name or number identifying the bifurcation point.

Note:
Entry of a reference number will cause a file to be generated using the name H(reference number).phy containing the results of the hydrograph addition. This file is used by the IDE for plot generation.

Example 4–42 ADDMOV—In sample job 5, the flows from watershed 2 and structure 256B4 are added together at J1.





GO,ADDHYD

GO,ADDHYD—Adds hydrographs together. The GO,ADDHYD initializes site data including the rainfall-runoff volume information and resets most program defined variables and coefficients to the program default values. It does not reset rainfall tables and any user defined dimensionless unit hydrograph tables. When GO,ADDHYD follows a GO,DESIGN, the program will accumulate up to three design hydrographs (principal, stability, and freeboard). When GO,ADDHYD follows GO,STORM, GO,RAINS, or GO,HYD, the program allows only one storm hydrograph to accumulate at a time.

Data field	Value	Type	Description
Col. 11	Operation control number	$I_x e$	Use of this operation control number is similar to that in GO,REACH. Enter one of the following numbers: **0 or blank**—Another site or subarea GO,ADDHYD will follow this GO,ADDHYD and the program will accumulate the hydrographs at the same point. **1**—This GO,ADDHYD is the last GO,ADDHYD before a GO,REACH routing. **2**—This subarea or site is the last one in series before routing through a downstream site. The program automatically adds uncontrolled area hydrographs to the accumulated hydrograph at the downstream site.

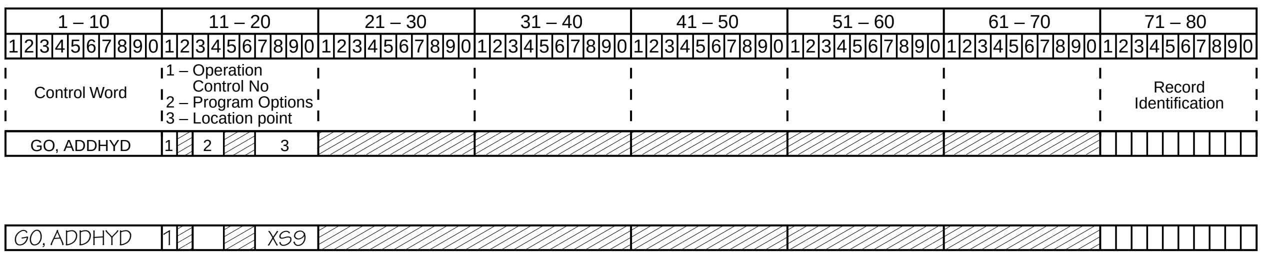
Note:
In design runs, the program automatically adds the principal, stability, and freeboard hydrographs to the accumulated values in storage whenever you enter GO,ADDHYD.

Data field	Value	Type	Description
Col. 13–14	Code letter for program options	A	Code letter(s) indicating the options in addition to the standard output: **I** – File of inflow hydrograph coordinates (10 column fields). **O** – File of outflow hydrograph coordinates (10 column fields). **B** – File of hydrograph coordinates in 12 column fields for TR–20. Use in combination with letters I and O to identify inflow and outflow hydrographs.

GO,ADDHYD (continued)

Data field	Value	Type	Description
Col. 17–20	Location point	A	Name or number for identifying the GO,ADDHYD location in the output. If left blank, the location point ID defaults to L 1, L 2, L 3, etc., based on the number of location points left blank in a run.

Example 4–43 GO,ADDHYD—Sample job 10 uses the GO,ADDHYD control word with an operation control number of one and a location point ID of XS9.



GO,REACH

GO,REACH—Control word to perform reach routing. When GO,REACH follows GO,DESIGN, the program reach routes the principal, stability, and freeboard hydrographs using the Muskingum-Cunge method by default or either the Modified Att-Kin or Convex methods, if they are specified. If GO,REACH follows GO,STORM, GO,RAINS, or GO,HYD, the program will reach route only one hydrograph at a time. You may enter the proper reach routing coefficients or insert a cross section rating table for the routing. The GO,REACH control word initializes site data including the rainfall-runoff volume information and resets all program defined variables and coefficients to program default values except rainfall tables and any dimensionless hydrograph tables you defined.

Data field	Value	Type	Description
Col. 11	Operation control number	I_xe	Enter one of the following operation control numbers: **0 or blank**—Another site or subarea will follow this reach routing and the program will accumulate the hydrographs to the same point. **1**—Another reach routing will follow this reach routing without adding additional lateral inflow. **2**—This reach routing is the only or last reach in series before routing through a downstream site. The program automatically adds uncontrolled area hydrographs to this reach routed hydrograph.

Notes:
1. In design runs, for values 0 or 2, the program automatically adds the reach-routed principal, stability, and freeboard hydrographs to the accumulated values in storage.

Data field	Value	Type	Description
Col. 13 –14	Code letter for program options	A	Code letter(s) indicating program options in addition to the standard output. Use blank if standard output is desired. **I** – File of inflow hydrograph coordinates (10 column fields). **O** – File of outflow hydrograph coordinates (10 column fields). **B** – File of hydrograph coordinates in 12 column fields for TR–20, use in combination with letters I and O to identify inflow or outflow hydrographs, or both. **L** – List of hydrographs as part of the output file.

GO,REACH (continued)

Data field	Value	Type	Description
			D – A very detailed output listing of intermediate computations for the Modified Att-Kin or Muskingum-Cunge reach routing methods.
Col. 16	Reach routing method	Ae	Enter one of the following letters to identify which reach routing method the program is to use: **M** = Muskingum-Cunge **A** = Modified Att-Kin method **C** = Convex method DAMSITE routines default to M. Entry of a value is recommended.

Notes: (continued)
2. The Muskingum-Cunge method is preferred for compatibility with other NRCS programs.

Data field	Value	Type	Description
Col. 17–20	Location point	A	Name or number for identifying the GO,REACH location in the output. If left blank, the location point ID defaults to L 1, L 2, L 3, etc., based on the number of blank location points in a run.
Col. 21–30	Cross section number	I	The cross section number to use for reach routing. The number must be in the range 1 to 200. If you enter routing coefficients, this field may be blank.

Notes: (continued)
3. If using cross section data, enter the cross section before the GO,REACH control word. Use the same cross section number used on the XSECTN or 2XSECTN table for retrieval.

Data field	Value	Type	Description
Col. 31–40	Reach length	Ne	Routing reach length in feet to be routed.
Col. 41–50	Convex coeff. "C"	N	Convex routing coefficient "C." Leave blank if using cross section.
	or		or
	Mod. Att-Kin "x"	N	Modified Att-Kin constant "x." Leave blank if using cross section.
	or		

GO,REACH (continued)

Data field	Value	Type	Description
	Musk.-Cunge Valley length	N	The valley length in feet to be used in the routing. Must be less than or equal to the reach length given in col. 31–40. Defaults to reach length if no value provided.
Col. 51–60	Mod. Att-Kin "m"	N	Modified Att-Kin power value "m." Leave blank if using cross section or convex routing coefficient.
Col. 61–70	Reach baseflow ft^3/s	N	Total baseflow (ft^3/s) included in hydrograph for this reach. If a previous reach has an identified baseflow, the program will add or subtract the difference between these baseflows to the inflow hydrograph (see note 5).

Notes: (continued)

4. If using routing coefficient(s) (col. 41–60), only enter values for the routing method selected. Leave other column(s) blank. The program requires both "x" and "m" for the Modified Att-Kin method.
5. The program does not identify or use baseflow in the Convex routing method. In the Att-Kin routing method, the program subtracts the total baseflow from the inflow hydrograph for the routing calculations and adds the baseflow to the outflow hydrograph. The Muskingum-Cunge routing assumes baseflow has already been added to the inflow hydrograph. After the routing is complete, the routed value is set to either the routed value or to the baseflow value, whichever is greater.

Example 4–44 GO,REACH—The reach data for sample job 5 call for Muskingum-Cunge routing to location Point S2. The operation control number is 2 because the reach is immediately above the lower site, and the program must add the uncontrolled area. You must enter stream cross section data for section 2 with a reach length of 6,000 feet.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	1 – Operation Contl. 2 – Program Options 3 – Routing Method 4 – Location point	Cross Section Number	Reach Length feet	Modified Att-Kin Routing: Musk.-Cunge Valley Length Coef. "x" Convex Coeff "c"	Modified Att-Kin Routing: Exponent "m"	Reach Baseflow cfs	Record Identification
GO, REACH	1 2 3 4						

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
GO, REACH	2 M S2	2	6000	5000			

SAVMOV

SAVMOV—Control word provides means to augment the internal hydrograph storage procedure. You may enter hydrograph storage location numbers to move a given hydrograph array from one location to another. This allows additional flexibility in modeling complex watersheds. See tables 4–5 and 4–6 for descriptions of the hydrograph storage locations and the internal procedures. SAVMOV will not change the internal procedures, it will only complement them. Check results carefully to see if routings and additions are as planned. The program version 96.0 and earlier programs allow only one hydrograph to be routed and saved using GO,DESIGN in a complex watershed. Later versions of the program allow routing of multiple hydrographs using stack storage (see note 4).

Data field	Value	Type	Description
Col. 11–15	From location no.	Ne	Original hydrograph storage location number.
Col. 16–20	To location no.	Ne	New hydrograph storage location number.
Col. 21–25	Element reference number	N	Element reference number used in output management by the Integrated Development Environment.
Col. 41–50	Element identification	A	Element identification used in output management by the Integrated Development Environment.

Notes:

1. Locations 1, 3, 5, 7, and 9 are for specific types of structure and subarea inflow hydrographs. Locations 2, 4, and 6 are for structure outflow hydrographs and inflow for reach routing. Locations 10, 11, and 12 are for reach outflow hydrographs and for hydrographs the program will add to the accumulation locations. Moving hydrographs into the accumulation locations 13 to 15 will destroy any hydrographs stored in them.
2. If you enter location 7 for a "To" location, the program automatically resets it to 9, the HYD location.
3. Do not use location 8, a temporary storage location for the structure outflow hydrograph, for the "To" location.
4. Location 101 indicates a stack location used by the Integrated Development Environment (IDE) to manage hydrograph storage directly. When the stack is used for hydrograph management, the following rules apply.
   a. The stack is initialized at the beginning of the file with the command: SAVMOV 0 101
   b. Each element of the series routing (subwatershed, reach, or structure) is initialized with the command: SAVMOV 101 x where x is equal to 1 for a subwatershed or a structure and 2 for a reach.

Data field	Value	Type	Description

SAVMOV (continued)

c. The stack is updated following routing through each element with the command: SAVMOV 2 101 y z where y is the element reference number, and z is the element identification.

d. The tree (watershed schematic) is traversed from top to bottom and left to right. Each time a bifurcation point is encountered from the left, the command: SAVMOV 0 101 is issued to initialize the top of the stack, and each time a bifurcation point is encountered from the right, the command: ADDMOV [y z] is issued to add the top hydrographs in the stack. The element reference number and element identification are not used in computations. Sample job 5 in appendix C contains the control words for IDE stack management for demonstration purposes.

Example 4–45 SAVMOV—Sample job 5 in appendix C uses the SAVMOV control word for stack management.

1 – 10	11 – 20		21 – 30		31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
Control Word	Hydrograph Storage Location From	To	Element Reference Number			Element Identification			Record Identification
SAVMOV									
SAVMOV	0	101							

XSECTN

XSECTN—Loads typical cross section data for a reach routing using 10 column field URB1 (NRCS, 1990) format. See 2XSECTN for alternate 12 column field TR–20 format. You must enter cross section data if routing coefficient(s) are not given on GO,REACH. Enter XSECTN data before the GO,REACH control word that they refer to.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	X-Section no.	Ie	Cross section ID number. Must be between 1 and 200 inclusively. ID number must match ID number on GO,REACH line for retrieval. Program allows a maximum of 200 cross sections (reaches).
Col. 21–30	Bank Full Elevation	N	The elevation in feet at which the channel is flowing full.
Col. 31–40	Low Ground Elevation	N	The elevation in feet of the low point in the valley if less than the bank full elevation.
Data Records 2–20			
Col. 21–30	Elevation	Ne	Elevation in feet corresponding to cross section discharge and end area on the same record. Enter elevations in increasing order and define the elevation-discharge-end area relationship as a series of straight line segments. If the maximum elevation is not high enough to obtain a solution, the program linearly extrapolates the last two points.
Col. 31–40	Discharge	Ne	Discharge in cubic feet per second corresponding to elevation given in col. 21–30. Cubic feet per second per square mile is not acceptable.
Col. 41–50	End Area	Ne	End area in square feet corresponding to elevation given in col. 21–30.

Notes:
1. The program allows a minimum of two records and a maximum of twenty data records to define the XSECTN data. Use only as many as necessary.
2. For accuracy in reach routing, at least two data records should define within-channel flow.

XSECTN (continued)

Data field	Value	Type	Description
Col. 51–60	Top Width	Ne	The width in feet of the section corresponding to the elevation given in col. 21–30.
Col. 61–70	Slope	Ne	The water surface slope in ft/ft at the elevation given in col. 21–30.

Notes: (continued)

3. Use of the Muskingum-Cunge reach routing method requires entries for top width in col. 51–60 for all elevations. At least one slope entry corresponding to the first elevation entry, is required in col. 61–70.
4. Use ENDTABLE to terminate the XSECTN table.

Example 4–46 XSECTN—This table in sample job 5 contains the elevation-discharge-end area data for routing through reach S2.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STREAM CROSS SECTION DATA

1-05

LOCATION ID ____ PREPARED BY ____ DATE ____ PAGE ____

JOB ____ CHECKED BY ____ DATE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Cross Section Number (001 to 200)	Bank Full Elevation feet	Low ground Elevation feet				Record Identification
XSECTN	2	588.3					
Control Word		Elevation feet	Discharge cfs	End Area square feet	Top width feet	Slope ft/ft	Record Identification
(maximum of 20 data records)		582	0	0	0	.0007	
		585.9	200	102	32	.0007	
		588.1	500	180	35	.0008	
		590.4	1000	368	137	.0008	
		592.6	2000	1196	519	.0007	
		594.1	3000	2031	564	.0005	
		595.3	4000	2706	584	.0004	
		596.3	5000	3327	601	.0003	
		598.2	7000	4468	631	.0003	
		599.6	9000	5394	655	.0003	
		601.4	12000	6616	685	.0003	
		603	15000	7670	710	.0003	
		605.2	20000	9341	819	.0003	
		607.3	25000	11108	846	.0003	
		609.2	30000	12773	872	.0003	
ENDTABLE							

2XSECTN

2XSECTN—This is a legacy control word not supported in SITES 2005. It loads typical cross section data for a reach routing using 12 column field TR–20 (WSP2 generated output file) format. See XSECTN for alternate 10 column URB1 (NRCS, 1990) format. You must enter cross section data if routing coefficient(s) are not given on GO,REACH. Enter 2XSECTN data before the GO,REACH control word that they refer to.

2XSECTN can only be used with the Modified Att-Kin reach routing method. This control word was used with 1992 and earlier versions of TR–20 and is not supported in SITES versions later than 2000.5.

Data field	Value	Type	Description
Data Record 1			
Col. 13–15	Cross section no.	Ie	Cross section ID number. Must be between 1 and 200 inclusively. ID number must match ID number on GO,REACH line for retrieval. Program allows a maximum of 200 cross sections (reaches).
Data Records 2–20			
Col. 25–36	Elevation	Ne	Elevation in feet corresponding to cross section discharge and end area on the same record. Enter elevations in increasing order and define the elevation-discharge-end area relationships as a series of straight line segments. If the maximum elevation is not high enough to obtain a solution, the program linearly extrapolates the last two points.
Col. 37–48	Discharge	Ne	Discharge in cubic feet per second corresponding to elevation given in columns 25–36. Cubic feet per second per square mile is not acceptable.
Col. 49–60	End Area	Ne	End area in square feet corresponding to elevation given in columns 25–36.

Notes:
1. The program allows a minimum of two records and a maximum of twenty records to define the 2XSECTN data. Use only as many as necessary.
2. For accuracy in reach routing, at least two data records should define within-channel flow.

Data field	Value	Type	Description

Notes: (continued)
3. Use an 9ENDTBL to terminate the 2XSECTN table.
4. The program uses only the above fields of the TR–20 cross section data. The others may be left blank or left as is from the TR–20 generated files.

2XSECTN (continued)

Example 4–47 2XSECTN—This table contains the same data for reach 18 as would be in a XSECTN table, except that the table itself is in the 2XSECTN format. The data fields do not require decimal points in SITES.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STREAM CROSS SECTION DATA

(TR–20 Format – 12 Column Data Fields)

4-95

CROSS SECTION NAME ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 12			13 – 24	25 – 36	37 – 48	49 – 60	61 – 72	73 – 80
Data Code		Table Name	Cross Section No.	Drainage Area sq. mi. * (use 1.0 if cfs)	Bankfull * Elevation–feet	Zero Damage * Elevation–feet	Low Ground * Elevation–feet	Record Identification
2		XSECTN	018					
*			(001 to 200)	Elevation feet	Discharge cfs or csm	End area square feet		Record Identification
8				637.5	0.0	0.0		
8				639.0	110	70		
8				641.0	400	160		
8				642.5	727	230		
8				643.4	858	790		
8				644.6	1040	2922		
8				644.9	1338	3744		
8				645.3	2230	5280		
8				645.8	2974	7180		
8				646.5	4758	10024		
8				646.9	5948	11860		
8				647.3	7732	13708		
8				647.6	8624	14972		
8				647.8	9814	16088		
8				648.3	11896	18620		
8				648.7	13383	20458		
8				649.0	14870	22006		
8								
8								
8								
9		ENDTBL	This record must be the last record of this table					

1. Maximum of 20 data records.
2. Data Fields in Col. 25 to 72 require decimal points.
3. * TR–20 Data Fields in Col. 25 to 72 on the 2 XSECTN record and Data Code 8 on the data records are not used in SITES. Discharge must be in cfs for SITES.

Alternative Input Possibilities

This section contains information on the control words that provide alternative ways to input similar types of data. Information is given on the differences and suggested use of each alternative. For more specific information on any control word, review the detailed descriptions of the data fields.

Structure data table

SITES requires this table for all types of runs where the program performs structure routing. The STRUCTURE table loads the elevation-area-capacity curve information. The minimum required information, when the program computes the discharge ratings for the structure spillways, is the elevation-surface area array. The program will compute the volume of storage from the surface areas. If you enter storage volume data directly, the surface area field may be left blank. If it is not entered, the program will output a surface area of zero. Find details on the computations in the STRUCTURE control word description.

You may enter the principal spillway or auxiliary spillway ratings, or both, on the STRUCTURE table. This is useful when ratings are known or when other control words cannot accurately represent the spillway's unusual configuration. Enter both the principal and auxiliary spillway ratings to the highest elevation of the STRUCTURE table.

Principal spillway ratings

To compute the principal spillway rating of a drop inlet structure, the program requires PSDATA and PSINLET. You may define single stage or two stage inlet spillways. The low stage of the two stage inlet is an orifice(s); the high stage is a weir(s). You may investigate both circular or rectangular conduits. The program uses standard hydraulic procedures to rate the spillway. The orifice flow must be less than the conduit capacity for proper rating.

The PSHOOD control word allows the program to develop ratings for hood inlet configurations. The program requires PSDATA to be used with PSHOOD.

The only way you may enter a known elevation-discharge rating for a principal spillway is by the STRUCTURE data table.

Auxiliary spillway ratings

Besides the STRUCTURE table, you may enter a known elevation-discharge rating for an auxiliary spillway by the ASRATING or the ASFILE control words.

The ASRATING enters a rating per foot of equivalent bottom width as a function of spillway head. This is useful if the crest elevation is not known and the final width might vary. The equivalent bottom width includes the actual bottom width plus a side slope correction (depth of flow times the side slope ratio).

SITES is distributed with an ASFILE that is loaded with ratings per foot of bottom width for small dams. The ratings are based on subcritical flow in the exit channel and vegetal retardance class friction factors.

The program will operate properly with only one ASFILE loaded. To load another ASFILE, insert it into the existing ASFILE or replace it.

The program requires that the ASDATA control word reference the ASRATING or ASFILE data to be retrieved. It also needs the ASCREST and BTMWIDTH control words to set the crest elevation and provide the bottom width information required for identification of the output.

SITES can compute the auxiliary spillway rating by several methods using the various AS- and the BTMWIDTH control words. The default method (WSPVRT) computes water surface profiles starting at the first supercritical slope and continuing upstream through the length of the spillway to the flood pool. Computations use the entire cross section width with a variable Manning's "n" value.

A second method (the frictionless side slope method) computes water surface profiles starting at critical depth at the specified control section and continuing upstream by a standard step method through the inlet channel to the flood pool. Computations are based on a foot of control section width, assuming frictionless side slopes and a constant Manning's roughness coefficient for the bottom. The output displays the preliminary results under Basic Data in the same format used by ASRATING. The program makes the side slope correction upon development of each rating table. This type of format allows the program to make many alternative auxiliary spillway runs without excessive calculations. You must enter an OFFWSPVRT control word to initiate the frictionless side slope method.

A third method of water surface profile computations (TRAPW) requires a TRAPW control word to initiate. TRAPW considers the entire cross section including side slopes in performing similar computations as described for the second method. Using TRAPW can increase the run time by a factor of four.

The detailed description of ASDATA gives the hierarchy that determines which auxiliary spillway discharge rating the program will select if you enter more than one of the above alternative methods in a run.

The ASDATA detailed description also contains table 4–3 and figure 4–2 illustrating the profile types, shapes, and identification numbers defined by the program.

Time of concentration

DAMSITE provides three methods to enter time of concentration (T_C) on WSDATA.

The first and most desirable is by entering the T_C directly. Compute T_C independently using the velocity method described in TR–55, chapter 3 (1986).

The other two methods require entries in two data fields to provide factors to compute T_C. The Kirpich equation requires watershed length and elevation difference in feet, and the TC–15.3 lag equation requires watershed length in feet and the watershed slope in percent. The

Kirpich method is not normally recommended. The TC–15.3 method is only recommended for small hydrologically homogeneous watersheds. Chapter 15, NEH 630 refers to the TC–15.3 method as the curve number method.

Rainfall-runoff input

PDIRECT is the most common method for entering rainfall data. The program assumes point rainfall data and performs all applicable adjustments except for storm duration corrections discussed in chapter 2, TR–60 and NEH 630, chapter 21. If using areal rainfall data, enter the AREACRCT record to suppress the areal correction when the drainage area exceeds 10 square miles.

If runoff volumes are known in place of rainfall, enter them by QDIRECT. Use this control word only for 10-day principal spillway hydrograph development unless the RAINTABLE data gives a runoff distribution.

The program can also calculate design rainfall amounts using the P100,PMP and the CLASS control word coefficients in the generalized NRCS design rainfall equation. This alternative is useful if the rainfall ratios will define an area where a local agency may wish to apply non-NRCS criteria.

SITES does not require a RAINTABLE for the 10-day PSH or for the pre-loaded standard NRCS 24-hour, rainfall distributions TYPE1, TP–1A, TYPE2, and TYPE3 usable for many SDH and FBH designs, or for the pre-loaded 6-hour rainfall distribution. It does require a RAINTABLE for all other rainfall or runoff distributions, synthetic or actual storms.

The program provides an alternative method to compute excess precipitation (runoff). The default method is the NRCS rainfall-runoff equation (curve number method) described in chapter 10, NEH 630. The initial abstraction (I_a) equals 0.2S, where S is defined as the potential maximum retention. With use of the Q,SCS control word, you may vary the ratio I_a/S to compute excess precipitation. The alternative method uses the Q,IA+I control word to trigger calculations by the initial abstraction-average infiltration method. Use of these alternative control words is not recommended in NRCS design or simulation runs.

Control words for alternative input

This section gives control word descriptions arranged in the order listed below. The control words are also indexed in appendix E.

ASFILE

ASFILE—Loads a new subcritical flow auxiliary spillway stage discharge record file for reference by ASDATA. You must load your ASFILE before the SITES control word. The program permits only one set of ASFILE records per run. Enter the following records if inserting additional records or substituting for the current ASFILE file. Only use the ASFILE control word on the header record in front of the data records. Only sites with A1 and S design class codes use the ASFILE.

Data Fields	Value	Type	Description
Data Records 1 to xxx			
Col. 1–2	Reference number	Ie	An auxiliary spillway channel bottom profile reference number. Current ASFILE uses 30 to represent subcritical flow in the exit channel and a level crest length.
Col. 3	Retardance	Ae	Retardance (A, B, C, D, or E) as defined in NRCS TR–61 (1954) or chapter 11, Engineering Field Handbook.
Col. 4–10	Crest length	Ne	Crest length. Current ASFILE is based on 25, 50, 100, or 200-foot level lengths.
Col. 11–20	Stage increment	Ne	The increment in feet of stage above the crest of the auxiliary spillway at which discharges are given.
Col. 21–80 by 5 col. fields	Q/BW	Ne	The discharge divided by the auxiliary spillway control section bottom width in cubic feet per second per foot at the various stages. Col. 21–25 is for a stage of 1 times the stage increment, col. 26–30 for 2 times the stage increment, etc. All 12 fields must have valid values. Do not complete the fields with zeros or blanks.
Data line xxx + 1			
Col. 2–10	End of file indicator	Blank or I (–)	Leave blank or insert any negative number to indicate the end the ASFILE. Current file uses –999.

ASFILE
(continued)

Data Fields	Value	Type	Description

Notes:
1. The program does not limit the maximum number of data records. Each data record is a unique AS stage-discharge file record.
2. The variables in col. 1–10 of ASFILE and col. 11–20 of ASDATA must be identical for retrieval.
3. The program can only retrieve ASFILE stage discharge records if you load the ASFILE ahead of the SITES control word. The current ASFILE is provided with the program and once loaded should not need to be reloaded.
4. The current ASFILE (reference No. 30) was developed from a compilation of about 3,000 ARS auxiliary spillway subcritical flow water surface profile computer runs made in 1979. The profiles were based on discharges from 20 to 500 cubic feet per second, bottom widths of 8 to 200 feet, side slope ratio of 3, level sections up to 200 feet, and exit channel slopes from 1 to 12 percent. Manning's "n" values were related to retardance by an approximate expression using velocity and hydraulic radius.
5. The total AS rating (Q_{AS}) is computed by the equation

$$Q_{AS} = q(BW + Zd)$$

where:
q = ASFILE discharge per foot of BW for depth (d)
BW = bottom width
Z = side slope ratio

The complete ASFILE provided with the program is shown on the following page.

Example 4–48 ASFILE—These records are from sample job 2 where ASFILE is loaded ahead of the SITES control word. The data record, 30D100, is called by ASDATA. This is for a pre-computed subcritical flow rating that has D retardance and a 100-foot level crest section. The provided ASFILE is loaded automatically in conjunction with the spillway profile reference number 30 and should reside in the same directory as the DAMSITE executable.

1 – 10	11 – 20	21 – 30		31 – 40		41 – 50		51 – 60		61 – 70		71 – 80	
1234567890	1234567890	1234567890		1234567890		1234567890		1234567890		1234567890		1234567890	
Control Word												Record Identification	
ASFILE													
1 – Reference No 2 – Retardance 3 – Crest Length	Stage Increment feet	Auxillary Spillway Discharge Rates cfs/ft of BW											
		q_1	q_2	q_3	q_4	q_5	q_6	q_7	q_8	q_9	q_{10}	q_{11}	q_{12}
1 2 3													
-999													

ASFILE													
30 D 100	0.2	0.02	0.06	0.14	0.58	1.15	1.81	2.59	3.54	4.65	5.94	7.42	9.08
-999													

Complete ASFILE

ASFILE

30E025	0.2	0.05	0.35	0.78	1.39	2.17	3.13	4.26	5.56	7.04	8.69	10.5	12.5
30E050	0.2	0.03	0.25	0.64	1.16	1.87	2.75	3.82	5.07	6.51	8.15	9.97	12.0
30E100	0.2	0.02	0.14	0.47	0.89	1.48	2.24	3.18	4.29	5.61	7.12	8.83	10.8
30E200	0.2	0.01	0.06	0.34	0.68	1.17	1.81	2.63	3.64	4.84	6.25	7.83	9.72
30D025	0.2	0.03	0.11	0.56	1.17	1.91	2.78	3.83	5.04	6.42	7.97	9.7	11.6
30D050	0.2	0.02	0.08	0.32	0.95	1.58	2.35	3.27	4.35	5.61	7.03	8.63	10.4
30D100	0.2	0.02	0.06	0.14	0.58	1.15	1.81	2.59	3.54	4.65	5.94	7.42	9.08
30D200	0.25	0.01	0.05	0.19	0.75	1.49	2.32	3.38	4.68	6.25	8.08	10.2	12.6
30C025	0.20	0.01	0.05	0.22	0.80	1.48	2.27	3.25	4.44	5.85	7.49	9.36	11.5
30C050	0.23	0.01	0.03	0.26	0.92	1.62	2.54	3.69	5.09	6.76	8.71	10.9	13.5
30C100	0.25	0.01	0.04	0.18	0.84	1.65	2.48	3.61	5.00	6.66	8.61	10.9	13.4
30C200	0.25	0.00	0.02	0.03	0.36	1.10	1.81	2.69	3.79	5.13	6.72	8.59	10.7
30B025	0.23	0.00	0.02	0.10	0.34	1.07	2.00	2.99	4.39	6.16	8.33	10.9	13.9
30B050	0.25	0.00	0.02	0.10	0.26	1.02	2.00	3.17	4.69	6.63	9.04	11.9	15.5
30B100	0.27	0.00	0.01	0.10	0.22	0.60	1.60	2.77	4.19	6.03	8.36	11.2	14.7
30B200	0.30	0.00	0.01	0.09	0.19	0.38	1.30	2.55	3.98	5.90	8.39	11.5	15.4
30A025	0.30	0.01	0.05	0.26	0.51	0.78	1.48	2.57	4.24	6.58	9.75	13.9	19.2
30A050	0.30	0.00	0.02	0.17	0.34	0.64	1.17	2.19	3.60	5.57	8.23	11.7	16.2
30A100	0.32	0.00	0.01	0.10	0.27	0.50	0.82	1.79	3.03	4.80	7.26	10.5	14.8
30A200	0.32	0.00	0.00	0.05	0.16	0.32	0.51	0.77	1.81	2.96	4.49	6.55	9.24

-999

ASRATING

ASRATING—Loads an auxiliary spillway rating curve in ft^3/s per foot of bottom width at the control section. The ASRATING must follow the ASDATA control word that refers to its reference number. The program assumes critical flow at the control section.

Data field	Value	Type	Description
Data Record 1			
Col. 11–20	Reference number	Ie	Rating curve identification number from 41 to 50. This number must correspond to col. 11–12 of the ASDATA line for retrieval.
Col. 21–30	Stage increment	Ne	The increment in feet of stage above the crest of the auxiliary spillway at which discharges are given.
Col. 31–70	Label	A	Any alphanumeric ID information.
Data Records 2 and 3			
Col. 1–10	ASRATING	Ae	Repeat control word ASRATING
Col. 11–70	Q/BW	N	The auxiliary spillway discharge rates at various stages divided by the control section bottom width in cubic feet per second per foot. Col. 11–20 is for a stage of 1 times the stage increment, col. 21–30 for 2 times the stage increment, and so on. All 12 data fields must have valid values. The values should represent stages in the reservoir (H_p) rather than depths at the control section.

Notes:

1. The program uses the ASRATING stage-discharge records to compute the capacity of the auxiliary spillway based on an equivalent bottom width. The formula used is:

$$Q_{AS} = q\left[BW + Z\left(\frac{q^{\frac{2}{3}}}{g^{\frac{1}{3}}}\right)\right]$$

where:
Q_{AS} = Total discharge at specific stage
q = Discharge per foot of bottom width from ASRATING
BW = Given control section bottom width
Z = Given side slope ratio
g = Gravitational constant

ASRATING (continued)

Data field	Value	Type	Description
	Notes: (contined)		

Notes: (contined)

2. The program designates the cubic feet per second per foot rating values printed in the Basic Data Table, similar to ASRATING data, as preliminary.

Example 4–49 ASRATING—This ASRATING is used for entering the auxiliary spillway rating for Site B in sample job 10. The reference number for the rating curve is 42, the same as on ASDATA. The stage increment is one foot and all 12 discharge values are given. The maximum depth at the 12th value of 116.7 cubic feet per second per foot is 12.0 feet.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Reference No 41 – 50	Stage Increment feet	Label Information				Record Identification
ASRATING							
Control Word	Auxillary Spillway Discharge Rates cfs/ft of BW (two data records)						
	q_1 / q_7	q_2 / q_8	q_3 / q_9	q_4 / q_{10}	q_5 / q_{11}	q_6 / q_{12}	
ASRATING							

ASRATING	42	1.0	Type 3 Profile				
ASRATING	1.83	6.30	12.5	20.2	28.9	38.8	
ASRATING	49.7	61.5	74.1	87.6	101.8	116.7	

KIRPICH

KIRPICH—Sets the program to use Kirpich's relationship when calculating the time of concentration. Col. 41–50 and 51–60 of the WSDATA control word must contain the watershed length and the watershed elevation difference, respectively. You must enter the KIRPICH control word to use Kirpich's relationship because the program defaults to the T_C-15.3 method.

The program uses the formula:

$$T_c = \frac{L^{1.1555}}{\left(7{,}700 \times H^{0.385}\right)}$$

where:
- T_C = Time of concentration in hours
- L = Watershed length in feet
- H = Watershed elevation difference in feet

TR–55 (1986), chapter 3, shows the recommended methods for computing the time of concentration. These methods or those in NRCS NEH 630, chapter 15, are recommended over the Kirpich method.

Example 4–50 KIRPICH

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
KIRPICH							

P100,PMP

P100,PMP—Calculates design rainfall amounts for your defined criteria with class coefficients. The program applies all areal and duration corrections to the computed rainfall values. P100,PMP applies only to class "C" and "S" (user defined) design class codes when the program computes the principal spillway hydrograph rainfall from the ratios in col. 41–60. If you give actual principal spillway hydrograph rainfall or runoff values, all classes apply (see note 2).

Data field	Value	Type	Description
Col. 11–20	C_i	N	Climatic index (NEH 630, chapter 21). See PDIRECT for additional information on use. Use 1.0 or leave blank if not applicable.
Col. 21–30	P100yr, 6-hr	Ne	100-year, 6-hour point rainfall in inches.
Col. 31–40	$PMP_{6\text{-hr}}$	Ne	Probable maximum precipitation 6-hour point rainfall in inches.
Col. 41–50	Ratio $P_{24\text{-hr}}/P_{6\text{-hr}}$	N	Ratio of 24-hour storm rainfall amounts to 6-hour storm rainfall amounts for the design PSH frequency.
Col. 51–60	Ratio $P_{10\text{-day}}/P_{24\text{-hr}}$	N	Ratio of 10-day storm rainfall amounts to 24-hour amounts for the design PSH frequency.

Notes:
1. Use P100,PMP only for a design run. It has no significance for a simulation run. Also do not use P100,PMP if rainfall values obtained from NWS publications already include areal corrections.
2. Columns 41–60 may be left blank providing the P100,PMP control word is followed by a PDIRECT or QDIRECT control word containing the principal spillway hydrograph rainfall or runoff values.
3. Use the CLASS control word with the P100,PMP control word to enter K_1 and K_2 coefficients as needed in the generalized design rainfall equation.
4. The P100,PMP control word is one of several alternative methods of specifying design rainfall (or runoff). If using the control words PDIRECT and/or QDIRECT with SDH and FBH amounts, do not use P100,PMP.

Example 4–51 P100,PMP—Site B in sample job 10 with a user defined class code "S" uses the P100,PMP and CLASS control words to provide the design SDH and FBH rainfall amounts for the site. The climatic index of 0.9 demonstrates the use of transmission losses.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Climatic index	100-Yr. 6–Hour Rainfall inches	PMP 6–Hour Rainfall inches	Ratio 24 Hour/6–Hour Rainfall Amounts	Ratio 10 Day/24–Hour Rainfall Amounts		Record Identification
P100, PMP							

P100, PMP	0.9	6.3	33.1	1.159	1.644		

PSHOOD

PSHOOD—Enters the required parameters for a hood pipe inlet principal spillway so the program can compute the principal spillway elevation-discharge rating. Replaces PSINLET. Must use in conjunction with conduit data on PSDATA. The elevation of the auxiliary crest should be above the elevation associated with slug flow for the spillway. The output includes this elevation when using HOODETL. Use HOODETL in at least one run to determine this elevation.

With unusual combinations of data input, the rating generated for the hood in versions of the program prior to December 1999 has been found to contain an incorrect discontinuity. This problem is identified by observing a reversal (decrease in discharge with an increase in head) in the rating in the output file. If this occurs, the user should first verify that the data has been input correctly and satisfies NRCS criteria. If the problem persists, the rating should be computed outside of the program and entered through the structure table. This is a bug that occurs rarely and has been corrected in version 99.1 or later of the program.

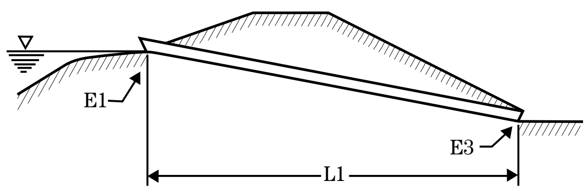
Data field	Value	Type	Description
Col. 11–20	Horz. distance inlet-bend	Ne	Horizontal pipe length from the inlet to the bend in feet. If there is no bend, use the total horizontal length to the outlet in this field.
Col. 21–30	Horz. distance bend-outlet	N	Horizontal pipe length from the bend to the outlet in feet. Leave blank if there is no bend.
Col. 31–40	Elevation pipe at bend	N	Elevation of the pipe invert at the bend, where the pipe changes slope. Must not be lower than the outlet elevation. Leave blank if there is no bend.
Col. 41–50	Elevation Pipe at Outlet	Ne	Elevation of the pipe invert at its outlet.
Col. 51–60	Circular Weir Inlet Coeff. C_e	N	Circular weir inlet edge coefficient. Default value of 0.6 (square edge). Use 1.35 for rounded edges.
Col. 61–70	Pipe Entrance Loss Coeff. K_e	N	Pipe entrance loss coefficient. Default value, 0.6 (box drop hood inlet). Use 0.83 for round edge concrete pipe. Values for CMP range from 0.9 to 1.1.

PSHOOD (continued)

Data field	Value	Type	Description

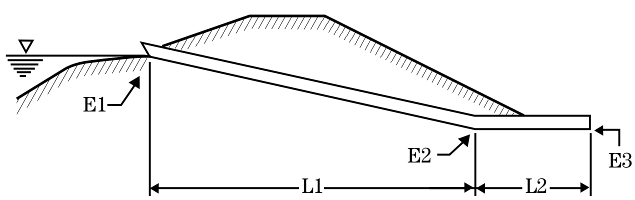
Notes:
1. The program uses data in columns 11 to 50 to calculate the actual slope length of the pipe (see fig 4–9).
2. You must use PSDATA with PSHOOD to provide the pipe parameters. If the hood is inside a box, develop the rating and enter it in the STRUCTURE table.
3. HOODETL will output a detailed list of parameter values, including coefficients, that the program uses in developing the ratings.
4. PSCOEFFS can be used to change the default values of the slug flow coefficient.
5. Discharge computation procedures are based on the research report by F.W. Blaisdell and C.A. Donnelly, 1958.
6. Using PSDATA with PSHOOD limits the number of pipes to 1 in versions of the program prior to December 1999.

Figure 4–9 PSHOOD control word entry definitions



Profile of principal spillway

L1 – Horizontal length of pipe from inlet to outlet
E1 – Elevation of pipe inlet
E3 – Elevation of pipe outlet



Profile of principal spillway

L1 – Horizontal length of pipe from inlet to bend
L2 – Horizontal length of pipe from bend to outlet
E1 – Elevation of pipe inlet (crest ps)
E2 – Elevation of pipe at bend
E3 – Elevation of pipe outlet

Example 4–52 PSHOOD—This PSHOOD control word in sample job 2 allows the program to develop the principal spillway rating.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
	Horizontal Pipe Length – ft		Elevation – ft		Coefficients		
Control Word	Inlet to Bend	Bend to Outlet	at Bend	at Outlet	Edge Weir Ce	Entrance Pipe Ke	Record Identification
PSHOOD							

PSHOOD	65	30	40.4	39.4	0.6	0.6	

Q,IA+I

Q,IA+I—Sets the program to calculate excess rainfall amounts by the initial abstraction-average infiltration method. This is an alternate method to the program default NRCS rainfall-runoff equation (curve number method). See also Q,SCS.

Data field	Value	Type	Description
Col. 21–30	I_a	Ne	The initial abstraction in inches.
Col. 31–40	Average infiltration rate	Ne	The average infiltration in inches per hour. Infiltration will be at this rate or the rainfall intensity, whichever is less, after the initial abstraction is exceeded.

Note:

The program will use Q,IA+I, once entered, to calculate excess rainfall-runoff amounts until you replace it by Q,SCS or until a GO,REACH, GO,ADDHYD, or SITES is encountered to reset it to the program default.

Example 4–53 Q,IA+I—This Q,IA+I control word sets the initial abstraction and the average infiltration rate for rainfall-runoff calculations.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Initial Abstraction inches	Average Infilitration inches/hour				Record Identification
Q, IA+I							

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
Q, IA+I		1.8	0.25				

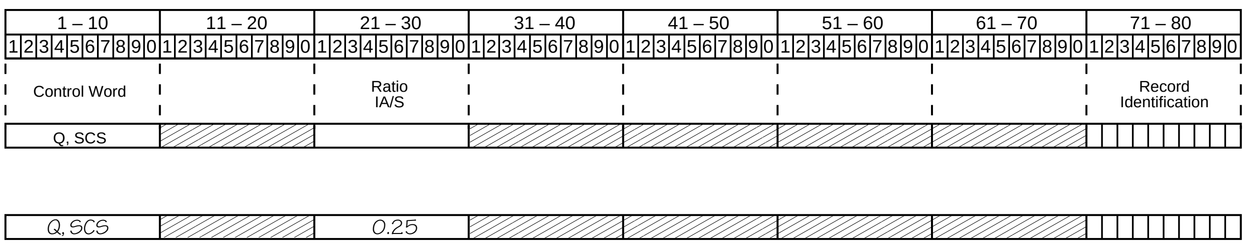
Q,SCS

Q,SCS—Sets the program to calculate excess rainfall amounts by the NRCS rainfall-runoff equation (curve number method) described in chapter 10, NEH 630. The program assumes this method with initial abstraction (I_a) = 0.2S.

Data field	Value	Type	Description
Col. 21–30	I_a/S	N	The ratio I_a/S used in the NRCS rainfall-runoff equation where S is the potential maximum retention. Maximum allowed is 1.0. Program assumes NRCS standard 0.2.

Note:
Use Q,SCS only to change the I_a/S ratio or to replace the control word Q,IA+I in the same computer run. The GO,REACH, GO,ADDHYD, or SITES control words will reset the program to the default described above.

Example 4–54 Q,SCS—This Q,SCS control word alters the I_a/S ratio to 0.25 for rainfall-runoff calculations.



T_C-15.3

T_C-15.3—Sets the program to use figure 15.3, NEH 630, when calculating the time of concentration. The program defaults to the T_C-15.3 method when both col. 41–50 and 51–60 of WSDATA contain values and the KIRPICH control word is not used. Use the T_C-15.3 control word only if the control word KIRPICH is in the same computer run to return to the T_C-15.3 method of calculating time of concentration.

Known as the lag equation or the curve number method in NRCS NEH 630, chapter 15, this method uses the formula:

$$T_c = \frac{\left[\dfrac{L^{0.8}\left(S+1\right)^{0.7}}{1,900Y^{0.5}}\right]}{0.6}$$

where:

T_C = Time of concentration in hours
L = Watershed length in feet
S = Potential maximum retention or $S = \dfrac{1,000}{CN} - 10$
CN = Curve number
Y = Average watershed land slope in percent

This method is only recommended for small, hydrologically homogeneous watersheds.

Example 4–55 T_C-15.3—Sample job 2 uses the T_C-15.3 method as the default since col. 51–60 of WSDATA contains a value and the KIRPICH control word was not used. The watershed length is 1,930 feet and the watershed slope is 2 percent on WSDATA.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
TC–15.3							

TRAPW

TRAPW—Selects the TRAPW method of water surface profile computations used for trapezoidal channels for computation of rating curves in the auxiliary spillway inlet, starting at critical depth. The method, adapted from the Corps of Engineers TRAPW computer program, is more accurate than the frictionless side slope method, but the computation time may increase significantly. The TRAPW method considers the effects of the whole section including side slopes. The method uses a constant "n" in the water surface profile computations and considers the inlet channel only. Use the default WSPVRT procedure to consider the effects of the exit channel and a variable Manning's "n" or vegetal retardance. After using TRAPW, turn it off by entering a WSPVRT, GO,ADDHYD, GO,REACH, OFFTRAPW, or SITES control word.

Data field	Value	Type	Description
Col. 11–20	Detailed computation list	I	Leave blank for normal output. Enter **1** if detailed listing is desired to check normal output results. Considerable output volume will result.
Col. 21–30	Number of Computation increments in reach	N	Leave blank if the present number of computation increments (2000) is adequate. Enter new number of increments (higher) if greater accuracy is desired or (lower) if less accuracy is more desirable. The program must use extremely small increments in the level crest reach to accurately project flow depths upstream from critical depth at the control section.

Notes:
1. Do not use the TRAPW procedure with profile reference number 30 or with spillways using the vegetal retardance class or curve index.
2. TRAPW only uses a constant Manning's "n" in the inlet channel. If you give multiple "n" values less than 1, the program assumes the "n" value of the constructed inlet channel or the "n" of the reach that includes the crest.

Example 4–56 TRAPW—Using this TRAPW control word will switch the water surface computation procedure from the default WSPVRT method to the requested TRAPW method using 2,000 computation increments. The "1" requesting detailed output will produce a volume of detailed output.

Warning: When you request the detailed computation list, the output from this control word may be greater than 80 columns in width.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Enter 1 for Detailed Output	Computation Increments					Record Identification
TRAPW							

TRAPW	1						

OFFTRAPW

OFFTRAPW—Turns off the TRAPW method of water surface profile rating curve computation for auxiliary spillways. The program reverts to the default WSPVRT method unless you enter another method. OFFTRAPW allows for more flexibility in alternate auxiliary spillway site studies within a DAMSITE run. To be effective, use OFFTRAPW with a separate alternate GO, control word that follows the TRAPW alternate.

Note:
You may also turn off the TRAPW procedure by entering a GO,ADDHYD, GO,REACH, or a new SITES control word.

Example 4–57 OFFTRAPW

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
OFFTRAPW							

Changes to Program Defined Input

This section contains the control words that you may enter to change variables and coefficients normally defined by the program. Find information on the specific data that you may change in the detailed descriptions of the control words. These descriptions also identify when you must re-enter all data field values on a record to avoid zeroing out the remaining values on that record.

Inflow hydrograph development

The NRCS revised its inflow hydrograph development procedure in 1989 and in 2004. The control words NEWHYD and OLDHYD allow switching between the 1989 and the pre-1989 procedures. The 2004 procedure is the default procedure in SITES 2005 and is recommended. The legacy control words NEWHYD and OLDHYD are no longer supported in SITES 2005.

You may replace the standard NRCS dimensionless unit hydrograph defined by 51 points with a user defined dimensionless unit hydrograph using a DIMHYD data table.

The control word STEPSTP allows you to set the number of increments to the peak of the unit hydrograph in the old hydrograph procedure, if the smoothness and accuracy of the composite hydrograph needs to be improved. The program default is five increments to the time of peak of the unit hydrograph.

Use the AREACRCT control word to override program default areal correction factors applied to point rainfall values. To enter new areal correction values, the special case climate zone should be number 4 on WSDATA. To suppress the areal corrections altogether, enter 1.0 for the corrections.

You may not employ the CLASS control word to alter the program defined constants from Chapter 2, TR–60 in the generalized rainfall equation for hydrologic design class codes "A1," "A2," "A3," or "B." You may enter CLASS, however, with design class code "S" to enter desired constants. You may also enter new constants when the P100, PMP control word controls the calculation of design rainfalls for class code "C."

Principal spillway flow

Use the PSCOEFFS control word to alter the standard coefficients used to compute orifice and weir capacity and the size of fillets in rectangular conduits.

Use the DDTESTS control word to change or set principal spillway drawdown computation limits. You may alter the standard 10-day time limit and ratio (0.15) of flood storage remaining to total routed flood storage at the time limit. DDTESTS will also alter these values for the freeboard (design) hydrograph when the NHCP–378 switch is on.

The PSFULL control word sets a switch that raises the minimum auxiliary spillway crest until the principal spillway closed conduit flows full.

Auxiliary spillway flow

You may alter the precision of the frictionless side slope method of water surface profile computations in the auxiliary spillway by using the WSPACCUR control word. The control word values set the maximum allowable changes in elevation and velocity in the computations. OFFWSPVRT allows you to use the alternate water surface profile calculation procedures while WSPVRT returns the program to the default method.

The ASINC control word provides a ratio to adjust the depth range of computed water surface profiles. This is especially useful with the frictionless side slope and TRAPW methods when expecting auxiliary spillway flow depths to exceed about 10 feet. ASINC also allows you to easily adjust the elevation range of the STRUCTURE table without re-entering it in multiple runs.

NEWCDEPTH (or OLDCDEPTH) allows you to switch between the new (1989) and old trial and error procedures for critical depth computations in the auxiliary spillway.

The BWDATA control word allows you to modify the conditions and precision when the auxiliary spillway bottom width is determined by the maximum exit channel velocity or effective stress options on the BTMWIDTH control word.

Output controls

Six control words are available for obtaining more extensive output from the DAMSITE routine. These will generally be of interest to advanced users wishing to examine some portion of the calculations. SHUTOFF controls the length of the hydrograph plot obtained with GO,STORMS, GO,RAINS, and GO,HYD control words. You may plot the entire hydrograph with a 0.0 shutoff value. NPOINTS allows you to set the number of design AS hydrograph points if the program default number of points is not adequate to define the hydrographs. TESTLIST provides detailed hydrograph data in table form. This table will supplement normal output to verify or analyze intermediate results. OEOVB provides detailed information on the computation of the volume of flow passing out the auxiliary spillway per foot of spillway bottom width.

HOODETL will give a listing of the PSHOOD hood inlet computation details. TRAPW also has a list switch for obtaining computation details. The use of these control words will add considerable output, but you may switch most of them off within a DAMSITE run.

The developers added three other control words to aid in debugging problems; they do not recommend them for normal use. DRAWDLIST gives detailed drawdown computations; PROFILELST gives details of the frictionless side slope method of water surface profile computations, and HDEVLST gives details of the old hydrograph development procedure. A switch on NEWHYD will give details of the hydrograph procedure. All give voluminous output and require a knowledge of the program coding to interpret.

The GRAPHICS control word provides condensed summary files of input, intermediate, and regular output. A separate program is required to interpret and plot the data. The NOGRAPHICS control word acts as a switch to discontinue GRAPHICS output.

Embankment quantities

The TEMPLATE, CROWN, and STABERM control words allow you to define the shape of the embankment cross section perpendicular to the CLPROFILE. Otherwise, the program uses the default template values for computation of embankment quantities.

Control words for changing defaults

This section contains control word descriptions arranged in order by types of parameter changes. The control words also are indexed in appendix E.

Control words	Page	Control words	Page
Hydrograph development		**Output controls**	
AREACRCT	4–156	DRAWDLIST	4–177
CLASS	4–157	GRAPHICS	4–178
DIMHYD	4–159	NOGRAPHICS	4–180
NEWHYD	4–161	HDEVLST	4–181
OLDHYD	4–162	HOODETL	4–182
STEPSTP	4–163	NOHOODETL	4–182
		NPOINTS	4–183
Principal spillway flow		OEOVB	4–184
ACCURACY	4–164	PROFILELST	4–185
DDTESTS	4–165	SHUTOFF	4–186
PSCOEFFS	4–167	TESTLIST	4–187
PSFULL	4–168		
		Embankment quantities	
Auxiliary spillway flow		CROWN	4–188
BWDATA	4–169	STABERM	4–189
ASINC	4–170	TEMPLATE	4–191
NEWCDEPTH	4–171		
OLDCDEPTH	4–172		
WSPACCUR	4–173		
OFFWSPVRT	4–175		
WSPVRT	4–176		

AREACRCT

AREACRCT—Allows you to enter areal rainfall correction factors when the drainage area exceeds 10 square miles and for special cases. These cases include user-defined correction factors to override program default values from chapter 2, TR–60; total watershed correction factors for systems of sites or subareas in series; factors for drainage areas greater than 100 square miles; and to suppress the areal corrections when they are already accounted for in the precipitation input (PDIRECT). The correction factors vary from 0.01 to 1.0.

Data field	Value	Type	Description
Col. 11–20	4	Ie	Enter **4**, the special case areal correction climate area zone number. This should agree with the climate area zone in column 11 in WSDATA.
Col. 21–30	PSH 1-day	N	Areal correction for the principal spillway hydrograph (PSH) 1-day storm point rainfall.
Col. 31–40	PSH 10-day	N	Areal correction for the 10-day storm point rainfall.
Col. 41–50	SDH & FBH	N	Areal correction for the stability design (SDH) and freeboard (FBH) hydrograph point rainfalls.

Notes:
1. If the drainage area for a site is greater than 100 mi^2 and you do not load special case correction factors with AREACRCT, the program uses the 100 mi^2 values from chapter 2, TR–60.
2. To suppress a program default correction value, enter 1.0 in the data field.
3. When used, enter all three values. A blank will zero out the rainfall. Reenter correction factors after GO,ADDHYD, GO,REACH, and GO,DESIGN control words.

Example 4–58 AREACRCT—The areal correction for the total watershed (14.8 mi^2) of sample job 10 is included in the PDIRECT values so the AREACRCT record is used with a climate area zone of 4 and corrections of 1.0 to suppress the program default values. However, because the uncontrolled area is less than 10 square miles, this control word is unnecessary.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Climate Area Zone (Use 4)	Area Correction Factors: PSH 1–Day	PSH 10–Day	SDH & FBH			Record Identification
AREACRCT							

AREACRCT	4	1.0	1.0	1.0			

CLASS

CLASS—Allows you to enter values of K_1 and K_2 for use in the generalized design rainfall equation:

$$PD = A\left[K_1\left(P100\right) + K_2\left(PMP - P100\right)\right]$$

where:

PD	=	the design rainfall in inches.
A	=	an adjustment factor incorporating areal corrections and storm duration extension if the time of concentration exceeds 6 hours (chapter 2, TR–60 and NEH 630, chapter 21).
P100	=	the 100-year, 6-hour point rainfall in inches (see P100,PMP).
PMP	=	the 6-hour point probable maximum precipitation in inches.
K_1	=	a constant that has a value of 0.0 or greater; for NRCS criteria applications the default value of K1 is 1.0.
K_2	=	a constant that has a value of 0.0 or greater. Table 2–5, TR–60, uses minimum NRCS K2 values.

Use CLASS only if design rainfalls are entered on the P100,PMP control word. See P100,PMP for limitations in its use.

Data field	Value	Type	Description
Col. 11–20	Constant K_1–PSH	N	K_1 for NRCS principal spillway hydrograph.
Col. 21–30	Constant K_1–SDH	N	K_1 for NRCS stability design hydrograph.
Col. 31–40	Constant K_1–FBH	N	K_1 for NRCS freeboard hydrograph.
Col. 41–50	Constant K_2–PSH	N	K_2 for NRCS principal spillway hydrograph.
Col. 51–60	Constant K_2–SDH	N	K_2 for NRCS stability design hydrograph.
Col. 61–70	Constant K_2–FBH	N	K_2 for NRCS freeboard hydrograph.

Note:

If principal spillway hydrograph design rainfalls or runoffs are input using the PDIRECT or QDIRECT control words following the P100,PMP control word, then the CLASS control word is not needed. The program uses the default constants for K_2 in table 2–5, TR–60 to calculate the SDH and FBH rainfall when CLASS is not entered. When using CLASS enter only the needed constants.

Example 4–59 CLASS—Site B of sample job 10 uses CLASS with coefficients as entered below. The coefficients will produce design rainfalls greater than the minimum NRCS criteria.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Design Rainfall Equation Constants						Record Identification
	K_1 for PSH	K_1 for SDH	K_1 for FBH	K_2 for PSH	K_2 for SDH	K_2 for FBH	
CLASS							

CLASS				0.0	0.3282	1.0	

DIMHYD—Enters coordinates of a user defined dimensionless unit hydrograph, if you desire to replace the standard NRCS dimensionless unit hydrograph defined in the program.

DIMHYD

Data field	Value	Type	Description
Data Record 1			
Col. 21–30	Peak factor	Ne	The value of k in the peak rate equation q = (kAQ)/Tp. See chapter 16, NEH 630.
Col. 31–70	Label	A	The label and description of the unit hydrograph.
Data Records 2–20			
Col. 21–70 by 10 col. fields	Unit discharges	Ne	The dimensionless discharges recorded at a uniform dimensionless time increment. The peak should have a value of 1.00 and the base time should add up to 1.00.

Notes:

1. Use only the number of data records needed, maximum is 20 records.
2. The program will compute but not revise the Peak Factor to correspond to the ratio of the volume to the peak to the total volume of the DIMHYD values entered. The program will compare the computed factor with the given factor. If not equal, you should examine the cause of the difference.
3. The SITES control word restores the program defined dimensionless hydrograph. If you still want to use the nonstandard DIMHYD, it must be reentered.
4. The standard NRCS dimensionless hydrograph, described in NEH 630, chapter 16, has a peak factor (k) of 484 with 100 discharge points at a time increment of 0.02. For most NRCS uses, this standard dimensionless hydrograph is adequate and does not need to be entered because it is defined by the program.
5. Use ENDTABLE to terminate the DIMHYD table.

Example 4–60 DIMHYD—This DIMHYD table is the standard NRCS DIMHYD table defined in the program.

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NATURAL RESOURCES CONSERVATION SERVICE

DIMENSIONLESS HYDROGRAPH

2-95

LOCATION ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Peak Factor	Label				Record Identification
DIMHYD		484.0	Standard NRCS DIMHYD Table				
		Enter successive entries left to right with initial entry for time = 0					Record Identification
(maximum of 20 data records)		0.0	.030	.100	.190	.310	
		.470	.660	.820	.930	.990	
		1.000	.990	.930	.860	.780	
		.680	.560	.460	.390	.330	
		.280	.241	.207	.174	.147	
		.126	.107	.091	.077	.066	
		.055	.047	.040	.034	.029	
		.025	.021	.018	.015	.013	
		.011	.009	.008	.007	.006	
		.005	.004	.003	.002	.001	
		0.0					
ENDTABLE							

NEWHYD

NEWHYD—This is a legacy control word not supported in SITES 2005. It sets the inflow hydrograph generation procedure to that procedure used in the program from 1989 to 2004. The 1989 procedure provided a better balance to the design need for peak runoff for large outflow-small storage structures with the runoff volume needs for small outflow-large storage structures than did the pre-1989 procedure. With NEWHYD, inflow hydrographs (peak and volume) should be similar to those of other revised NRCS hydrologic programs, including TR–20 and TR–55. You normally enter NEWHYD to compare results after running an alternative including the OLDHYD control word. To be effective, enter NEWHYD with a separate alternative GO, control word that follows the OLDHYD alternative.

Data field	Value	Type	Description
Col. 11–20	Hydrograph details	I	Leave blank for normal output. Enter **1** if a detailed listing is desired to check the 1989 hydrograph development procedure. Considerable output will result.

Notes:
1. A new SITES control word will automatically terminate the OLDHYD procedure.
2. An alternate use of NEWHYD is to turn on and off the detailed hydrograph listing.

Example 4–61 NEWHYD—Normal output using the new hydrograph generation procedure will result from this NEWHYD control word.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word	Enter 1 for Hydrograph Details						Record Identification
NEWHYD							

NEWHYD							

OLDHYD

OLDHYD—This is a legacy control word not supported in SITES 2005. It selects the original DAMS2 procedure for inflow hydrograph generation, contained in program versions prior to 1989. The old procedure was primarily designed for conserving runoff volume in routing small outflow-large storage volume structures. This procedure was replaced in 1989 by a new procedure, which itself was updated in 2004 by that in WinTR-20 which is now the program default. To change procedures after using the 1989 procedure, use OLDHYD with a separate alternative GO, control word.

Notes:

1. A new SITES control word terminates the OLDHYD procedure.
2. See the HDEVLST control word to obtain detailed listing of the original hydrograph development procedure.

Example 4–62 OLDHYD

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
OLDHYD							

STEPSTP

STEPSTP—This is a legacy control word not supported in SITES 2005. It does not apply to the default hydrograph generation procedure and its use is not recommended. It allows you to set the number of increments to the peak of a unit hydrograph in the old (pre-1989) hydrograph development procedure. Controls the smoothness and accuracy of the composite hydrograph. Program assumes five increments, but allows a maximum of ten. The minimum number of steps should be four.

Data field	Value	Type	Description
Col. 11–20	Number	Ie	The number of steps to the peak of unit hydrograph.

Notes:

1. Use STEPSTP only if you are not satisfied with five time increments to the peak of the unit hydrographs.
2. No change in the unit hydrograph will result unless the minimum number of steps is exceeded as calculated by the formula:

$$\text{Minimum Number Steps}=\left(\frac{1.05\ T_c}{\Delta P}\right)$$

where:

T_C = Time of concentration in hours.

ΔP = Increment of time in hours used in defining the rainfall distribution. It is obtained by dividing the rainfall duration by the number of points in the RAINTABLE minus one.

3. This control word should not be used with the default hydrograph generation procedure in SITES 2005.

Example 4–63 STEPSTP—In this example, the number of increments to the unit hydrograph peak is 10.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Number of Steps to Peak of Unit Hydrograph						Record Identification
STEPSTP							

STEPSTP	10						

ACCURACY

ACCURACY—Sets the elevation tolerance to satisfy the trial and error procedures that determine the reservoir elevations associated with full orifice flow and full pipe flow. The program uses these elevations in developing the elevation-discharge rating of the principal spillway. The ACCURACY value will affect run time as well as accuracy of the rating. The larger the value, the faster the run time and the less accurate the elevations. Because the program shows rating table elevations only to hundredths, accuracy values smaller then 0.001 are not practical.

Data field	Value	Type	Description
Col. 11–20	Elevation difference feet	Ne	The program requires a positive value for the minimum acceptable elevation difference in feet in the PS trial and error procedures to compute full orifice flow and full pipe flow elevations. The program default is 0.01 feet. Any value entered greater than zero will be used.

Example 4–64 ACCURACY—The example shows an elevation difference of 0.02 foot. This will result in a faster run time for the job, but less accuracy in the rating.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	PS Full Flow Computations Δd – feet						Record Identification
ACCURACY							

ACCURACY	0.02						

DDTESTS

DDTESTS—Enters variables to control drawdown computations for the principal spillway allowing you to change the program default values. These variables apply primarily to GO,DESIGN, GO,DRAW, and GO,TDD control words.

Data fields	Value	Type	Description
Col. 11–20	Time limit days	N	Drawdown time limit in days. If exceeded, the program uses elevation of drawdown at the time the limit is exceeded to start routing the stability design and freeboard hydrographs. If left blank or zero, program assumes TR–60 value of 10 days.
Col. 21–30	Ratio storage	N	Ratio of floodwater storage remaining after drawdown time to total routed floodwater storage. If ratio is not reached within time limit, program adds the remaining storage to the total to raise the crest of the auxiliary spillway. Program assumes TR–60 value of 0.15 or NHCP–378 value of 0.0. This ratio does not set start routing elevation for SDH and FBH. For use with GO,DRAW, see note 3.
Col. 31–40	Ratio primary head	N	Ratio of remaining floodwater pool stage after drawdown time to stage for full conduit flow of single stage inlets. Program assumes 0.00.
Col. 41–50	Ratio to orifice height	N	Ratio of remaining floodwater pool stage after drawdown time to height of orifice for two-stage inlets. Program assumes 0.00.
Col. 51–60	Ratio to QRF	N	Ratio of structure discharge (outflow) to quick return flow (QRF). Program assumes 1.00.
Col. 61–70	Ratio to peak outflow	N	Ratio of structure discharge (outflow) to peak outflow. Program assumes 0.00.

DDTESTS (continued)

Data field	Value	Type	Description

Notes:
1. TR–60 drawdown computations begin with the water surface of the reservoir at the maximum elevation during passage of the PSH and continue to the elevation corresponding to the time limit or the maximum elevation from the application of the last four ratios. This maximum elevation (storage remaining), if not within the specified time limit, is a factor in determining the start routing elevation of the stability design and freeboard hydrographs. If the time limit is not reached, routing will continue until the time limit is reached. If storage limit is not reached within the time limit, the routing will continue up to a maximum of 30 days.
2. NHCP–378 drawdown computations differ in that computations are for the freeboard (design) hydrograph instead of the PSH used in TR–60. If a PSH is used, the drawdown computations are for informational use only. The NHCP–378 computations start at the crest of the auxiliary spillway or the maximum water surface of the routed FBH if lower. If the drawdown is not within the time limit in col. 11 to 20, reroute the site, starting the design hydrograph (FBH) at the elevation of the drawdown time limit.
3. When using GO,DRAW, the program assumes the ratio of storage (col. 21–30) is 0.0, unless you enter a DDTESTS record for the site ahead of the GO,DRAW.
4. Enter only the values to be changed; blanks instruct the program to use default values for the parameters.
5. The ratios in columns 31–70 are not part of NRCS TR–60 or NHCP–378 criteria. Their use as criteria is at the discretion of the user.

Example 4–65 DDTESTS—This example is for site C of sample job 10. The DDTESTS control word changes the time limit to 12 days. The remaining storage ratio is 0.20. The program assumes the default value of 1.0 for the ratio to QRF, and the other parameters remain at zero defaults since there are no entries.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Drawdown Time Limit days	Ratio Storage Remaining to Total Storage	Ratio Remaining Pool Stage to stage Full Conduit Flow	Ratio remaining Pool Stage to Orifice Height	Ratio Remaining Structure Discharge to QRF	Ratio Remaining Structure Discharge to Peak Outflow	Record Identification
DDTESTS							

DDTESTS	12.0	0.20					

PSCOEFFS

PSCOEFFS—Allows you to change the defaults for principal spillway inlet flow coefficients. The program uses the coefficients when computing rating curves.

Data field	Value	Type	Description
Col. 11–20	Blank	–	–
Col. 21–30	Orifice weir flow coeff. (low stage)	N	The discharge coefficient for calculating weir flow over the low stage principal spillway inlet. Program assumes 3.1.
Col. 31–40	Orifice flow coeff. (low stage)	N	The discharge coefficient for calculating full orifice flow. Program assumes 0.6.
Col. 41–50	Weir flow coeff.	N	The coefficient for computing weir flow over the principal spillway drop inlet. Program assumes 3.1.
Col. 51–60	Fillet size	N	The size of the fillet in inches for rectangular principal spillway conduits. Program assumes 6 inches.
Col. 61–70	Slug flow coeff.	N	Coefficient C_s for computing slug flow in a hood inlet pipe spillway. Coefficient range is 1.0 to 1.6. The program assumes the following based on the roughness of the pipe: C_s = 1.05 for "n" $\leq$ 0.01 C_s = 1.05 + 51(n – 0.01) for 0.01< "n" < 0.02 C_s = 1.56 for "n" $\geq$ 0.02

Note:

Use PSCOEFFS only if changing any of the default values indicated. Enter only the parameters to be changed; blank values will remain at default values. Use PSCOEFFS with design and simulation runs.

Example 4–66 PSCOEFFS—Site B, sample job 10 uses this example PSCOEFFS control word to change the orifice coefficient from 0.6 to 0.65 and the rectangular conduit fillet size from 6 to 8 inches. The weir coefficients remain 3.1 because the data fields are blank.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word		Low Stage Orifice Weir Coeff.	Orifice Coeff.	Drop inlet Weir Coeff.	Conduit Fillet Size inches	Hood inlet Slug Flow Coeff.	Record Identification
PSCOEFFS							
PSCOEFFS			0.65		8.0		

PSFULL

PSFULL—Sets the program so that during design runs the principal spillway closed conduit will flow full with the water surface at the auxiliary spillway crest. Once used, PSFULL remains in effect until the next SITES, GO,REACH, or GO,ADDHYD is reached.

Note:

If using PSFULL and the conduit fails to flow full, the program raises the auxiliary spillway crest to make it flow full. The program ignores PSFULL if you load the principal spillway rating in the STRUCTURE data table.

Example 4–67 PSFULL

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word							Record Identification
PSFULL							

BWDATA

BWDATA—Allows you to specify precision controls for determining auxiliary spillway bottom width when entering the maximum velocity or allowable effective tractive stress in the exit channel on the BTMWIDTH record. The default values will cause the program to converge on the proper bottom width with reasonable accuracy and run time within the range specified.

Caution: You should be familiar with the hydraulic relations involved before replacing the default value for Precision. Also, note that the relative convergence in bed width may be less than the relative convergence of velocity or stress.

Data field	**Value**	**Type**	**Description**
Col. 11–20	Blank	–	–
Col. 21–30	Min. BW	Ie	The minimum acceptable control section bottom width in feet. Program assumes 20 feet.
Col. 31–40	Precision	N	Precision of calculated bottom width in feet. Program assumes one foot.

Notes:
1. Use BWDATA only when specifying exit channel velocity or allowable effective tractive stress with BTMWIDTH. The program does not use it if you only specify bottom width in feet with BTMWIDTH. Also, note that BWDATA is not necessary if you accept the program default values indicated in the description.
2. The program will try up to 150 iterations to compute the bottom width for a specified tractive stress or allowable velocity. If the 150th trial does not produce the requested accuracy, the output will contain a warning and the results will be based on the bottom width of the last trial. If the accuracy ratio is not close enough, change the precision if warranted, and rerun.
3. When using BWDATA, enter only the values that differ from the default values.

Example 4–68 BWDATA—This BWDATA control word would change the precision controls to compute the auxiliary spillway bottom width.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Minimum Bottom Width feet	Precision of BW Computation feet				Record Identification
BWDATA							
BWDATA		10	2.0				

ASINC

ASINC—Provides a factor to increase or decrease the standard stage increments to change the total elevation range of the auxiliary spillway discharge rating table. ASINC is used by the frictionless side slope, TRAPW, and WSPVRT water surface profile methods. The highest elevation in the STRUCTURE table controls the range of elevations in the rating table. ASINC eliminates the need to reenter the STRUCTURE table to change its maximum elevation. To obtain full benefit of the ASINC ratio, the maximum elevation should approximate the expected stage associated with the maximum design flow.

Data field	Value	Type	Description
Col. 11–20	Stage increment multiplier	Ne	An increment multiplier to increase or decrease the stage range of auxiliary spillway ratings that the program develops from water surface profile computations. Normally this multiplier is in the range of 0.5 to 2.0.

Notes:

1. When expected design flow depths exceed 10 feet, use a ratio value greater than 1.0 to increase the stage range to avoid linear extrapolation of the rating. When expected design flow depths are 5 feet or less, use a value less than 1.0 to decrease the stage range to provide better definition of the rating curve.
2. The program uses the following standard stage increments:
   - Frictionless side slope method—1.0 foot increments with a maximum reservoir stage of 12 feet above the AS crest.
   - TRAPW method—1.0 foot increment with a maximum critical depth of 12 feet at the control section.
   - WSPVRT method—Variable increments, 12 values depending directly on the highest elevation in the STRUCTURE table.

Example 4–69 ASINC—In this example, the increment multiplier 1.5 would increase the stage range of the auxiliary spillway discharge rating table.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Stage Increment Multiplier						Record Identification
ASINC							
ASINC	1.5						

NEWCDEPTH

NEWCDEPTH—This is a legacy control word not supported in SITES 2005. It returns the critical depth computation procedure for auxiliary spillway flow to the revised default procedure (in program versions 1989 and later) after the program uses the original DAMS2 procedure (OLDCDEPTH) in a run. You would normally enter NEWCDEPTH to compare results after an alternative including the OLDCDEPTH control word is run. To be effective, use NEWCDEPTH with a separate alternative GO, control word that follows the OLDCDEPTH alternative.

Data field	Value	Type	Description
Col. 11–20	Critical depth details	I	Leave blank for normal output. Enter **1** to obtain detailed listing to check the new critical depth computation procedure. Considerable output will result.

Notes:

1. An alternative use of NEWCDEPTH would be to turn on and off the detailed output of the new critical depth computation.
2. The new procedure is a trial and error solution for critical depth based on the general critical flow equation:

$$\frac{Q^2}{g} = \frac{a^3}{T}$$

where:
Q = Given discharge, ft^3/s
g = Acceleration of gravity, ft/s^2
a = Area of cross section at critical depth, ft^2
T = Water surface top width at critical depth, ft

3. The new procedure is more accurate with narrow auxiliary spillway bottom widths because the method accounts for the side slopes in the area and top width computations. For wide spillways, you will notice almost no difference in results between the two procedures.

Example 4–70 NEWCDEPTH—In this example, the NEWCDEPTH control word requests normal output.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Critical Depth Details						Record Identification
NEWCDEPTH							

NEWCDEPTH							

OLDCDEPTH

OLDCDEPTH—This is a legacy control word not supported in SITES 2005. It selects the original critical depth computation procedure for auxiliary spillway flow used in program versions prior to 1989. Use NEWCDEPTH to return to the new procedure. A new SITES will also restart the new procedure. Use OLDCDEPTH to compare results with the new procedure.

Data field	**Value**	**Type**	**Description**
Col. 11–20	Critical depth details	I	Leave blank for normal output. Enter **1** to obtain detailed output of original critical depth computation procedure. Considerable output will result.

Notes:

1. An alternative use of OLDCDEPTH would be to turn on and off the detailed output of the original critical depth computation.
2. The original procedure is a trial and error solution for critical depth to within 1/1000 of a foot, based on a rectangular cross section formula for critical discharge:

$$q_c = \left(g \times d_c^3\right)^{0.5}$$

where:
q_c = Critical discharge, per unit width, ft^3/s per ft
g = Acceleration of gravity, ft/s^2
d_c = Critical depth estimate, ft

Then the program computes the total discharge by multiplying the adjusted width times q_c:

$$Q_T = \left(BW + Z \times d_c\right) q_c$$

where:
Q_T = Total discharge of the spillway, ft^3/s
BW = Bottom width of the spillway, ft
Z = Side slope ratio

3. The program compares the total discharge at the trial depth with the given discharge until a match is found, which determines the critical depth.

Example 4–71 OLDCDEPTH—In this example, the OLDCDEPTH control word requests normal output.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Critical Depth Details						Record Identification
OLDCDEPTH							

OLDCDEPTH							

WSPACCUR

WSPACCUR—Sets the values of test variables to control the precision of auxiliary spillway water surface profile calculations. This record is needed to change the default parameters indicated. If changing any one value, the other values may be left blank to use the defaults. The program uses the values in columns 21–40 in the frictionless side slope method and the value in columns 41–50 in the WSPVRT method.

Data field	Value	Type	Description
Col. 21–30	Delta elevation	N	The maximum allowable difference in feet between the calculated and the estimated water surface elevation at any section. The program assumes 0.005 feet.
Col. 31–40	Delta velocity ratio	N	The maximum allowable change in average velocities between adjacent upstream and downstream sections, expressed as a ratio of the average velocities at the sections. The program assumes 0.05.
Col. 41–50	Base value Manning's "n" vegetation	N	Base value or minimum value of Manning's "n" in the inlet and exit channels when the program converts a vegetal retardance curve index to flow resistance. The program also uses this value as a minimum value of "n" in eroding areas. The default is 0.02; the minimum value is 0.015 and the maximum value is 0.1.

Notes:
1. If the soil grain roughness (computed from particle diameter) is greater than this entered base value, the program uses the soil grain roughness as the minimum "n" value in the exit channel and on eroding surfaces.
2. The base value of "n" does not apply to backwater or exit channel velocity computations when you enter Manning's "n".
3. Only experienced users familiar with the details of the auxiliary spillway erosion technology should adjust this base value.

Example 4–72 WSPACCUR—In this example, the values shown control the precision of the auxiliary spillway water surface profile calculations by the frictionless side slope method rather than the original default values. The base value of "n" is not changed.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
		Maximum Allowable					
Control Word		Delta Elevation feet	Delta Velocity Ratio	Base Value "n" Vegetation			Record Identification
WSPACCUR							

WSPACCUR		0.01	0.1				

OFFWSPVRT

OFFWSPVRT—Turns off the WSPVRT default water surface profile method within a run. The OFFWSPVRT record has no parameters.

The program uses WSPVRT water surface profile techniques unless you enter the OFFWSPVRT control word or the TRAPW control word. If you enter OFFWSPVRT, the program uses the frictionless side slope method. If you enter TRAPW, the program uses the TRAPW method. Once you have entered OFFWSPVRT or TRAPW in a run, you must enter a WSPVRT record to reactivate the WSPVRT water surface profile method for that run.

Note:

The TRAPW and frictionless side slope methods require a constant value of Manning's "n" for the spillway inlet. Entry of vegetal retardance curve index values for flow resistance ($C_I > 1$) for the constructed inlet channel will cause a fatal error when these procedures are called. If multiple reaches with different flow resistance values are entered for the inlet, the program uses the value associated with the downstream end of the crest section for the entire inlet when either the TRAPW or frictionless side slope procedures are requested.

Example 4–21 OFFWSPVRT—Sample job 10 uses OFFWSPVRT to turn off the default water surface profile calculation procedure for site A and use the frictionless side slope method instead.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
OFFWSPVRT							

WSPVRT

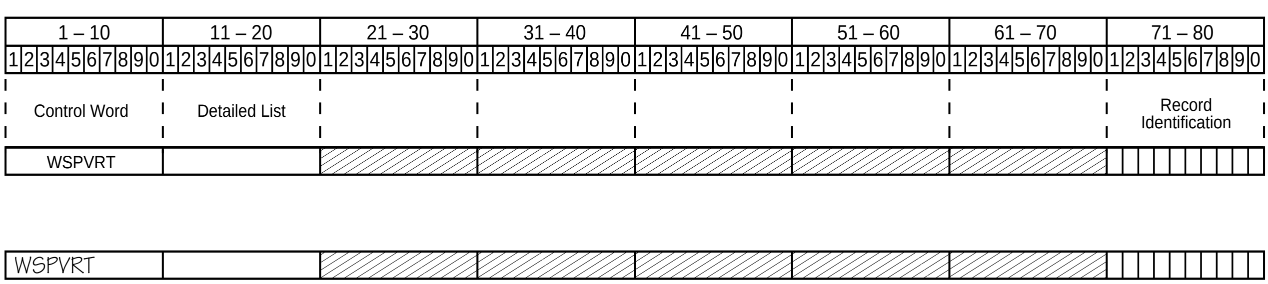
WSPVRT—The WSPVRT Water Surface Profile Method is the default computation procedure used to develop the rating curve based on variable retardance for the auxiliary spillway for each alternative in TR–60 and NHCP–378 design runs and for STORM or HYD (simulation) runs. The WSPVRT control word turns on the WSPVRT Water Surface Profile Method, if you turned it off earlier in the run, or allows you to obtain detailed stage-discharge files. WSPVRT is the only water surface profile method that is completely compatible with the auxiliary spillway integrity procedure. The WSPVRT procedure requires a spillway exit channel slope and a valley floor elevation. Use Manning's "n" or Vegetal Retardance Curve Index values for flow resistance as appropriate.

Data field	Value	Type	Description
Col. 11–20	Detailed list switch	I	Leave blank for normal operation. Enter 1 to obtain a detailed listing of the water surface profiles generated.

Notes:

1. The WSPVRT Method is on for all runs unless you turn it off with an OFFWSPVRT or a TRAPW control word switch. You may want to turn it off when making preliminary runs. If you have not turned it off, any missing input associated with its use will cause the program to give a fatal error.
2. If you request a detailed listing of the water surface profiles, the program writes the output to a file with the base name of the standard output and the extension .DWS. The program will append to this file during a run, but it will overwrite the file without warning during subsequent runs using the same base name for output. The detailed list is only available for the pass that contains the WSPVRT control switch.

Example 4–31 WSPVRT—This WSPVRT control word instructs the program to begin using the default WSPVRT water surface profile method after it has been using either TRAPW or the frictionless side slope method. Entering a "1" in col. 11–20 produces a detailed listing of the water surface profile computations.



DRAWDLIST

DRAWDLIST—Control word to obtain detailed output from the drawdown computations. Its use gives a considerable amount of output labeled by FORTRAN variable names. Restrict its use to understanding error conditions or problem sites. Drawdown computations may extend up to 30 days with inflow continuing at a constant rate beyond 5,000 time increments.

The drawdown list tabulates the following variables:

Time (hr) = Drawdown at time 2.
Discharge (ft^3/s) = Outflow hydrograph discharge at time 2 (O2)
O1 (ft^3/s) = Outflow hydrograph discharge at time 1
F1 (ft^3/s) = Inflow hydrograph discharge at time 1
F2 (ft^3/s) = Inflow hydrograph discharge at time 2
STOR (ac-ft) = Storage in site at time 2
TERM1 (ft^3/s-hr) = DELTM (F1 + F2 – O1) + 24.2 STOR
where:
DELTM = Time increment for drawdown
24.2 = Conversion factor for ac-ft to ft^3/s-hr for the average inflow and outflow over the time interval

Notes:
1. If inflow is included in drawdown, the program uses the internal time increment of the inflow hydrograph. If the inflow is not included, the program uses 0.5 hour.

Q2 (ft^3/s) = Discharge at rating table point 2.
V2 (ac-ft) = Volume of storage at rating table point 2.
TERM2 (ft^3/s-hr) = DELTM(Q2) + 24.2 V2.
TRAVT = (V2 – V1)/(Q2 – Q1)
where:
Q1 & V1 = Discharge and storage at rating table point 1.
QTEST (ft^3/s) = Discharge at which the drawdown will stop.

The program computes the outflow hydrograph discharge (O2) by the formula:

$$O2 = \frac{\left\{\text{TERM1} + 24.2\left[\text{TRAVT}\left(\text{Q2}\right) - \text{V2}\right]\right\}}{24.2\ \text{TRAVT} + \text{DELTM}}$$

Notes: (continued)
2. The program obtains results by interpolating between rating table points. The program locates the points in the rating table by finding the first value of TERM2 that is greater than TERM1.

Warning: The output from this control word can be greater than 80 columns in width.

Example 4–73 DRAWDLIST

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
DRAWDLIST							

GRAPHICS

GRAPHICS—Switches on the DAMSITE graphic file options only. The program opens only files with options selected. See table 4–1 for details on program options needed on the GO, control words to obtain the correct data type. The program compresses and does not identify the data in graphic files. The IDE uses outputs from the graphic I option to interpret and plot data.

Note:
GRAPHICS does not control the automatically generated earth spillway erosion technology graphics.

Data field	Value	Type	Description
Col. 11–20	File Option Code Letter	Ae	Specify one or more of the following: **L** = Ratings **P** = Hydrographs **E** = Embankment data **I** = Interface **S** = Summary data
Col. 21–30	Hydro-graph Type Number	I	If P is selected in col. 11–20, designate which hydrographs to save using the following numbers: **1** = Principal spillway (PSH) **3** = Stability design (SDH) **4** = The I option used in conjunction with the Integrated Development Environment, turns on L, P, and E as well (DAMSITE.EXE). **5** = Freeboard (FBH) **7** = Storm hydrographs **9** = GO,HYD hydrographs You may select more then one number. The program saves both inflow and outflow hydrographs.

Notes:
1. To stop saving data to the graphic files within a run, use the NOGRAPHICS control word or another SITES control word.
2. To change graphic files or hydrograph types between alternatives, use another GRAPHICS control word with new options.

Warning: The output from this control word can be greater than 80 columns in width.

Example 4–74 GRAPHICS—You request hydrograph plot files for the principal spillway.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Output File Options	Hydrograph Type Options					Record Identification
GRAPHICS							

GRAPHICS	P	1					

NOGRAPHICS

NOGRAPHICS—Turns off the GRAPHICS file option. Use only within a run to stop saving data to the graphics files. To be effective, use NOGRAPHICS with a separate GO, control following an alternative that uses the GRAPHICS options. Another SITES control word will also terminate the graphics files.

The NOGRAPHICS control word does not affect graphics files normally generated by the auxiliary spillway integrity analysis.

Note:
NOGRAPHICS is the default setting when not using the GRAPHICS control word.

Example 4–75 NOGRAPHICS

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
Control Word							Record Identification
NOGRAPHICS							

HDEVLST

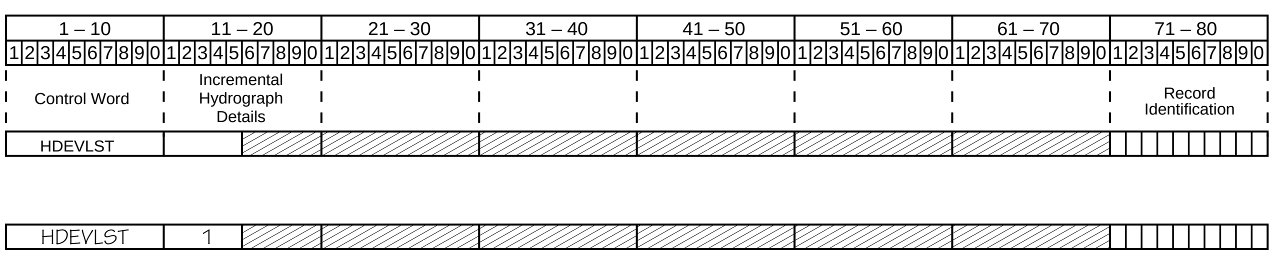
HDEVLST—This is a legacy control word not supported by SITES 2005. It obtains detailed output from the old hydrograph (OLDHYD) development procedure computations used prior to 1989. Its use gives an unwieldy amount of output for each hydrograph and labels them with FORTRAN variable names. Use only if familiar with the program coding and error conditions. The FORTRAN variable names that appear in the output listing are: NPTS, BASE, DUR, TBPTS, STEPS, TIP, TITRY, KCHECK, TIUSE, PEAKC, DASM, QMULT, DELTAM, RAIN, KPART, PTABL1, PTABL2, P2, Q2, PKRAT, CONST, TSTRM, LINK, THYD, N, T, and UNIT(N).

Data field	Value	Type	Description
Col. 11–15	Hydr. detail lists	I	Leave blank for listings of the composite hydrograph development procedure. Enter **1** for additional listings of the incremental hydrograph details.

Note:
To obtain details of the new hydrograph development procedure, see the NEWHYD control word.

Warning: The output from this control word can be greater than 80 columns in width.

Example 4–76 HDEVLST—This example of HDEVLST requests detailed information on the OLDHYD incremental hydrograph development procedure.



HOODETL

HOODETL—Provides details of the hood inlet computations. Use for checking the elevation-discharge rating of a hood inlet principal spillway computed using PSHOOD and PSDATA control words. Its use generates considerable technical data in the output. Turn off HOODETL with NOHOODETL, GO,ADDHYD, GO,REACH, or another SITES control word.

This control word is not supported in versions of the program later than 1/1/2000.

Example 4–77 HOODETL

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
HOODETL							

NOHOODETL

NOHOODETL—Terminates the detailed hood inlet computation output provided by the HOODETL control word. To be effective, use NOHOODETL in a separate alternative with another GO, control word following the HOODETL alternative. You may also turn off HOODETL with GO,ADDHYD, GO,REACH, or another SITES control word.

Example 4–78 NOHOODETL

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
NOHOODETL							

NPOINTS

NPOINTS—This is a legacy control word not supported by SITES 2005. It does not apply to the default hydrograph generation procedure, and its use is not recommended. It allows the user to set the number of points the program uses in development of the stability design hydrograph, freeboard hydrograph, and all other hydrographs except for the 10-day principal spillway hydrograph. Maximum allowable number of points is 500. The program uses 101 points for T_C greater than 1.0 hour, 250 points for T_C between 0.3 and 1.0 hour, and 350 points for T_C less than 0.3 hour.

Data field	Value	Type	Description
Col. 11–20	Number points	Ie	Number of points to define the SDH, FBH and PSH's other than the 10-day design hydrograph.

Notes:
1. Use this control word only to use other than 101 points to define the SDH, FBH, and nonstandard PSH when using GO,DESIGN.
2. Use the STORM control word to set the number of points for simulation runs (GO,STORM, GO,RAINS).
3. The 10-day PS design storm hydrograph uses 241 points; the program does not allow you to change this number.
4. NPOINTS applies in both the old and new hydrograph development procedures.

Example 4–79 NPOINTS—This example sets up to 150 points to define the stability design and freeboard hydrographs.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	No. of points SDH & FBH						Record Identification
NPOINTS							
NPOINTS	150						

OEOVB

OEOVB—Obtain detailed output from the computation of the volume of auxiliary spillway outflow in acre-feet divided by the bottom width in feet (OE/B). Its use can give considerable amount of output and should be restricted to understanding error conditions or problem sites.

Note:

The total site outflow is tabulated by the hydrograph time increment (DELTM) for the duration of the auxiliary spillway flow. At each time increment, the program interpolates the elevation and principal spillway outflow from the rating table. The program computes the auxiliary spillway outflow as the difference between the total discharge and principal spillway discharge. The program averages the auxiliary spillway discharge between time increments and multiplies by the time increment and accumulates to give the volume in cubic feet per second hours. The program converts this value to acre-feet, multiplying by the factor 0.08264. The program tabulates the accumulated auxiliary spillway outflow volume, duration of flow, and OE/B by time increment.

Warning: The output from this control word can be greater than 80 columns in width.

Example 4–80 OEOVB

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
OEOVB							

PROFILELST

PROFILELST—Obtains detailed output from the frictionless side slope water surface profile computations for auxiliary spillway ratings. Its use will give an extremely large amount of output.

Notes:

1. Output from PROFILELST for the frictionless side slope, discharge per foot of width, computation method is written to the standard output file. The program labels the output with FORTRAN variable names. Use this control word only if familiar with the program coding.
2. Use the WSPVRT control word to obtain detailed output from the WSPVRT computation method.
3. Use the TRAPW control word to obtain detailed output from the TRAPW computation method.

Example 4–81 PROFILELST

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
PROFILELST							

SHUTOFF

SHUTOFF—Allows you to control length of tabular hydrograph plots generated when using GO,STORM, GO,RAINS, and GO,HYD control words. The "P" option on the GO, control word specifies the plots.

Data field	Value	Type	Description
Col. 11–20	Ratio of inflow to peak inflow	N	Enter the ratio of the inflow to the peak inflow hydrograph discharge as a decimal value to stop the print-out of the printed plot of the hydrograph. The program default is 0.1 of the inflow peak. Value must be between 0.0 and 1.0 or else program assumes 0.0 and plots the entire hydrograph.
Col. 21–30	Hydrograph cutoff	N	Value in ft^3/s that limits the points of the hydrograph to values above this amount. Default is 0.5 ft^3/s

Note:
You cannot use SHUTOFF to stop the GO,DESIGN hydrograph plots. If used, the program plots the entire principal spillway hydrograph and shuts off the stability design and freeboard hydrographs at the end of the inflow hydrograph or at the crest of the auxiliary spillway, if reached. If no auxiliary spillway flow occurs, the program skips the plot and prints a message.

Example 4–82 SHUTOFF—This example SHUTOFF control word limits the length of the requested hydrograph plots to discharges greater than 2 percent of the peak value.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	% of Peak to Stop Plot (Use Decimal)	Hydrograph Cutoff ft^3/s					Record Identification
SHUTOFF							
SHUTOFF	.02						

TESTLIST—Provides detailed tabular listings of most inflow and outflow hydrographs. The output shows the computed hydrograph time increments to five decimal places. TESTLIST is useful where you need to supplement the normal output to verify or analyze intermediate results. The use of TESTLIST generates considerable output volume. You can only turn off TESTLIST by a GO,ADDHYD, GO,REACH, or SITES control word. The output lists all hydrographs to 5,000 points unless the hydrograph ends earlier. This is to insure the program combines and accounts for outflow from upper structures, including baseflow, in the drawdown computations of lower sites.

TESTLIST also provides a volume check for the routed structure outflow hydrograph. The volume is summed up to the 5,000 point limit and expressed in inches of runoff from the watershed. The number of points shown is minus the leading zeros.

TESTLIST

Example 4–83 TESTLIST

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word							Record Identification
TESTLIST							

CROWN

CROWN—Sets the maximum crown depth used in computing embankment quantities. The crown is the overfill above the top of the dam. The program assumes a parabolic cross section area above the computed top of dam (fig. 4–10a).

Data field	Value	Type	Description
Col. 11–20	Crown depth in feet	Ne	Enters a maximum crown depth directly. Must be zero or greater. Enter a zero if a crown is not needed on top of the dam. The default crown depth is 2/3 of a foot.

Notes:
1. The crown volume is computed based on assumptions shown in figure 4–10.
2. Use another SITES control word to reset the crown factor to the default value.

Example 4–84 CROWN—This example CROWN control word for sample job 8 sets the crown depth at 0.25 foot.

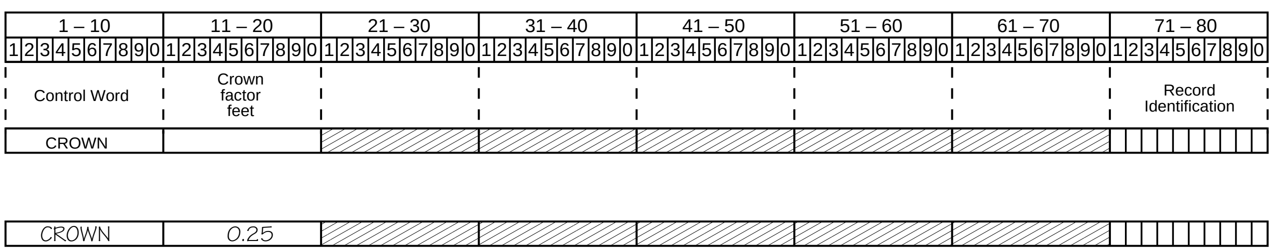
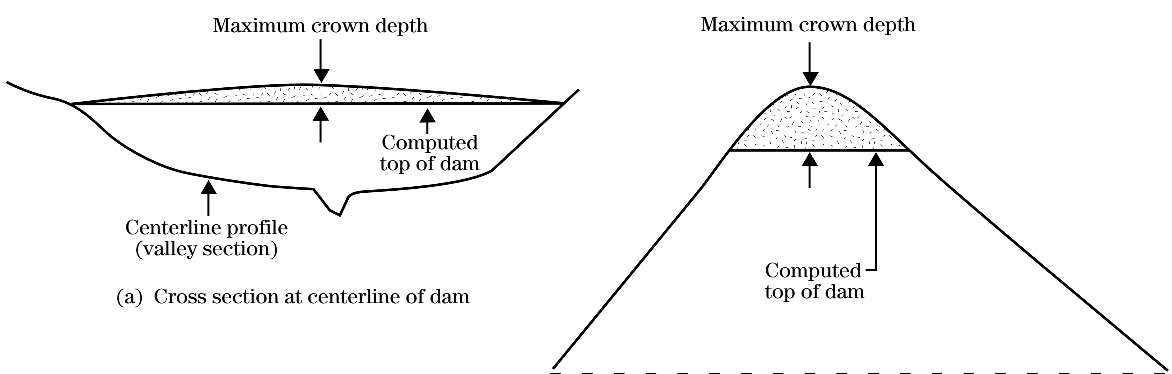


Figure 4–10 Cross sections of dam and crown depth



(a) Cross section at centerline of dam

(b) Cross section perpendicular to centerline of dam at maximum crown depth

STABERM—Adds stability berm(s) on either or both upstream and downstream sides of the embankment. Allows for berm top widths and vertical heights to be different in the computation of embankment quantities. If used on the TEMPLATE control word, both stability berms must be identical. You may enter a STABERM control word without the TEMPLATE control word if other default TEMPLATE values are acceptable. See figure 4–11 for an example of single stability berm per dam face.

Data field	Value	Type	Description
Col. 11–20	Upstream Berm Width	N	Top width of upstream stability berm in feet.
Col. 21–30	Downstream Berm Width	N	Top width of downstream stability berm in feet.
Col. 31–40	Both berms, Maximum Vertical Height Increment	N	Maximum vertical height increment between stability berms in feet. (Same as TEMPLATE col. 61–70.) Program will calculate multiple stability berms as required (see figure 4–11).
Col. 41–50	Upstream Berm Only, Vertical Height	N	Vertical height in feet of upstream berm above the permanent pool (see note 5). Use only if a single upstream stability berm is needed.
Col. 51–60	Downstream Berm Only, Vertical Height	N	Vertical height in feet of downstream berm above low point in centerline profile of valley. Use only if a single downstream stability berm is needed.

Notes:

1. The default values for all of the above parameters are 0.0. It is only necessary to enter the parameters needed. Parameters are reset to zero with a GO,ADDHYD, GO,REACH, or another SITES control word.
2. Both the berm width and the vertical increment or height must be greater than zero to compute volume.
3. For stability berms with equal vertical height increments, leave col. 41–60 blank. If the elevation (vertical height) of a single stability berm per dam face is known, leave col. 31–40 blank and enter the heights in col 41–60.
4. If you enter stability berms on both TEMPLATE and STABERM, the program uses the stability berm parameters on STABERM.

STABERM (continued)

Data field	Value	Type	Description

Notes: (continued)

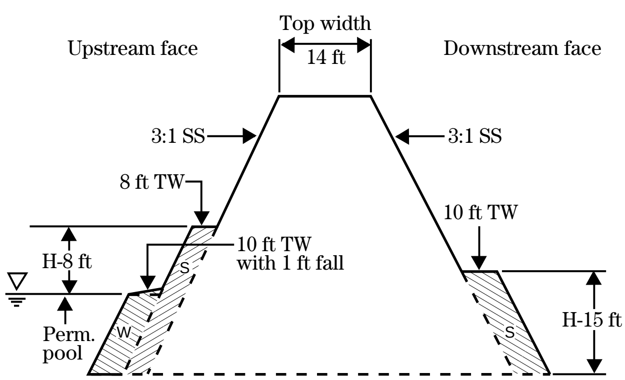
5. The permanent pool or crest of the principal spillway elevation is set on POOLDATA or GO,EMB. The program adds the vertical height (col. 41–50) to this elevation to set the elevation of the single upstream stability berm. For a dry dam, enter an equivalent permanent pool elevation. If you do not provide the permanent pool elevation, the program measures the upstream stability berm height from the low point of the centerline profile.

Example 4–85 STABERM—In this example for sample job 8, the widths of the upstream and downstream stability berms are set respectively at 8 feet and 10 feet, and the upstream and downstream berm vertical heights are 8 and 15 feet, respectively.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Upstream Berm width–feet	Downstream Berm width–feet	Both Berms Max. ΔH–feet	Upstream Berm Height–feet	Downstream Berm Height–feet		Record Identification
STABERM							

STABERM	8.0	10.0		8	15		

Figure 4–11 Single stability berm per dam face using STABERM



Cross section of dam

Legend

TW = Top width
SS = Side slope ratio
W = Wave berm
S = Stability berm
H = Vertical height specified by user

TEMPLATE

TEMPLATE—Allows you to specify the variables which define the shape of the cross section of the fill. The program uses this information with the CLPROFILE table in the calculation of embankment quantities. If you do not load TEMPLATE, the program assumes sets of variables for TR–60 and NHCP–378 criteria structures. If using TEMPLATE, you must enter all values except the top width and stability berm values if they are applicable. Enter stability berm values either on the TEMPLATE or the STABERM control words. Program computed embankment quantities are primarily estimates for comparison of costs between alternatives. You may need more accurate quantities for detailed cost estimates.

Data field	Value	Type	Description
Col. 11–20	Top width	N	Top width of the dam (ft). Leave blank to use default value from table in note 1.
Col. 21–30	U/S Z	Ne	The side slope ratio (Z) of the upstream faces of the fill if not 2.5.
Col. 31–40	D/S Z	Ne	The side slope (Z) ratio of the downstream faces of the fill if not 2.5.
Col. 41–50	Wave berm width	N	Top width of the upstream wave action berm in feet. Leave blank if not using wave action berm. See notes 3 and 4.
Col. 51–60	Stability berm width	N	Top width of all stability berms in feet. Leave blank if not used. See note 8 if berms are different widths.
Col. 61–70	Maximum vertical height increment	N	Maximum vertical height increment of dam (feet) for placement of stability berms. Leave blank if not using stability berms. See notes 7 and 9.

TEMPLATE (continued)

Data field	Value	Type	Description

Notes:

1. The volume of fill and embankment quantities are based on:
   - An 8-inch (2/3 foot) parabolic crown across the top of the dam (see CROWN to revise this default depth).
   - Level ground surface perpendicular to the centerline profile.
   - The top width default criteria tables are:

TR–60 H*	TR–60 TW**	NHCP–378 H*	NHCP–378 TW**
< 15	8	10 or less	6
15 to < 20	10	10+ to < 15	8
20 to < 25	12	15 to < 20	10
25 to 95	14	20 to < 25	12
> 95	16	25 to < 35	14
		35 and over	15

* Dam height in feet from top of dam to low point in centerline profile (CLPROFILE).
** Minimum dam top width in feet specified in criteria.

2. If not using TEMPLATE, the program also assumes for both sets of criteria:
   upstream and downstream side slope ratios (Z) = 2.5
   wave action berm width = 10 feet
   stability berm width (none assumed) = 0 feet
   maximum vertical increment stability berm = 0 feet
3. The lowest top elevation of the wave action berm is the permanent pool of conventional reservoirs and the crest of the principal spillway of dry dams.
4. The calculated volume of the wave berm automatically includes a slope across the berm top width for the length of the berm. This slope, for drainage back into the permanent pool, has a maximum fall of 1 foot across the wave berm.
5. Vertical planes perpendicular to the centerline are assumed at the first or last points, or both, on the centerline profile if the top of the embankment is higher than one or both points.
6. The program calculates the area of the dam to the toe of slope line. The area to seed is the area of the dam less any area below the permanent pool.
7. TEMPLATE places stability berms on the upstream as well as the downstream face of the embankment whenever the maximum vertical increment is exceeded by the following heights:

Upstream face	height (H_U) between top of dam and wave action berm (permanent pool or crest of principal spillway).
Downstream face	height (H_D) between top of dam and lowest point in the CLPROFILE.

Data field	Value	Type	Description

Multiple stability berms are possible. The program computes the vertical increment between berms by the following equations (see fig. 4–12):

$$\frac{H_{U\ or\ D}}{\Delta H} = NB \quad \text{and} \quad VI = \frac{H_{U\ or\ D}}{(NB+1)}$$

where:

$H_{U\ or\ D}$ = Height computed for upstream or downstream face
ΔH = Maximum delta height increment
NB = Number of berms per face (truncated)
VI = Vertical increment between berms per face

8. When stability berm widths are different on the upstream and downstream faces, use the STABERM control word instead of col. 51–60.
9. If single upstream or downstream, or both stability berms with known elevations are desired, use the STABERM control word.

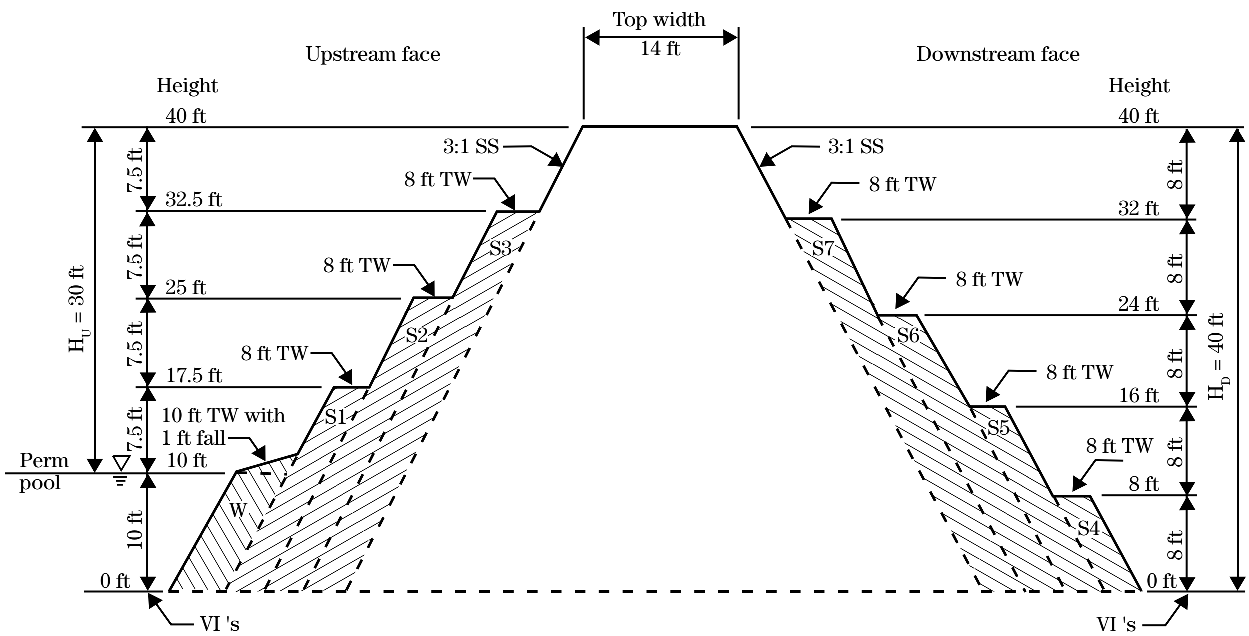
TEMPLATE (continued)

Example 4–86 TEMPLATE—In this example for sample job 8, the program determines the top width by the criteria, the side slope ratios for both the upstream and downstream faces of the fill are 3, and the wave berm width is 10. Single stability berms will be entered on STABERM.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
		Side Slope Ratio			Stability Berms		
Control Word	Embankment Top Width feet	Upstream face	Downstream face	Wave Berm Width–feet	Width–feet	Maximum ΔH feet	Record Identification
TEMPLATE							

TEMPLATE		3	3	10.0			

Figure 4–12 Multiple stability berm placement using TEMPLATE



Cross section of Dam

Legend

TW = Top width
SS = Side slope ratio
W = Wave berm
S_n = Stability berms
VI = Vertical increment

Example: TEMPLATE calculations for stability berm placement using maximum vertical height increment ΔH=9 ft:

Upstream

$$\frac{H_U}{\Delta H} = \text{Number of berms (truncated)}$$

$$\frac{30\text{ ft}}{9\text{ ft}} = 3$$

$$\frac{H_U}{(NB+1)} = \text{VI (Vertical Increment)}$$

$$\frac{30\text{ ft}}{4\text{ ft}} = 7.5\text{ ft}$$

Downstream

$$\frac{H_D}{\Delta H} = \text{Number of berms (truncated)}$$

$$\frac{40\text{ ft}}{9\text{ ft}} = 4$$

$$\frac{H_D}{(NB+1)} = \text{VI (Vertical Increment)}$$

$$\frac{40\text{ ft}}{5\text{ ft}} = 8\text{ ft}$$

Changes to Program Defined Criteria

The DAMSITE program contains numerous defaults and the attempt has been made to make these defaults consistent with NRCS criteria as of the program date indicated on the SITES control record. However, the user is responsible for verification that values used are appropriate for the analysis being performed. Entry of data in all pertinent fields is recommended. These criteria may not apply to all structures. Also, you may conduct tests using old and new criteria. Therefore, the developers set the following control words: TDD/NOINFL that allows the inflow hydrograph to be left out of the drawdown computations under GO,DESIGN; MINDEPTH or MINDISCH, which allow changing the minimum depths or capacity specified in NHCP–378 or TR–60; and OLD378 and OLDTR60, which allow reverting to some of the old criteria pertaining to design routings.

Control words for changing criteria

Control word descriptions in this section are arranged in alphabetical order on the following pages. The control words are indexed in appendix E.

MINDEPTH

MINDEPTH—Allows you to set minimum depth criteria that will override the minimum NRCS national criteria. All data fields must contain entries.

Data field	Value	Type	Description
Col. 11–20	Diff. in crests NHCP–378	Ne	The minimum depth in feet between the principal spillway and auxiliary spillway crests. NHCP–378 default is 1.0 feet for sites that have drainage area greater than 20 acres (see note 1).
Col. 21–30	Depth auxiliary TR–60	Ne	The minimum depth in feet between the auxiliary spillway crest and the top of dam. TR–60 default is 3.0 feet.
Col. 31–40	Freeboard NHCP–378	Ne	The minimum depth in feet between the design flow elevation and the top of dam. NHCP–378 default is 1.0 foot.
Col. 41–50	Depth auxiliary NHCP–378	Ne	The minimum depth in feet between the auxiliary spillway crest and the top of dam. NHCP–378 default is 2.0 feet for sites that have drainage area greater than 20 acres or that have structures more than 20 feet in effective height (see notes 1 and 2).

Notes:
1. For sites equal to or less than 20 acres in drainage area, the default values in the NHCP–378 criteria are 0.5 foot for col. 11–20 and 1.0 foot for col. 41–50.
2. For sites with 20 feet or less effective height, the NHCP–378 default value is also 1.0 foot for col. 41–50. The effective height is the elevation difference between the auxiliary spillway crest and the low point of the ground at the dam.

Example 4–87 MINDEPTH—This example MINDEPTH control word for site B in sample job 10 changes the minimum depth of the auxiliary spillway to 4.0 feet in columns 21–30. The remainder of the record repeats the default values.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	NHCP–378 PS to AS CREST feet	TR–60 AS Crest to Top of Dam–feet	NHCP–378 Design flow to Top Dam–feet	NHCP–378 AS Crest to Top Dam–feet			Record Identification
MINDEPTH							
MINDEPTH	1.0	4.0	1.0	2.0			

MINDISCH

MINDISCH—Control word to allow you to set minimum spillway capacity criteria that will override the NRCS national criteria.
All data fields must contain an entry.

Data field	Value	Type	Description
Col. 11–20	Minimum AS capacity coefficient	Ne	Coefficient of the minimum auxiliary spillway capacity equation. Default coefficient = 237.0; see note 1.
Col. 21–30	Minimum AS capacity exponent	Ne	Exponent of the minimum auxiliary spillway capacity equation. Default exponent = 0.493; see note 1.
Col. 31–40	NHCP–378 minimum pipe size	Ne	Minimum NHCP–378 principal spillway pipe diameter in inches. Default diameter = 10 inches (0.545 ft^2 area)

Notes:

1. Minimum auxiliary spillway capacity equation is:

$$Q_{AS} = \text{Coeff} \times \text{D.A.}^{\text{EXP}}$$

where:
Q_{AS} = Auxiliary spillway capacity in ft^3/s
Coeff. = Coefficient (col. 11–20)
D.A. = Drainage area in mi^2
EXP = Exponent (col. 21–30)

This equation produces a straight character plot on log-log paper. With a minimum drainage area of 200 acres, the equation is derived from NRCS TR–60 criteria. SITES uses the same equation with no minimum drainage area for NHCP–378.

2. If the principal spillway pipe size (col. 31–40) is less than the minimum cross sectional area, the program allows no credit for the pipe outflow when flood routing NHCP–378 design flood hydrographs. The program considers pipe sizes less than the minimum to be plugged with trash during a major storm event. You may override this criteria decision by using the OLD378 control word.
3. Parameters are reset to the default values with a GO,ADDHYD, GO,REACH, or another SITES control word.

Example 4–88 MINDISCH—This example MINDISCH control word for site B in sample job 10 gives the minimum auxiliary spillway capacity coefficient as 200 and the minimum auxiliary spillway capacity exponent as 0.5. The NHCP–378 minimum principal spillway pipe diameter would be 6.0 inches, but this information is ignored because Site B is a TR–60 site with a large culvert spillway.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Minimum AS Capacity Coeffieicnt	Minimum AS Capacity Exponent	NHCP–378 Min. pipe Dia. inches				Record Identification
MINDISCH							

MINDISCH	200	0.5	6.0				

OLD378

OLD378—This is a legacy control word not supported in SITES 2005. It changes the NHCP–378 criteria for the starting elevation for routing the design hydrograph when the principal spillway pipe cross-sectional area is less than minimum size. If the default procedure is acceptable, OLD378 is not required.

Data field	Value	Type	Description
Col. 11–20	NHCP–378 start routing criteria option	Ie	Enter **1**, assuming PS storage is not available during routing of design hydrograph. Routing starts at the crest of the auxiliary spillway, the program default. It assumes the PS, if any, is plugged and the entire PS hydrograph, if given, is stored with no outflow. Enter **2**, if assuming principal spillway flow and storage in setting the auxiliary spillway crest. Routing starts at the elevation of the principal spillway crest.

Notes:
1. Use OLD378 to turn the default start routing switch off or on again in a run. The switch is always reset to 1 when using GO,ADDHYD, GO,REACH, or another SITES control word.
2. The minimum default cross-sectional area of the principal spillway is the equivalent of a 10-inch diameter pipe. To change this minimum area, enter a new minimum pipe size on the MINDISCH control word.
3. If the given pipe cross-sectional area is greater than the minimum or the program is using TR–60 criteria the program ignores the OLD378 control word.

Example 4–89 OLD378—In this example OLD378 control word, the option 2 starts routing at the normal starting elevation related to the principal spillway.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Option to start routing Less Min. PS Size						Record Identification
OLD378							
OLD378	2						

OLDTR60

OLDTR60—This is a legacy control word not supported in SITES 2005. It uses the 1976 version of TR–60 hydrologic design criteria. Use for checking prior designs and testing effects of new versus old criteria. Enter a value in all fields. Enter the option numbers desired. If changing one or more, enter the remainder.

Data field	Value	Type	Description
Col. 11–20	Option No. hyd. to set exit slope	Ie	Enter **1** to use the freeboard hydrograph to set the auxiliary spillway exit channel slope based on 25 percent of the discharge. This is the program default and will control unless the exit slope is specified. Enter **2** to use the stability design hydrograph instead of the freeboard hydrograph above.
Col. 21–30	Option No. to start "C" FBH	Ie	Enter **1** to start the freeboard hydrograph routing for class code "C" (high hazard) sites at the crest of the principal spillway. Enter **2** to start routing the freeboard hydrograph for class code "C" (high hazard) sites at the same elevation as the stability design hydrograph. This is the program default.
Col. 31–40	Option No. to add residual storage to AS crest	Ie	Enter **1** to use residual retarding storage volume not drawn down in time limit to add volume for setting crest of auxiliary spillway. This is the program default. Enter **2** to use residual retarding storage volume, not drawn down in the time limit, to only set the starting elevation of routing for stability design and freeboard hydrographs.

Example 4–90 OLDTR60—In this example, the stability design hydrograph sets the exit channel slope of the auxiliary spillway, the freeboard hydrograph routing (for class code "C" (high hazard) sites) starts at the crest of the principal spillway, and the residual retarding storage volume not drawn down sets the starting elevation for the stability design and freeboard hydrographs.

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Hydrograph to Set AS Exit Slope if Not Given	Elevation to Start Routing Class "C" FBH	Add Drawdown Residual Storage to AS Crest				Record Identification
OLDTR60							

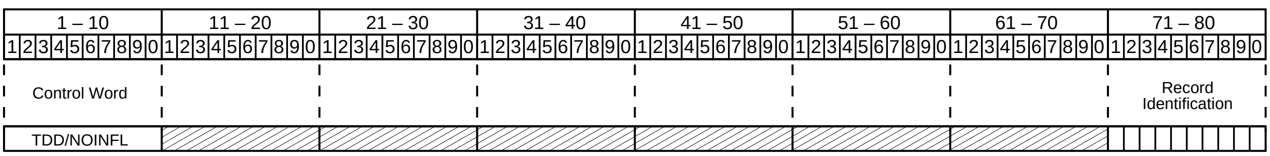
1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
OLDTR60	2	1	2				

TDD/NOINFL

TDD/NOINFL—Includes only a portion of the inflow hydrograph in computation of the drawdown. The inflow hydrograph is cut off at the point of maximum storage (stage) in the reservoir where drawdown computations start.

The program default is to use the entire inflow hydrograph in the drawdown computations. Use this control word only with GO,DESIGN to change the default. The GO,TDD option has no inflow to include.

Example 4–91 TDD/NOINFL



Alternative Spillway Designs

The SITES program makes it easy to design or analyze the "standard" NRCS spillway system consisting of a drop inlet or hood inlet conduit principal spillway and a separate excavated auxiliary spillway. The program also contains the flexibility to allow design of other configurations.

Table 4–7 indicates suggested methods of preparing input for the design of typical and nontypical spillway configurations. Utilize similar procedures in simulation runs; but, if ratings are available, enter them in the STRUCTURE table. The procedures described in table 4–7 assume you will enter one or more AS control words and BTMWIDTH control words to provide the required output.

Table 4–7 Alternative spillway designs

Principal spillway	Auxiliary spillway	Procedure
1. Drop/hood inlet pipe spillway	Excavated	This is the standard NRCS configuration. Use PSDATA and PSINLET or PSHOOD to enable the program to rate the principal spillway. Use ASINLET/ASEXIT, ASEXIT, and ASDATA or ASRATING and ASDATA along with BTMWIDTH to describe the auxiliary spillway.
2. Culvert or orifice controlled spillway	Excavated	Input same as #1 above using PSINLET, except in PSDATA column 11–20, use zero (0) for number of principal spillway conduits. Specify the orifice size in columns 51–60 and 61–70 of PSINLET.
3. Drop/hood inlet pipe spillway	Separate drop structure	Use PSDATA and PSINLET or PSHOOD to describe the principal spillway. Use ASDATA and ASRATING for a weir with 1-foot bottom width to describe the auxiliary spillway. Using BTMWIDTH, you may study several auxiliary spillway weir lengths in the same run.
4. Drop/hood inlet pipe spillway (Principal and auxiliary spillway are in same pipe. In effect, there is no auxiliary spillway as commonly understood.)	Drop/hood inlet pipe spillway	Use PSDATA and PSINLET or PSHOOD to describe principal spillway. Use ASDATA and ASRATING with insignificant, above zero, dummy values and BTMWIDTH of 1.0. The program will combine principal spillway and auxiliary spillway ratings, but the auxiliary spillway rating will be zero, thus accurately modeling the physical situation. Use of this method causes the program to also design a structure to satisfy minimum auxiliary flow requirements.
5. Drop/hood inlet pipe spillway	No auxiliary spillway	Same as number 4.

Table 4–7 Alternate spillway designs—continued

Principal spillway	Auxiliary spillway	Procedure
6. Drop structure (one structure using a weir notch as the principal spillway)	Drop structure	Input a rating table for the principal spillway in the STRUCTURE table, columns 41–50. Be sure to extend the principal spillway rating notch curve up to the expected top of dam elevation. Use ASDATA and ASRATING for a weir with 1-foot bottom width to describe the auxiliary spillway. By using BTMWIDTH, you may study several auxiliary spillway weir lengths in the same run.
7. Drop structure (One weir serves as principal and auxiliary spillway. The site has flood storage between principal and auxiliary spillway crest elevations.)	Drop structure	Input a total spillway rating in the STRUCTURE table (columns 51–60) or use ASRATING and ASDATA for a weir with 1-foot bottom width. By using the STRUCTURE table, you may analyze only one weir length in each run but you may update the STRUCTURE table to analyze another weir length. Using ASRATING, you may study several weir lengths in the run with BTMWIDTH.
8. No principal spillway	Excavated or drop structure	Same as number 7.
9. Drop structure	Excavated	Input a rating table for the principal spillway in the STRUCTURE table columns 41–50. Be sure to extend the rating up to the expected top of dam elevation. Use ASINLET/ASEXIT or ASRATING, along with BTMWIDTH and ASDATA to describe the auxiliary spillway.
10. Gated principal spillway or any other type	Any other type	Input the principal spillway rating in columns 41–50 and the auxiliary spillway rating in columns 51–60 of the STRUCTURE table. You may analyze only one table in each run, but can update the STRUCTURE table to analyze another combination and/or gated condition.

Chapter 5 Output Description

This chapter describes only the output file (*.out) produced by the DAMSITE routine. The IDE gives the user easy access to the extensive summary tables and graphics that are not actually in the *.out, and use of the IDE can greatly facilitate output interpretation.

Appendix C contains sample jobs with illustrations of the IDE output. The output is fairly self-explanatory and you control a number of options regarding the volume and type of output so that it is compatible with the number of alternatives being considered. For designs with a large number of alternatives, you should generally hold output to the minimum. A summary table at the end of each run provides an easy comparison between alternatives. For final studies, you may wish to request detailed listings of the rating tables and line plots of the inflow and outflow hydrographs. Output files of the rating tables and inflow and outflow hydrographs are also available in forms compatible with the other NRCS project formulation programs. Table 5–1 is a glossary of terms used in the output.

Program options

The standard output without program options consists of an 80–80 listing of the input, table of basic data, summary of key parameters including spillway crests, reservoir and rainfall-runoff data, routed results with stability and integrity analyses, and a summary table.

The detailed descriptions of the control words GO,DESIGN, GO,STORM, GO,RAINS, GO,ADDHYD, GO,REACH, and GO,HYD give the various program options available for each.

Of the five program options that relate to normal output, the rating tables (L), basic data or default values (C) or (A), and plotted hydrographs (P) are the most useful in analyzing the results for correctness. Program options (A) and (C) are similar, except (A) will list all five program defined rainfall distribution tables instead of just the one used in the pass. Sample job 1 contains the four main print output options (ELPC) in the first pass. Program option (E) is for computation and display of embankment quantities only.

You may request output with only the auxiliary spillway stability procedure using option H, with only the integrity procedure output using option U, or with neither stability nor integrity output using option N.

Two other program options are special cases. Option (S) limits GO,STORM and GO,HYD routings to the use of the principal spillway only. Option (D) on the GO,REACH control word provides a listing of the Muskingum-Cunge or Modified Att-Kin reach routing computation details for debugging or error analysis.

The five output file options (R, T, I, O, and B) save rating tables or hydrographs in files for subsequent use in SITES or other NRCS hydrologic programs. The program lists all output files in their generated forms.

Table 5–1 Abbreviations used in output

Abbreviation	Definition
A	Character plot symbol of stability design outflow hydrograph
AC	Surface area in acres
ACFT or AC.FT.	Volume in acre-feet
ACCUM	Accumulation as in 'sediment accumulation'
ADDHYD	Accumulated or added hydrographs
AH–667	USDA, Agriculture Handbook 667, Stability Design of Grass–Lined Open Channels
AMAX, AREA–MAX	Surface area at peak outflow in acres
AS	Auxiliary spillway
ATT–KIN	Attentuated-Kinematic reach routing method
AUX	Auxiliary (reference to auxiliary spillway)
A1, A2, A3	Subclasses of TR–60 low hazard design class code 'A' for low hazard structures
B	TR–60 significant hazard structure class code
BTM or BW	Bottom width of auxiliary spillway in feet
C	TR–60 high hazard structure class code
C	Convex routing coefficient for reach routing
CALC.	Calculation
CAP.	Capacity
CFS	Discharge in cubic feet/second (see ft^3/s)
CFS–HRS	Volume in cfs–hours (see ft^3/s-hr)
CN	NRCS runoff curve number
CN 10–DAY	TR–60 10-day runoff curve number
COEF or C	Coefficient
COND	Conduit for principal spillway
CY	Volume in cubic yards
D	Storm duration (precipitation) in hours
DA	Drainage area of watershed
DA–SM	Drainage area in square miles
DAMS2	Former code name of Water Resource Site Analysis Program (SITES)

Table 5–1 Abbreviations used in output—Continued

Abbreviation	Definition
DDT	Drawdown test to determine drawdown time in days
DELTA–H	Vertical height increment
DH	Maximum vertical increment in feet for placement of stability berms
DIA	Diameter
D/S	Downstream
D/W – /H	Diameter of conduit in inches or width and height of box conduit in feet
E	Elevation in feet
EL or ELEV	Elevation in feet
EMAX	Elevation at peak outflow in feet
EMB	Embankment
EXIT	Auxiliary spillway exit channel
EXP	Exponent
EXTVEL	Exit velocity in auxiliary spillway in feet/second
FB	Freeboard
FBH	Freeboard hydrograph (TR–60), or the Design hydrograph (NHCP–378)
FP	Flood storage pool
FT	Feet
FSS	Frictionless side slope water surface profile procedure
ft^3/s	Cubic feet per second
ft^3/s-hr	Cubic feet per second-hours
H	Height in feet
HORZ	Horizontal
HP	Flow depth at inlet to auxiliary spillway in feet above its crest (H_p)
HRS	Hours
HYD	Discharge hydrograph
I	Inflow hydrograph in cfs or its character plot symbol

Table 5–1 Abbreviations used in output—Continued

Abbreviation	Definition
Ia or IA	Initial abstraction in NRCS runoff equation
ID	Identification
IN	Inches depth
INC or INCS	Increment(s)
INLET	Auxiliary spillway inlet channel
KE	Coefficient for entrance losses from the reservoir to the conduit
K1, K2	Coefficients used in generalized design rainfall equation (CLASS)
L	Length in feet
LT	Less than
M	Modified Att-Kin power value
MAINT.	Maintenance code
MAX	Maximum
MIN.NHCP378	Minimum required by NHCP–378 criteria
MIN TR60	Minimum required by TR–60 criteria
N, n	Manning's roughness coefficient
NHCP–378	NRCS National Conservation Practice Standard for Ponds
NEH 4	NRCS National Engineering Handbook, Hydrology, now referred to as NEH part 630
NRCS	National Resources Conservation Service, formerly Soil Conservation Service (SCS)
NO.	Number
O	Outflow in cubic feet per second
OE/B	Volume of auxiliary spillway flow divided by the bottom width in acre-feet per foot
ORF	Orifice, low stage of principal spillway
P	Precipitation in inches or character plot symbol of principal spillway outflow hydrograph
P1DA	24-hour precipitation (1 day)
P6HR	6-hour precipitation

Table 5–1 Abbreviations used in output—Continued

Abbreviation	Definition
P10DA	10-day precipitation
PERM POOL	Permanent pool
PS	Principal spillway
P–SD	Precipitation for stability design hydrograph in inches
P–FB	Precipitation for freeboard or design hydrograph in inches
PMP	Probable maximum precipitation in inches
PRECIP	Precipitation
PSDATA	Principal spillway data
PSH	Principal spillway hydrograph (TR–60)
P–PS1 DAY	Precipitation PSH 1-day storm in inches
P–PS10 DAY	Precipitation for PSH 10-day storm in inches
Q	Discharge in cubic feet per second or cubic feet per second per foot or inches of runoff
Q–AUX.	Discharge through auxiliary spillway in cubic feet per second
Q–ES	Runoff for stability design hydrograph in inches
Q–FB	Runoff for freeboard hydrograph in inches
QMAX	Discharge at peak outflow in cubic feet per second
Q–PS	Discharge from principal spillway in cubic feet per second
Q–PS1 Day	Runoff for PSH 1-day storm in inches
Q–PS10 Day	Runoff for PSH 10-day storm in inches
QRF	Quick return flow in cubic feet per second
Q–TOT.	Same as Q–TOTAL
Q–TOTAL	Combined principal and auxiliary spillway discharge in cubic feet per second
RETARD	Retardance index
REV	Revision data of program executed
RL	Reach length in feet for routing

Table 5–1 Abbreviations used in output—Continued

Abbreviation	Definition
S	Slope of auxiliary spillway exit channel in feet per foot or percent, or maximum potential retention in inches in NRCS runoff equation, or user design class code
S–BERM	Stability berm width in feet
Sc	Critical slope in feet per foot for a discharge
SCS	Soil Conservation Service, USDA, now the Natural Resources Conservation Service
SDH	Stability design hydrograph
SED	Sediment
SIG	Significant baseflow (TR–60) in cubic feet per second
SITES	Code name of Water Resources Site Analysis Program, formerly DAMS2
SM	Square miles
STA	Station, horizontal distance in feet
STAB. BERM	Stability berm
START	The water surface elevation in feet (0.0 if not entered) at the start of rainfall when not routing the PSH
STG	Stage (inlet level) in feet of principal spillway
STRUC	Structure
SUBWS	Subwatershed or subarea identification in input
T	Time in hours
TC	Time of concentration in hours
TC/L – /H	Time of concentration (hr), or watershed length and height (ft, ft), or watershed slope (ft/ft)
TOD	Top of dam embankment elevation in feet
TOP–W	Top width of dam embankment in feet
TOT	Total, used with Q–TOT
TR–48	Former SCS Technical Release 48, Structure Site Analysis Program, now called SITES
TR–60	NRCS Technical Release 60, Earth Dams and Reservoirs

Table 5–1 Abbreviations used in output—Continued

Abbreviation	Definition
TW	Tailwater
U/S	Upstream
VALLEY FL	Elevation of valley floor
VBAR	Average velocity for Convex reach routing method
VEL or V	Velocity in feet per second
VER	Version number (or date) of the program
V/C	Critical velocity in auxiliary spillway in feet per second
VOL	Volume in acre-feet
VOL–AUX.	Volume in acre-feet related to flow depth (H_p) in auxiliary spillway
VOL–MAX	Volume at peak outflow in acre-feet
WAVE BERM	Wave action berm width in feet
W/S or WS	Watershed
WSID	Watershed identification in input
WSP	Water surface profile
WSPVRT	Water surface profile using variable retardance (default procedure), developed by Darrel Temple, ARS, Stillwater, OK
X	Character plot symbol for peak inflow and max. storage locations or Modified Att-Kin routing coefficient
XEQ	Date program was executed (run date)
XSEC	Cross section
Z	Side slope ratio of auxiliary spillway
Z–D	Side slope ratio downstream face of embankment
Z–U	Side slope ratio upstream face of embankment
25% of Q	Critical slope in feet per foot (see Sc) based on 1/4 of the peak discharge
80–80	Echo listing of 80 column input data
– /H	See D/W – /H or TC/L – /H

Interpretation

The output may be grouped into six categories: preparatory information, principal spillway routing, auxiliary spillway routing, embankment quantities, summary table, and generated output files. This section provides information to interpret the output by these categories. Annotated output from actual program runs is used for illustration. Check the output data for consistency, error or warning messages, and reasonable results.

Preparatory information

This section explains the headings, echo list of input, comments, basic data (input) display, and detailed list of basic data (defaults).

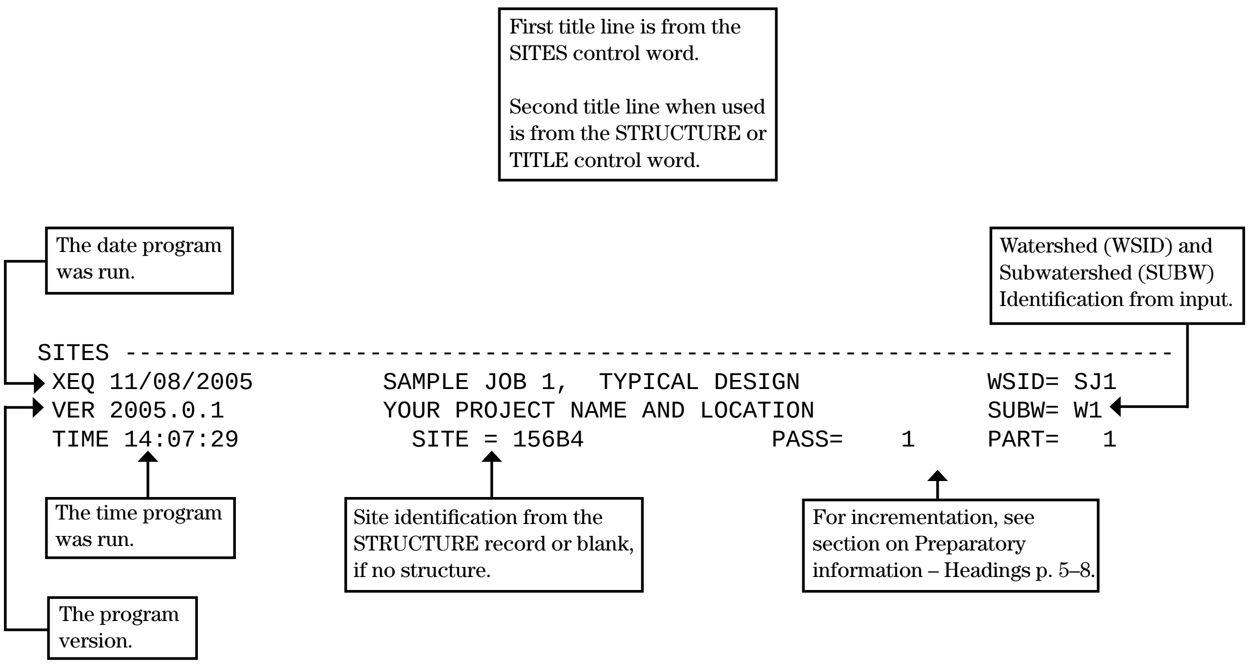
Headings—The DAMSITE program displays a heading (fig. 5–1) at the start of the echo, basic data, and comment lists, and each major structure routing alternative.

In the upper left corner of the heading, you will find the program name, SITES. Next to or below this is the XEQ date – the date the program was run. Below this is VER, the program version identification. The revision date associated with the version identification must agree with the date in columns 11–20 of the SITES control word record for the program to run the input data. If these dates do not agree, the program lists the input changes since the previous official version. The time the program started execution is found below the version identification.

The first line of the title in the middle of the heading is from columns 31–70 of the DAMS2 control word. It remains the same throughout a job. The second title line when shown is from columns 21–70 of the STRUCTURE control word. It changes within a job whenever the program encounters a new structure or subwatershed. The middle of the third title line contains the site identification from columns 11–15 of the STRUCTURE control word. This is blank for a subwatershed without a structure. The PASS number on the same line begins at one for each structure or subwatershed, and the program increments the pass number by one each time it encounters a GO control word.

In the upper right hand corner of the heading is the watershed ID (WSID) from columns 21–28 of the DAMS2 control word. Below this is the subwatershed ID (SUBW) from columns 14–15 of the WSDATA control word. In the third line beside the PASS number is the PART number, which the program increments by one within each job. This is not a true page number. For a simple job with one site, the first part is the basic data, the second part is the principal spillway or simulation routing, and the third and subsequent parts are auxiliary spillway alternative routings.

Figure 5–1 Output—headings



Echo (80–80) list—The 80 column list (fig. 5–2) is an echo print of the data input to the program. It is an exact duplicate of the input records before the program processes them. You should carefully check the 80–80 list to detect data entry errors. The program provides the list in front of each job.

Figure 5–2 Output—Echo (80–80) list

```
************************** 80-80 LIST OF INPUT DATA ***************************

SITES     01/01/2005SJ2       SAMPLE JOB 2, NHCP 378        0.3703125 H5
SAVMOV    0    101
SAVMOV    101  1                                                      1
*         TRIAL NO. 1, HOOD INLET PRINCIPAL SPILLWAY WITH SINGLE
*         18 INCH PIPE.  SUBCRITICAL FLOW AUXILIARY
*         SPILLWAY RATING BASED ON 'D' RETARDANCE, 20'
*         BOTTOM WIDTH, 3:1 SIDE SLOPES, 100' FLAT INLET SLOPE
*         AND 2% EXIT CHANNEL SLOPE.  ONLY THE PSH
*         AND DESIGN HYDROGRAPH (FBH) ARE USED IN THE DESIGN
*         TC-15.3 IS USED TO CALCULATE Tc.  NO EROSION ANALYSIS
STRUCTURE FARM      YOUR COUNTY, ANY STATE
                    48        0
                    50        0.5
                    52        1.3
                    54        2.2
                    56        3.3
                    58        4.7
                    60        6.3
                    62        8.1
ENDTABLE
WSDATA    5A1X   AC 72        237       1930      2.0
PDIRECT   1.0       4.4                 .00       6.20
POOLDATA  ELEV      52.5      52.5                44.0                HD
PSHOOD    65        30        40.4      39.4      0.6       0.6       B
PSDATA    1                   18                  0.015     40.4
ASDATA    30D100                        3                   0.020     3
BTMWIDTH  FEET      20
GRAPHICS  I
GO,DESIGN NL        TYPE2     24        TYPE2378  24
SAVMOV    2    101  1                   FARM
ENDJOB

*******************************************************************************
```

This echo list is an exact duplicate of the input records. Check it carefully for data entry errors. Only the ENDRUN record is not listed.

Comments—Each group of comments in the input (fig. 5–3) generates a separate page of output. You may enter comments with the COMMENT or * control words. Use comments to describe the major alternatives or trials. The program may also display informational or warning messages on the comment page.

Figure 5–3 Output—Comments

```
TRIAL NO. 1, USING 36 IN. PIPE, SINGLE STAGE INLET PRINCIPAL

SPILLWAY AND 50 ft AUXILIARY SPILLWAY CREST

WITH BOTTOM WIDTH = 100 FEET.  PRINCIPAL

SPILLWAY HYDROGRAPH BASED ON RAINFALL AND

RUNOFF CURVE NUMBER PROCEDURE.
```

The program prints comment (*) lines singly or as a group on separate pages ahead of each pass. Use comments to document the job, as well as to describe alternatives and trials.

The user should be alert for input error or informational warning messages that may appear on the comment page. See appendix D for explanation of Output Error and Warning messages.

Basic Data—The Basic Data table (fig. 5–4) automatically displays the data input for each structure or subarea after input processing. Table 5–1 gives the abbreviations used for headings. The program does not display the data in the same order as entered; nor does it display all the input data.

The first two or three lines list the designated climate area associated with program defined areal precipitation corrections, the given design class code, and the specified storm distributions.

The next lines display the processed input variables as the program will use them in the computations.

The table contains the preliminary auxiliary spillway rating per feet of bottom width when you specify the frictionless side slope water surface profile procedure. The preliminary rating, without correction for side slopes, is in the ASRATING format.

At the bottom of the Basic Data table the program indicates the water surface profile procedure, including the ASINC variable, if the auxiliary spillway rating is computed.

The program displays only the first part of the Basic Data Table for subwatersheds. Hydrograph data and informational, warning, or error messages may appear with the Basic Data, especially with systems of structures or subareas. Check the data for reasonable values. Transposition errors may occur in entering the data.

Figure 5–4 Output—Basic data table

```
              **********  MATERIAL PROPERTIES  **********
                              DRY                         PERCENT       DETACH.      REP.
     MATERIAL       PI    DENSITY          Kh          CLAY          RATE       DIAMETER
                          lbs/CuFt                              (Ft/H)/(lb/SqFt)  inches
    ALLUVIUM       12.       110.       0.07         20.0           --        0.00800
    WTHRD-ROCK      0.       120.       0.40          0.0           --        2.00000
    SHALE           0.       130.       7.00          0.0           --        7.00000
    LIMESTONE       0.       160.     200.00          0.0           --       18.00000
    TS_FILL        12.       100.       0.05         15.0           --        0.00800
    GEN_FILL       12.       110.       0.07         20.0           --        0.00800

****************************    BASIC DATA    *********************************
HUMID- SUBHUMID CLIMATE AREA                      DESIGN CLASS  S = USER DEFINED

STORM DISTRIBUTION PSH..10 DAY NRCS DESIGN STORM (CHAPTER 21, NEH4 & TR-60).

STORM DISTRIBUTION AUX. -24 HOUR TYPE II RAINFALL DISTRIBUTION

PRECIP. - P-PS,1-DAY    P-PS,10-DAY       P-SD           P-FB
              5.80         10.20         11.40          18.10

WSDATA -        CN           DA-SM          TC/L            -/H          QRF
             82.00          7.50          2.57           0.00         2.67

SITEDATA- PERM POOL     CREST PS        FP SED        VALLEY FL        378?
           2600.00       2600.00         30.00         585.00           NO

          BASEFLOW      INITIAL EL     EXTRA VOL     SITE TYPE
              0.00          0.00          0.00         DESIGN

PSDATA -  NO. COND        COND L         DIA/W            -/H
              1.00        250.00         36.00           0.00

              PS N            KE        WEIR L          TW EL
             0.013          1.00         18.00         584.00

           2ND STG         ORF H         ORF L      START AUX.
              0.00          0.00          0.00           0.00

ASCRESTS -    AUX.1         AUX.2         AUX.3          AUX.4         AUX.5
              0.00          0.00          0.00           0.00          0.00

AUX.DATA -  REF.NO.    RETARD. Ci   TIE STATION    INLET LENGTH
                41          0.00        450.00              0

AUX.DATA - INLET Ci    SIDE SLOPE       EXIT Ci     EXIT SLOPE     ACTUAL AUX?
             4.900          2.50         5.600          0.035           NO

BTM WIDTH -    BW1           BW2           BW3            BW4           BW5
  ft        100.00          0.00          0.00           0.00          0.00
AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.
```

The climate area, design class code, and storm distribution specified by the user or by default are listed above the parameters.

A summary of input parameters as processed by the computer. See table 5–1 for abbreviaitons used in the headings. Check the data for reasonable values. Look for data entered out of the proper fields. The program prints an abbreviated table for subareas.

The program prints the method of water surface profile computation if the auxiliary spillway rating is computed.

Detailed List of Basic Data—This list (fig. 5–5) of current program default or replacement parameters, coefficients, natural ground or auxiliary spillway surface coordinates, dimensionless unit hydrographs, and rainfall distributions is optional output. You normally obtain it by using program option C. It is good practice to obtain this listing whenever changing defaults to ensure that the program is using correct values and for design documentation. The A program option is the same as C except it will display a longer list that includes all the program defined rainfall distributions instead of just the one designated in the input for the pass.

Figure 5–5 Output—Detailed list of basic data table

```
*********************     DETAILED LIST OF BASIC DATA     *********************
 WEIR COEF. FOR ORIFICES.......... 3.10    RATIO OF Ia TO S (CH.10,NEH4). 0.20
 WEIR COEF. FOR DROP INLET........ 3.10    TIME INCS TO PEAK OF UNIT HYD.  11.
 DISCHARGE COEF. FOR ORIFICES..... 0.60    NO. POINTS FOR DESIGN HYD. ... 5000

 HOOD, WEIR INLET COEF. .......... 0.60    DRAWDOWN TIME LIMIT - DAYS.... 10.0
 HOOD, PIPE ENTRANCE COEF. ....... 0.60    DRAWDOWN RATIO STORAGE LIMIT.. 0.15
 HOOD, SLUG FLOW COEF. ........... 0.00    OTHER DRAWDOWN RATIOS APPLY ?.   NO

 PS ACCURACY OF FULL FLOW CALC.,FT 0.01    WSP ALLOWABLE FSS VEL. CHANGE. 0.05
 FILLET SIZE FOR BOX CONDUITS..... 6.00    WSP FSS CALC. PRECISION, FT.. 0.005

 GRAVITATIONAL CONSTANT.......... 32.16    AUX. SPILLWAY MIN. CAP. COEF. 237.0
 MIN. NHCP378 PS PIPE AREA SQFT.. 0.545    AUX. SPILLWAY MIN. CAP. EXP.  0.493

 MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00    MIN. AUX. BW IN BW SOLUTION,FT 20.0
 MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00    PRECISION OF BW SOLUTION......  1.0
 MIN. NHCP378 DEPTH PS - AUX.CREST 1.00    OLD TR60 CRITERIA USED .......   NO
 MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00    OLD NHCP378 CRITERIA USED ....   NO

 EMBANKMENT TEMPLATE:  TOP WIDTH = (calc.),  MAX. CROWN = 0.667 ft,
 SIDE SLOPE   WAVE BERM   MULTIPLE STABILITY BERMS    SEPARATE STABILITY BERMS
    RATIOS      WIDTH      U&D/S WIDTHS   DELTA H     WIDTHS, ft   HEIGHTS, ft
   U/S  D/S       ft             ft          ft        U/S   D/S    U/S   D/S
  2.50 2.50      10.0           0.0        0.00       0.00  0.00   0.00  0.00
```

This table follows the Basic Data Table and the user obtains it by using the C or A program option on the GO,DESIGN, etc. records. It provides a listing of the current default and criteria factors defined by the input data or program.

The TEMPLATE control word describes the embankment template. The top width is shown as asterisks if computed by the program. The rainfall equation constants apply to the P100,PMP control word.

The program lists the dimensionless unit hydrograph and rainfall distribution currently used by this pass on the page(s) following this table. The A program option lists all the rainfall distributions defined by the program. The unit hydrograph displayed in the chapter 4, DIMHYD control word example is not repeated here. Due to space limitations, none of the pre-programmed rainfall distributions are displayed in the manual.

Principal spillway routing

The output related to the principal spillway routing consists of initial conditions, rainfall-runoff data, routing results, drawdown computations, hydrograph plots, and the rating table.

Initial conditions—You specify the starting conditions for the principal spillway routing. The program displays the data in tabular format (fig. 5–6) listing the elevation and associated storage volume, surface area, and discharge for each of the following: permanent pool, crest of the principal spillway, sediment accumulation, and constant baseflow and second stage crest when used. The Starting Elev (elevation) for the routing is the maximum of the Crest PS (principal spillway), the Sed Accum (flood pool sediment accumulation), or the initial elevation on the BASEFLOW record from significant baseflow or a prior storm event.

Figure 5–6 Output—Initial conditions principal spillway

```
PERM POOL      603.43 FT     2600.0 ACFT    321.89 AC       0.0 CFS
CREST PS       603.43 FT     2600.0 ACFT    321.89 AC       0.0 CFS
SED ACCUM      603.52 FT     2630.0 ACFT    324.15 AC       3.4 CFS
START ELEV     603.52 FT     2630.0 ACFT    324.15 AC       3.4 CFS
```

Principal spillway initial conditions, elevations, and the associated storage volume, surface area, and discharge. Includes baseflow and 2nd stage crest when used. Starting elevation for routing is the maximum of crest PS, Sed Accum, or Initial elevation.

Rainfall-runoff data—The program next displays the 1- and 10-day rainfall and runoff volumes, associated adjustments, and QRF information (fig. 5–7). If runoff volumes are input, asterisks fill the rainfall field. If you enter only one principal spillway storm, the program displays the storm data, including the actual storm duration used.

The program adjusts rainfall values for areal corrections if they are applicable. The program lists the 1- and 10-day areal corrections if used. The given Climatic Index and the associated 10-day runoff curve number are also listed. If transmission losses apply (climatic index less than 1.0), the program shows the runoff adjustment, a channel loss factor.

The program determines the Quick Return Flow (QRF) by selecting the larger of the value associated with Climatic Index or the value given on the WSDATA control word. The program shows the larger value along with a message explaining where it came from.

Figure 5–7 Output—Rainfall-runoff data for PS

```
NRCS-PSH  RAINFALL    1-DAY = 5.80 IN     10-DAY = 10.20 IN     DA = 7.50 SM
          RUNOFF      1-DAY = 3.80 IN     10-DAY =  6.14 IN

     CLIMATIC INDEX = 1.32   CN 10-DAY = 68.    CN 1-DAY =  82.
     QRF  =     34.57 CFS     604.14 FEET,  FROM CLIMATIC INDEX COMPUTATION.

     PEAK =      4725.0 CFS, AT 121.3 HRS.
```

Data used in developing the principal spillway hydrograph. If using areal corrections, the program will list them near the top of the page.

The climatic index with associated 10-day runoff curve number and channel (transmission) loss factor if applicable.

The quick return flow and associated elevation. Maximum of the given WSDATA value or computed from the climatic index.

Inflow hydrograph peak. If it includes upstream hydrographs as part of a complex system of watersheds, the accumulated drainage area for the system is shown below the peak.

Routing results—The program summarizes the principal spillway hydrograph results (fig. 5–8) in two lines. The first gives the elevation and associated storage volume, surface area, and discharge at the maximum pool stage attained during passage of the principal spillway hydrograph. In design routings, this is the computed auxiliary spillway crest elevation. The second line is the flood storage required, the difference in acre-feet between the maximum routed elevation and the principal spillway crest or flood sediment accumulation if higher.

Figure 5–8 Output—Routing results for PS

Elevation and associated storage volume, surface area, and PS discharge at the maximum pool stage attained by routing the principal spillway hydrograph. This is the computed auxiliary spillway crest.

The storage required by the principal spillway hydrograph routing.

```
ROUTED RESULTS - HYD TYPE        EMAX        VOL-MAX          AMAX        QMAX
                 NRCS-PSH     607.77 FT     4227.2 ACFT     427.17 AC    141.7 CFS

      PS STORAGE     1597.2 ACFT,    BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.
```

Drawdown computations—The principal spillway drawdown computations (fig. 5–9) determine the adequacy of the release rate. The program sets or you give the drawdown (DDT) tests. See DDTEST control word. The program displays the most restrictive test along with the spillway's elevation, storage volume, and drawdown outflow discharge.

The drawdown computations either reach the required DDT test discharge within the drawdown time limit criteria or the program gives the discharge at the time limit and continues the drawdown routing. The computations stop when the test discharge is reached or at a maximum of 30 days.

If not drawn down within the time limit criteria, the routing for the stability design and freeboard hydrographs will start at the discharge listed at the time limit. In sites designed by TR–60 criteria, the program adds the flood storage not drawn down at the time limit to the storage volume at the computed auxiliary spillway crest elevation. This raises the crest as noted in the message.

Figure 5–9 Output—Drawdown computations

The most restrictive drawdown test elevation and associated volume and outflow discharge determined by user criteria as appropriate for the site.
The message "Control is . . ." explains which test controls. See DDTESTS control word.

The discharge and associated elevation reached at the time limit and/or the time in days when the drawdown test above was reached.

```
DRAWDOWN (DDT) TEST        604.24 FT    2869.6 ACFT      41.54 CFS
     CONTROL IS  0.150 DETENTION STORAGE

     TIME LIMIT REACHED = 10.00 DAYS; FLOW WAS     45.39 CFS,   ELEV =     604.29
     (ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

     TIME TO DDT TEST DISCHARGE IS 11.09 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD   258.46 ACFT NOT EVACUATED IN
             DRAWDOWN TIME LIMIT.  TOTAL STORAGE REQUIRED =  4485.63 ACFT,
             NEW ELEVATION OF AUXILIARY SPILLWAY CREST    =  608.36 FT.
```

Time in days to reach the test discharge, QRF in this case.

Since the drawdown time was exceeded, TR–60 criteria require the ASCREST to be raised by 258.46 ac-ft which results in the crest elevation of 608.36.

Principal spillway hydrograph computations are also performed at upper sites; however, the 15 percent detention storage test is not meaningful at upper sites. The auxiliary spillway crest elevation at upper sites is a user input that will not be changed by the program. The stability design hydrograph and freeboard hydrograph routing for upper sites will start at the highest elevation of the 10-day drawdown, the principal spillway crest, the total sediment, or the baseflow elevations.

Use DRAWDLIST to obtain detailed drawdown output.

Hydrograph plots—Enter program option **P** to obtain hydrograph data and character plots for the principal spillway routing (fig. 5–10). For each time increment (Time) in hours, the columnar data consists of inflow (Qin) and outflow (Qout) discharge in cubic feet per second, reservoir surface elevation (Elev), associated storage volume (Vol) in acre-feet, surface area (Area) in acres, and flow velocity (ExtVel), if applicable, in the auxiliary spillway exit channel. In addition, the digital plot indicates the shape of the inflow and outflow hydrographs with I representing inflow and P representing the principal spillway outflow. An X marks the peaks of the inflow and outflow hydrographs. The P supersedes the I if plotting both at the same location except for an X where the inflow equals the outflow. In this case the maximum storage volume is reached.

The hydrograph data is useful in checking the addition of quick return flow, baseflow, starting elevations, and the effects of the routing. The program ends the principal spillway routing plot at the end of the inflow hydrograph. You have no control over the length of the plot.

Figure 5–10 Output—Hydrograph plots

```
PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH,  1 INCH=   1000. CFS
                                                  0.      1000.     2000.     3000.     4000.     5000.     6000.     7000.
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
   0.65     1     1  603.4  2605.4 322.3          .
   0.81     1     1  603.5  2610.7 322.7          .
   0.98     2     2  603.5  2618.7 323.3          .

 118.91   524    92  604.8  3070.8 355.8          .P   I
 119.07   554    93  604.8  3076.7 356.2          .P    I
 119.24   596    95  604.8  3083.2 356.6          .P    I
 119.40   670    97  604.9  3090.4 357.1          .P     I
 119.56   795   100  604.9  3098.9 357.7          .P      I
 119.72   986   103  604.9  3109.4 358.4          .P        I
 119.88  1262   107  605.0  3123.1 359.4          .P           I
 120.05  1648   112  605.0  3141.1 360.6          .P              I
 120.21  2139   119  605.1  3164.9 362.2          .P                   I
 120.37  2691   128  605.2  3195.6 364.2          .P                         I
 120.53  3252   134  605.3  3233.6 366.7          .P                               I
 120.69  3775   134  605.4  3278.8 369.7          .P                                    I
 120.86  4217   135  605.5  3330.5 373.0          .P                                        I
 121.02  4535   135  605.7  3387.3 376.7          .P                                           I
 121.18  4700   136  605.8  3447.3 380.5          .P                                             I
 121.34  4725   136  606.0  3508.6 384.4          .P                                             X
 121.50  4630   137  606.2  3569.4 388.2          .P                                            I
 121.67  4430   137  606.3  3628.2 391.8          .P                                          I
 121.83  4149   138  606.4  3683.8 395.3          .P                                       I
 121.99  3816   138  606.6  3735.3 398.4          .P                                    I
 122.15  3467   138  606.7  3782.2 401.2          .P                                 I
 122.31  3117   139  606.8  3824.4 403.8          .P                              I
 122.48  2781   139  606.9  3862.0 406.0          .P                           I
 122.64  2480   139  607.0  3895.4 408.0          .P                        I
 122.80  2224   139  607.0  3925.0 409.7          .P                     I
 122.96  2002   140  607.1  3951.4 411.3          .P                   I
 123.12  1805   140  607.2  3975.0 412.7          .P                 I
 123.29  1630   140  607.2  3996.2 413.9          .P               I
 123.45  1474   140  607.3  4015.1 415.0          .P              I
 123.61  1335   140  607.3  4032.0 416.0          .P            I
 123.77  1213   140  607.3  4047.2 416.9          .P           I
 123.93  1107   140  607.4  4060.8 417.7          .P          I

 135.76   143   142  607.8  4227.2 427.2          .P
 135.92   142   142  607.8  4227.2 427.2          .X
 136.08   141   142  607.8  4227.2 427.2          .P

 809.84    35    35  604.1  2835.0 339.2          .
 810.00    35    35  604.1  2835.0 339.2          .
 810.17    35    35  604.1  2835.0 339.2          .
 810.33    35    35  604.1  2835.0 339.2          .
  Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I         I         I         I
                                                  0.      1000.     2000.     3000.     4000.     5000.     6000.     7000.
         END NRCS-PSH   PLOT
```

Inflow hydrograph

Peak inflow

Principal spillway outflow hydrograph
P = Principal spillway outflow
A = Auxiliary + Principal spillway outflow

Peak outflow and max. storage volume

The "P" program option on the GO,DESIGN, etc., control words obtains the plot. The program plots all hydrographs within a pass.

For each time increment, the columnar data present time (Time) in hours, inflow (Qin), and outflow (Qout) discharge in cfs, reservoir surface elevation (Elev) associated storage volume (Vol), surface area (Area), and exit channel velocity (ExtVel) in ft/s if there is any flow in the auxillary spillway.

The plot is useful in checking the starting elevations, addition of quick return flow and baseflow, and in analyzing the effects of the routing.

The program determines the time scale by the hydrograph time increment and the discharge scale by the magnitude of the inflow peak.

Rating table number 1—Enter program option **L** to obtain rating tables (fig. 5–11). A message indicates how the rating tables were developed. Rating table 1 only includes principal spillway discharges. The first point, zero discharge, is at the principal spillway crest. The last point is the highest elevation in the STRUCTURE data table. Intermediate points are based on fixed ratios to hydraulic control stages (see table 5–2). The program interpolates rating table values of elevation, surface area, and volume from the STRUCTURE data table at the intermediate points. The computations for discharges at these points are based on the type of flow that controls.

Rating tables are essential in analyzing the correctness of runs and for documenting design.

Figure 5–11 Output—Rating table 1

Program option "L" on the GO,DESIGN, etc., control words obtains rating tables.

```
*************************************************************************

RATING TABLE DEVELOPED, SITE = 156B4 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.
```

Message indicates source of the rating table discharges. The program computes this rating.

```
RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1   603.43      0.00      0.00      0.00   2600.00    321.89
  2   603.87     16.73     16.73      0.00   2746.66    332.82
  3   604.32     47.33     47.33      0.00   2898.21    343.75
  4   604.77     86.94     86.94      0.00   3054.65    354.68
                                        FULL CONDUIT FLOW, ELEV =  605.22 FT
  5   605.22    133.86    133.86      0.00   3215.99    365.55
  6   606.44    137.65    137.65      0.00   3680.99    395.08
  7   607.66    141.35    141.35      0.00   4182.15    424.61
  8   608.89    144.96    144.96      0.00   4719.41    454.14
  9   610.11    148.47    148.47      0.00   5293.43    484.84
 10   611.33    151.91    151.91      0.00   5905.11    515.65
 11   612.55    155.27    155.27      0.00   6554.48    546.47
 12   613.78    158.56    158.56      0.00   7241.47    577.12
 13   615.00    161.79    161.79      0.00   7965.85    607.70
```

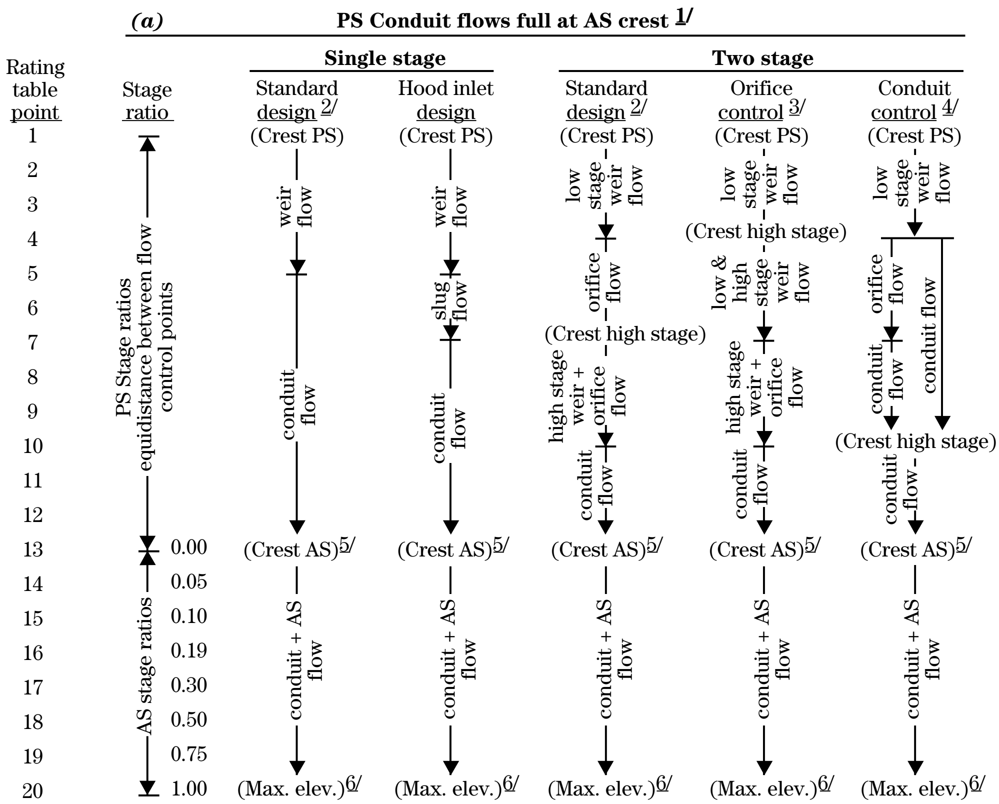
Crest PS

Max. STRUCTURE elev.

The program gives the computed hydraulic control elevations.

Rating table 1 only includes principal spillway discharges.

Table 5–2 Development of rating tables computed in program (drop or hood inlet PS and earth or vegetated AS)



1/ Number of conduits must be one or greater, see PSDATA.

2/ NRCS standard pipe drop inlet and excavated auxiliary spillway.

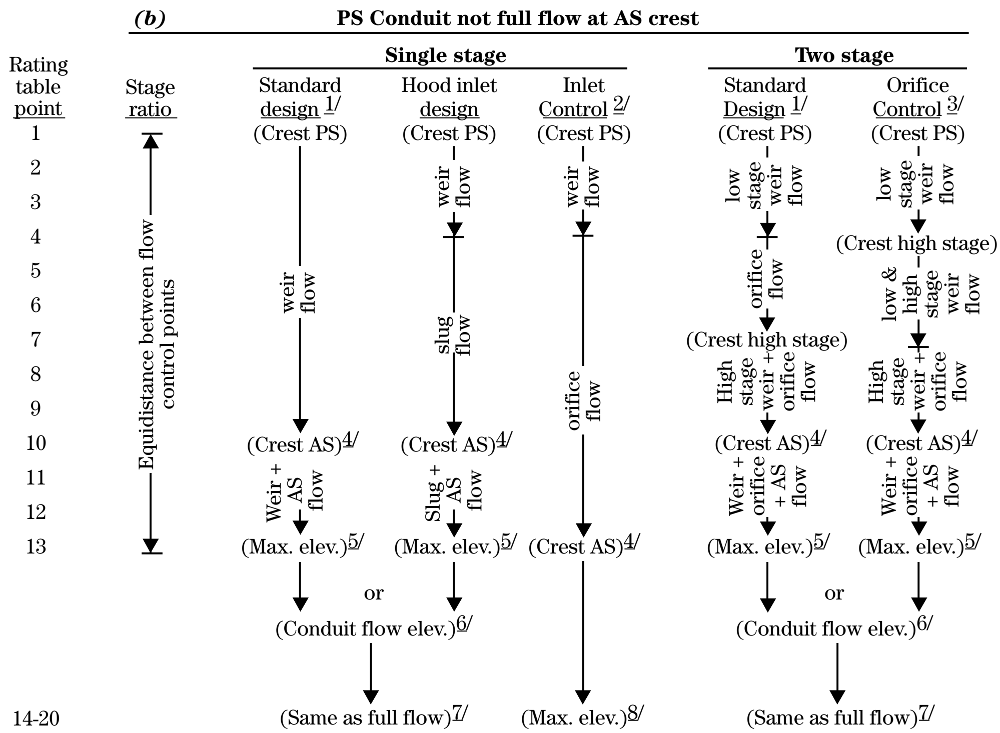
3/ Full orifice flow occurs above high stage crest.

4/ Full orifice flow occurs below high stage crest, the size of the conduit effects where it starts.

5/ For PS rating table 1, Point 13 is the maximum input elevation.

6/ Maximum input elevation in STRUCTURE table.

Table 5–2 Development of rating tables computed in program (drop or hood inlet PS and earth or vegetated AS)—Continued



1/ NRCS standard pipe drop inlet and excavated auxiliary spillway.

2/ Number of conduits equals zero, see PSDATA.

3/ Full orifice flow occurs above high stage crest.

4/ For PS rating table 1 (not full flow), point 10 is the maximum input elevation when it is lower than the elevation of full conduit flow, except for inlet control where point 13 is the maximum input elevation.

5/ Maximum input elevation in STRUCTURE table.

6/ Full conduit flow elevation when it is less than the maximum input elevation

7/ Point 20 is the maximum input elevation when point 13 is the elevation of full conduit flow. Points 14 to 20 are based upon the AS stage ratios from table 5–2(a), except even increments are used when the difference is less than 1 foot.

8/ Points 14 to 20 include orifice flow plus AS flow to the maximum input elevation.

Auxiliary spillway routing

The output in this category consists of initial conditions, hydrograph data, rating tables, routing results with stability and integrity analyses, and hydrograph plots for both the stability design and freeboard hydrograph. The output for simulation runs is similar except the program develops and routes only one hydrograph at a time.

Initial conditions—The program displays the starting conditions for the auxiliary spillway routings in tabular format (fig. 5–12). The auxiliary spillway (AS) crest is set by the maximum stage from the principal spillway routing, the additional stage if not evacuated within the given time limit, or by direct user input. The starting elevation for the routings is the same as for the principal spillway routing, except when the drawdown is not completed within the given time limit. The starting elevation will then be the stage reached at the time limit. The program lists the elevation and associated storage volume, surface area, and discharge for each item.

For design runs, the program checks your assigned design class code if you enter the low point in the dam centerline profile. The program computes the product of effective height and storage volume at the AS crest. If the site is misclassified in relation to this product, the program gives a message.

Figure 5–12 Output—Auxiliary spillway initial conditions

The starting elevation for the stability design and freeboard hydrograph routings is the same as for the principal spillway unless the elevation related to the drawdown time limits controls.

Basic data concerning the auxiliary spillway crest elevation and associated storage volume, surface area, and discharge.

```
AUX. CREST      608.36 FT    4485.6 ACFT    441.54 AC     143.4 CFS

     PS STORAGE   1855.6 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV      604.29 FT    2888.5 ACFT    343.06 AC      45.4 CFS

EFFECTIVE HEIGHT(H)= 29.4 FEET,  PRODUCT=  131715. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = S = USER DEFINED
```

Check against user defined design class code. Program gives a message if misclassified.

Hydrograph data—Stability design (SDH) and freeboard (FBH) inflow hydrograph data (fig. 5–13) include: the rainfall duration (D) and amount (P), the runoff volume in inches (Q), the drainage area of the uncontrolled area (DA), time of concentration (TC), runoff curve number (CN), runoff volume in acre-feet (VOL), and the peak and time to peak of each hydrograph. If the program applies an areal correction, it will be shown at the top of the page. For a system of structures or subwatersheds, the accumulated drainage area of the system appears below the peak.

For lower sites in series the hydrograph data represents the last uncontrolled area above the site, except for the peak data, which is the peak of the total accumulated hydrograph at the site.

Figure 5–13 Output—Inflow hydrograph data for auxiliary spillway and freeboard

For sites in series, this is the uncontrolled area. However, the peak is the total inflow hydrograph peak. If using areal corrections, the program lists them at the top of the page.

Data used in developing the stability design and freeboard hydrographs.

```
NRCS-SDH      D=  24.00 HR    P= 11.40 IN     Q=  9.13 IN      DA=   7.50 SM
             TC=   2.57 HR   CN=  82.00     VOL=   3652.8 ACFT

     PEAK =     11853.0 CFS, AT   13.7 HRS.

NRCS-FBH      D=  24.00 HR    P= 18.10 IN     Q= 15.71 IN      DA=   7.50 SM
             TC=   2.57 HR   CN=  82.00     VOL=   6283.4 ACFT

     PEAK =     20008.9 CFS, AT   13.5 HRS.
```

Peak of the inflow hydrograph. If it includes upstream hydrographs as part of a complex system of watersheds, the accumulated drainage area for the system is shown below the peak.

Rating table number 2, 3, etc.—Use program option L to obtain the total rating tables (fig. 5–14). The program prints sequential tables for each auxiliary spillway size or crest alternative. These rating tables include principal spillway flow and combined principal and auxiliary spillway flow columns. The method of determining the rating table points and values is similar to that described under rating table 1 (see fig. 5–11).

If the outflow exceeds the maximum computed or given auxiliary spillway rating, the program prints a warning message ahead of the rating table. The message gives the last unextrapolated elevation in the rating table. Examine extrapolated routing data carefully.

Figure 5–14 Output—Rating tables number 2, 3, . . .

Entering program option "L" on the GO, type control words produces the total rating tables.

```
******************************************************************

RATING TABLE DEVELOPED, SITE = 156B4 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.
```

Message indicates source of the rating table discharges. The program computes this rating.

Sequential table number

```
 RATING TABLE NUMBER  2
        ELEV.    Q-TOTAL     Q-PS     Q-AUX.    VOLUME     AREA
        FEET       CFS        CFS       CFS      AC-FT     ACRE
   1   603.43      0.00       0.00      0.00   2600.00    321.89
   2   603.87     16.73      16.73      0.00   2746.66    332.82
   3   604.32     47.33      47.33      0.00   2898.21    343.75
   4   604.77     86.94      86.94      0.00   3054.65    354.68
                                          FULL CONDUIT FLOW, ELEV =  605.22 FT
   5   605.22    133.86     133.86      0.00   3215.99    365.55
   6   605.61    135.08     135.08      0.00   3361.59    375.05
   7   606.00    136.31     136.31      0.00   3510.97    384.55
   8   606.40    137.52     137.52      0.00   3664.09    394.05
   9   606.79    138.72     138.72      0.00   3820.94    403.55
  10   607.18    139.91     139.91      0.00   3981.53    413.05
  11   607.58    141.09     141.09      0.00   4145.85    422.54
  12   607.97    142.27     142.27      0.00   4313.91    432.04
  13   608.36    143.43     143.43      0.00   4485.70    441.54
  14   608.70    154.32     144.40      9.92   4633.45    449.55
  15   609.03    165.23     145.37     19.86   4783.96    457.59
  16   609.62    353.18     147.09    206.08   5061.74    472.64
  17   610.35    725.38     149.17    576.21   5413.47    491.04
  18   611.68   1693.24     152.88   1540.36   6087.38    524.48
  19   613.34   3251.94     157.40   3094.54   6992.20    566.22
  20   615.00   5175.06     161.79   5013.27   7966.00    607.70
```

Crest PS

Crest AS

Max. STRUCTURE ele.

The program lists key computed hydraulic control elevations.

The total discharge column contains combined principal and auxiliary spillway flow.

The program prints rating table 2 and subsequent tables for each auxiliary spillway size or crest alternative.

Routing results—The program first provides a tabular summary of the surface conditions in each reach of the auxiliary spillway, identifying the reaches as being part of the inlet, crest (level portion of the inlet furthest downstream), constructed exit channel or natural exit channel. The next section summarizes the stability design (SDH), freeboard (FBH), or storm hydrograph routing results (figs. 5–15 and 5–16) for each hydrograph and each alternative auxiliary spillway size.

In the first set of lines of the design routing (fig. 5–15), the hydrograph type is followed by the given or computed auxiliary spillway bottom width and the maximum elevation reached in the routing with its associated storage volume and surface area. The AUX–HP and VOL–AUX are the reservoir stage and volume above the auxiliary spillway crest associated with the maximum water surface elevation. The maximum principal spillway and auxiliary spillway discharge and the combined total outflow related to the maximum elevation are in the second set of lines. The third set contains the critical depth, critical velocity, and critical slope (S/C) related to the maximum auxiliary spillway discharge. The critical slope based on one-quarter of this discharge (25% of S/C) may be used for the exit channel slope if not user input. The fourth set of lines has the duration in hours of auxiliary spillway flow. The fifth set gives the flow type in the exit channel of the auxiliary spillway along with the maximum exit velocity, exit channel slope, and flow depth.

The velocity and effective stress values for the exit channel stability analysis follow the SDH routing results (fig. 5–15). Conditions in the constructed exit channel reaches that influence stability and the resultant values are tabulated. You must compare the computed velocity and/or effective stress values to permissible velocity (TP–61, 1954) and/or allowable stress values (AH 667, 1987).

The first few lines of the FBH routing output (fig. 5–16a) are similar in format to the SDH routing. The auxiliary spillway integrity analysis results fall within the FBH routing results. The reach surface performance summary for the integrity analysis gives the time of vegetal cover failure and the development of concentrated flow for each reach. The headcut erosion damage summary gives the height and location of the initial formation of the highest and furthest upstream headcuts evaluated. The distance between the most upstream headcut to the upstream edge of the level crest is tabulated next to the duration of flow and attack results. The attack parameter is the volume of the auxiliary spillway flow in ac-ft divided by the bottom width in feet (OE/B). If the distance between the most upstream headcut and the upstream edge of the level crest is zero or less, the label BREACH is shown with its depth. Distances less than zero do not have meaning because headcut advance computations are terminated on the time step following prediction of a breach. The output for the integrity analysis in sample job 6 (fig. 5–16b) shows the location of a barrier in the spillway, and its impact on the headcut's upstream progress.

For NHCP–378 designs, the program performs drawdown computations for the freeboard (design) hydrograph. The computations are similar to these described under principal spillway drawdown computations. If the drawdown is not complete within the design time limit, you should redesign the structure with greater spillway capacity.

Figure 5–15 Output—Routing results for AS (SDH)

```
SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH  FROM     TO   SLOPE  RETARDANCE  VEGETAL  MAINT. ROOTING  REACH
       STA     STA            CURVE      COVER    CODE    DEPTH  LOCATION
       (ft)    (ft)   (%)     INDEX      FACTOR     +     (ft)     *
-----  ----   ----  ------ ----------  -------  -----  ------- --------
  1      0.    100.   -8.0     4.9          **       **      **   inlet
  2    100.    156.   -5.0     4.9          **       **      **   inlet
  3    156.    400.   -1.1     4.9          **       **      **   INLET
  4    400.    450.    0.0     4.9          **       **      **   CREST
  5    450.    777.    3.5     5.6        0.90       1      1.0   EXIT !
  6    777.    800.    5.3     5.6        0.90       3      1.0   exit
  7    800.    900.    5.7     5.6        0.90       3      1.0   exit
  8    900.    950.   10.0     5.6        0.90       3      1.0   exit

   + The minimum maintenance code value of 2 is used in INTEGRITY computations
        (the program changes values of 1 to 2 during computation).
   * Upper case indicates a reach of constructed spillway channel.
  ** The program does not use vegetal cover factor, maintenance code, and
        rooting depth for inlet and crest reaches in computations.
   ! Reach    5 used in computing exit channel velocities.
****************************************************************************

ROUTED     BTM WIDTH  MAX ELEV  VOL-MAX  AREA-MAX  AUX. HP  VOL-AUX.
RESULTS       FT         FT      ACFT       AC        FT      ACFT
NRCS-SDH     100.0     610.92   5693.3     505.2     2.55    1207.6

        PEAK - CFS       Q-PS     Q-AUX.     Q-TOT.
        DISCHARGE  =     151.      977.      1127.

                     CRITICAL  CRITICAL   CRITICAL  25% OF Q
                       DEPTH   VELOCITY   SLOPE-Sc     Sc
        AUXILIARY       FT      FT/SEC     FT/FT     FT/FT
        SPILLWAY---    1.42      6.65      0.018     0.054

        AUXILIARY SPILLWAY DURATION FLOW =              59.5 HOURS

        EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=  8.2 FT/SEC
                                        EXIT SLOPE   = 0.035 FT/FT
                                        FLOW DEPTH   =  1.2 FT
        **************************************************************

        EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
       (Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
         Aux. Discharge =    977. cfs;   Bottom Width =   100. ft.

                                                         TOTAL    EFFECTIVE
         REACH   FROM    TO   SLOPE  MANNING'S  VELOCITY  STRESS   STRESS
          NO.     STA    STA    %        n        ft/s    lb/ft^2  lb/ft^2
           5     450.   777.  3.50    0.036       8.24     2.52    0.046
       **************************************************************
```

AS reaches

Hydrograph type and alternate

At maximum routed elevation

Max. outflow discharges

At maximum stage in AS

Critical flow conditions

Duration of flow through AS

Type of flow in exit channel and parameters

Maximum velocity and stress

Conditions in constructed exit channel

The program displays the results of the stability design and freeboard hydrograph routings separately. Each alternative bottom width is identified along with the hydrograph type.

If the minimum criteria related to depth of flow and capacity are not met, the program increases the depth to meet the criteria and prints another line of output along with appropriate messages.

Figure 5–16a Output—Routing results for AS (FBH)

Hydrograph type and alternative

At maximum routed elevation

At maximum stage in AS

```
ROUTED        BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
RESULTS          FT         FT        ACFT      AC        FT        ACFT
NRCS-FBH        100.0     613.64    7161.3    573.6      5.27     2675.6
```

Max. outflow discharges

```
          PEAK - CFS         Q-PS     Q-AUX.    Q-TOT.
          DISCHARGE  =       158.     3428.     3586.
```

Critical flow conditions

```
                         CRITICAL  CRITICAL   CRITICAL  25% OF Q
                           DEPTH   VELOCITY   SLOPE-Sc     Sc
          AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
          SPILLWAY ---     3.23      9.83      0.010     0.019

          INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
           (The auxiliary spillway began flow at time =   13.0 hours
            and peaked at time =   16.9 hours.)


            REACH   5: FROM STATION    450. TO    777. ON    3.5% SLOPE.
               Vegetal cover failed and concentrated flow developed
               at time =   17.1 hours.


            REACH   6: FROM STATION    777. TO    800. ON    5.3% SLOPE.
               Vegetal cover failed and concentrated flow developed
               at time =   14.8 hours.


            REACH   7: FROM STATION    800. TO    900. ON    5.7% SLOPE.
               Vegetal cover failed and concentrated flow developed
               at time =   14.8 hours.


            REACH   8: FROM STATION    900. TO    950. ON   10.0% SLOPE.
               Vegetal cover failed and concentrated flow developed
               at time =   14.5 hours.
```

Details of vegetal cover failure and concentrated flow on each reach of exit channel. Both constructed and natural reaches are described.

```
          INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

            The most upstream headcut began at station    450.
            and progressed upstream to station    427.
            The final height of the headcut was    3.2 ft.

            The headcut having the maximum final overfall height began
            at station    450. and progressed upstream to station   436.
            The final height of the headcut was    12.4 ft.

          THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

                          DURATION    ATTACK   DIST. FROM MOST U/S
                            FLOW       OE/B    HEADCUT TO U/S EDGE
          AUXILIARY         HRS      ACFT/FT     AUX. CREST, FT
          SPILLWAY ---     66.4        38.0            27.

          EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=  14.5 FT/SEC
                                           EXIT SLOPE  = 0.035 FT/FT
                                           FLOW DEPTH  =   2.2 FT
```

Details of the most upstream headcut

Details of the deepest headcut

Attack OE/B

Duration of flow through AS

Distance from the most upstream headcut to the upstream edge of the level crest

Type of flow in exit channel and parameters

Figure 5–16b Output—Routing results for AS (FBH) with barrier

Hydrograph type and alternative

At maximum routed elevation

At maximum stage in AS

Max. outflow discharges

Critical flow conditions

```
ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION   604.00

 ROUTED        BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
 RESULTS          FT         FT        ACFT      AC        FT        ACFT
 STORM HYD       150.0     612.01    6259.3    532.7      3.65     1775.4

           PEAK - CFS        Q-PS      Q-AUX.    Q-TOT.
           DISCHARGE  =      154.      2715.     2869.

                          CRITICAL  CRITICAL   CRITICAL  25% OF Q
                            DEPTH   VELOCITY   SLOPE-Sc     Sc
           AUXILIARY         FT      FT/SEC     FT/FT     FT/FT
           SPILLWAY ---     2.14      8.16      0.013     0.030
          *******************************************************************

          EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
          (Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)
            Aux. Spillway Discharge =    2715. cfs;   Bottom Width =   150. ft

                                                         TOTAL  EFFECTIVE
            REACH   FROM    TO    SLOPE  MANNING`S  VELOCITY  STRESS  STRESS
             NO.    STA     STA     %        n        ft/s    lb/ft^2 lb/ft^2
              5     450.    604.   4.78   0.033      12.33      4.28   2.601   max.
              6     604.    777.   2.36   0.033       9.92      2.61   1.586
          *******************************************************************

           INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
            (The auxiliary spillway began flow at time =   13.3 hours
             and peaked at time =   17.0 hours.)

             REACH   5: FROM STATION    450. TO    604. ON    4.8% SLOPE.
                Vegetal cover failed and concentrated flow developed
                at time =   15.6 hours.

             REACH   6: FROM STATION    604. TO    777. ON    2.4% SLOPE.
                Vegetal cover failed and concentrated flow developed
                at time =   15.6 hours.

             REACH   7: FROM STATION    777. TO    800. ON    5.3% SLOPE.
                Vegetal cover failed and concentrated flow developed
                at time =   15.2 hours.

             REACH   8: FROM STATION    800. TO    900. ON    5.7% SLOPE.
                Vegetal cover failed and concentrated flow developed
                at time =   15.2 hours.

             REACH   9: FROM STATION    900. TO    950. ON   10.0% SLOPE.
                Vegetal cover failed and concentrated flow developed
                at time =   14.7 hours.
```

Details of vegetal cover failure and concentrated flow on each reach of Exit Channel. Both constructed and natural reaches are described.

```
           INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

             Barrier placed at Station   405.0

             The most upstream headcut began at station    450.
             and progressed upstream to station    405.
             The final height of the headcut was    4.6 ft.
             Upstream progress of Headcut stopped by Barrier.

             The headcut having the maximum final overfall height began
             at station    882. and progressed upstream to station   806.
             The final height of the headcut was   10.4 ft.

           THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

                          DURATION    ATTACK   DIST. FROM MOST U/S
                            FLOW       OE/B    HEADCUT TO U/S EDGE
           AUXILIARY        HRS      ACFT/FT     AUX. CREST, FT
           SPILLWAY ---     55.1       17.5            5.

           EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=  12.3 FT/SEC
                                            EXIT SLOPE  = 0.048 FT/FT
                                            FLOW DEPTH  =   1.4 FT
 -------------------------------------------------------------------------------
```

Details of the most upstream headcut

Details of the deepest headcut

Attack OE/B

Duration of flow through AS

Distance from the most upstream headcut to the upstream edge of the level crest

Type of flow in Exit Channel and parameters

TR–60 and NHCP–378 have specific depth of flow and capacity criteria. If this criteria is not met, the program gives a message followed by another section of output similar to the routed results. To meet the depth and capacity criteria, the program increases only the depth to handle the minimum capacity, then again to meet the minimum depth requirement if necessary.

Hydrograph plots—The stability design and freeboard hydrograph character plots are similar to the principal spillway hydrograph plots (fig. 5–10). Enter program option P to obtain these plots (not displayed in this section). The program stops the plots at the end of the inflow hydrograph or at the auxiliary spillway crest.

The ExtVel column to the right of the plot contains the auxiliary spillway exit channel velocity for each increment of time. If a * follows the value, this indicates that it is a subcritical velocity; otherwise the value is the critical flow velocity at the exit channel slope. If a $ follows the value, this indicates that the exit velocity shown exceeds the theoretical velocity limit and a reconfiguration of the auxiliary spillway is probably necessary.

Embankment quantities

Enter program option E on the GO,DESIGN control word to obtain the quantity computations (fig. 5–17). You must input the CLPROFILE table to obtain the volume of fill and surface area of the dam. Enter the cross-sectional shape of the dam using TEMPLATE, CROWN, and/or STABERM if the program defaults are not adequate.

The program computes embankment quantities for each alternative design top of dam elevation. You may convert the quantities to costs for preliminary cost comparisons between alternatives.

All berms included on the embankment quantities are summarized separately as to type, top elevation, and volume of fill.

Figure 5–17 Output—Embankment quantities

Enter program option "E" on GO,DESIGN to obtain embankment quantities.
The CLPROFILE table is required input.

These are preliminary quantities for cost comparisons between alternate designs.

Includes volume of all berms

Surface area of dam not under water on horizontal plane

```
EMBANKMENT QUANTITIES
        VOLUME FILL= 137882. CY,    MAX. HEIGHT =   34.6 FT
        TOP WIDTH  =    14.0 FT,    TOP LENGTH  = 2771.1 FT
        AREA OF DAM=    7.04 AC,    AREA TO SEED=   5.62 AC (PROJECTED HORZ. AREA)

        WAVE BERM AT ELEVATION =   603.43,   VOLUME =   9380.2 CY
              (BERM IS INCLUDED IN VOLUME OF FILL.)
```

Base area of dam

Summary of berms included in volume of fill

Summary table

At the end of each job the passes are summarized by structure sites (fig. 5–18). Each site is identified by its physical parameters and criteria; then the key pass results are displayed. Alternative PS sizes, AS crest elevations, and bottom widths are tabulated to make a quick comparison of results. The results consist of the maximum H_p, the maximum water surface elevation, and the embankment volume. The distance from the most upstream headcut to the upstream edge of the level crest and the maximum exit channel velocity are also given for the type of hydrograph listed.

The summary table concludes with a catalog of all file names used or generated by the program along with their associated dates and times. A similar catalogue is also displayed on the screen at the end of a job.

Figure 5–18 Output—Summary table

```
SITES.....COMPUTATIONS COMPLETE


                              SUMMARY TABLE  1         SITES VERSION 2005.1.00
                              ----------------               DATED 01/01/2005


 WATERSHED ID                           RUN DATE                          RUN TIME
 ------------                           --------                          --------
 SJ1                                  05/01/2007                          07:44:20

 >>>   SITE   SUBWS   SUBWS DA   CURVE    TC   TOTAL DA   TYPE    STRUC    <<<
        ID     ID     (SQ MI)    NO.    (HRS)  (SQ MI)   DESIGN   CLASS
       -----  ----   --------   -----   ----   -------   -----    -----
       156B4   W1        7.50     82.   2.57      7.50    TR60      S

 PASS  DIA./  AUX.CREST  BTM.  MAX.    MAX.    EMB.  INTEGR.*  EXIT*    TYPE
  NO.  WIDTH    ELEV    WIDTH   HP     ELEV    VOL.   DIST.     VEL.     HYD
      (IN/FT)   (FT)     (FT)  (FT)    (FT)    (CY)   (FT)   (FT/SEC)
 ----  -----  -------  ------  ----  -------  -------  -----  ------  ---------
    1   36.0    608.4   100.0   5.3    613.6  137882.    27.    14.5  NRCS-FBH


 *  INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED
    HYDROGRAPH SHOWN UNDER TYPE HYD.




 SITES.......SUMMARY TABLE 1 COMPLETED.


                    NRCS  SITES    VERSION 2005.1.00,01/01/2005
                             SJ1      FILES

INPUT  = samplejob1a.d2c
OUTPUT = samplejob1a.OUT
         DATED 05/01/2007 07:44:20

                         GRAPHICS FILES GENERATED

OPTION "L"  = samplejob1a.DRG DATED 05/01/2007 07:44:20

OPTION "P"  = samplejob1a.DHY DATED 05/01/2007 07:44:20

OPTION "E"  = samplejob1a.DEM DATED 05/01/2007 07:44:20

AUX.GRAPHICS = samplejob1a.DG* DATED 05/01/2007 07:44:20
```

Design Type Key

TR–60 - TR–60
378–R - NHCP–378 with retardation (Profile No. 30)
378NR - NHCP–378 without retardation (subcritical flow)
378CR - NHCP–378 without retardation (supercritical flow)

The summary table contains the date and time of the run, the site's physical parameters, spillway data by pass, and gives input, output, and generated file names.

Output files generated

By selecting specific program options, you may instruct DAMSITE to generate machine readable files for input into other NRCS programs and summarize data for graphics. Table 4–1 in chapter 4 contains the program defined output file names, the required program options to obtain them, and general description of these files. The program will write the files to any disk drive available on the computer system (i.e., c:, a:). You may save the following types of files for future use:

Discharge hydrographs—Use the I or O program option to save the inflow or outflow hydrograph in 10-column field format for future use in 10-column field format by using the I or O program option. You may process and plot the hydrograph with a graphics program or reenter it into another segment of a DAMSITE system run. To obtain the file in 12-column fields, use the B program option with the I and/or O options. The program will write all hydrographs in a run to the file.

Rating tables—Use the R program option to save the total rating tables in 10-column field format. The rating tables consist of elevation-discharge-storage volume data for each alternative in a run. The program option T is similar except the data are in 12-column field format.

Graphic files—The DAMSITE program develops two types of graphic files. The program automatically generates the auxiliary spillway graphic files relating to stability and integrity when these analyses are requested. SITES uses these files to display a variety of plots through the IDE.

The GRAPHIC control word options L, P, E, I, or S with the appropriate program options on the GO, control word save rating tables, hydrographs, embankment and summary data for standard graphics. See table 4–1 for the options required for each file.

The program saves the standard graphic data in compressed format to facilitate transmission and save space. SITES saves a combination of input, intermediate, and final results. You may keep the files within reasonable storage limits by controlling the portions of a run to be saved by turning the program and graphic options on and off or by using the NOGRAPHICS control word. The NOGRAPHICS control word does not affect graphic files generated by the auxiliary spillway integrity analysis. You may further control the size of the GRAPHICS hydrograph file by selecting the type of hydrograph (PS, SD, FB, STORM, or HYD) to save.

The sample jobs in appendix C contain additional outputs available through the IDE.

Program and computer system messages

Input data mistakes or omissions cause most error conditions. This section assists you in understanding the types of program or computer system messages and in finding and solving problems that cause the error conditions.

Output error and warning messages

Program generated output messages occur when known input errors or peculiarities cause the program to modify input data or terminate execution. Messages may also clarify program action.

Program messages fall into four major categories by severity:

NOTE Informational message that may require action by you.

MESSAGE These messages bring your attention to changes in input or some non-standard design or criteria procedure that was necessitated by the data. You should examine the message and determine if the program changes or procedures are acceptable. Messages also identify unusual data combinations that you may wish to check.

WARNING These messages indicate that the data have some problems. The program uses standard changes or assumptions to make the data acceptable. You should examine the message and determine if the modifications are acceptable.

ERROR These messages indicate the data have a serious problem that caused the pass or job to terminate. You must correct the data before rerunning the program.

The program numbers error messages between 1 and 150. The program gives an error number at the end of each run when an error occurs and the program stops the run.

Appendix D lists the error messages consecutively by their assigned number with detailed explanations and suggested actions for you. The Appendix also lists notes, messages, and warnings alphabetically by category based on the first word(s) in the message. All program messages have a standard format so the output file can be easily searched for warnings, etc., using an edit program. The messages start with 5 asterisks in columns 1 to 5, followed by a blank, then followed with the message category: ***** WARNING.

Computer system messages

When input data do not conform to what the computer expects, the computer gives a run-time error and terminates execution. The Fortran library produces run-time errors for certain errors that occur during execution of the program. Different Fortran compilers may produce slightly different forms of these errors. The system errors have the following general form:

```
Run-time error Annnn:    OPERATION (file name)
  –  message text
```

where:

A is a letter code, usually F, M, or R,
nnnn is a code number,
OPERATION or MATH is the operation being performed when the system error occurred,
file name is the file involved,
message text is a short description of the reason for the system error.

Fortran manuals that describe system error messages can provide further information.

The developers of SITES made every effort to avoid system errors. Still some unforeseen combination of input data may produce one. Common sources of these errors are, for example: division by zero, taking the square root of zero or a negative number, or the occurrence of an unexpected character. Report to NRCS all system errors relating to input, data handling, or output and save files involved for further analysis.

Output examples

Appendix C has 10 sample jobs that illustrate the major types of runs. None of the samples represent actual jobs nor is their input representative of identified regions.

Each job consists of a list of features demonstrated and a list of input data. Jobs 1 through 6 show selected input and output data screens. Input and output data sets for these jobs are included in the diskette distributed with the program and you may examine the output. This guide does not include copies of the output due to space limitations.

Chapter 6 References

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Chapter 7 Glossary

Aerated sediment The portion of the total sediment accumulation deposited above the permanent pool subject to alternate wetting and drying.

Alternative A system of structural or nonstructural measures in a watershed. Also see pass and trial.

Att-Kin (modified) The Modified Attenuation-Kinematic reach flood routing method first used in NRCS Technical Release 20. See Hydrology Note 2.

Auxiliary spillway A spillway designed to convey excess water through, over, or around a dam, formerly called the emergency spillway.

Auxiliary spillway system A single auxiliary spillway or a combination of auxiliary spillways designed to work together.

Barrier Something that is placed in the spillway to stop the upstream advance of headcuts. A barrier does not affect erosion initiated upstream of the barrier or erosion that takes place downstream of the barrier.

Baseflow The sustained or fair-weather discharge which persists after storm runoff and associated quick return flow are depleted. It is usually derived from groundwater discharge or gradual snow or ice melt over extended periods of time, but need not be continuous flow. It can be based on annual or seasonal periods depending upon when major floods usually occur.

Centerline profile A valley cross section along the center line of a proposed dam.

Conservation storage Water impounded for consumptive uses such as municipal, industrial and irrigation and nonconsumptive uses such as recreation and fish and wildlife.

Control section A cross section where accelerated flow passes through critical depth in an open channel spillway.

Crest The elevation of the uppermost surface of a dam or an earth spillway.

Cross section (stream or valley) Shape of a channel, stream, or valley viewed across its axis.

Dam An artificial barrier, together with any associated spillways and appurtenant works, across a watercourse or natural drainage area, which does or may impound or divert water.

Default drive directory The current computer directory from which SITES is run. For example, c:> a:SITES; where c: is the default drive and a: is the drive the program is stored on. The program writes temporary files to the default directory, that directory which is current.

Delta t See Time increment.

Design life The period of time during which a dam is designed to perform its assigned functions satisfactorily.

Design storm (1) The storm for which the user designs a flood protection project or spillway.
(2) The rainfall estimate corresponding to an enveloping depth-duration curve for the selected frequency.

Dimensionless unit hydrograph A table of dimensionless time and discharge with a peak discharge of 1. 0 and a base time of 1. 0. SITES uses this table to calculate the unit hydrograph for a watershed which has 1 inch runoff volume. See NEH 4, chapter 16.

Drainage area See Watershed.

Drawdown Time required to evacuate the flood storage from the maximum storage elevation reached during routing of a given storm to an elevation set by the user or by design criteria.

Dry dam A dam that has an ungated outlet positioned so that essentially all stored water will drain from the reservoir by gravity. The reservoir will normally be dry.

Earth dam A dam in which the principal barrier is an embankment of earth or rock fill, or a combination of earth and rock fill.

Earth spillway An open channel spillway in soil and/or rock.

Economic life The period of time during which economic benefits accrue to a dam.

Effective height of dam The difference in elevation in feet between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section on the centerline of the dam. If there is no open channel auxiliary spillway, the top of the dam is the upper limit.

Effective tractive stress The hydraulic shear stress experienced by the soil boundary. This is the gross stress adjusted by a factor accounting for form roughness and a factor accounting for turbulence damping effects of vegetal cover. May be expanded to erosionally effective stress or erosionally effective tractive stress for clarity or shortened to effective stress for brevity depending on context.

Element An object used to represent a structure, reach, subwatershed, or junction point in the watershed schematic.

Embankment template A description of the dam cross section including embankment slopes and the relative location of any berms.

Emergency spillway See auxiliary spillway.

Emergency spillway hydrograph See stability design hydrograph.

Emergency spillway system See auxiliary spillway system.

Exit channel The portion of an open channel spillway downstream from the crest which conducts the flow to a point where it may be released without jeopardizing the dam.

Flood pool sediment See aerated sediment.

Freeboard hydrograph The hydrograph used to establish the minimum settled elevation of the top of the dam. It is also used to evaluate the structural integrity of the spillway system.

Gross stress The total hydraulic shear stress on the boundary without adjustment for form roughness or turbulence damping effects of vegetal cover. Normally computed as the product of the unit weight of water, the flow depth, and the slope of the energy grade line.

Headcut erodibility index Index describing the resistance of the material to erosion by headcutting. A value of 0.01 is a weak resistance, and 1,000 is a strong resistance. This variable controls the rate of headcut advance within the auxiliary spillway.

Hydrograph (1) A graph showing, for a given point on a stream or for a given point in any drainage system, the discharge, stage, velocity, or other property of water with respect to time.
(2) The tabular data from which a graph can be plotted.

Inlet channel The portion of an open channel spillway upstream from and including the crest.

Integrated development environment Two or more complementary components merged together into a single software system.

Integrity analysis Analysis of an earth auxiliary spillway using a three phase erosion model to determine the potential for breach. Analysis is normally carried out for the freeboard hydrograph in design situations. Output includes an estimate of the extent of erosion resulting from flow through the spillway.

Job The execution of DAMSITE from initialization at the SITES record through completion at the first ENDJOB record; may include any number of passes through the structure.

Joint use pool The portion of a reservoir which serves two or more purposes; for instance, conservation storage and floodwater storage.

Muskingum-Cunge Default reach routing method in SITES 2005.

Null structure A nonfunctional or dummy structure that is used in a subwatershed to indicate a potential structure location for use in other alternatives.

Hydrology Note 2 (draft 2000) Documentation of the modified Att-Kin reach routing method.

Pass	Each alternative run through a structure or system of structures and subwatersheds ending with a GO, control word. See also trial.
Path	The computer drive, directory structure, and file needed to read from, or write to, a specific file storage location.
Permanent pool	The portion of the reservoir allocated to submerged sediment and storage of water for purposes other than flood control. It is usually set at the crest of the principal spillway.
Postorder transversal	A technique for recursively processing the nodes of a tree in which any subtrees are processed first, then the root is processed.
Primary auxiliary spillway	The spillway with the lowest crest elevation in an auxiliary spillway system.
Principal spillway	The lowest ungated spillway designed to convey water from the reservoir at predetermined release rates.
Principal spillway hydrograph	The hydrograph used to determine the minimum crest elevation of the auxiliary spillway. It is used to establish the principal spillway capacity and determine the associated minimum floodwater retarding storage.
Quick return flow	The diminishing discharge directly associated with a specific storm that occurs after surface runoff has reached its maximum. It includes base flow, prompt subsurface discharge (commonly called interflow), and delayed surface runoff.
Ramp spillway	A vegetated spillway constructed over an earth dam in a manner such that the spillway is part of the embankment.
Rating curve (structure)	The elevation- or stage-discharge relationship with a constant tailwater. Each water surface elevation in the reservoir produces a certain discharge through the spillway system.
Reach	A length of spillway channel, stream channel, or valley selected for use in hydraulic or other computations. Reaches are usually selected to have constant hydraulic properties.
Record	A single line of input data for computer processing. It also can refer to a single line of output data. DAMSITE input records and most output have a maximum length of 80 characters.
Reservoir	A pond, lake, tank, basin, or other space, either natural in its origin or created in whole or in part by the building of engineering structures. A reservoir stores, regulates, and controls water.
Retardance class	A relation between Manning's roughness coefficient "n" and the product of velocity and hydraulic radius in grass lined channels. Curves A to E (SCS–TP–61, 1954) represent five degrees of vegetal retardance.
Retardance curve index	A parameter describing the retardance potential of a vegetal cover (AH 667, 1987). Retardance curve index is a more refined representation of retardance class.

Retarding pool The portion of the reservoir allotted to the temporary impoundment of floodwater. Its upper limit is the elevation of the crest of the auxiliary spillway.

Retarding storage The volume of the retarding pool.

Run A computer processing term; the placing of a program into memory and executing it. DAMSITE can process one or more jobs within a run.

Runoff curve number (CN) A dimensionless number of 100 or less that relates runoff to the soil-cover complex of the watershed. Higher numbers mean greater runoff.

Sediment pool The portion of the reservoir allocated to the accumulation of submerged sediment during the design life of the dam.

Sediment pool elevation The elevation of the surface of the anticipated submerged sediment accumulation at the dam.

Sediment storage The reservoir capacity allocated to total sediment (submerged and aerated) accumulation during the design life of the dam.

Simulation The process of routing a given storm through a structure, or a system of structures, to evaluate the effects.

Spillway An open or closed channel, conduit, or drop structure used to convey water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of water.

Spillway template Bottom profile of the auxiliary spillway expressed in coordinates relative to the downstream end of the inlet channel. You may control the location of the template relative to the spillway geology, or you may allow the template to "float" such that during program execution the design criteria fix the spillway crest elevation. The program computes the intersection of the template with the existing ground surface.

Stability analysis Analysis of an earth auxiliary spillway exit channel using the concept of a non-eroding channel at the experienced peak velocity or stress.

Stability design hydrograph The hydrograph used to establish the dimensions of the earth auxiliary spillway from a stability analysis of the exit channel. Older documents use the term emergency spillway hydrograph.

Stack A set of items in which only the most recently added item may be removed. The latest added item is at the top.

Storage The capacity of the reservoir below the elevation of the crest of the auxiliary spillway.

Storm A rainfall event used to evaluate the performance of a structure or a spillway.

Stress Hydraulic shear stress in force per unit area. See also Effective tractive stress and Gross stress.

Subarea See Subwatershed.

Submerged sediment The portion of the total sediment accumulation that is deposited in an underwater environment within the permanent pool.

Subwatershed A watershed that is part of a larger watershed. It may be analyzed separately, when necessary, in order to improve computational accuracy for results on a whole watershed basis or to get results for that area only.

Synthetic storm A storm obtained by taking a selected value from the frequency line based on historical storm series data.

Template May refer to either the auxiliary spillway profile shape or the shape of the dam cross section.

Time increment The program computes the increment of time to develop hydrographs. The program uses the increment for all routing computations, adding of hydrographs, and tabulations of hydrograph coordinates.

Time of concentration The time for water to travel from the hydraulically most distant point of the watershed to the outlet.

Transmission loss A reduction in volume of flow in a stream, canal, or other waterway due to infiltration or seepage into the channel bed and banks. Evaporation is also a transmission loss, but, assuming that it is small, you ordinarily neglect it.

Trial Each alternative ASCREST and/or BTMWIDTH run at a design site.

Unit hydrograph A discharge hydrograph resulting from one inch of direct runoff distributed uniformly over the watershed, with the direct storm runoff generated at a uniform rate during the unit storm duration. A watershed may have 1-hour, 2-hour, etc., unit hydrographs.

Vegetated spillway A vegetated open channel spillway in earth materials.

Velocity, theoretical The velocity which water or other liquid, under a given head, would attain in passing through an orifice, conduit, or other structure were its flow not reduced by friction or other losses.

Visual focal An element in the landscape upon which the eyes automatically focus because the element's size, form, color, or texture contrast clearly with its surroundings.

Watershed The surface area draining into a stream at a given point.

Chapter 8 Conversions

These units	Multiplied by	Gives
ft^3/s days (cfs–days)	1.983	acre feet
ft^3/s days (cfs–days)	0.03719	inches depth on 1 square mile
ft^3/s days per square mile (cfs–days/sq. mi.)	0.03719	inches depth
ft^3/s hours (cfs–hr)	0.08264	acre feet
ft^3/s hours per square mile (cfs-hrs/sq. mi.)	0.001550	inches depth
ft^3/s (cfs)	1.983	acre feet per day
ft^3/s (cfs)	724.0	acre feet per year (365 days)
ft^3/s (cfs)	448.8	U.S. gallons per minute
ft^3/s (cfs)	0.6463	million U.S. gallons per day
csm (cubic feet per second per square mile)	0.03719	inches depth per day
csm	13.57	inches depth per year (365 days)
inches per hour	645.3	csm
inches per hour	1.008	ft^3/s per acre
inches depth	53.33	acre feet per square mile
inches depth on 1 square mile	53.33	acre feet
acre feet	0.5042	ft^3/s days
acre feet	12.10	ft^3/s hours
acre feet	0.01875	inches depth on 1 square mile
acre feet	0.3258	million U.S. gallons
acre feet per day	0.5042	ft^3/s
acre feet per square mile	0.01875	inches depth
U. S. gallons per minute	0.002228	ft^3/s
million U.S. gallons per day	1.547	ft^3/s
feet per second	0.6818	miles per hour
cubic feet	7.481	U.S. gallons
imperial gallons	1.200	U.S. gallons
inches	*0.0254	meters
inches	*25.4	millimeters
feet	*0.3048	meters
acres	0.40469	hectares
acres	4046.9	square meters
gallons (U.S.)	3.7854	liters
pounds	0.45359	kilograms
cubic meters	*1000.0	liters
acre feet	1233.5	cubic meters
cubic feet	0.028317	cubic meters
square feet	0.09290	square meters
square miles	2.590	square kilometers
ft^3/s hours	101.94	cubic meters
csm	0.010933	cubic meters/second/square kilometer

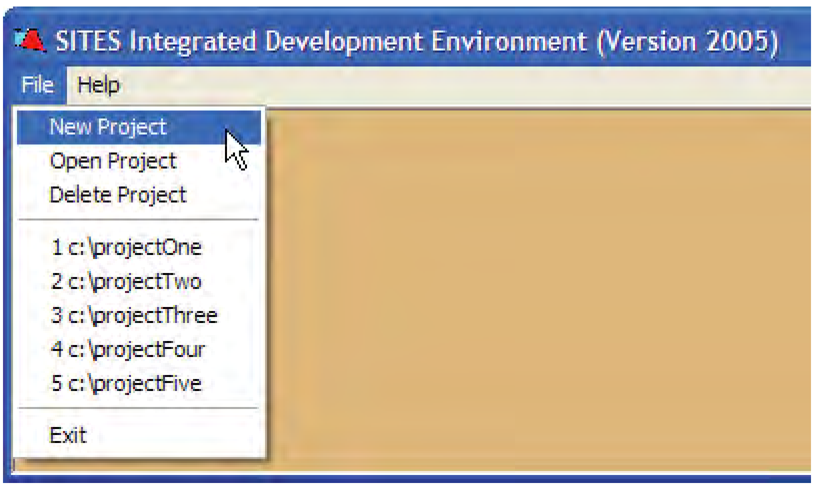
* Exact conversion

Appendices

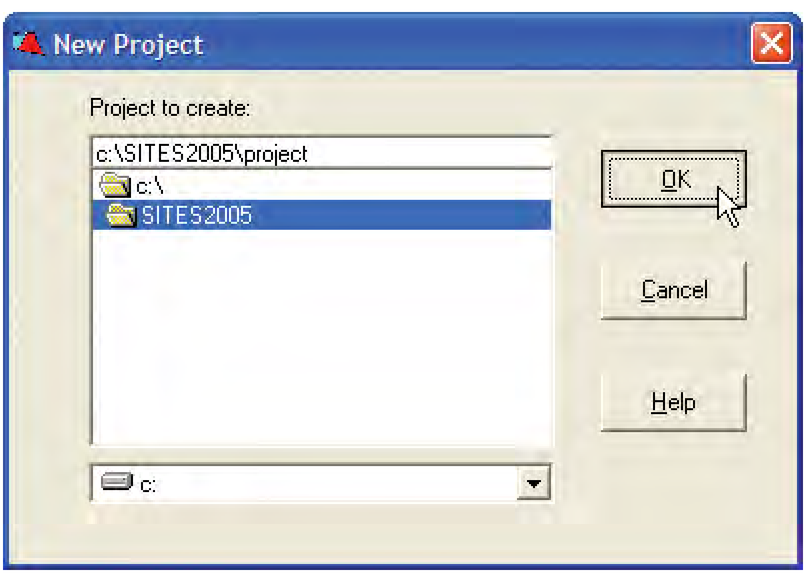
Appendix A SITES Integrated Development Environment Quick Start Guide

Step 1

The first step in using the SITES Integrated Development Environment is to create a new project. Click **File** and **New Project** or open an existing project by clicking **File** and **Open Project**, or by selecting a recently opened project from the history list. The project directory must be created by SITES.

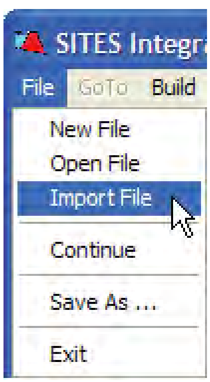


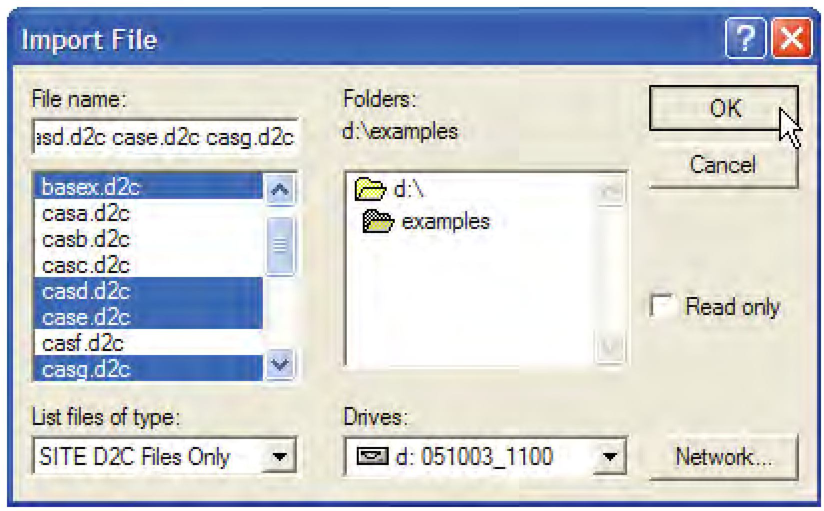
In the New Project dialog box, you must provide the name of a new project directory; e.g., c:\Sites2005\project. Note that in this example, the directory c:\Sites2005 was already created outside of the IDE.



Step 2

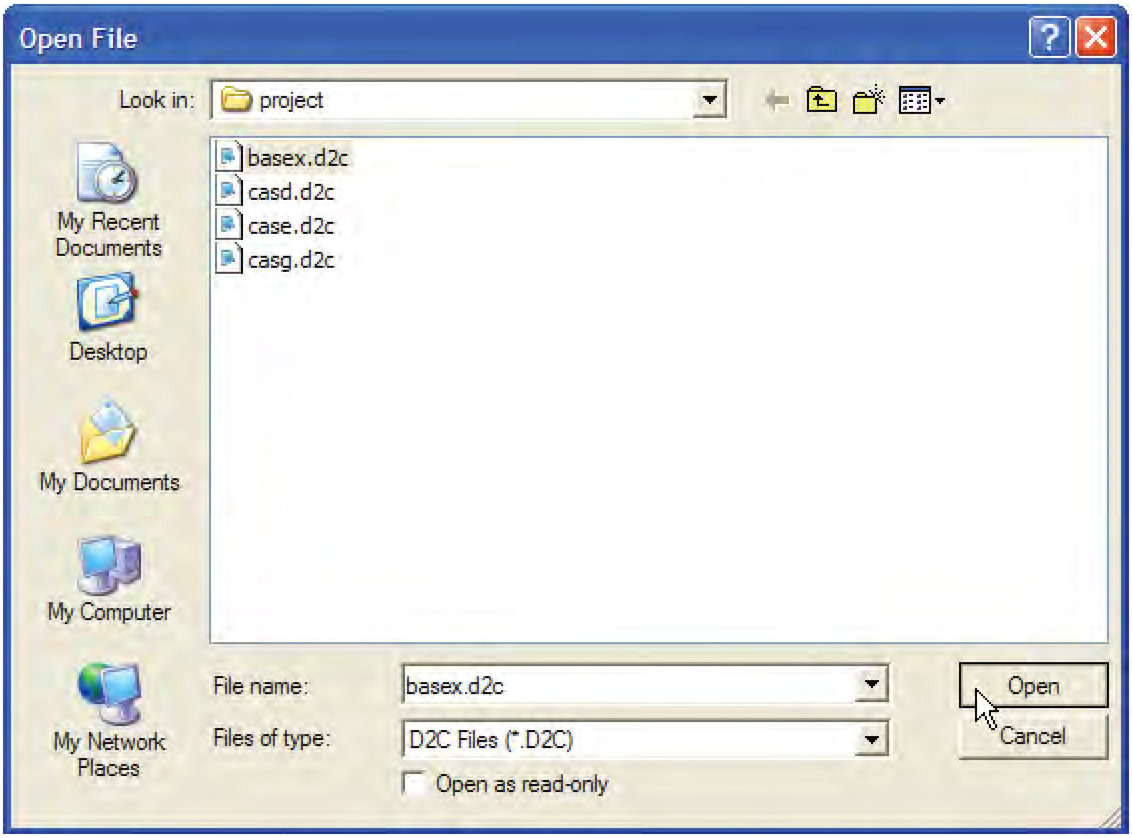
Once a project is opened or created, an individual control file (new run) may be added to the project, either by creating a new file by clicking **File** and **New File** or by importing an existing file from another directory by clicking **File** and **Import File**. Several existing control files are available on the CD–ROM in the Examples directory. Each input control file identifies a particular run. Several control files can be selected at once by using the Shift key to select a block or the Ctrl key to select several individual files. For example, to import the examples called *basex.d2c*, *casd.d2c*, *case.d2c*, and *casg.d2c* click on *basex.d2c*, then hold the Ctrl Key down and click on *casd.d2c*, *case.d2c*, and *casg.d2c*. Finally, click on **OK** to select all four files.





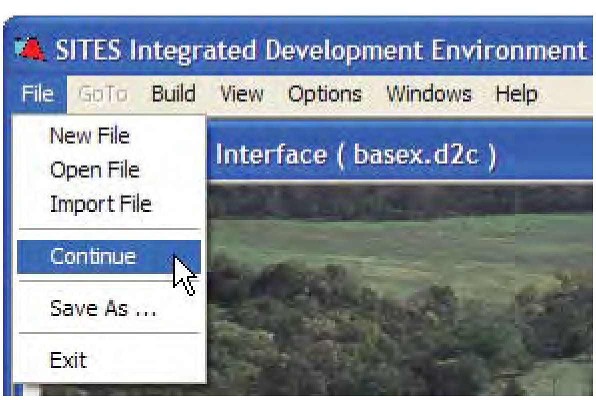
Step 3

After a file has been imported into the project directory, open the file by selecting **File** and **Open File**. Suppose that the file basex.d2c has been imported from the Examples directory on the CD–ROM. To view or edit the data in the file, it must first be opened.

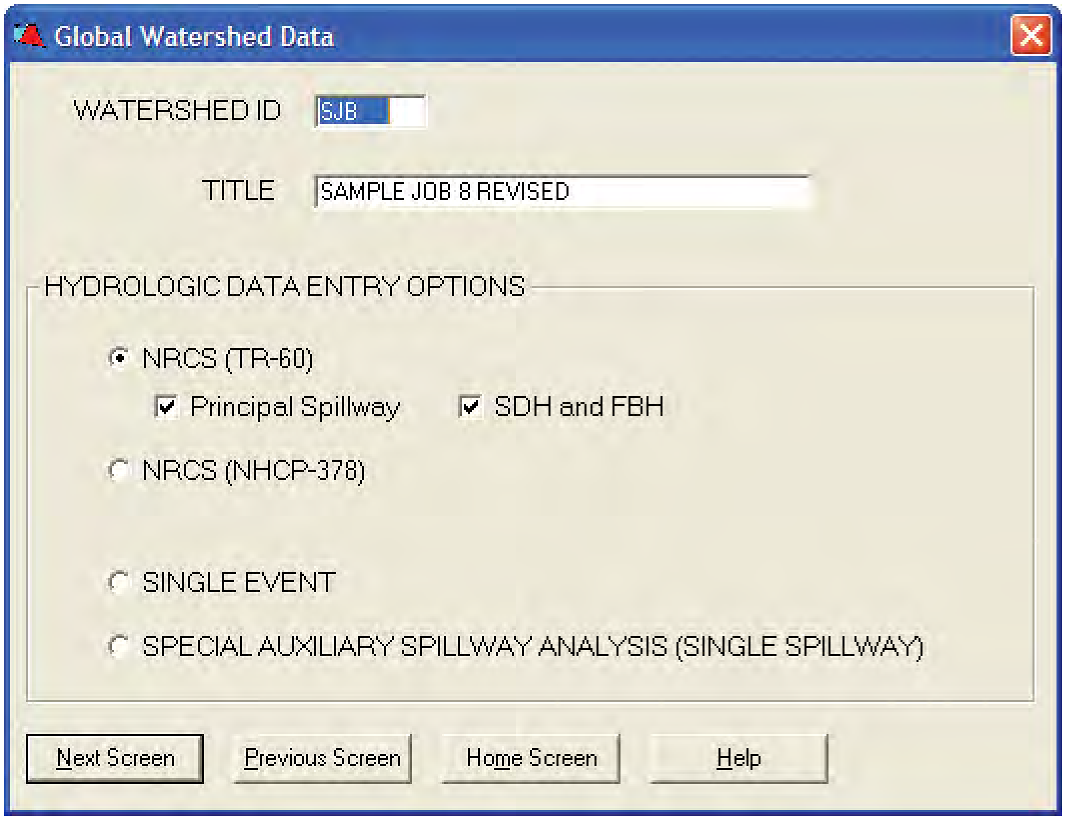


Step 4

After opening a file you are returned to the Sites home screen. Once opened, the data in the file may be edited and checked for consistency by selecting **Build** and **Check File**, or passed to the SITES Simulator to generate output by selecting **Build** and **Build File**. To edit an opened input control file, select **File** and **Continue**.

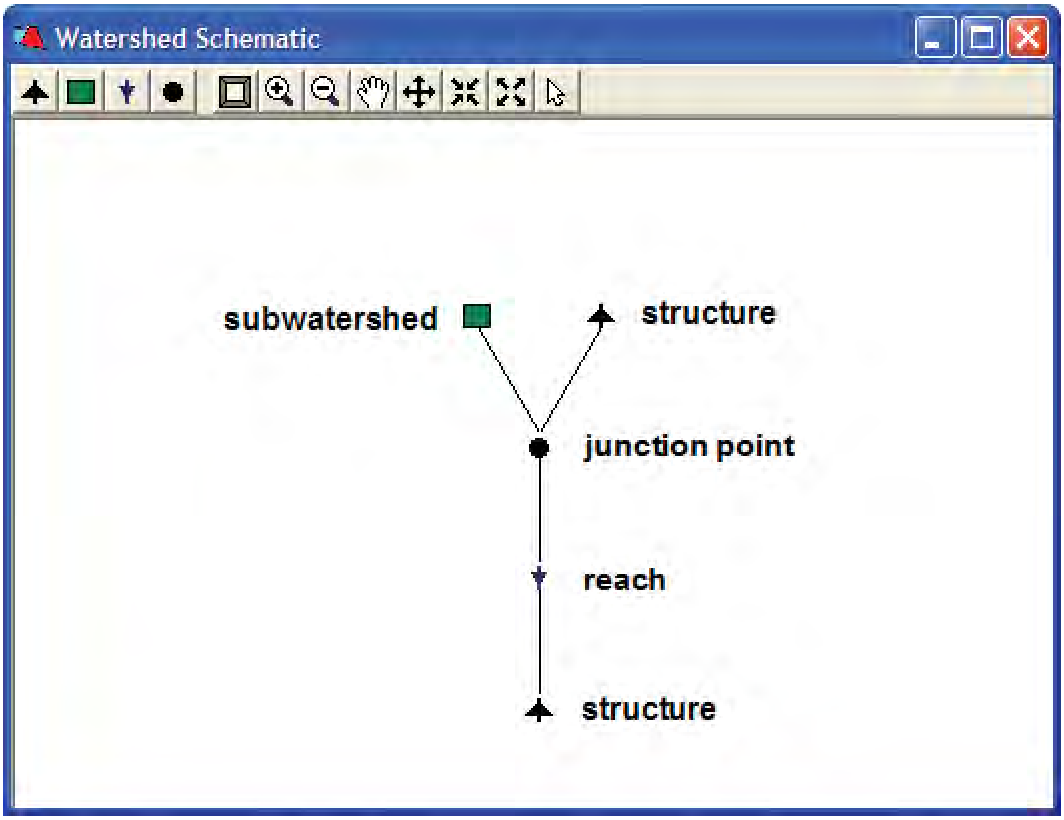


Step 5 The Global Watershed Data screen will be the first input screen displayed. This screen defines the type of run to be performed. Refer to the User Guide or the system help for a more detailed description of each run type.



Step 6

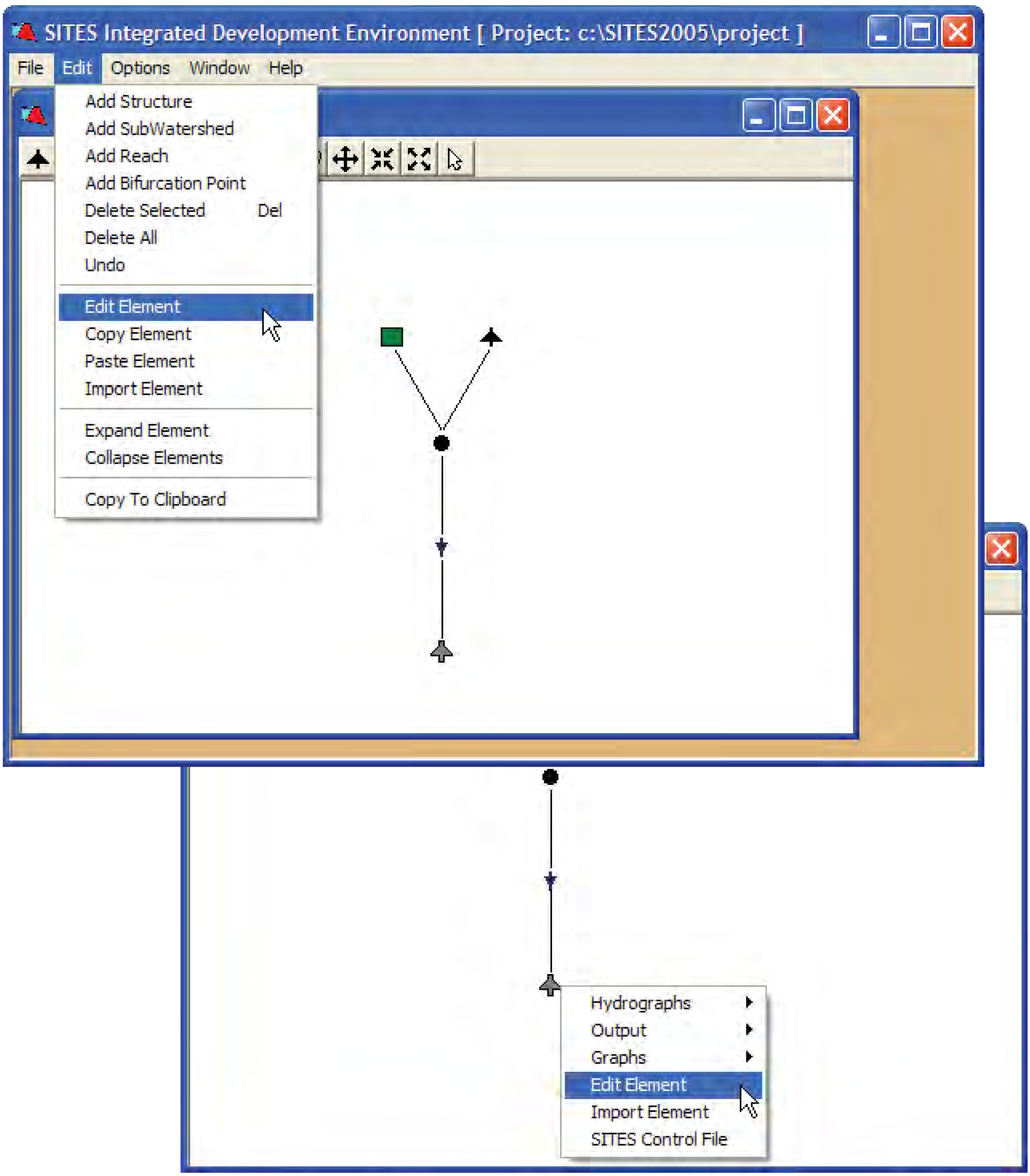
After verifying the global options selected, click on the **Next Screen** button to jump to the Watershed Schematic screen.



The Watershed Schematic defines the logical relationships between hydrologic elements in the watershed. Typically, the downstream structure is the structure being designed or analyzed, whereas the upstream structures, reaches, junction points, and subwatersheds are simply features of the watershed.

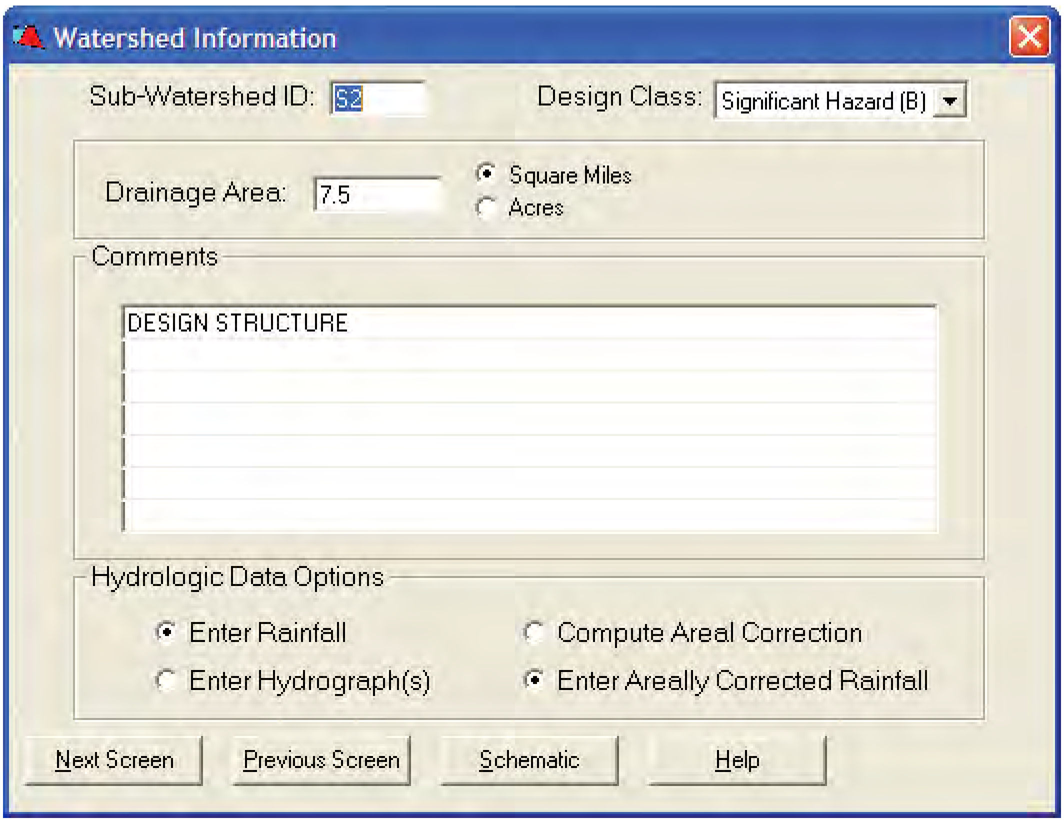
Step 7 Within the Watershed Schematic, three different methods can be used to edit an element:

- click on the element icon to select the desired element, and select **Edit Element** from the **Edit** menu (shown below),
- right click on the element icon and select **Edit Element** from the pop up menu (also shown below), or
- simply double-click on the icon of the element to be edited.



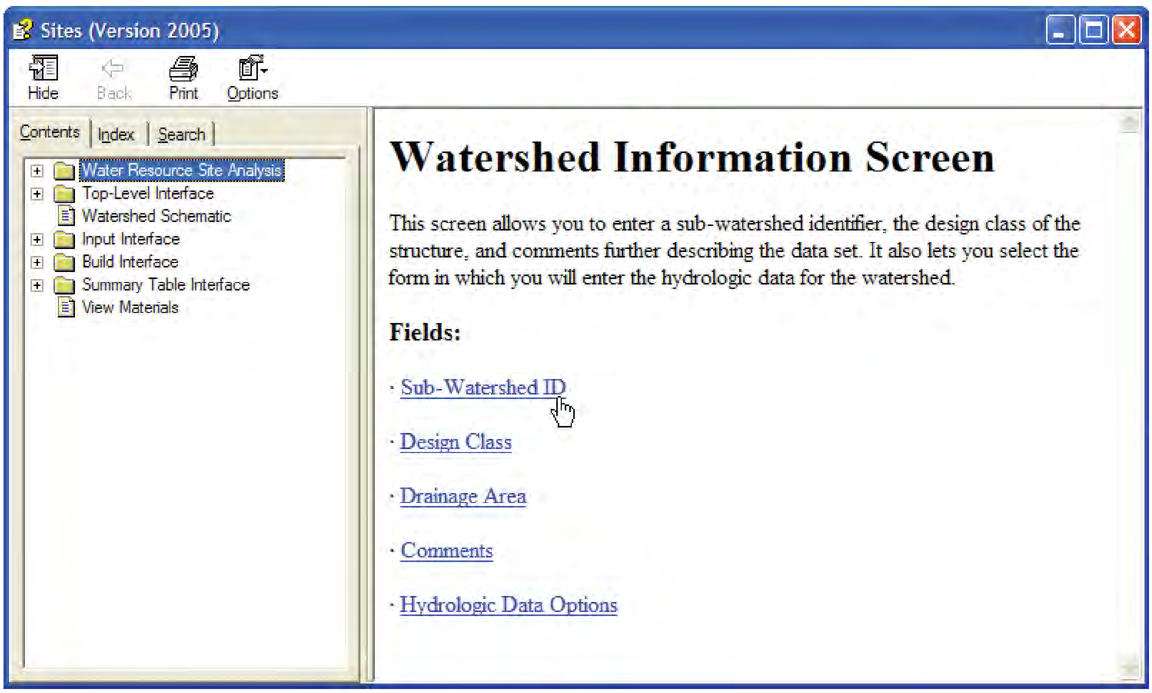
Step 8

Then, the Data Input screens associated with the selected element are loaded (as shown below for the downstream structure). Changes made to the element are only stored in memory, they are saved to the data file in the project directory when you select **File** and **Save As ...** from the Home screen.



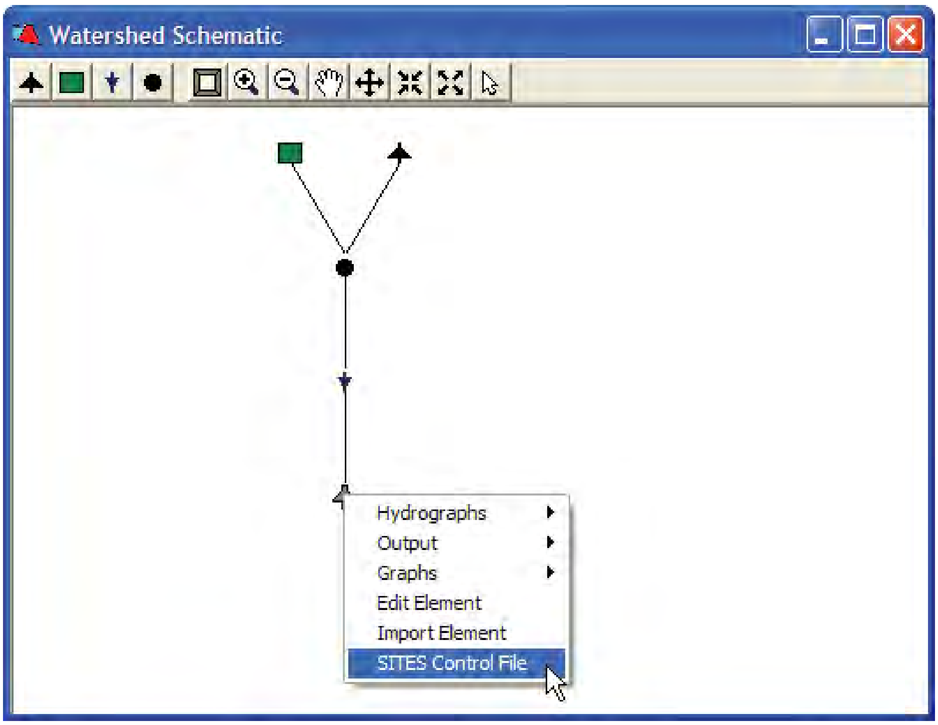
Step 9

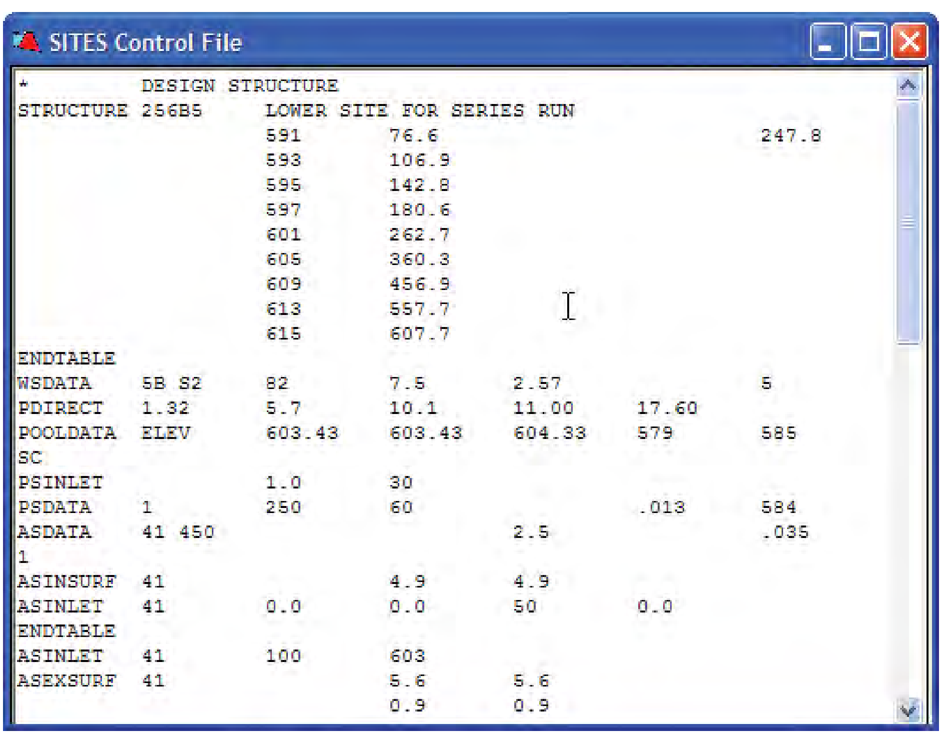
For a structure, the first input screen displayed will be Watershed Information. Browse through the screens in sequential order by clicking on **Next Screen** and **Previous Screen**. Also, from any input screen, you can return directly to the Watershed Schematic by clicking on **Schematic**. Finally, Screen-Level Help is available to explain the meaning of each field in a screen by clicking on **Help** or the F1 key. Shown below is the Screen-Level Help for the Watershed Information Screen.



Step 10

After browsing though the input screens, you are automatically returned to the Watershed Schematic. Changes made to the section of the control file associated with the element can be viewed by right-clicking on the element and selecting **SITES Control File**. Remember that these changes are only stored in memory; after all hydrologic elements have been modified, the changes must be saved by selecting **File** and **SaveAs ...** from the Home screen.

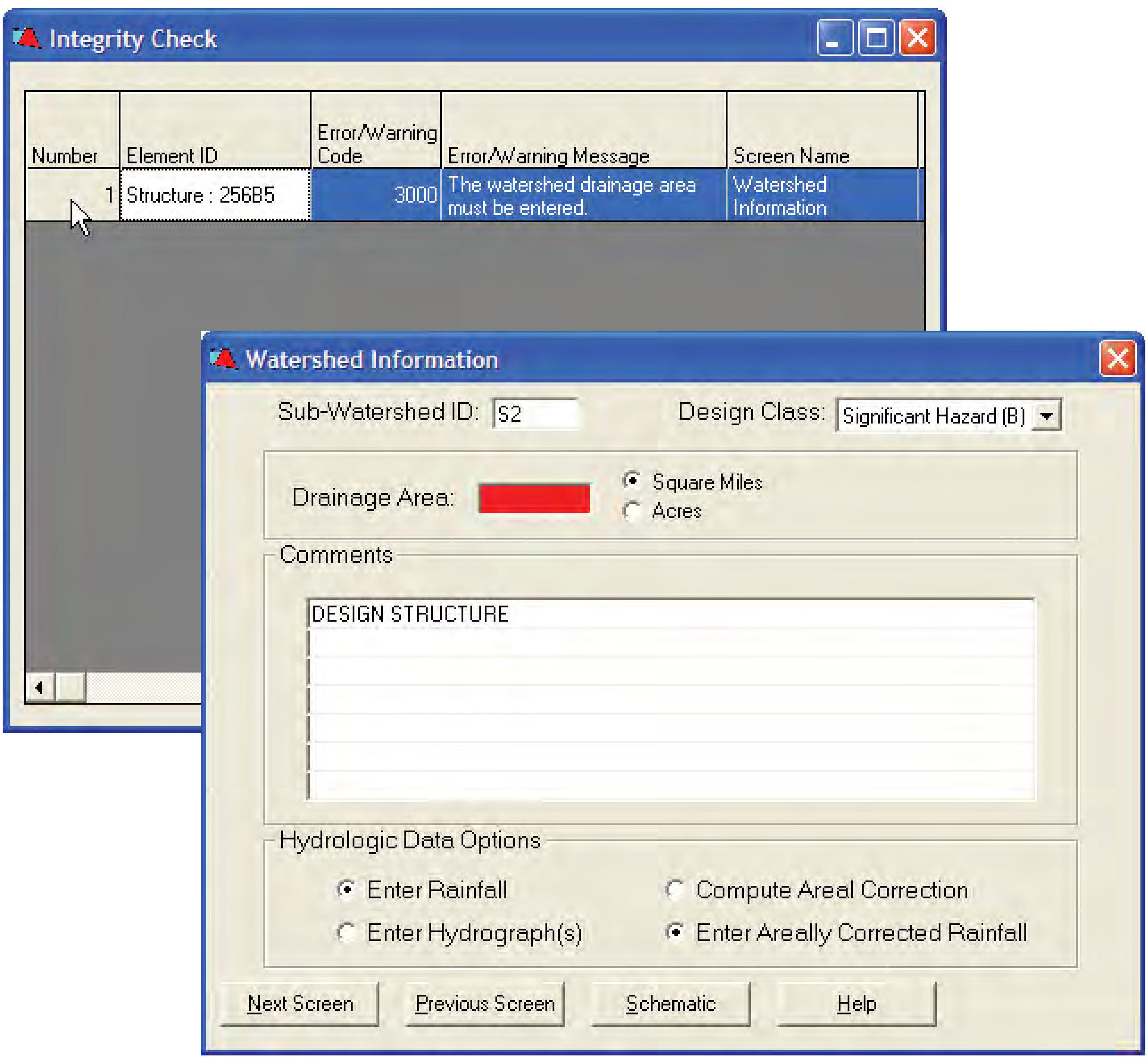



SITES Control File

```
*          DESIGN STRUCTURE
STRUCTURE 256B5      LOWER SITE FOR SERIES RUN
                     591       76.6                          247.8
                     593       106.9
                     595       142.8
                     597       180.6
                     601       262.7
                     605       360.3
                     609       456.9
                     613       557.7
                     615       607.7
ENDTABLE
WSDATA    5B S2      82        7.5       2.57                5
PDIRECT   1.32       5.7       10.1      11.00     17.60
POOLDATA  ELEV       603.43    603.43    604.33    579       585
SC
PSINLET              1.0       30
PSDATA    1          250       60                  .013      584
ASDATA    41 450                         2.5                 .035
1
ASINSURF  41                   4.9       4.9
ASINLET   41         0.0       0.0       50        0.0
ENDTABLE
ASINLET   41         100       603
ASEXSURF  41                   5.6       5.6
                               0.9       0.9
```

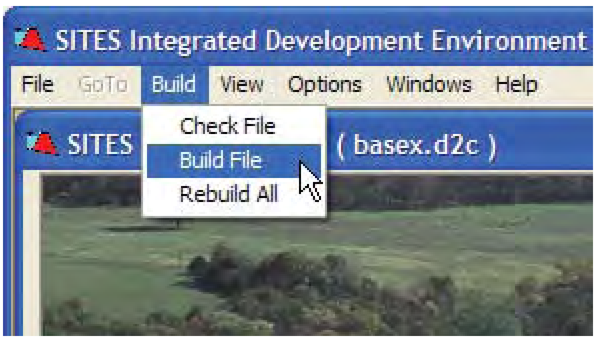
Step 11

After saving the modified file (usually with a new name), you can select **Build** and **Check File** to test the integrity of the data in the file (i.e. checks are made to identify missing data or inconsistent data). Any errors or warnings generated by the Integrity Checker (stored in an *.ERR file) can be displayed by selecting **View** and **Error Table**. From the Error Table, double-click on an error or highlight an error and select **Edit** and **Element** to jump directly to the element and screen that contains the error. For example, suppose that you intentionally remove the Drainage Area entry from the Watershed Information screen for Basex.d2c, save the erroneous file with a new name, select **Build** and **Check File**, and select **View** and **Error Table**. The following Error Table screen is displayed. You can jump directly to the Watershed Information screen to correct the error. Remember that the corrected entry will need to be saved before invoking the Integrity Checker or Sites Simulator because these routines only operate on external files rather than the information stored in memory.



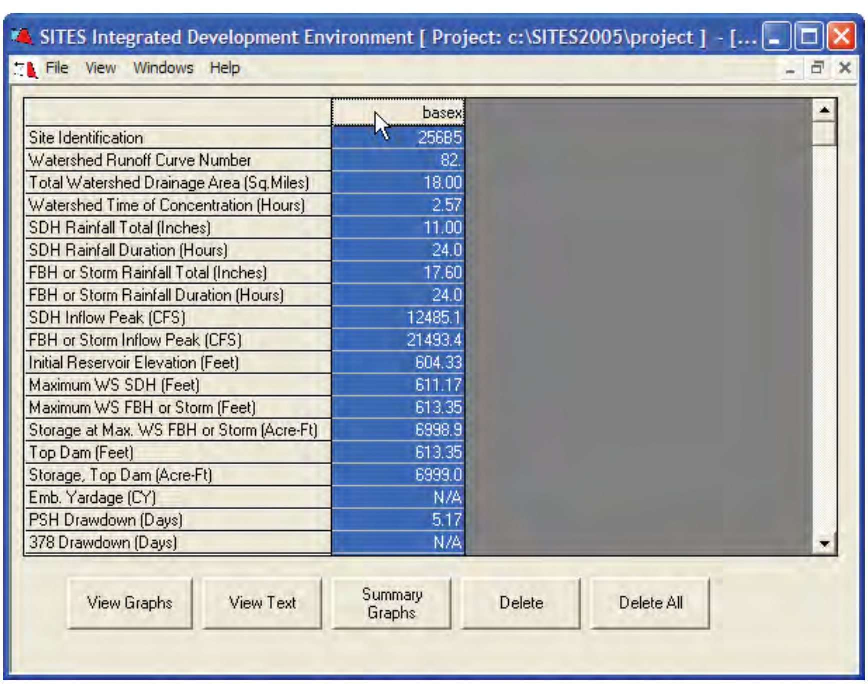
Step 12

After correcting the errors and saving the modified run, select **Build** and **Build File** to invoke the SITES Simulator to build the output files associated with the selected input control file. The simulator can either be executed on a single control file or on all control files in the project by selecting **Build** and **Rebuild All**. Several output files are created for each input control file.

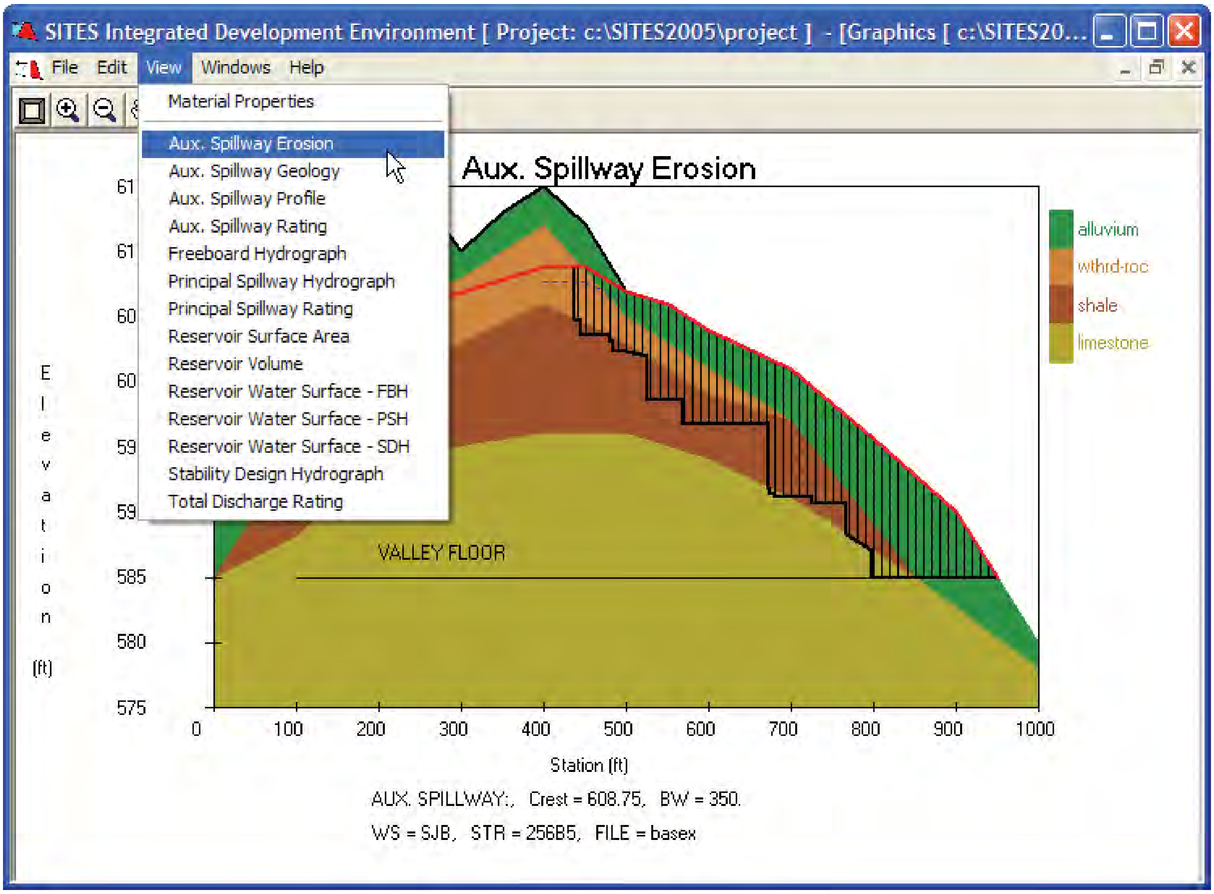


Step 13

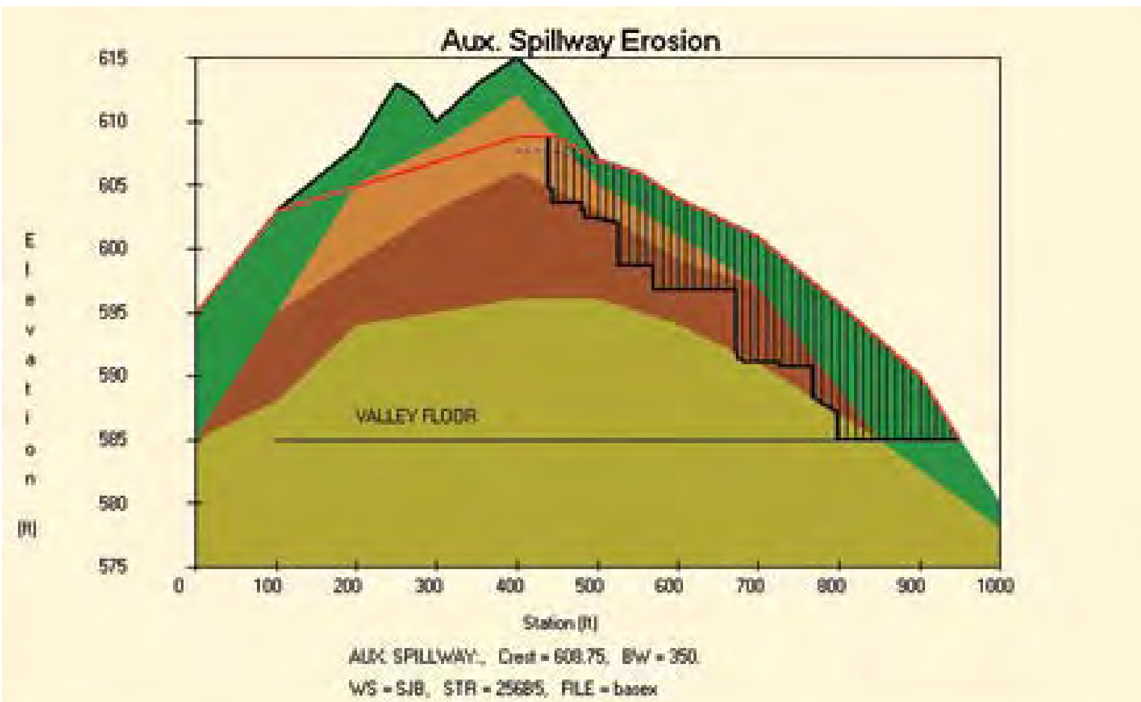
After the output files have been built by invoking the SITES Simulator, the results can be viewed by selecting **View** and **Summary Table**. The summary table contains information for all files in the project for which the build command has been executed. By default, all summary fields are displayed. To view graphs or text associated with a given run, select the run (in this case column) to be displayed (by clicking on Basex). Then, select **View** and **Graphs** or **View** and **Text** to view output generated by the simulation run. **View** and **Summary Graphs** are used to graphically display data from the summary table in the form of scatter or line plots. Data included in the summary table and the graphic information accessed through the summary table is that associated with the downstream structure.



Step 14 View Graphs allows you to visualize the output in a graphical format for a specific run. Individual graphs can be selected from the **View** menu.



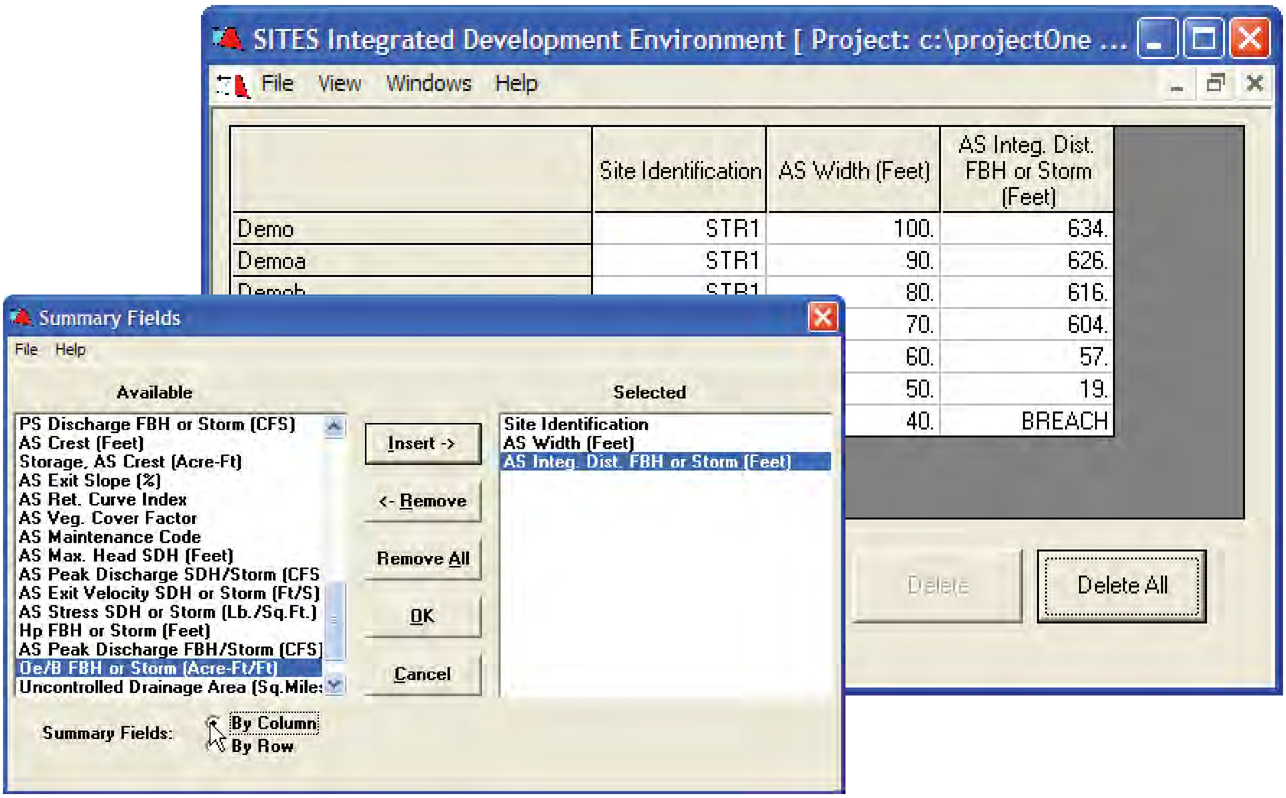
By selecting **<u>V</u>iew** and **<u>M</u>aterial Properties**, and a Scroll Screen Height of 2, the size of the screen is doubled, and a scroll bar is added to view the bottom half which includes the Material Properties. The Scroll Screen Height and Screen Size can be adjusted to fit a user's requirements. A snapshot of any image can be saved as a Windows® Bitmap using **<u>F</u>ile** and **<u>S</u>ave As**…, sent to printer using **<u>F</u>ile** and **Print**, or copied to the Windows® Clipboard using **<u>E</u>dit** and **<u>C</u>opy to Clipboard**. After copying to the clipboard, the file can be pasted into any other application, such as Microsoft® Word®, as we have here, using **<u>E</u>dit** and **<u>P</u>aste** (or Ctrl-V).



Material Description	Detach. Rate (ft/h)/(lb/sq ft)	Dry Density (lbs/cu ft)	Headcut Index (Kh)	Percent Clay	Plasticity Index	Rep. Diameter (in)
ALLUVIUM	–	110.	0.07	20.0	12.	0.00800
WTHRD-ROCK	–	120.	0.40	0.0	0.	2.00000
SHALE	–	130.	7.00	0.0	0.	7.00000
LIMESTONE	–	160.	200.00	0.0	0.	18.00000
TS_FILL	–	110.	0.07	20.0	12.	0.00800
GEN_FILL	–	110.	0.07	20.0	12.	0.00800

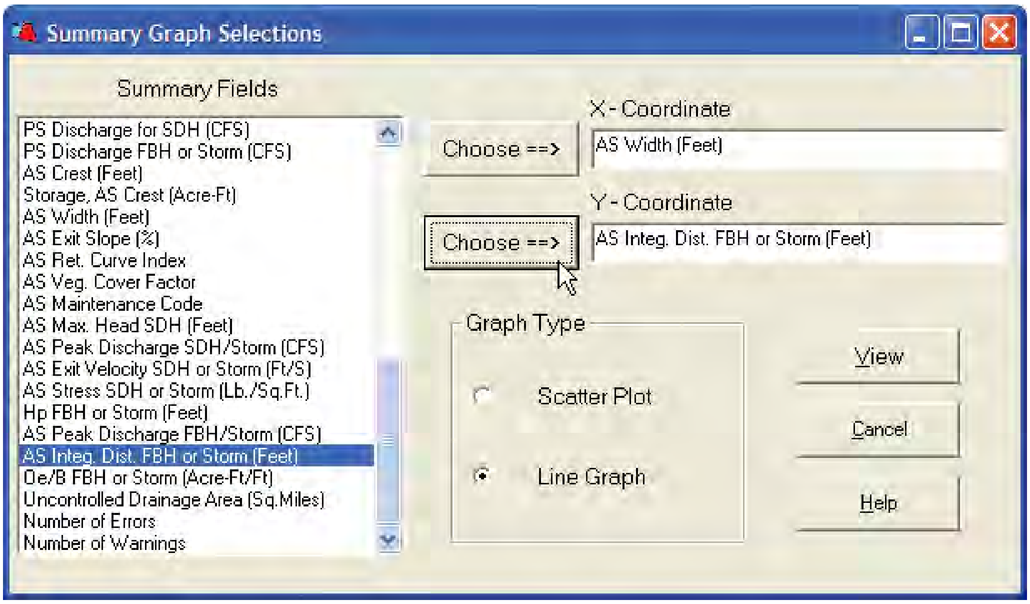
Step 15

The Summary Graphs Option is used to compare differences between several runs. For example, open up an existing project on the CD–ROM called Training\Demo Project. Select **View** and **Summary Table**. Note that this project consists of seven runs, each with a different AS Width (feet) and a different resultant AS Integrity Distance.



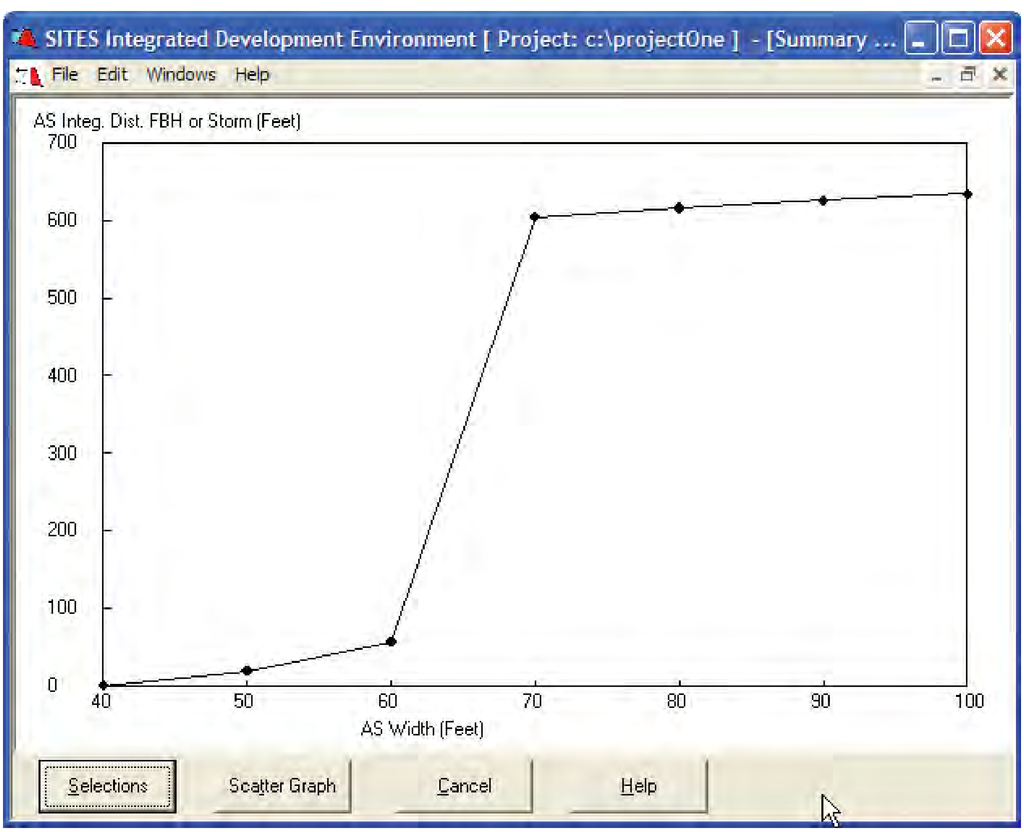
Step 16

To get a better picture of their relationship, select **View** and **Summary Graphs** (or click on the **Summary Graphs** button). Select AS Width (feet) as the X-Coordinate and AS Integ. Dist. FBH or Storm (feet) as the Y-Coordinate.

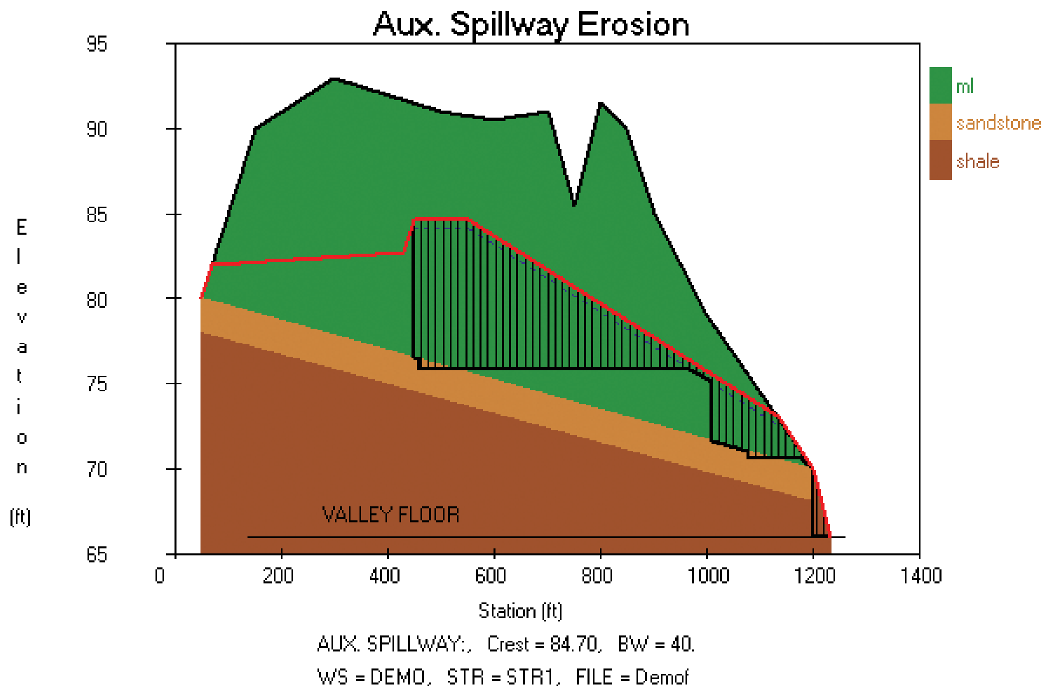


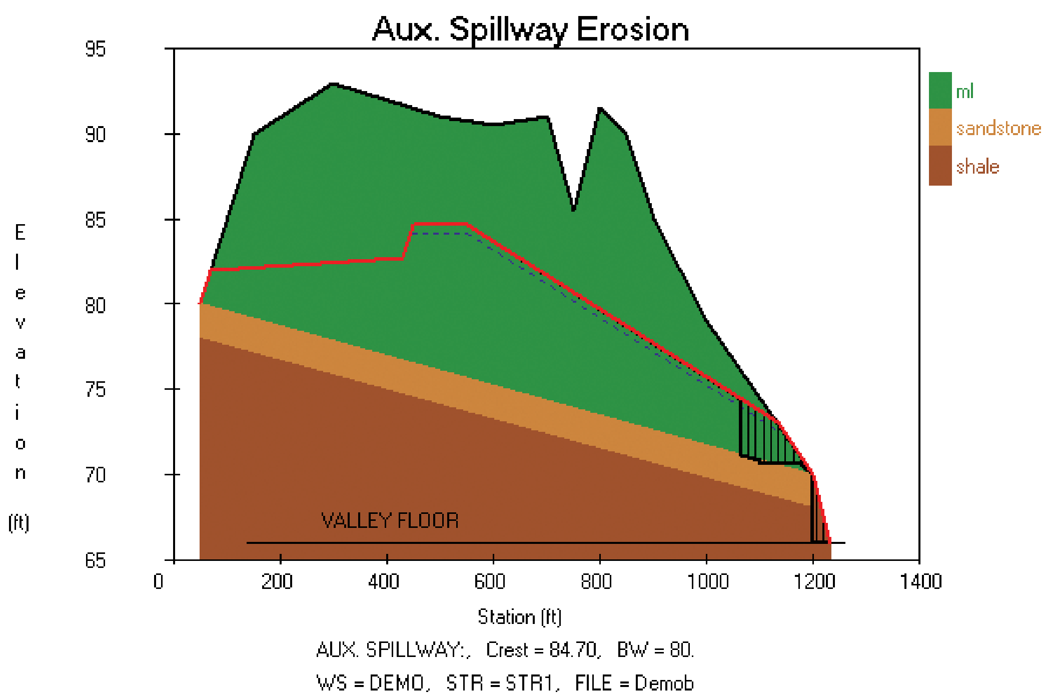
Step 17

Finally, click the **View** button to display the corresponding graph; then select **Line Graph** to display a line graph.



Step 18 Individual graphs depicting AS Erosion confirm the observation about a significant difference in erosion between an AS Width of 45 feet versus 80 feet.

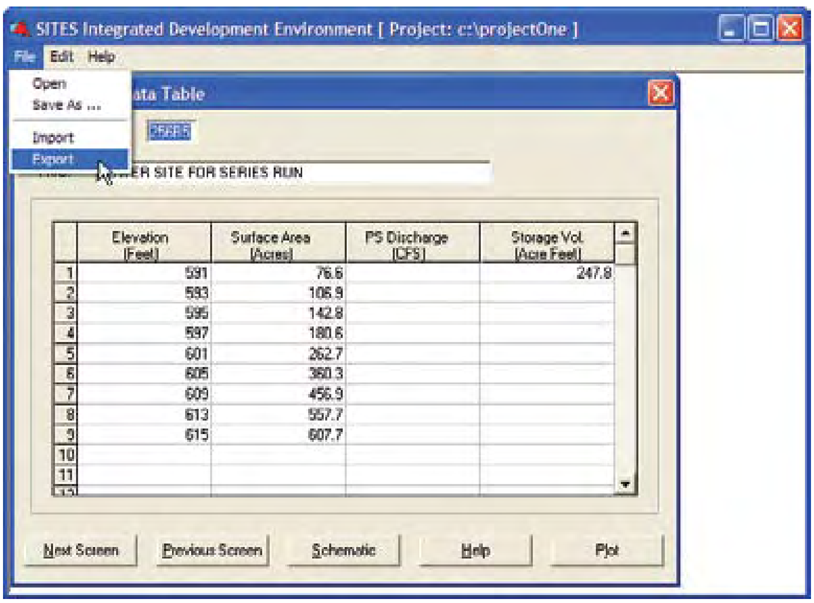


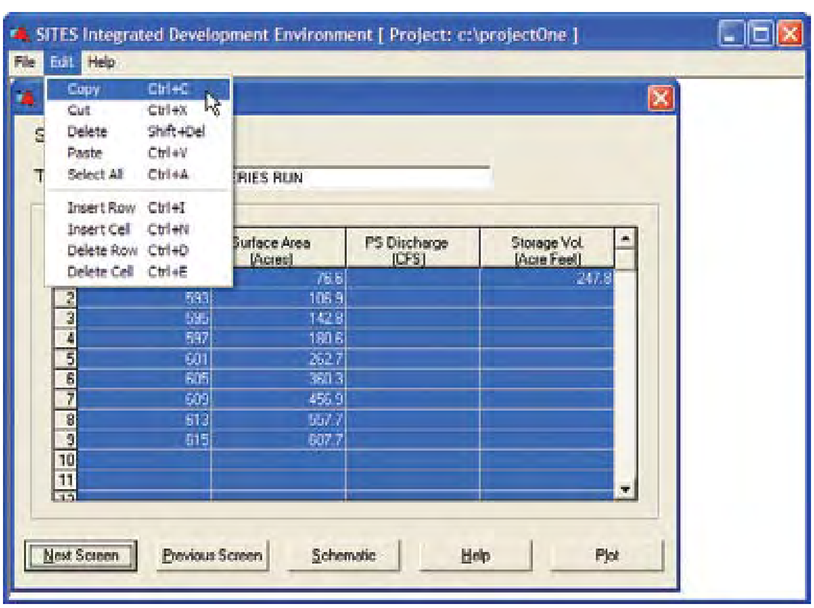


Appendix B SITES Integrated Development Environment: Frequently Asked Questions

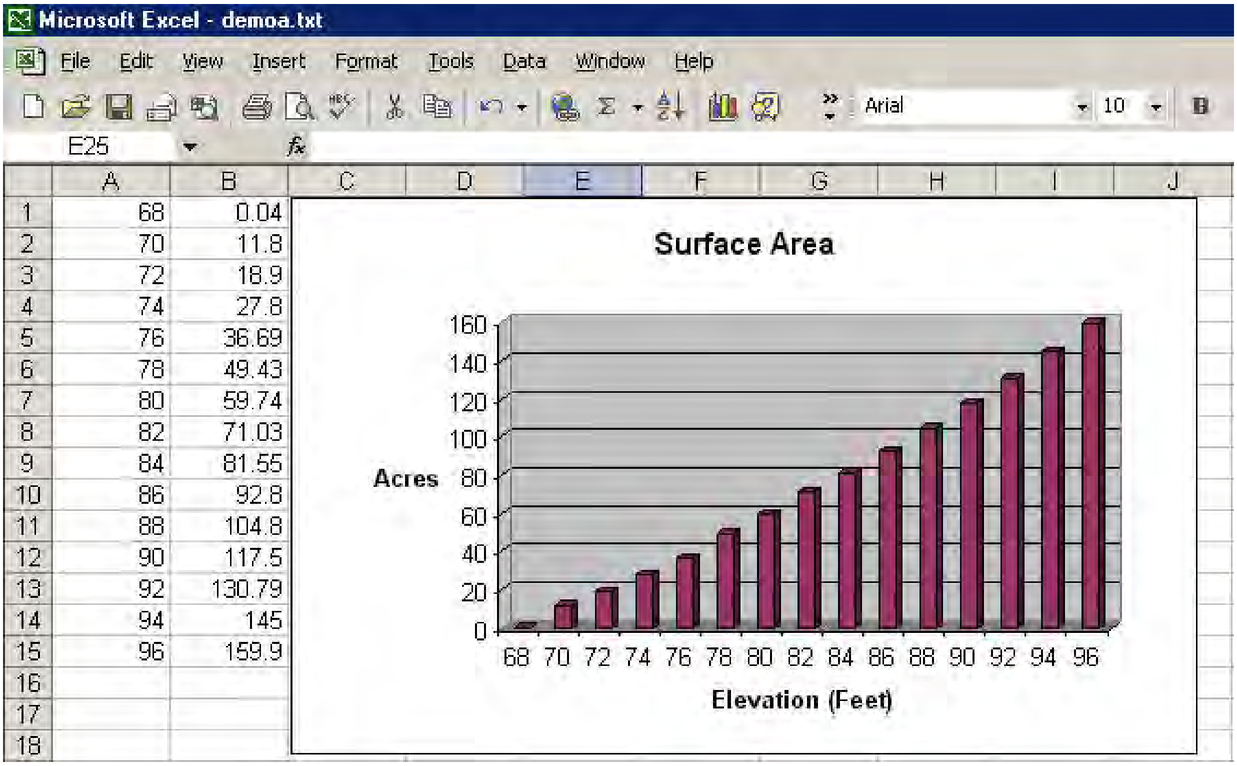
1. **Can tab-delimited text files be imported (exported) into (out of) tables in SITES?**

   Yes. Data can be imported/exported to or from Structure Data Tables, Hydrograph Data Tables, or Rainfall Data Tables. To save data in tab-delimited format for use in another application such as Microsoft® Excel®, select **Export** from the File menu. Sections of any table can be copied to the clipboard by using **Edit** and **Copy** (or Ctrl-c). Likewise, data copied to the clipboard can be pasted to the current position selected in any table by using **Edit** and **Paste** (or Ctrl-v). The **Open** and **Save As...** options save the data in SITES format.





After exporting data from a table, import the tab-delimited text into another application (such as Microsoft® Excel®) and manipulate the data as desired.



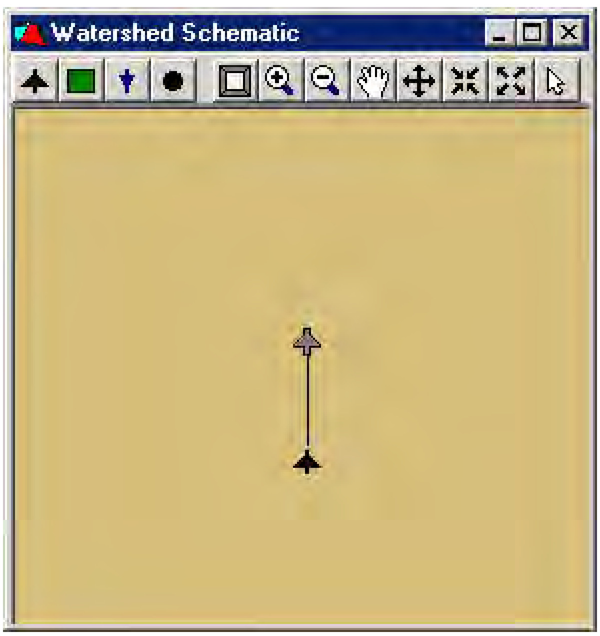
To load tab-delimited text data from another application, select **Import** from the File menu.

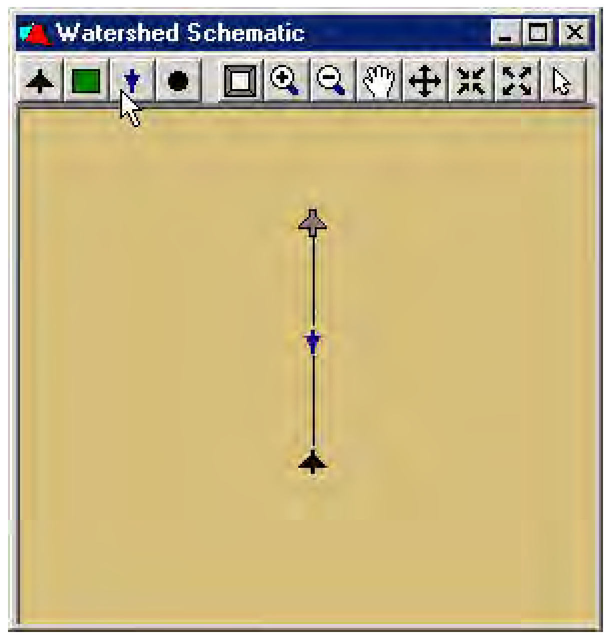
To paste data from the Windows® Clipboard, just use **Edit** and **Paste** (or Ctrl-v).

2. Can an element be inserted downstream in the Watershed Schematic?

Yes. Under the Options menu, select **Add Elements Downstream**.

Select **element** and click on element to be added immediately downstream. In this example, a reach is added downstream from the upstream structure.



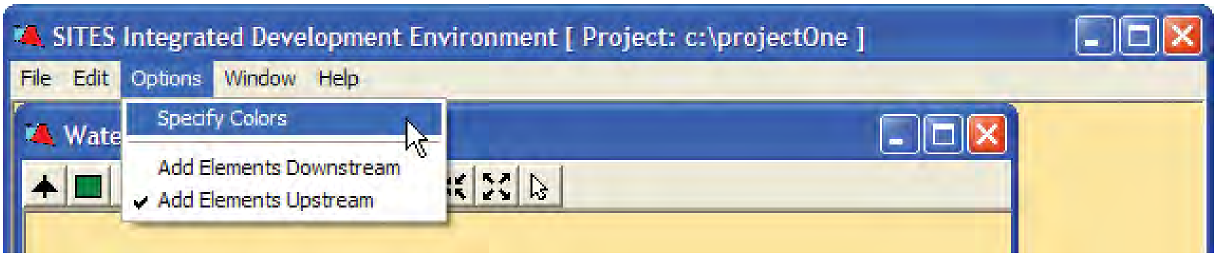


Note that after adding an element downstream, you must select **Add Elements Upstream** to add elements. Also, you can select **Undo** from the Edit menu to undo ONE modification.

Also, note that data stored for an element can be copied from one element to another by selecting **Copy** and **Paste** from the Edit menu, respectively. Just select the element to be copied from or pasted to, respectively. To see the data associated with a given element, right click on an element and select **SITES Control File**. At this point, it is possible to directly edit the data associated with a given element, but it is generally advisable to make all changes through the interface. Finally, changes made to an element are only stored in memory until you return to the home menu and store the data to an external file by selecting **Save As...** from the File menu.

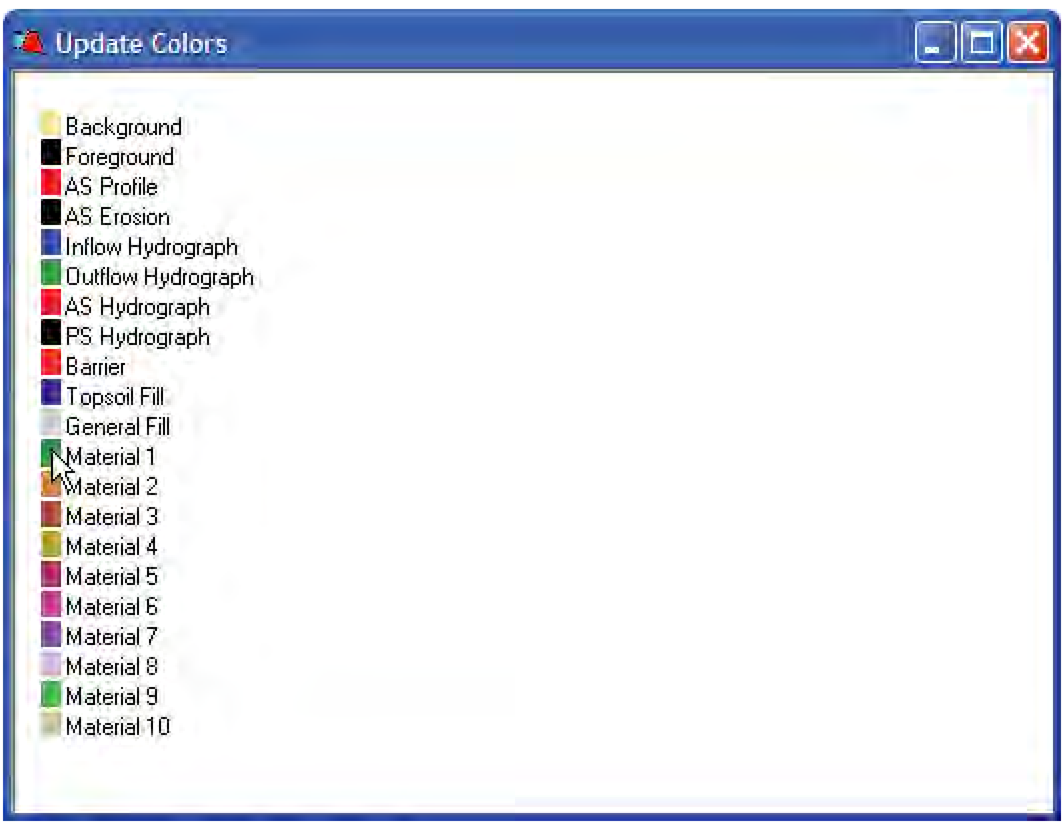
3. Can the colors on a graph be changed?

Yes. Under the Options menu, select **Specify Colors**.



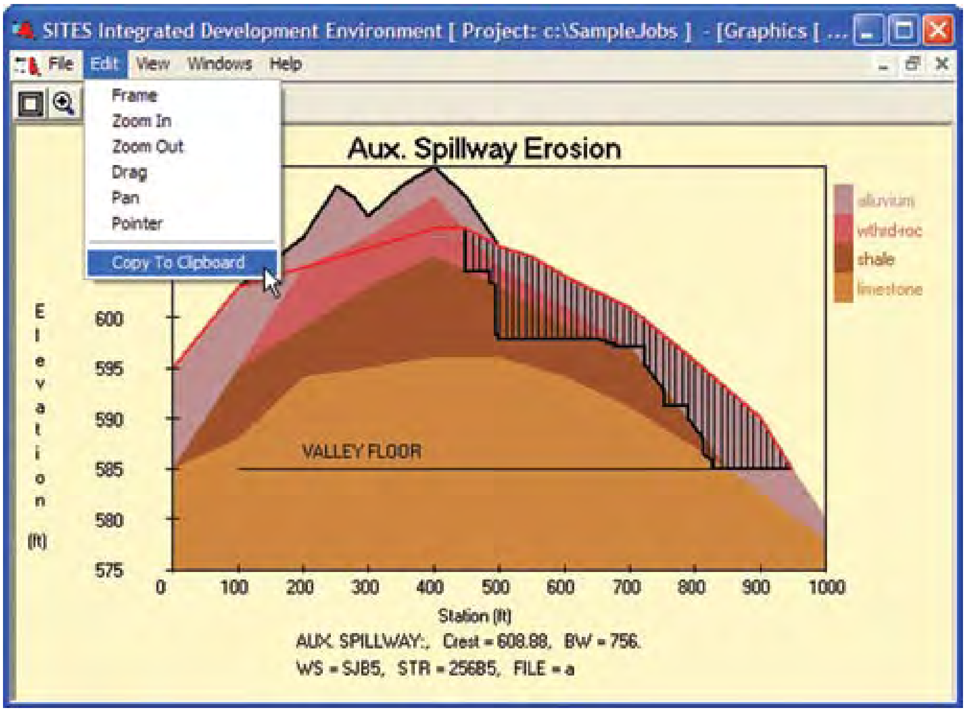
Double click on the icon for the color to be changed, and select a new color from the color chart.

The change in color will be reflected when the corresponding graph is reloaded. Changes to colors will be automatically retained. To restore the original default colors, just select **File** and **Restore Defaults**. Color lists can also be saved and loaded.



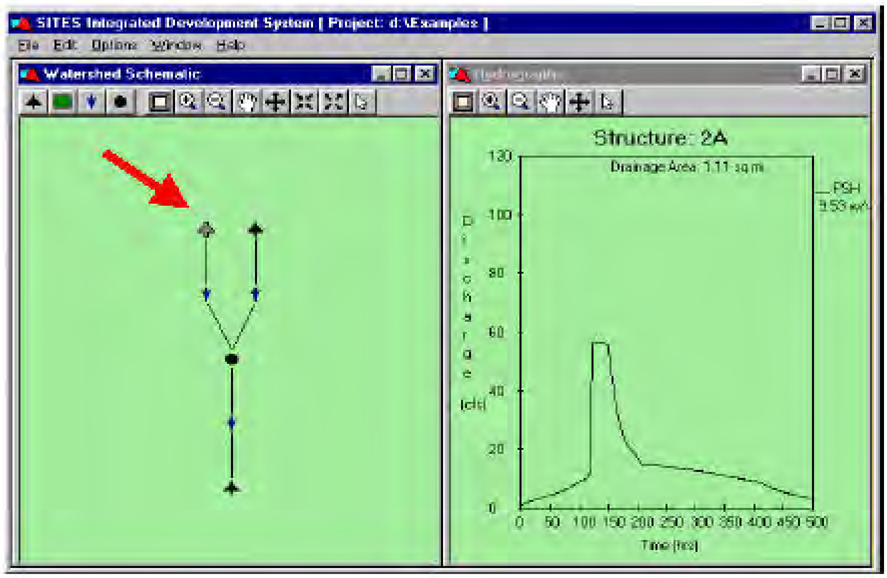
4. Can graphs be copied to the Windows® Clipboard?

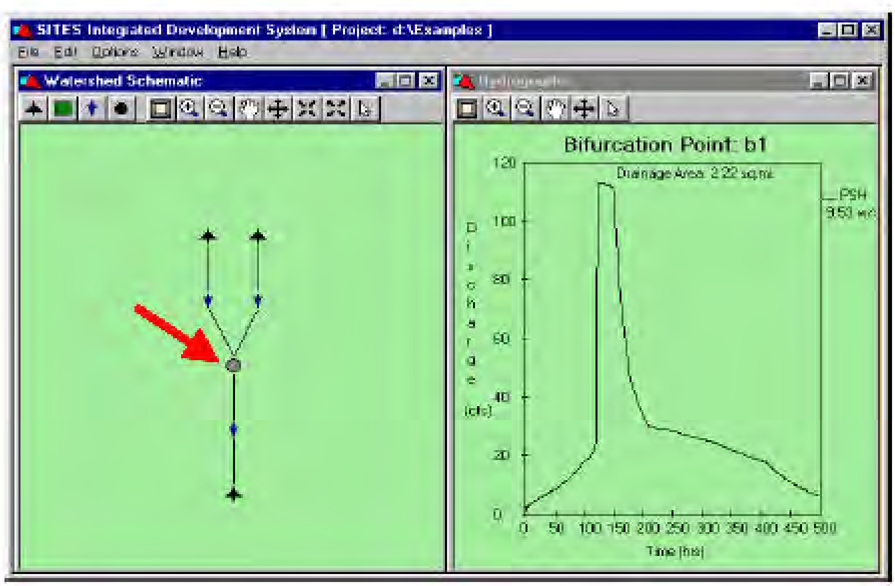
Yes. Select **Copy to Clipboard** from the Edit menu. The graph will be the same size as it is on the screen. Graphs copied to the clipboard can be pasted into other applications such as Microsoft® Word®.



5. How can you compare hydrographs for all elements in a Watershed Schematic?

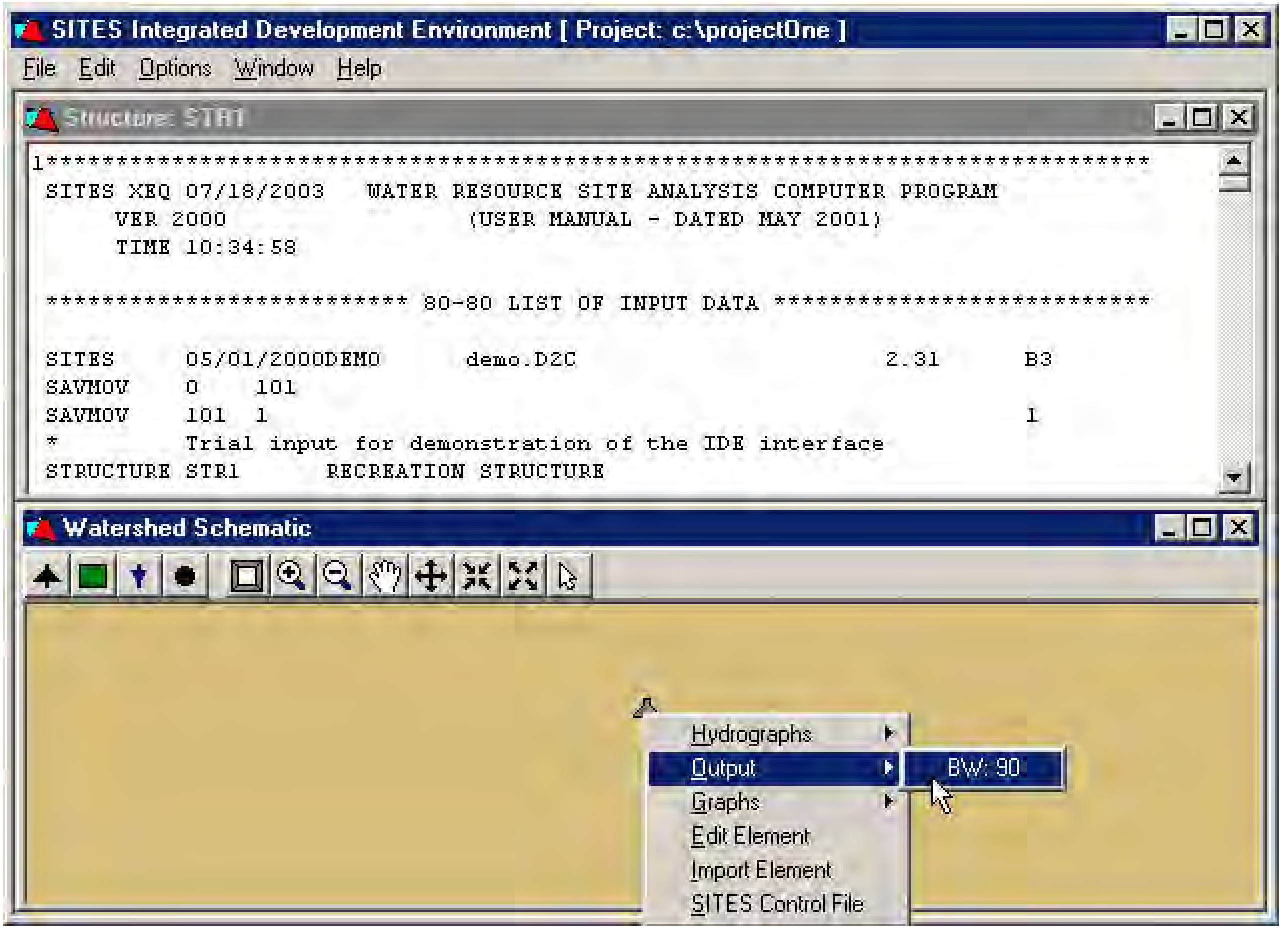
Right click on an element in the Watershed Schematic and select **View Hydrographs**. Then, select **Tile Vertical** from the window menu. This allows both screens to be displayed at the same time. Select different elements (double click on element icons) to see changes in hydrographs. Under the Hydrographs menus, select **Fix Scales** under the Options menu to freeze the current scales on the graph. This allows you to more easily compare changes between elements because hydrographs for all elements will be displayed using the same scale.





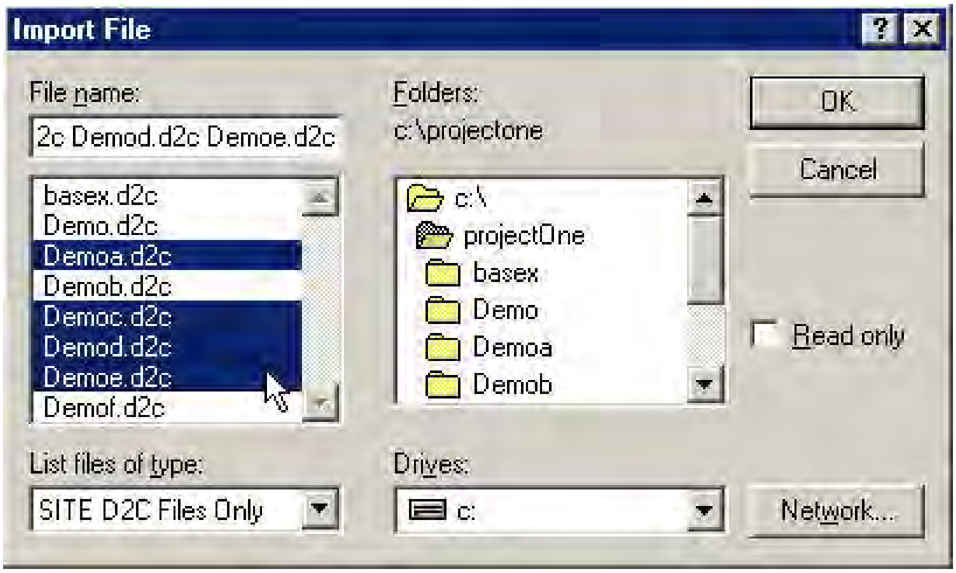
6. How can you compare output for all elements in a Watershed Schematic?

Right click on an element and select **View Output**. From the Window menu, select **Tile Horizontal**. Then, simply double-click on each element to see the corresponding output for each element.

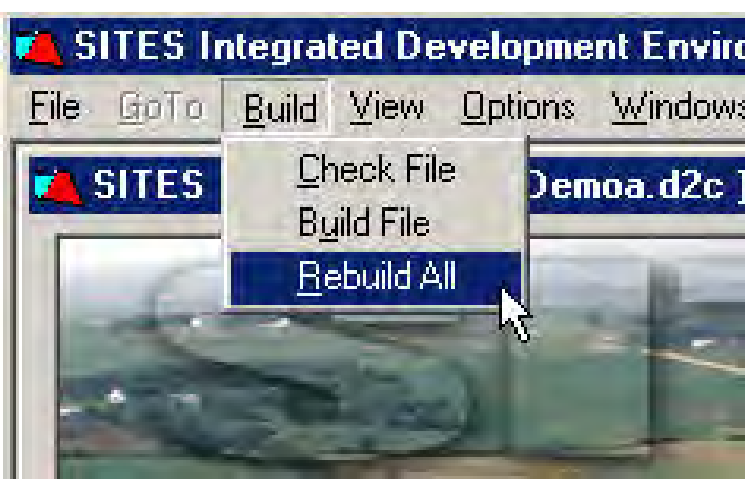


7. How can a user import several files into a project at once?

From the File menu, select **Import File**. In the Import File Dialog, click on the first file and then use the Shift Key to select a range of files or the Ctrl Key to select or deselect individual files. Then, just click **OK**. All selected files will be imported into the currently opened project directory.



Select **Rebuild All** from the Build menu to generate simulation output for all files in the project directory.



Appendix C Sample Jobs

NOTE: Input and output files for all sample jobs are distributed with the program CD.

Page

Sample Job 1—Typical design run – TR–60

Inflow Data

PSH – Precipitation (first pass)
PSH – Runoff (second pass)
SDH – Precipitation
FBH – Precipitation

Ratings

PS – Computed, single stage drop inlet
Aux – Computed, vegetated surface

Stage Storage Data

Elevation – Given
Surface Area – Given
Storage Volume – Initial value given

Special Features Demonstrated

Auxiliary Spillway crest computed
Aerated sediment
Multipurpose pool
Integrity and stability analysis of auxiliary spillway
Embankment volume estimated

Output Features Demonstrated

Auxiliary Spillway graphics
IDE summary table, compare results from alternative PSH entries

Text Output Options Demonstrated

Detailed list of basic data
Rating tables
Detailed hydrograph table

Figure C–1a Input data screens for sample job 1a input file

Figure C–1a Input data screens for sample job 1a—Continued

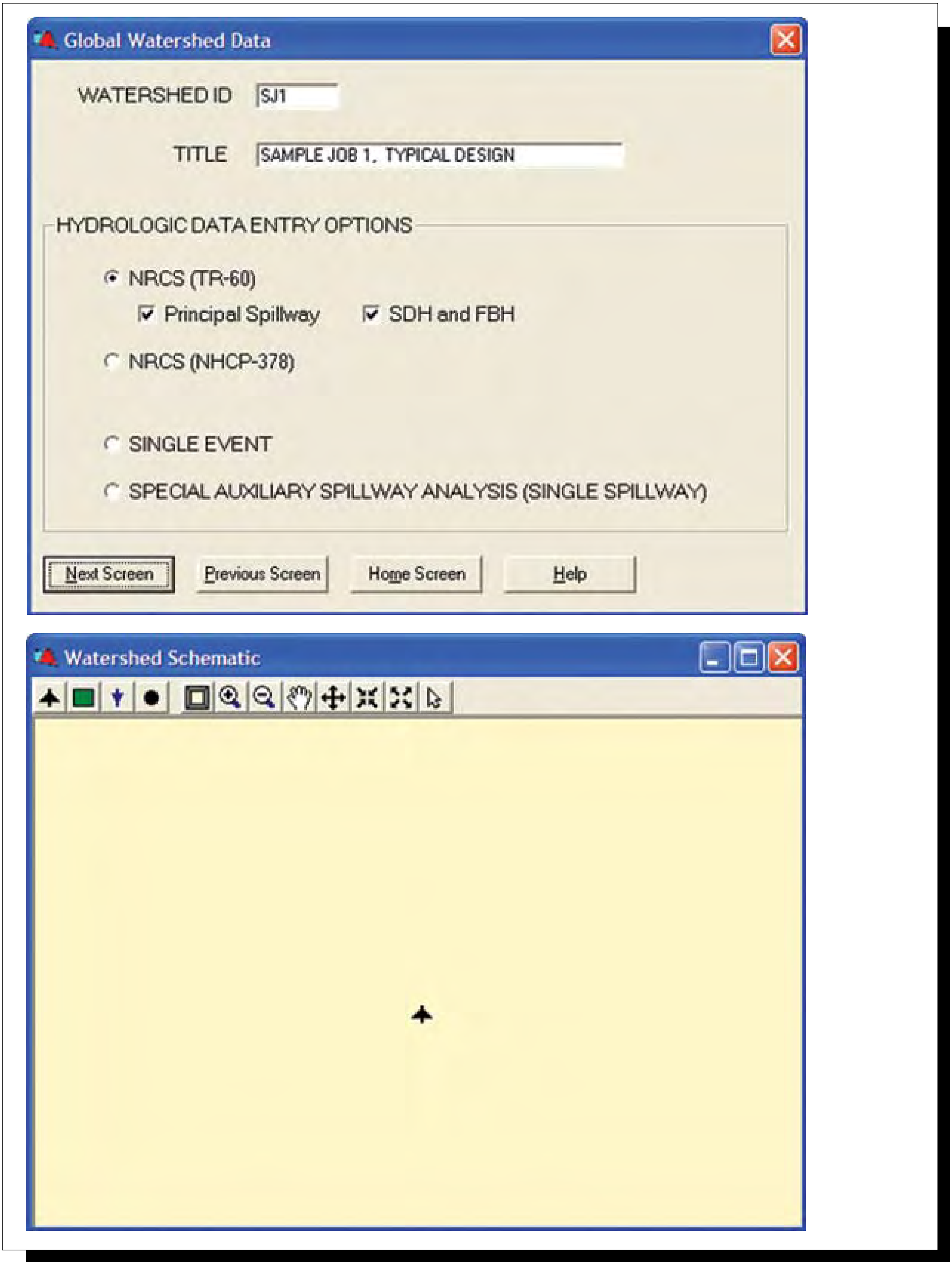
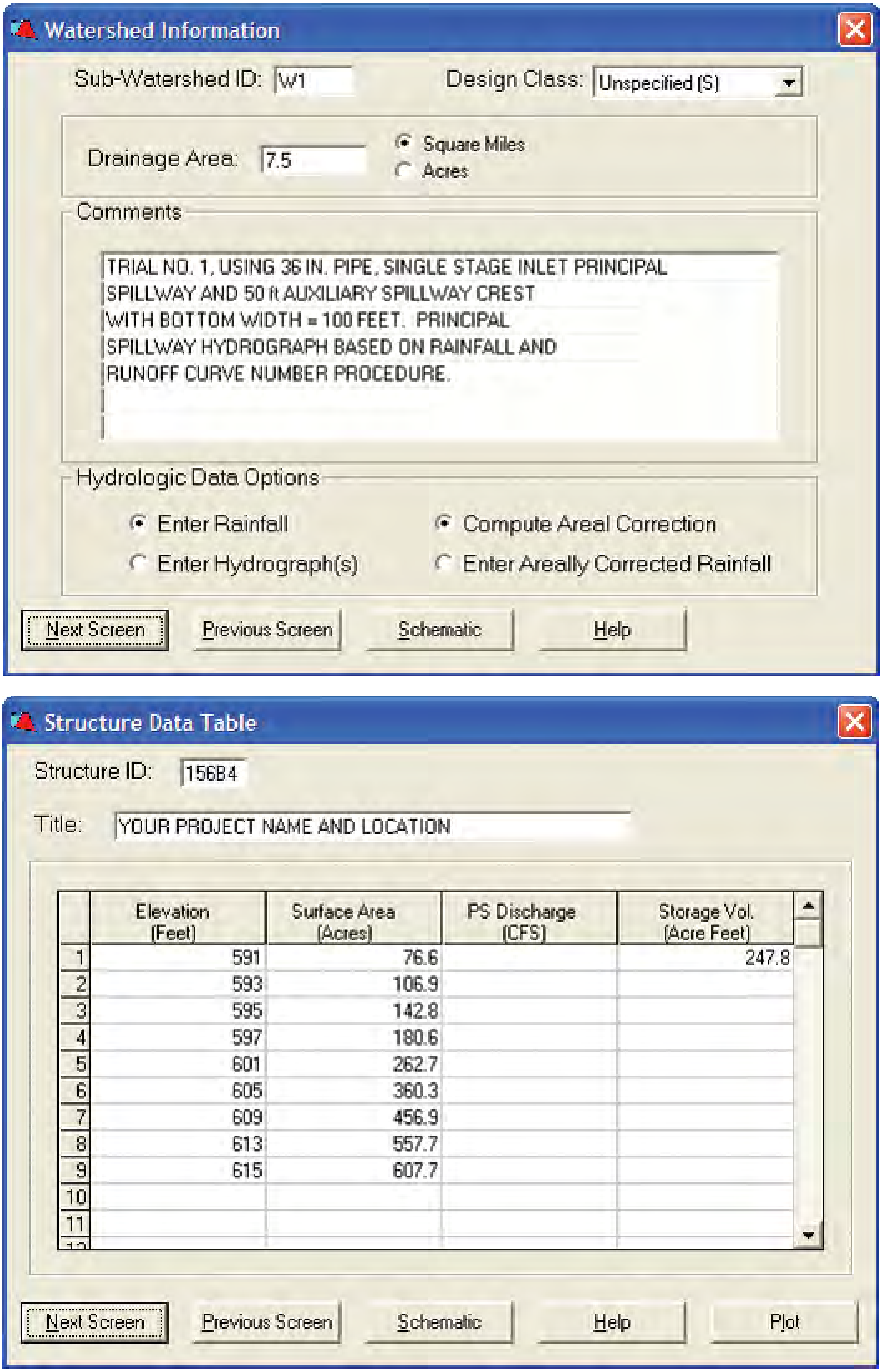


Figure C–1a Input data screens for sample job 1a—Continued



Watershed Information

Sub-Watershed ID: W1

Design Class: Unspecified (S)

Drainage Area: 7.5 (Square Miles / Acres)

Comments

TRIAL NO. 1, USING 36 IN. PIPE, SINGLE STAGE INLET PRINCIPAL
SPILLWAY AND 50 ft AUXILIARY SPILLWAY CREST
WITH BOTTOM WIDTH = 100 FEET. PRINCIPAL
SPILLWAY HYDROGRAPH BASED ON RAINFALL AND
RUNOFF CURVE NUMBER PROCEDURE.

Hydrologic Data Options

Enter Rainfall / Enter Hydrograph(s)

Compute Areal Correction / Enter Areally Corrected Rainfall

Next Screen | Previous Screen | Schematic | Help

Structure Data Table

Structure ID: 156B4

Title: YOUR PROJECT NAME AND LOCATION

	Elevation (Feet)	Surface Area (Acres)	PS Discharge (CFS)	Storage Vol. (Acre Feet)
1	591	76.6		247.8
2	593	106.9		
3	595	142.8		
4	597	180.6		
5	601	262.7		
6	605	360.3		
7	609	456.9		
8	613	557.7		
9	615	607.7		
10				
11				

Next Screen | Previous Screen | Schematic | Help | Plot

Figure C–1a Input data screens for sample job 1a—Continued

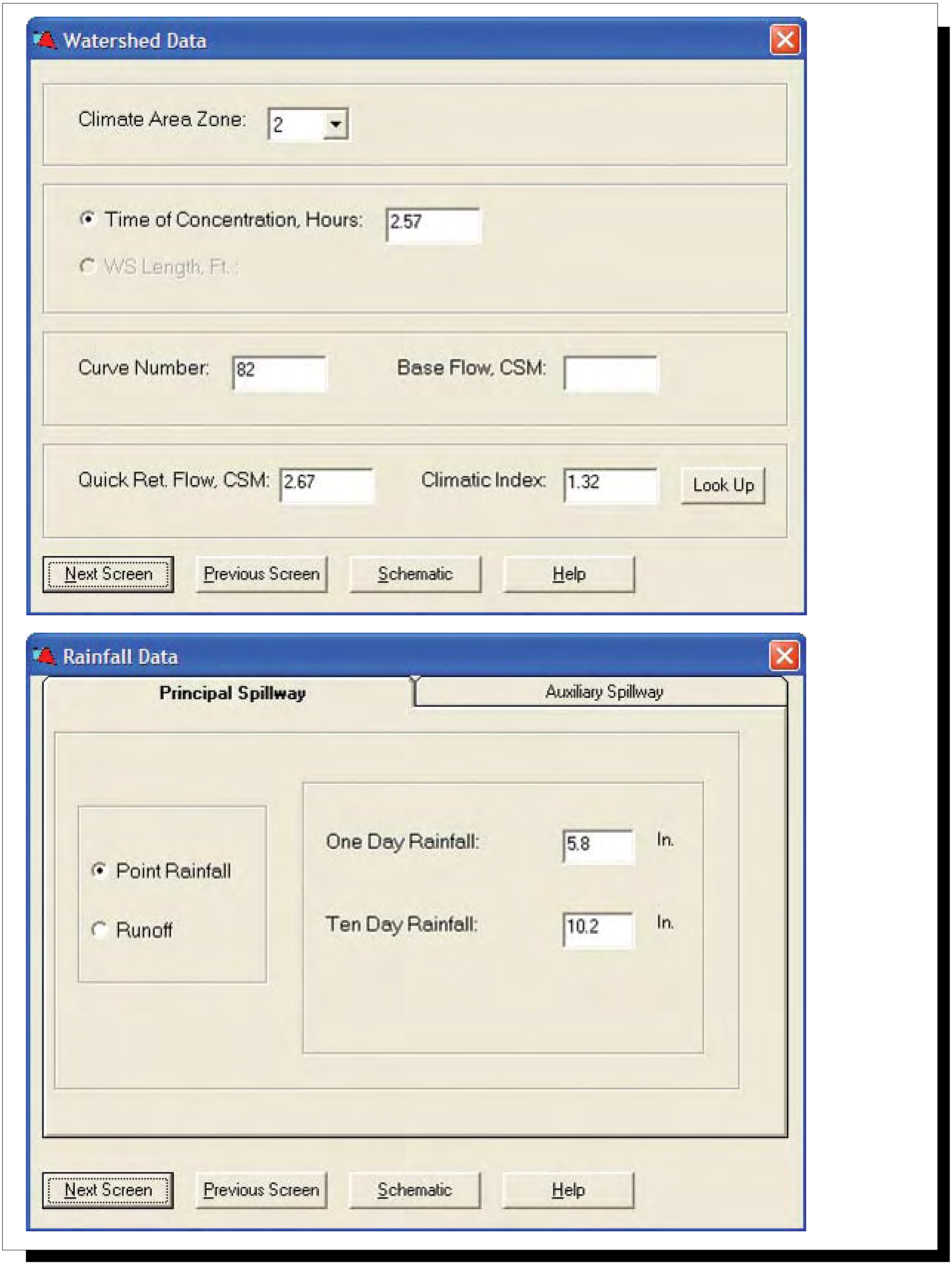


Figure C–1a Input data screens for sample job 1a—Continued

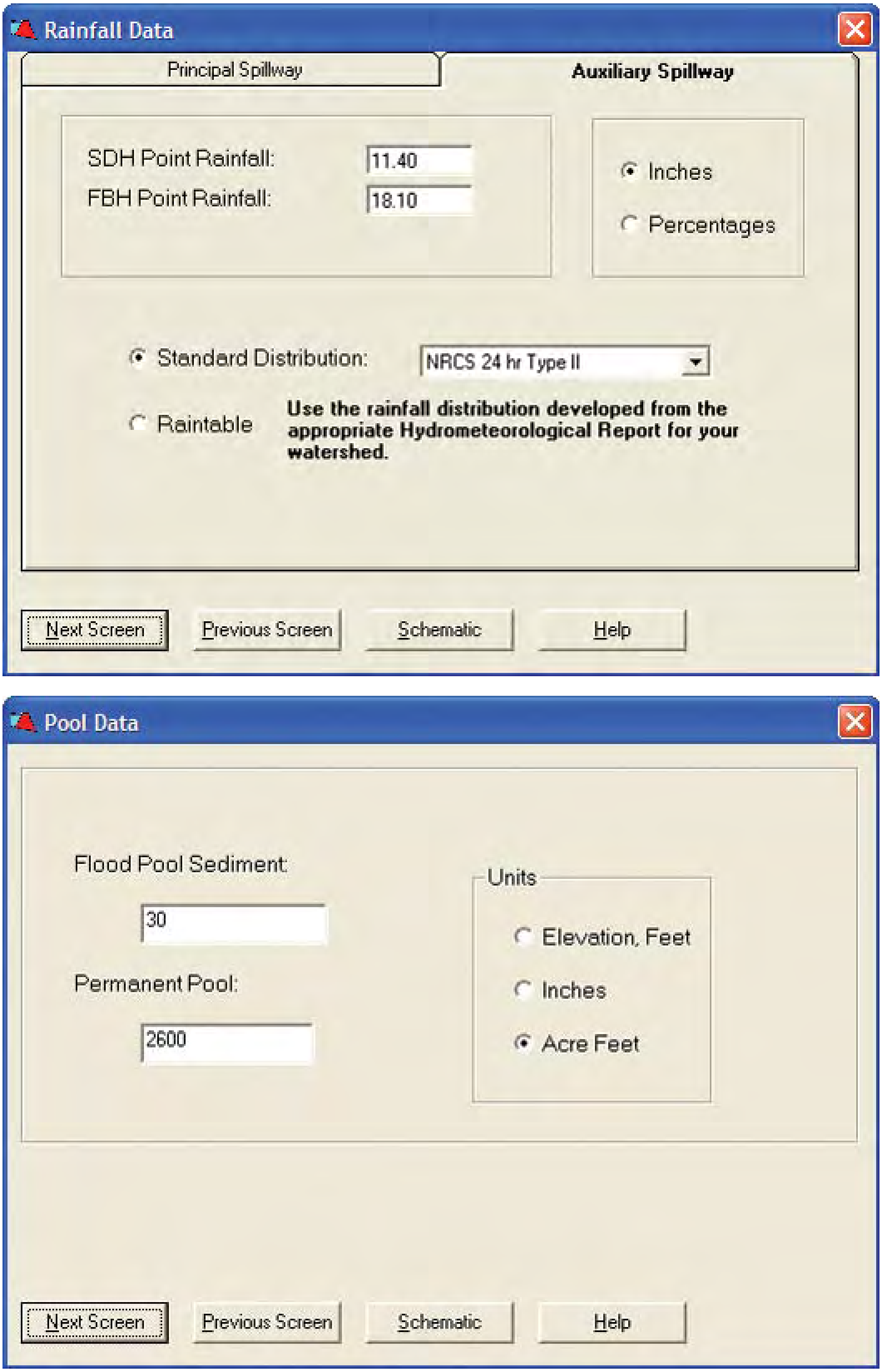


Figure C–1a Input data screens for sample job 1a—Continued

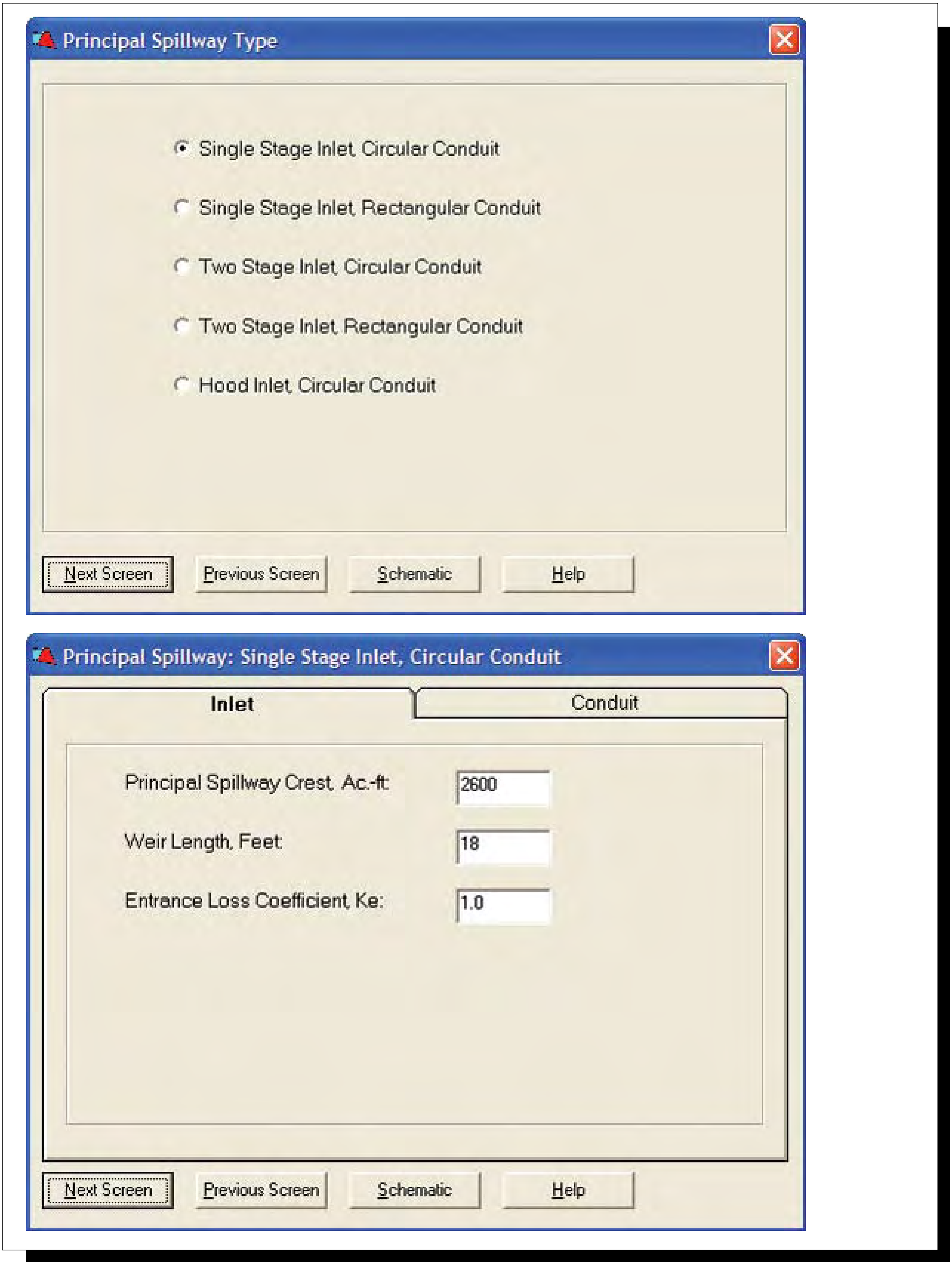


Figure C–1a Input data screens for sample job 1a—Continued

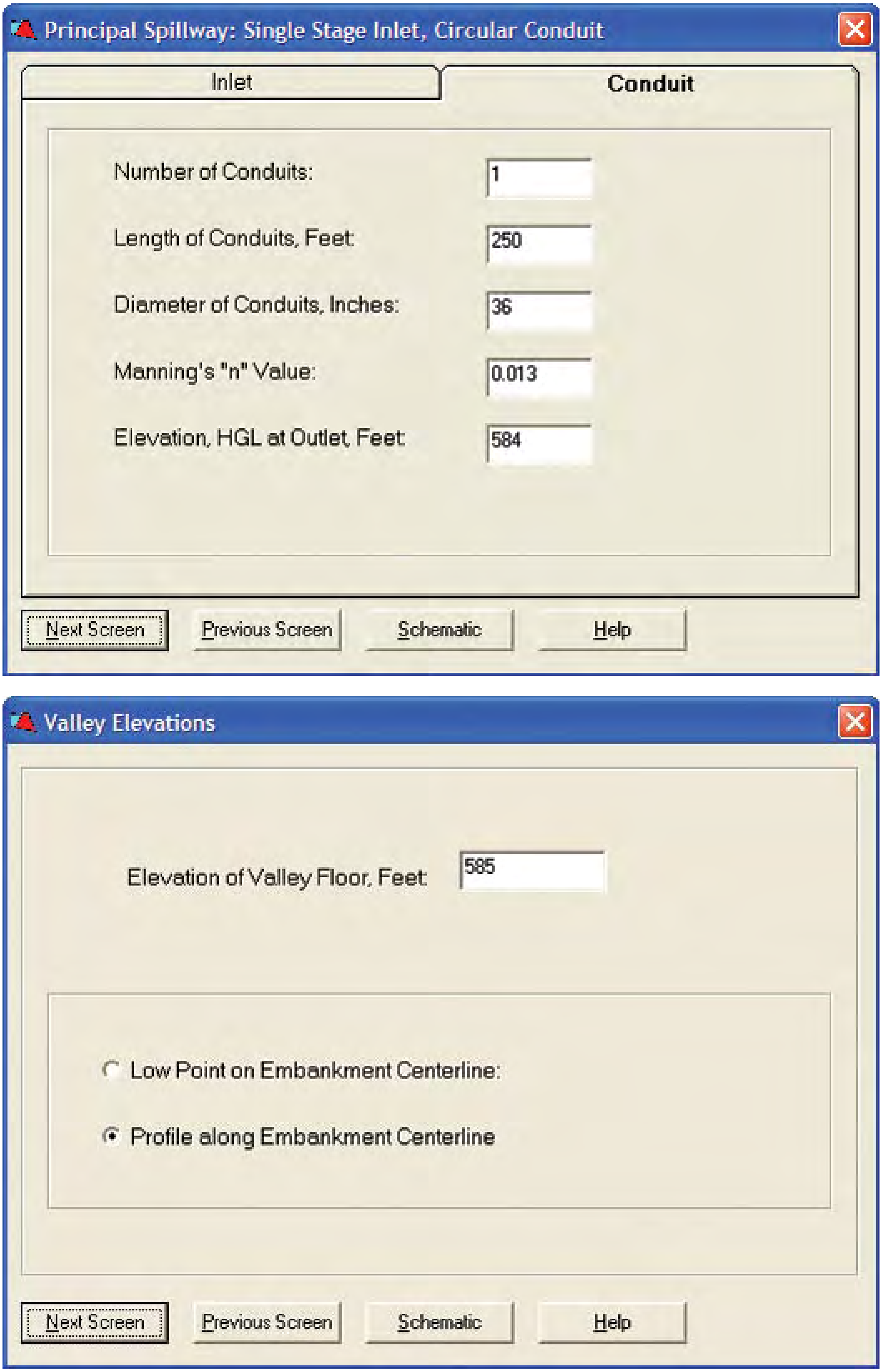


Figure C–1a Input data screens for sample job 1a—Continued

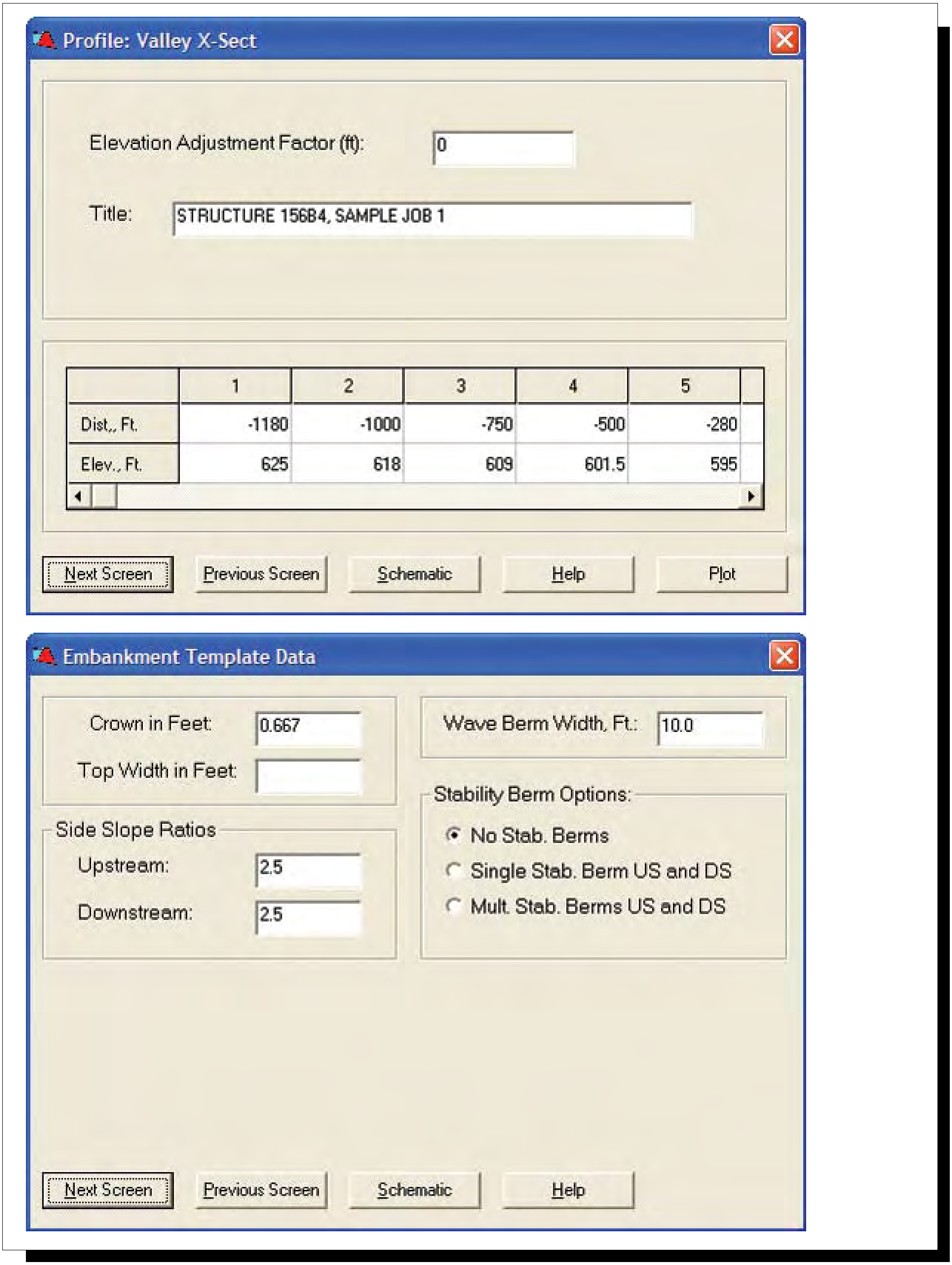


Figure C–1a Input data screens for sample job 1a—Continued

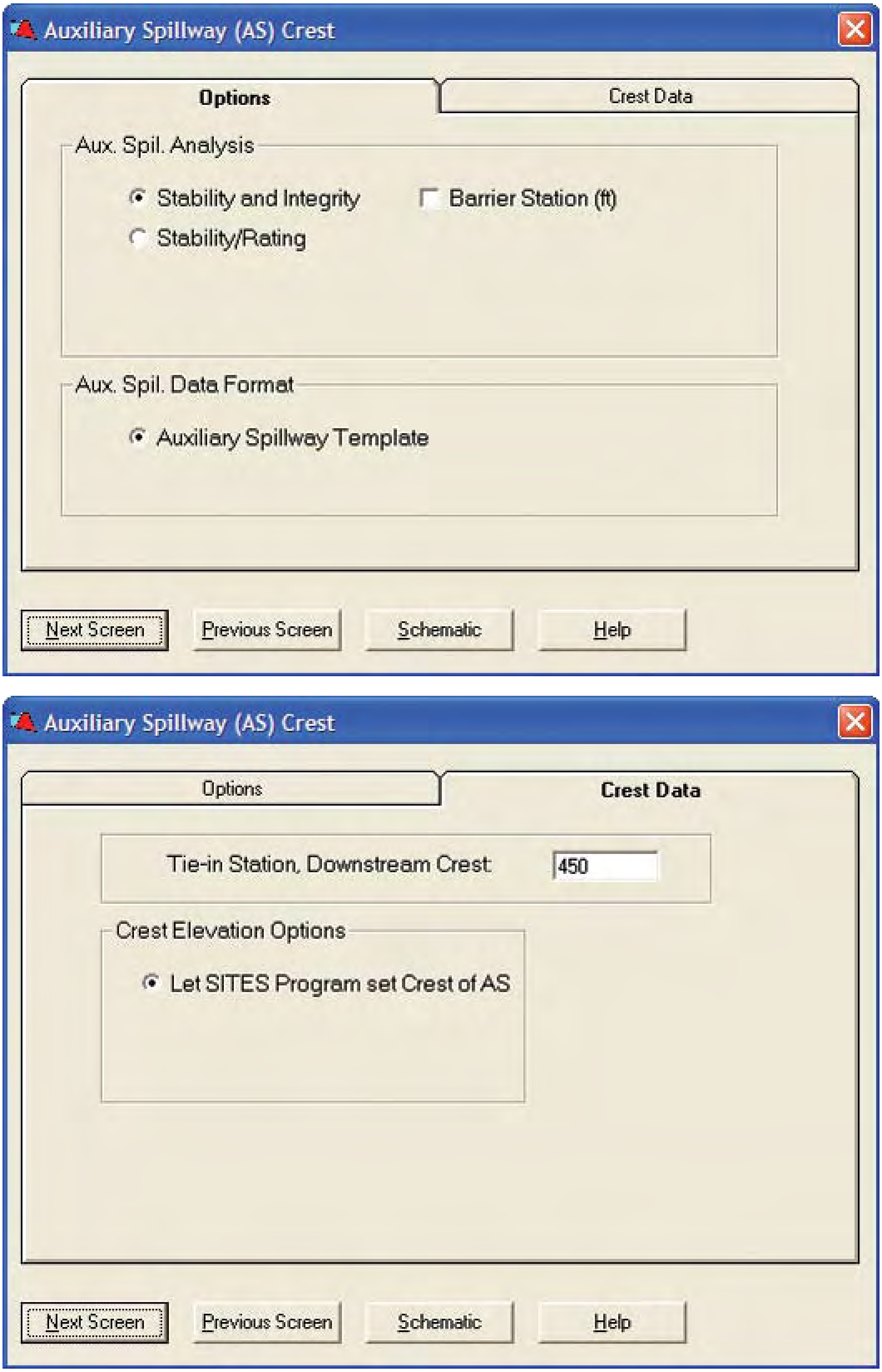


Figure C–1a Input data screens for sample job 1a—Continued

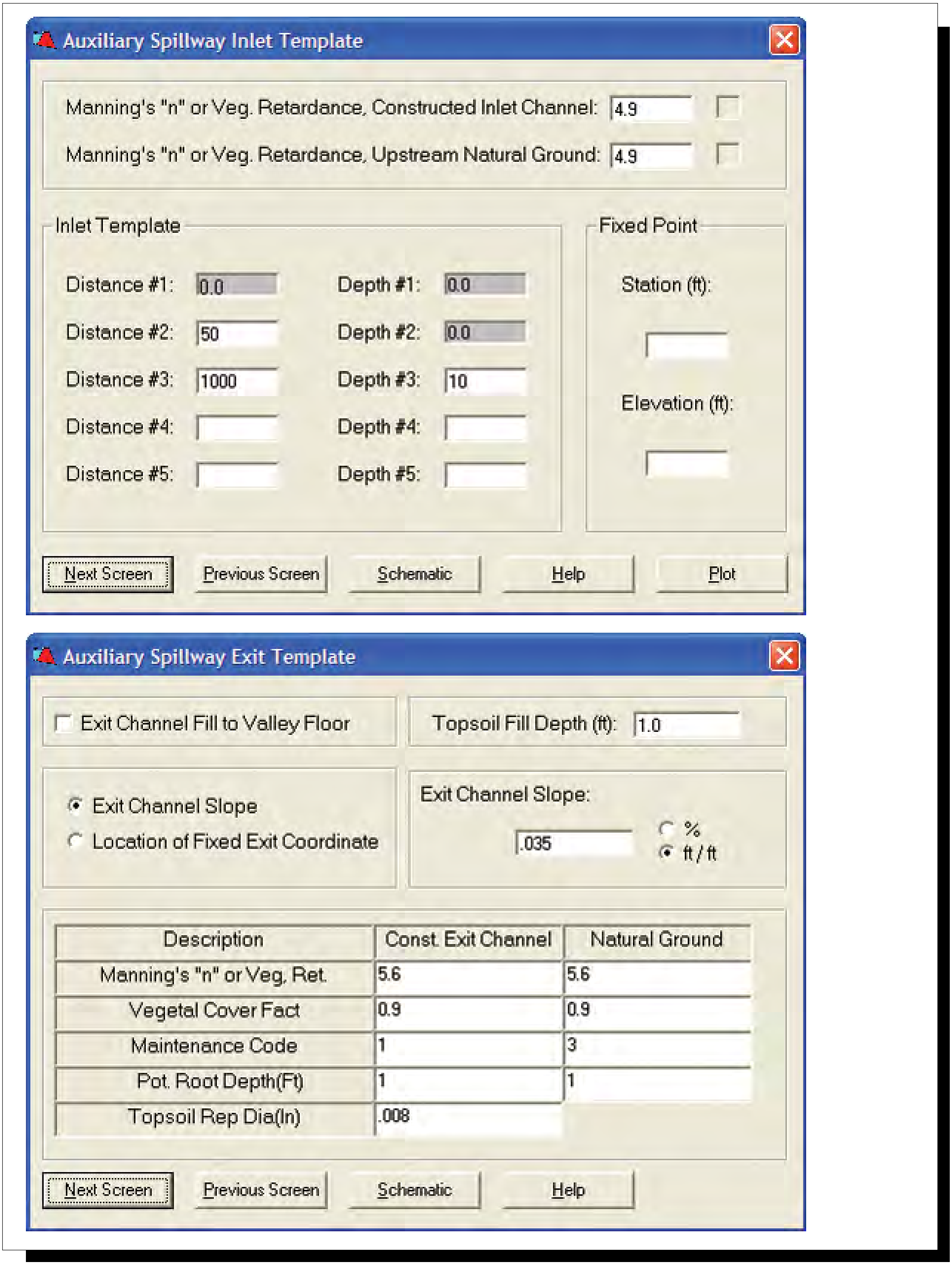


Figure C–1a Input data screens for sample job 1a—Continued

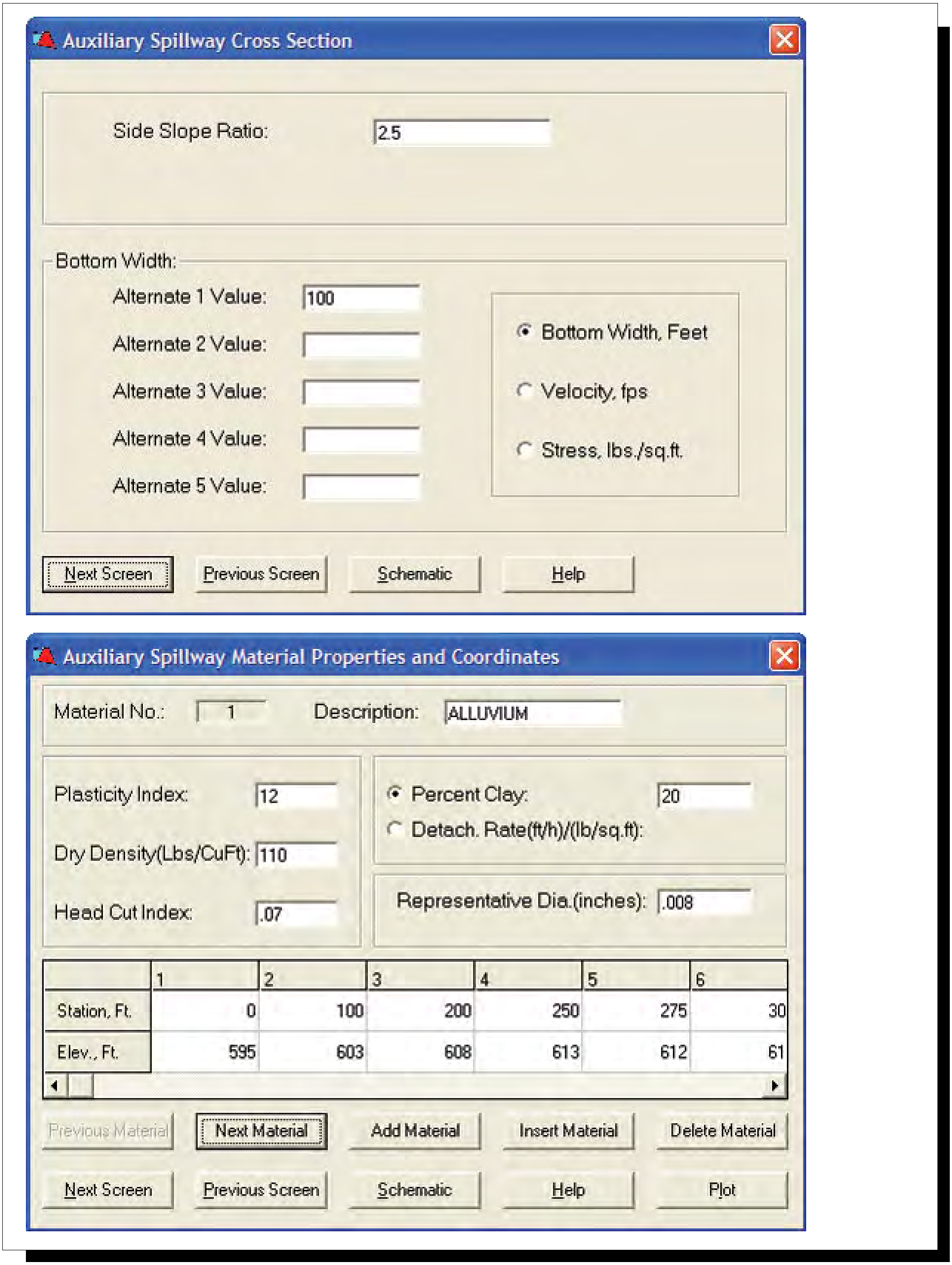
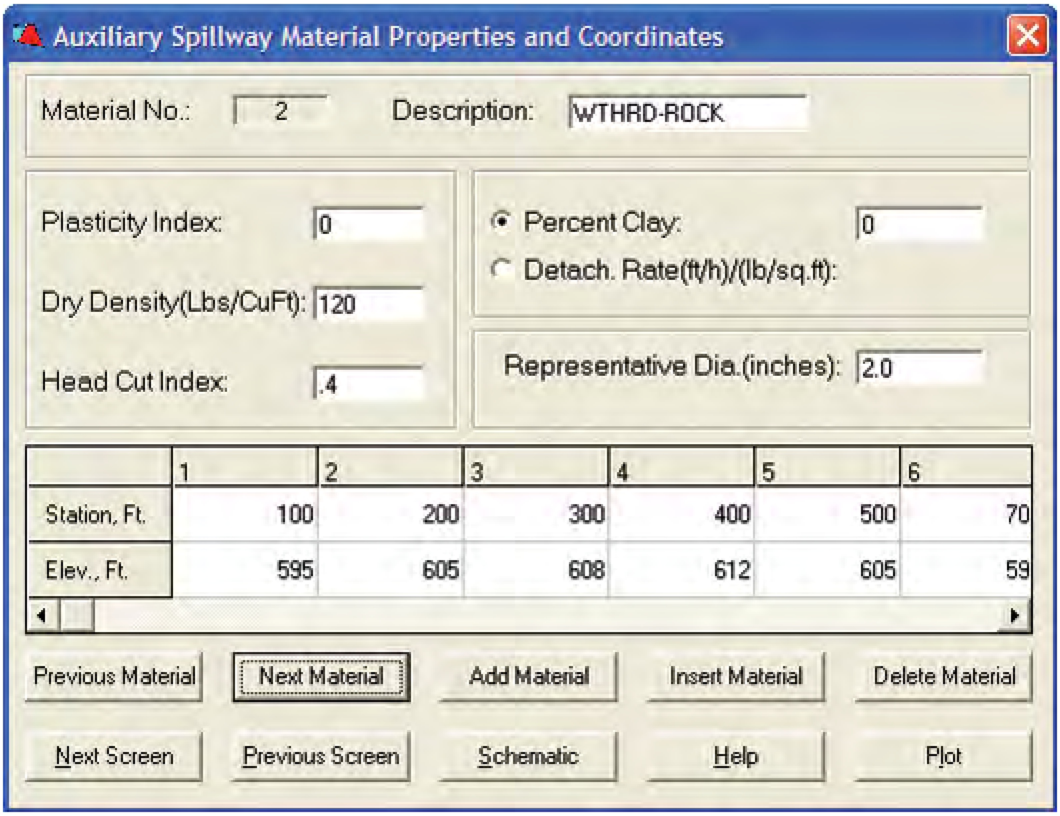


Figure C–1a Input data screens for sample job 1a—Continued



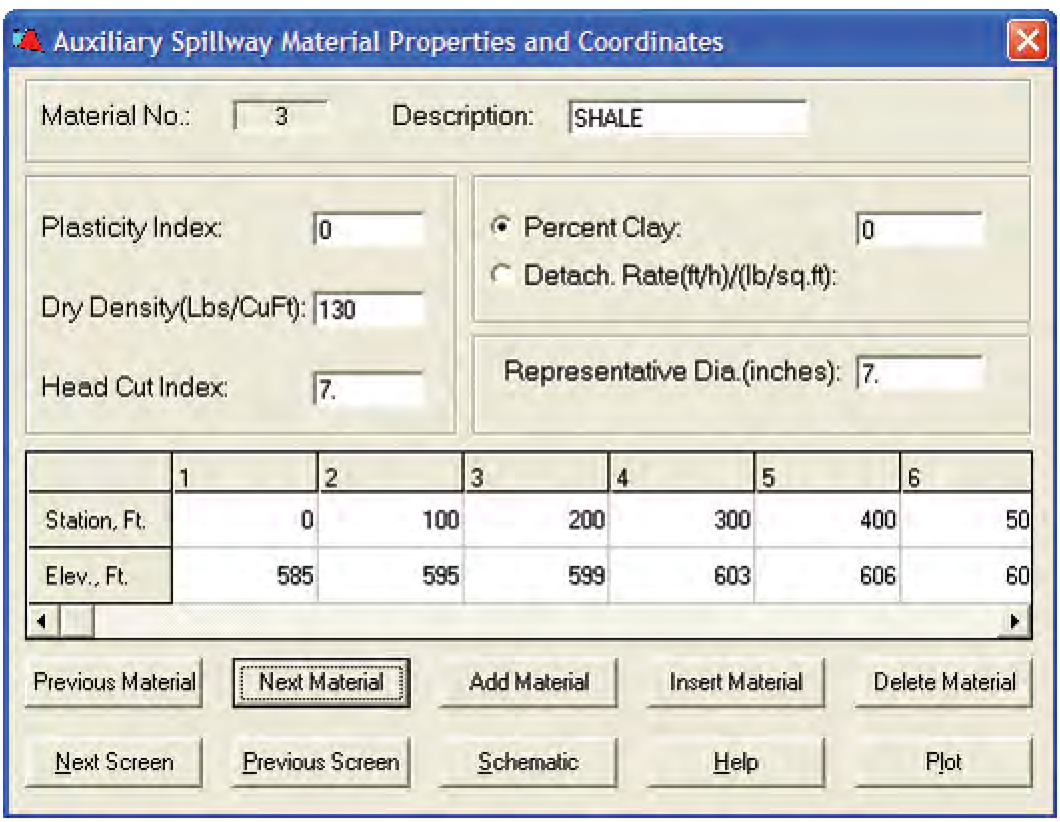


Figure C–1a Input data screens for sample job 1a—Continued

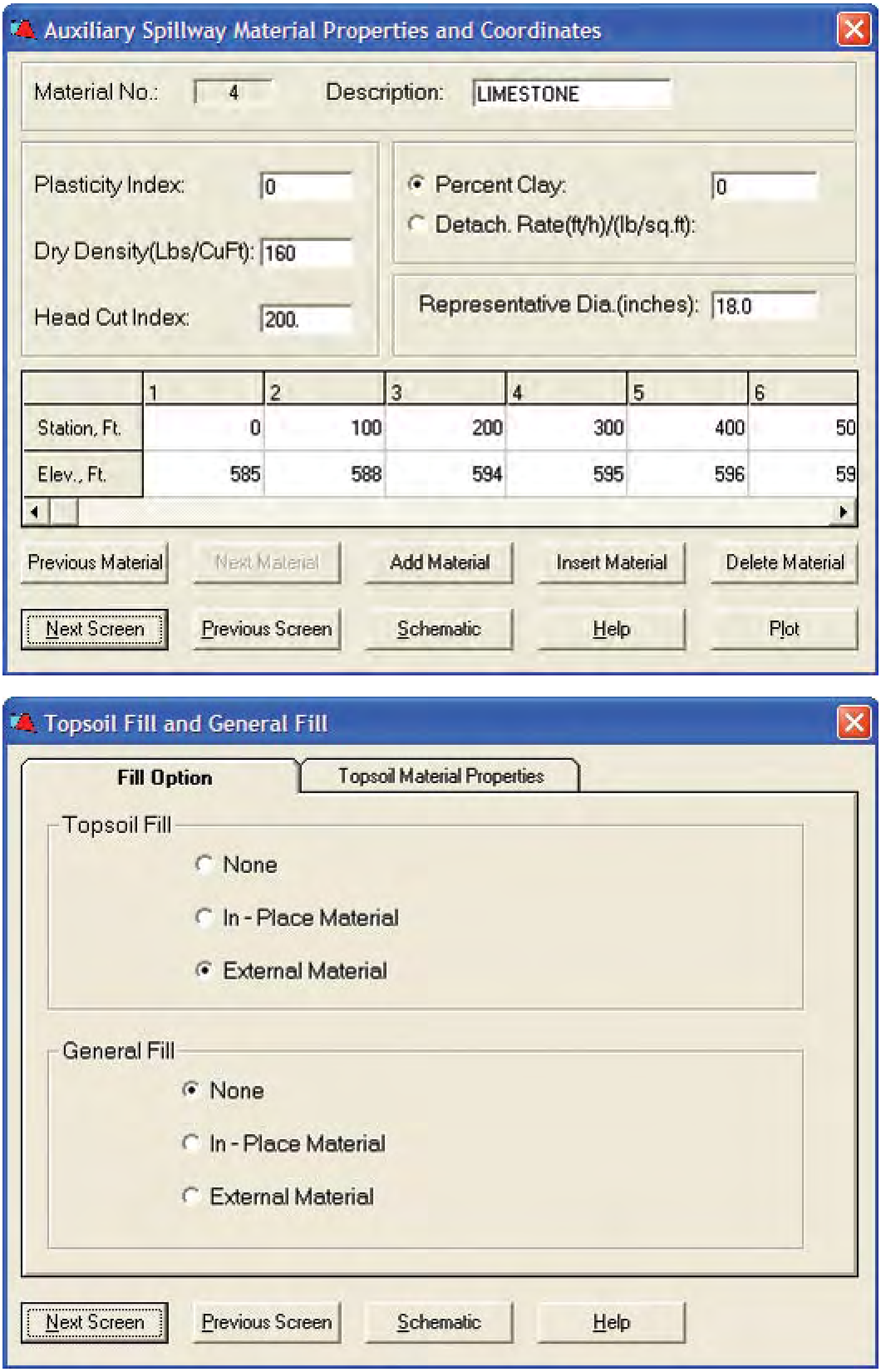


Figure C–1a Input data screens for sample job 1a—Continued

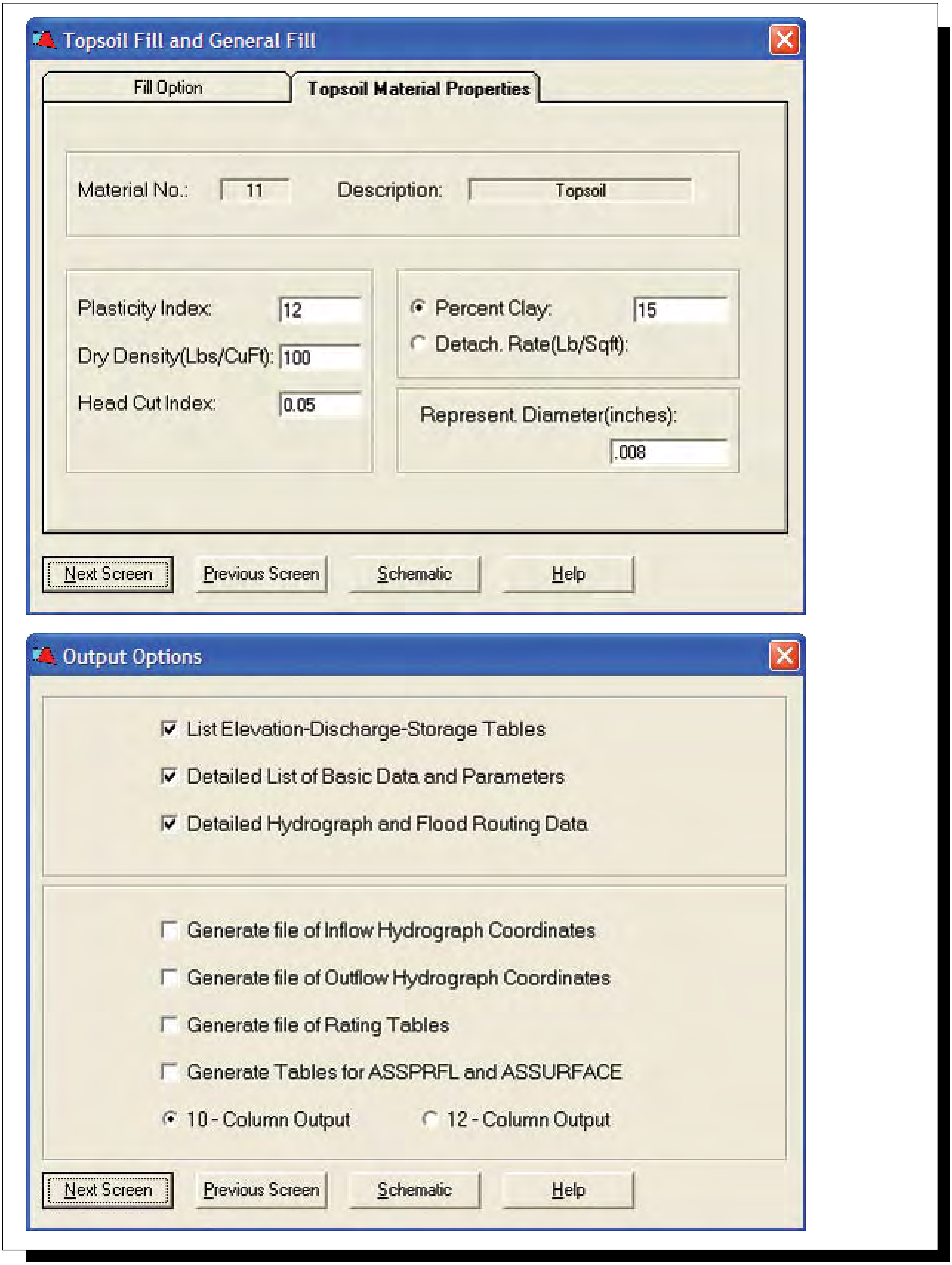


Figure C–1b Input data screens for sample job 1a modified to create sample job 1b

Figure C–1b Input data screens for sample job 1a modified to create sample job 1b—Continued

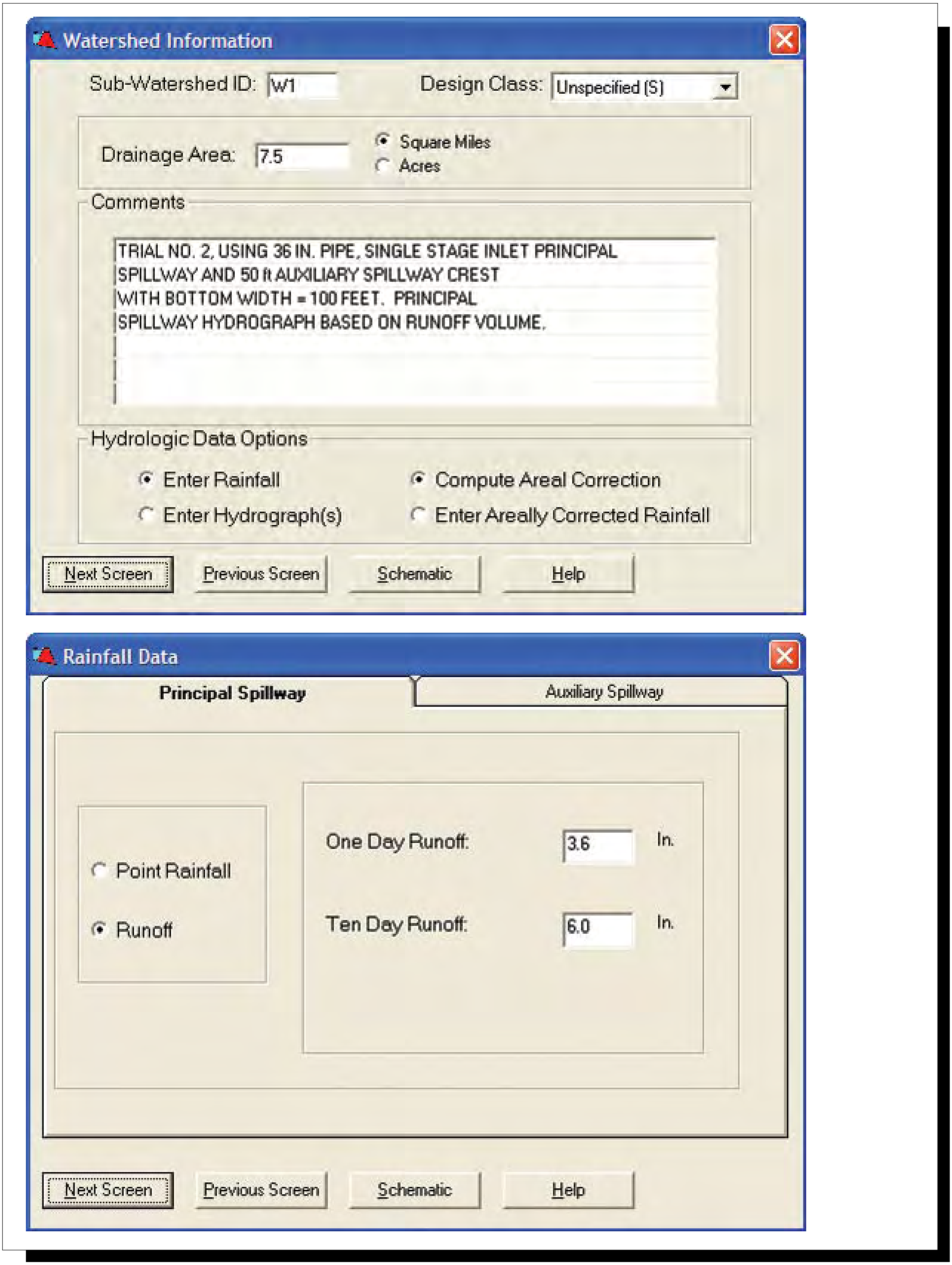
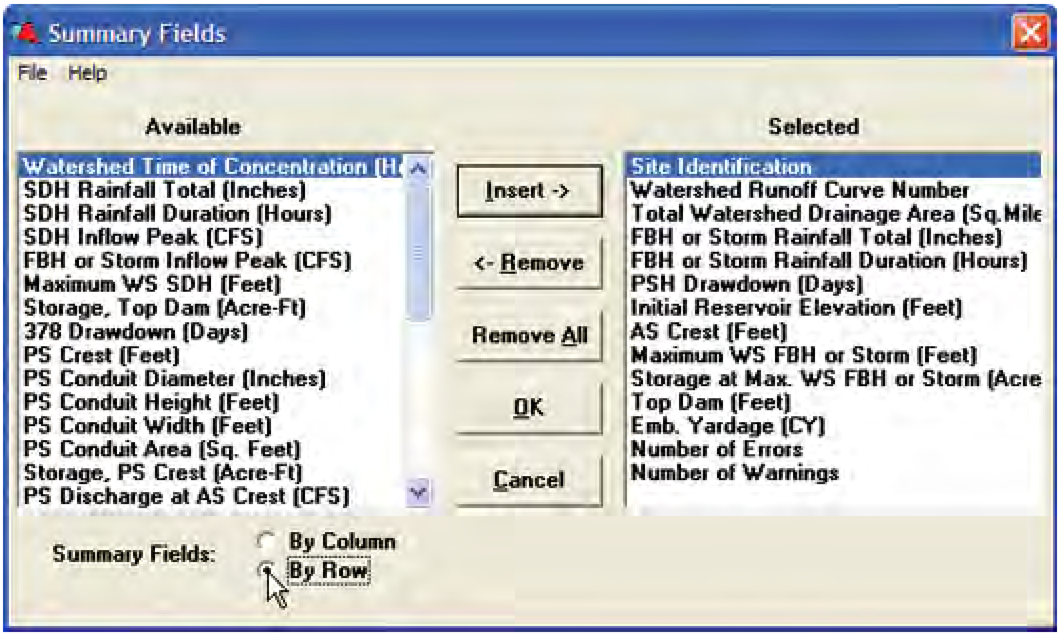


Figure C–1c Customized summary table from IDE comparing output from sample jobs



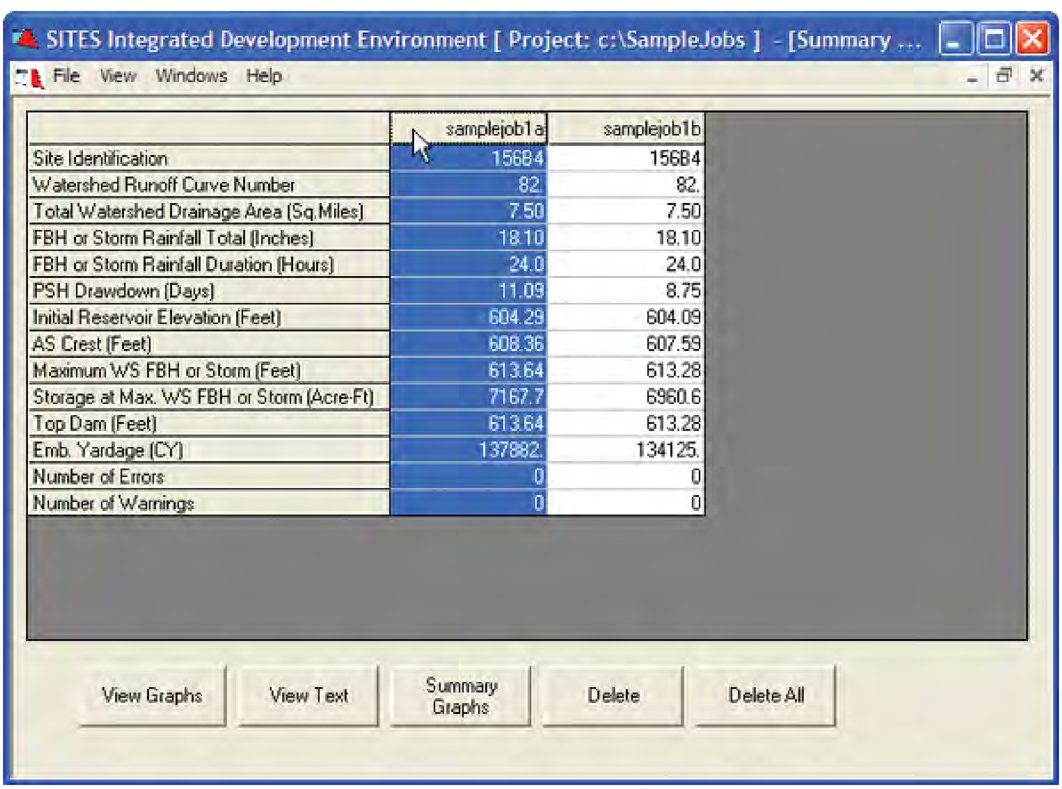


Figure C–1d Graphical output of predicted auxiliary spillway erosion for sample job 1a

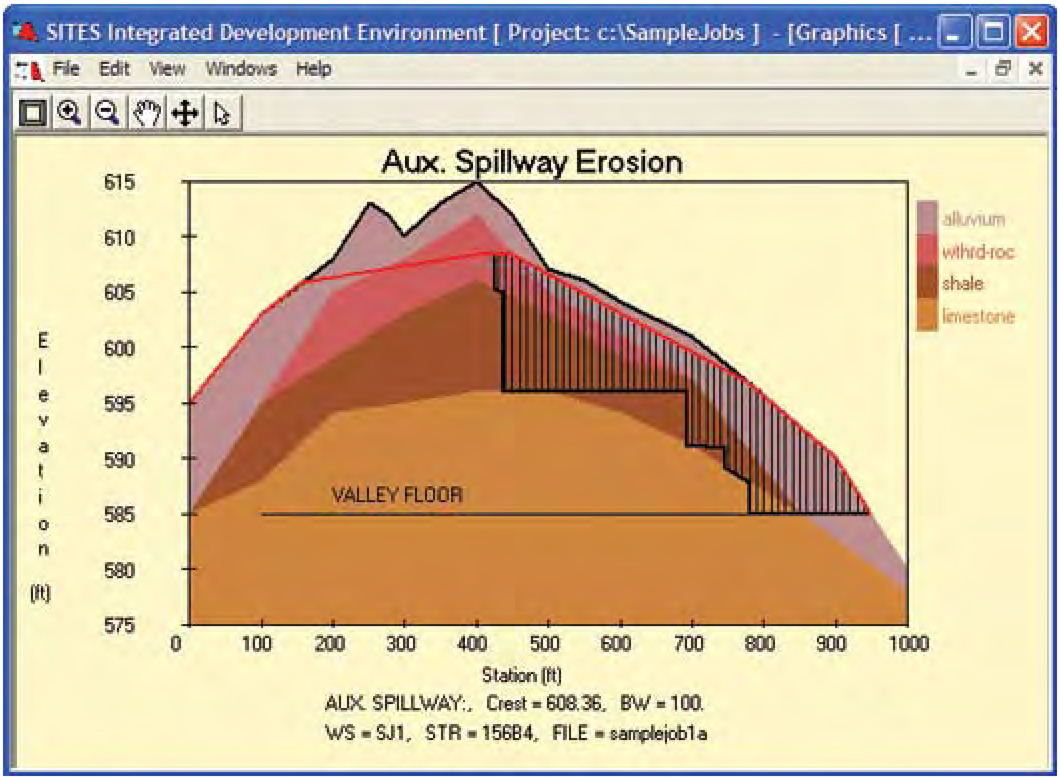


Figure C–1e Control file containing input for sample job 1a

```
SITES     01/01/2005SJ1       SAMPLE JOB 1,  TYPICAL DESIGN 7.5       B3
SAVMOV    0    101
SAVMOV    101  1                                                      1
*         TRIAL NO. 1, USING 36 IN. PIPE, SINGLE STAGE INLET PRINCIPAL
*         SPILLWAY AND 50 ft AUXILIARY SPILLWAY CREST
*         WITH BOTTOM WIDTH = 100 FEET.  PRINCIPAL
*         SPILLWAY HYDROGRAPH BASED ON RAINFALL AND
*         RUNOFF CURVE NUMBER PROCEDURE.
STRUCTURE 156B4     YOUR PROJECT NAME AND LOCATION
                    591       76.6                          247.8
                    593       106.9
                    595       142.8
                    597       180.6
                    601       262.7
                    605       360.3
                    609       456.9
                    613       557.7
                    615       607.7
ENDTABLE
WSDATA    2S W1     82        7.5       2.57                2.67
PDIRECT   1.32      5.8       10.2      11.40     18.10
POOLDATA  AC–FT     2600      2600      30                  585       SC
PSINLET             1.0       18
PSDATA    1         250       36                  0.013     584
CROWN     0.667
TEMPLATE            2.5       2.5       10.0
CLPROFILE           -0        STRUCTURE 156B4, SAMPLE JOB 1
          -1180     625       -1000     618       -750      609
          -500      601.5     -280      595       -150      591
          -50       589       200       588       600       589
          620       579       670       581       690       588
          1110      590       1360      596       1600      607
          1870      613       2010      617
ENDTABLE
ASDATA    41 450                        2.5                 .035      1
ASINSURF  41                  4.9       4.9
ASINLET   41        0.0       0.0       50        0.0                 3
                    1000      10
ENDTABLE
ASEXSURF  41                  5.6       5.6
                              0.9       0.9
                              1         3
                              1         1
                              .008
ENDTABLE
ASEXIT    41        N         1.0
BTMWIDTH  FEET      100
ASMATERIAL11
          1         12        .008      20        110       .07
          2         0         2.0       0         120       .4
          3         0         7.        0         130       7.
          4         0         18.0      0         160       200.
          11        12        .008      15        100       0.05
ENDTABLE
```

Figure C–1e Control file containing input for sample job 1a—Continued

```
ASCOORD    1        ALLUVIUM  N
          0         595       100       603       200       608
          250       613       275       612       300       610
          350       613       400       615       450       612
          500       607       550       606       600       604
          700       601       800       595.7     900       590
          950       585       1000      580
ENDTABLE
ASCOORD    2        WTHRD-ROCK
          100       595       200       605       300       608
          400       612       500       605       700       597
ENDTABLE
ASCOORD    3        SHALE
          0         585       100       595       200       599
          300       603       400       606       500       603
          600       599       700       597       850       585
ENDTABLE
ASCOORD    4        LIMESTONE
          0         585       100       588       200       594
          300       595       400       596       500       596
          600       594       700       591       850       585
          1000      578
ENDTABLE
GRAPHICS  IE
GO,DESIGN ELCP      TYPE2     24
SAVMOV    2    101  1                   156B4
ENDJOB
ENDRUN
```

Sample Job 2—Typical design run – NHCP–378

Inflow Data

PSH – 378 One Day – Precipitation
FBH – 378 Design – Precipitation

Ratings

PS – Computed, single stage hood inlet
Aux – Precomputed, retardance class input

Stage Storage Data
Elevation – Given
Surface Area – Given
Storage Volume – Computed

Special Features Demonstrated
Time of concentration computed from length and slope
Hood inlet
Precomputed auxiliary spillway rating approximation

Output Features Demonstrated

IDE summary table, compare results from alternative principal spillway size entries

Figure C–2a Input data screens for sample job 2a

Figure C–2a Input data screens for sample job 2a—Continued

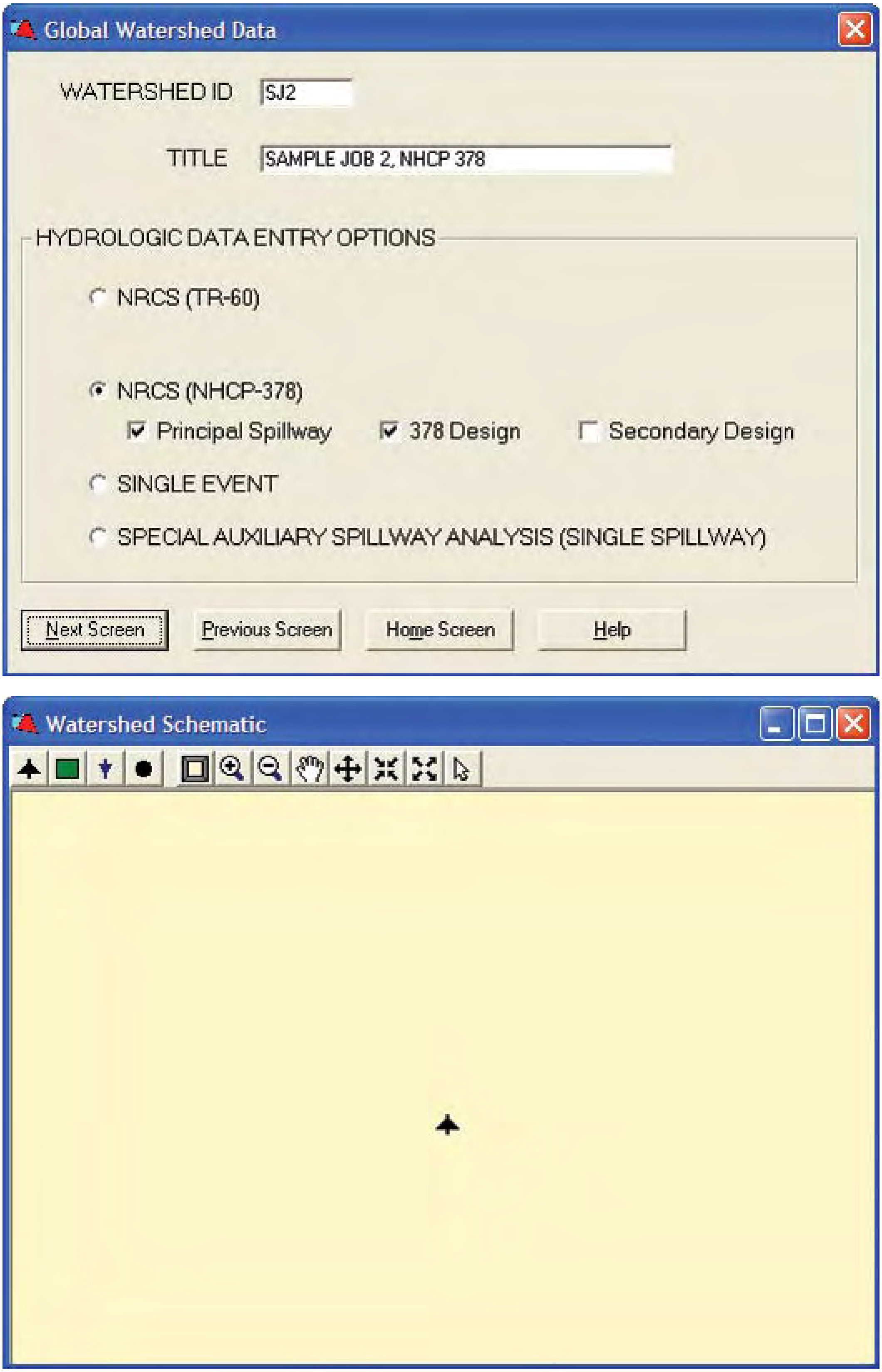
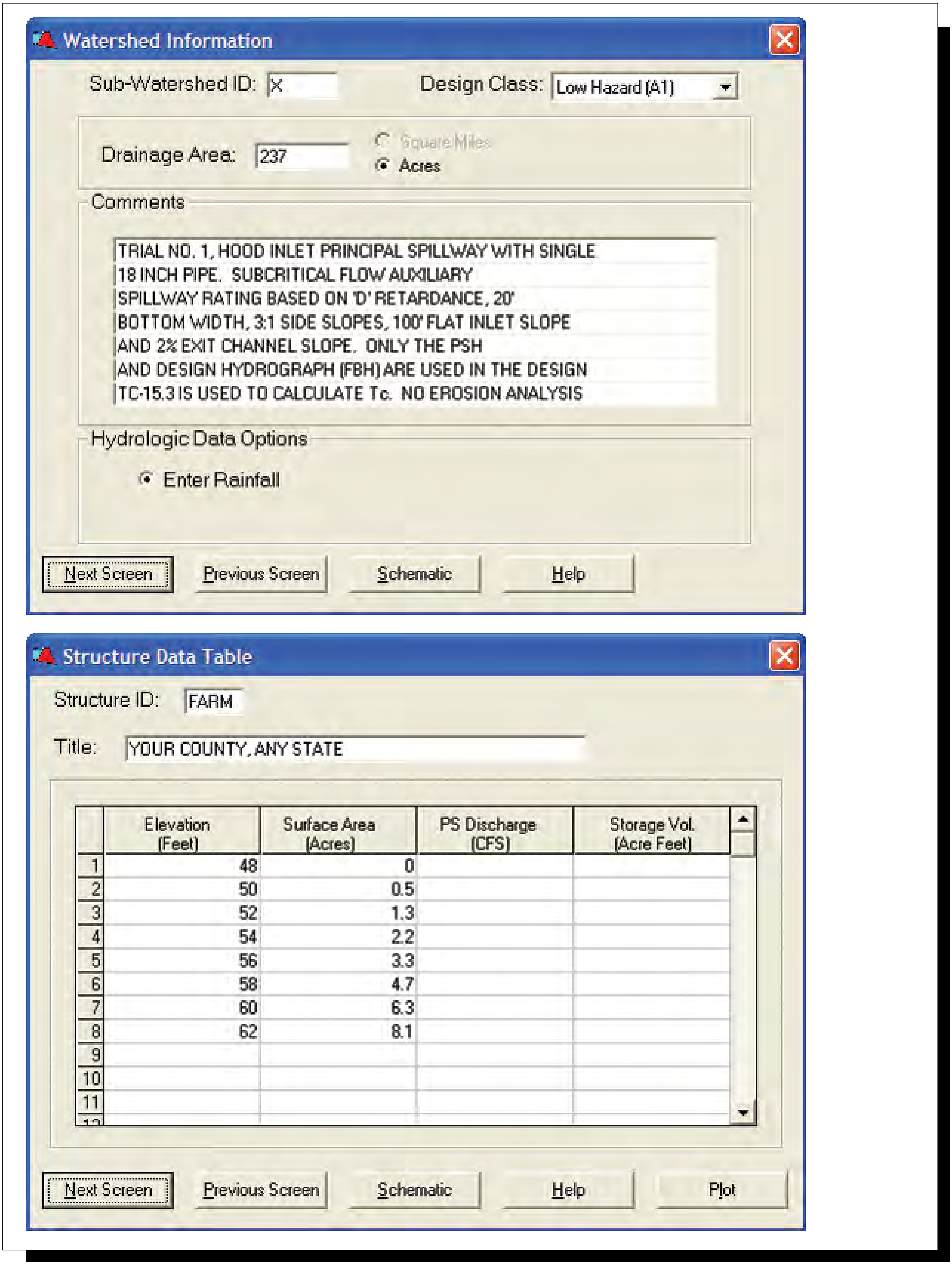


Figure C–2a Input data screens for sample job 2a—Continued



	Elevation (Feet)	Surface Area (Acres)	PS Discharge (CFS)	Storage Vol. (Acre Feet)
1	48	0		
2	50	0.5		
3	52	1.3		
4	54	2.2		
5	56	3.3		
6	58	4.7		
7	60	6.3		
8	62	8.1		
9				
10				
11				

Figure C–2a Input data screens for sample job 2a—Continued

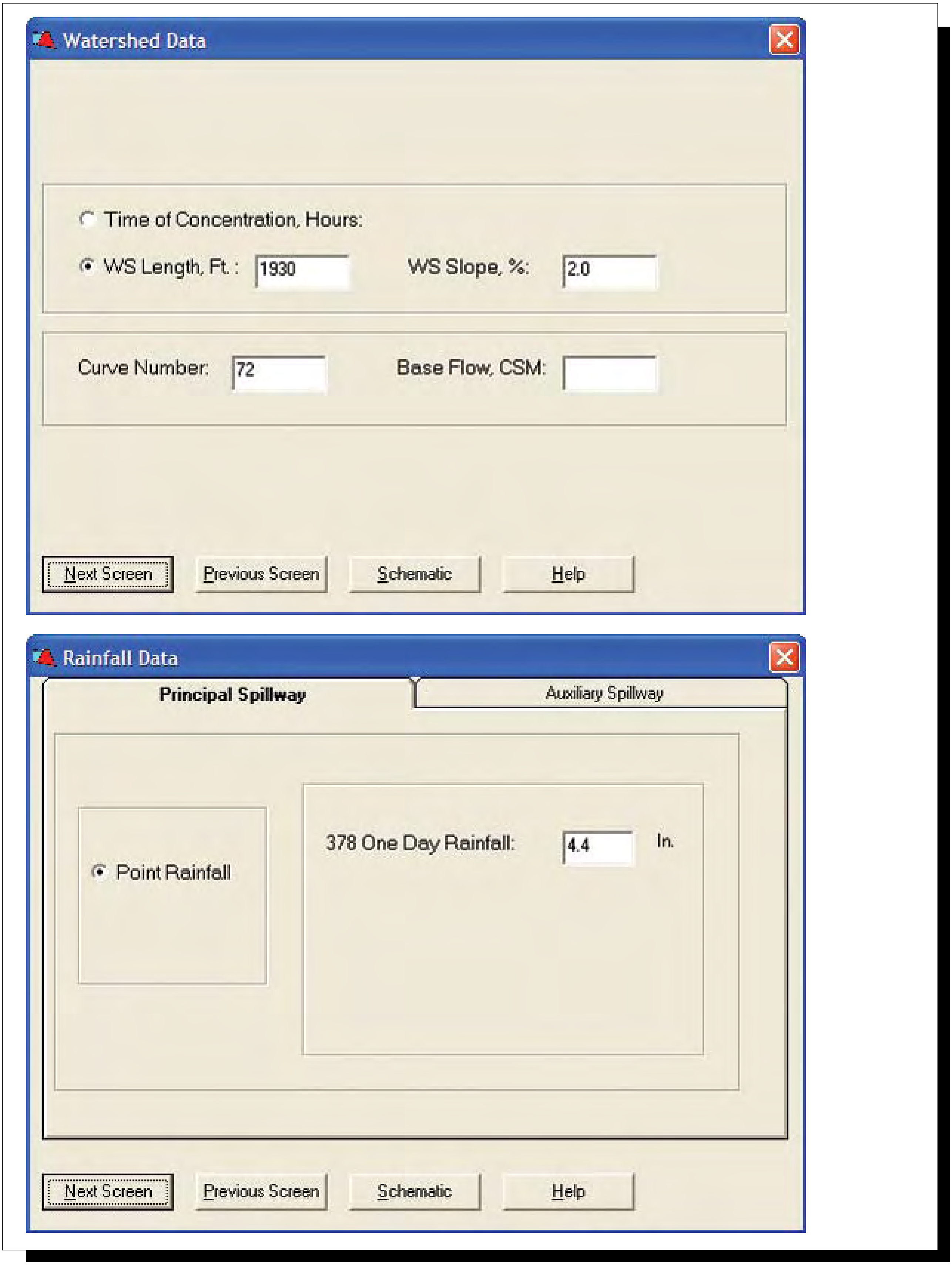


Figure C–2a Input data screens for sample job 2a—Continued

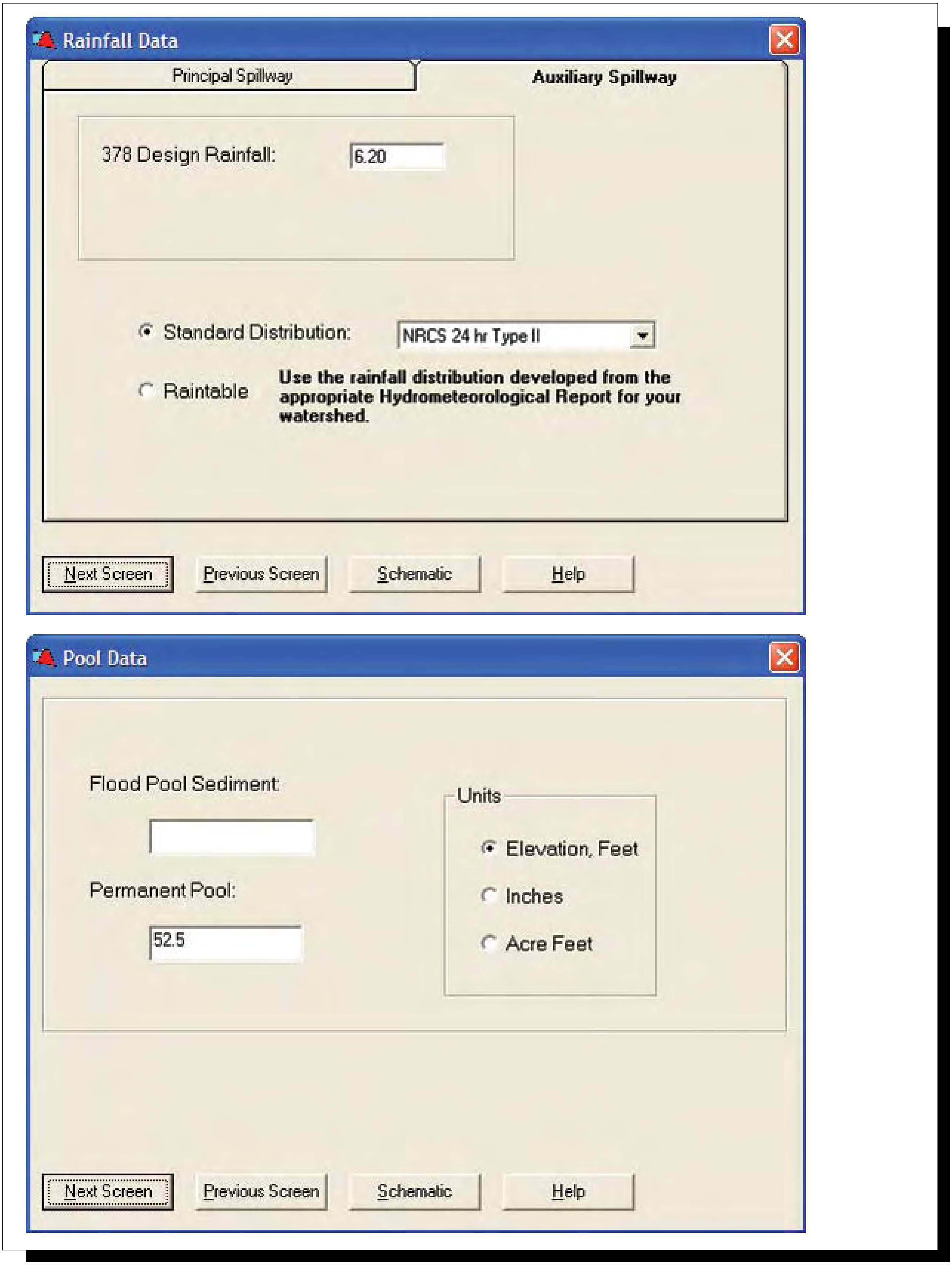


Figure C–2a Input data screens for sample job 2a—Continued

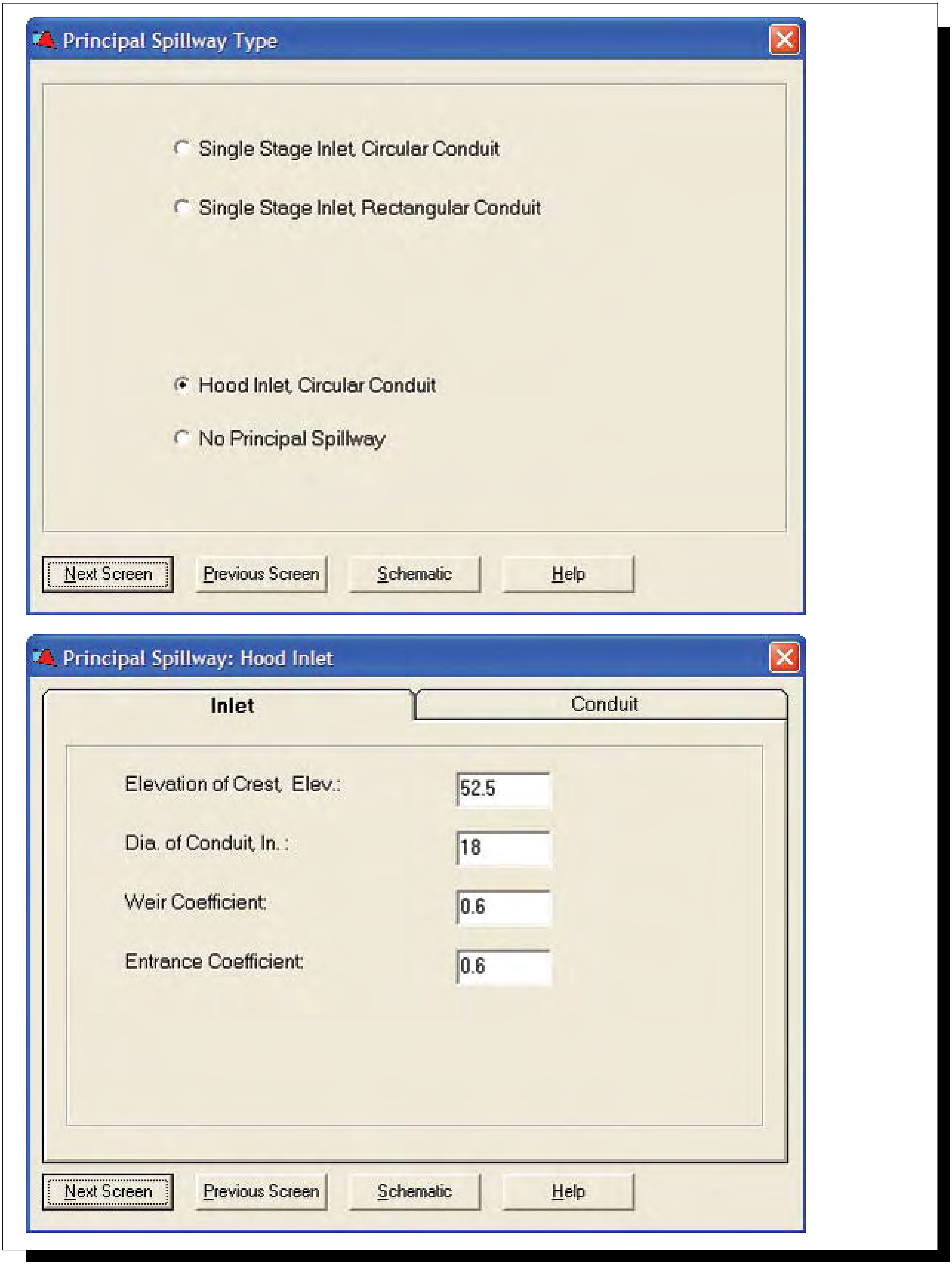


Figure C–2a Input data screens for sample job 2a—Continued

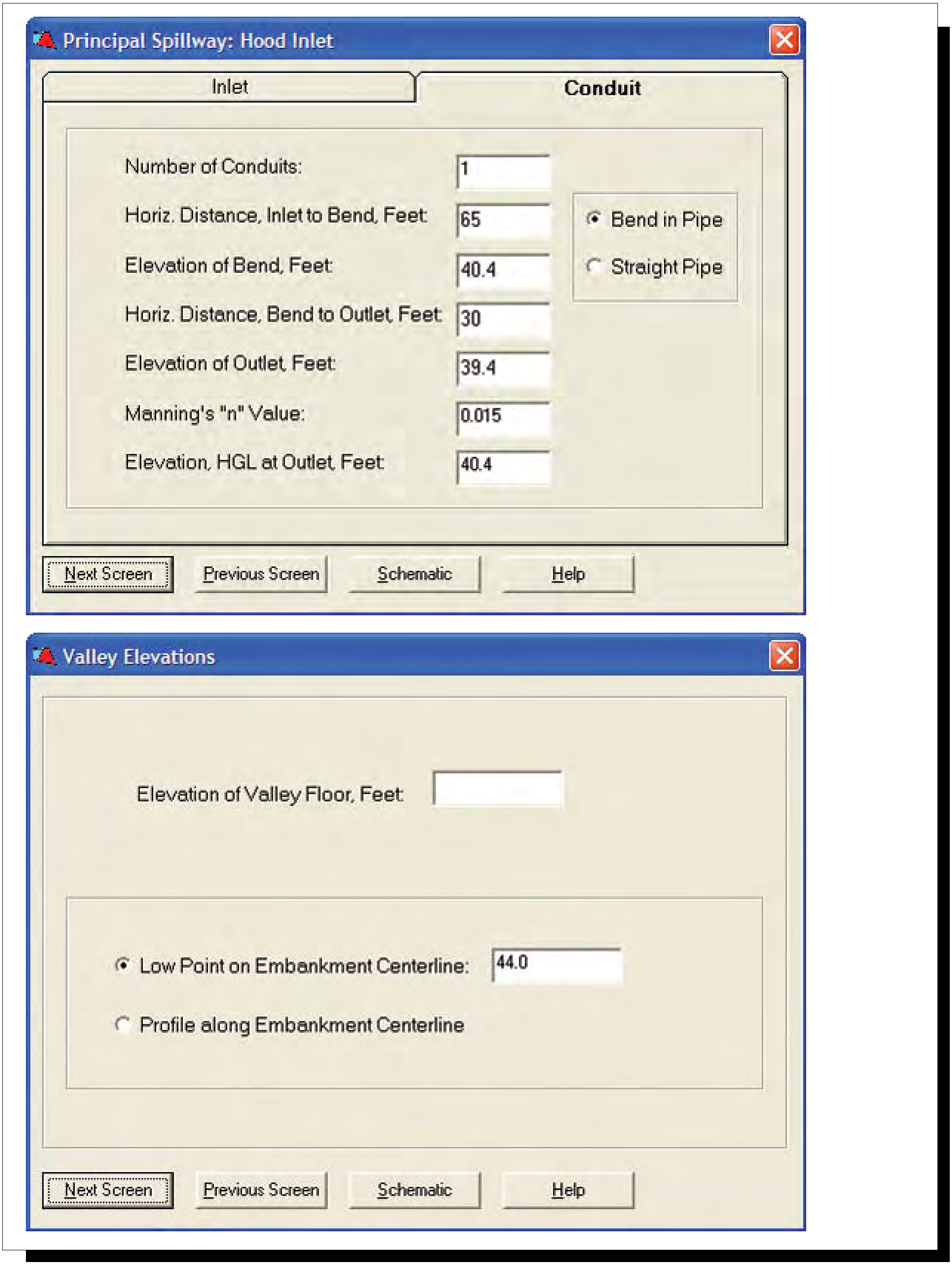
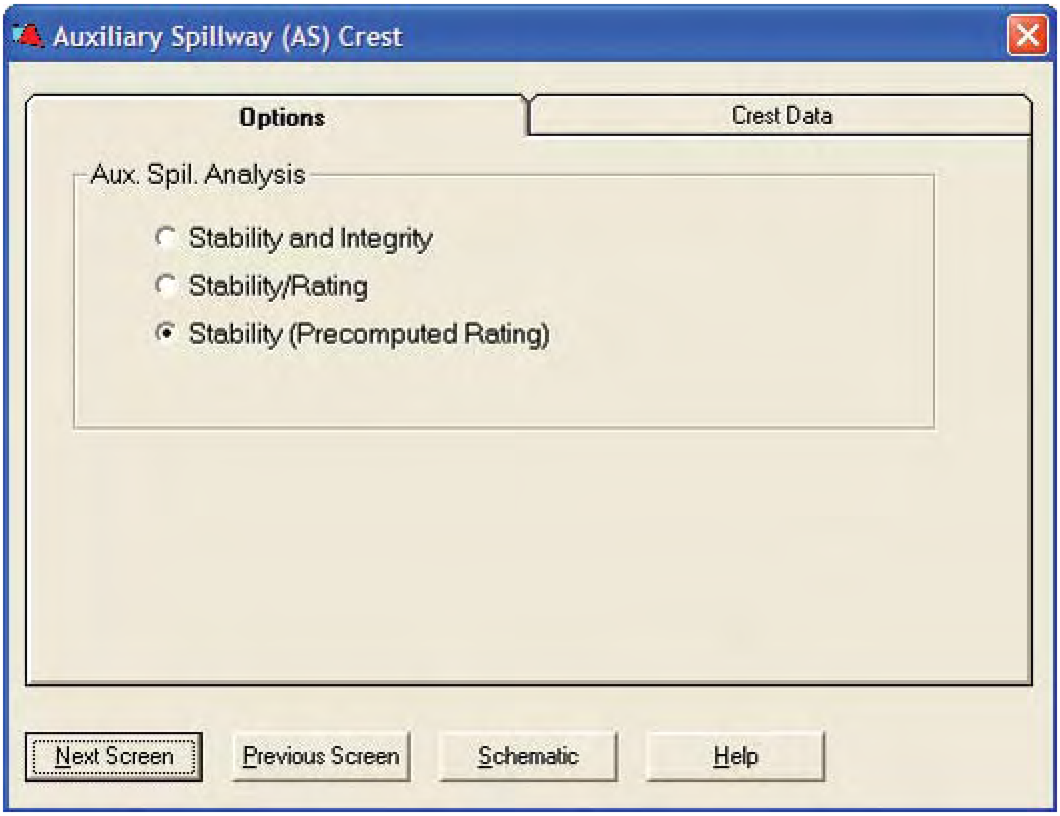


Figure C–2a Input data screens for sample job 2a—Continued



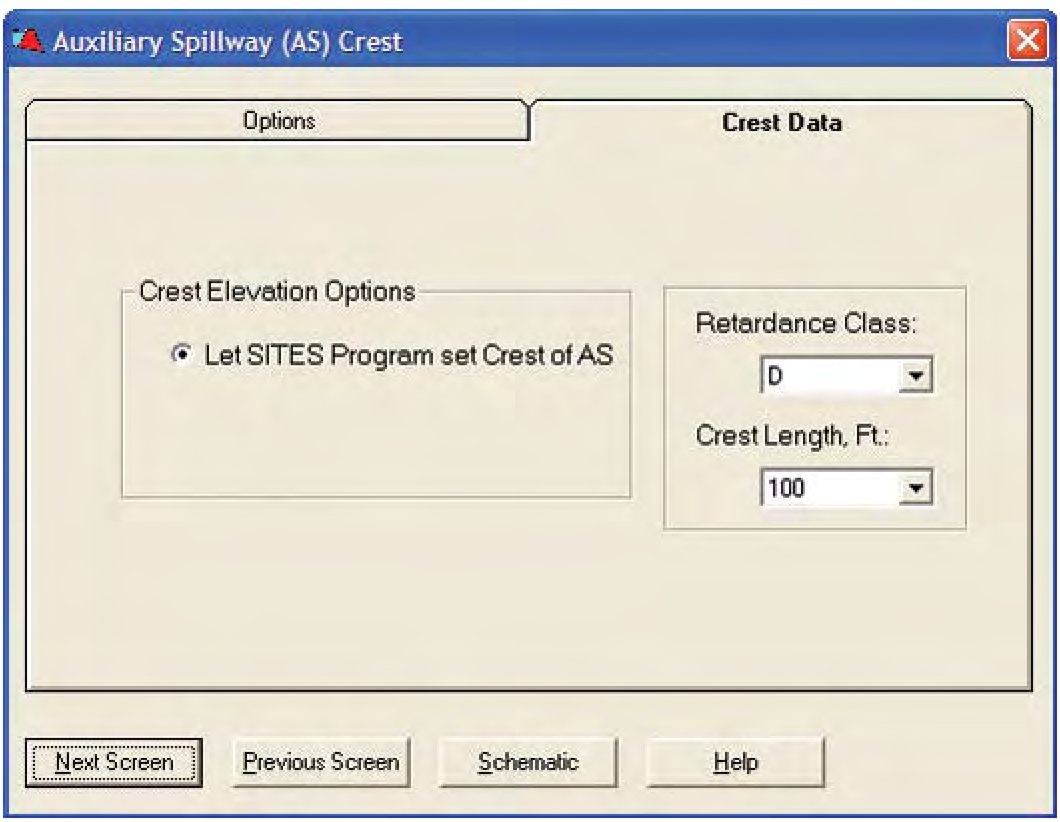


Figure C–2a Input data screens for sample job 2a—Continued

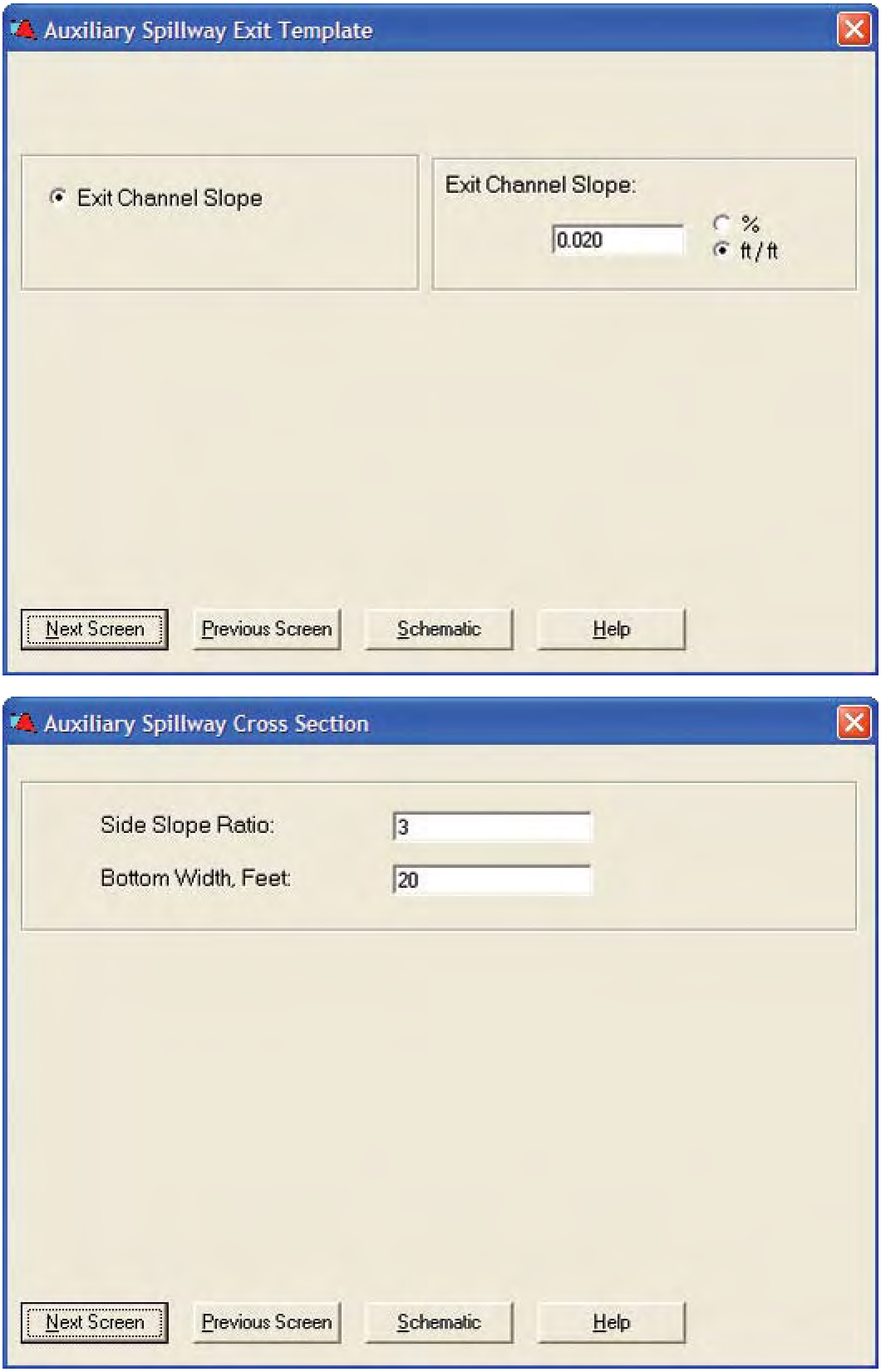


Figure C–2a Input data screens for sample job 2a—Continued

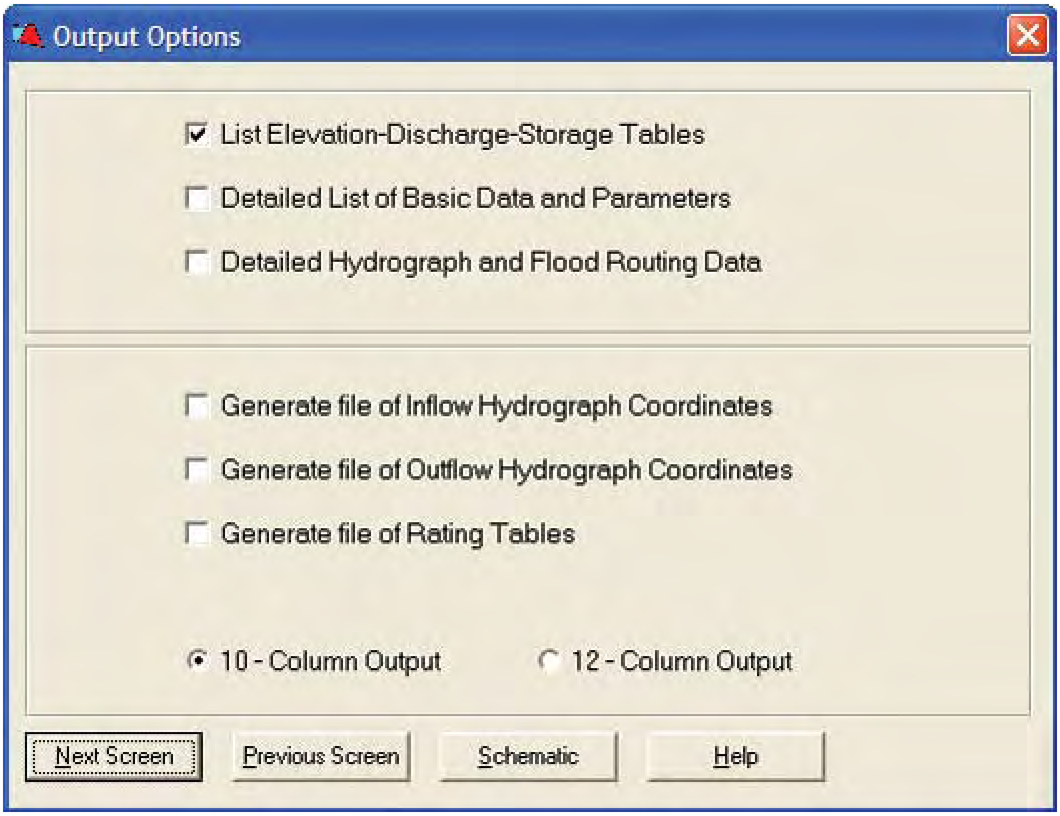


Figure C–2b Input data screens for sample job 2a modified to create sample job 2b

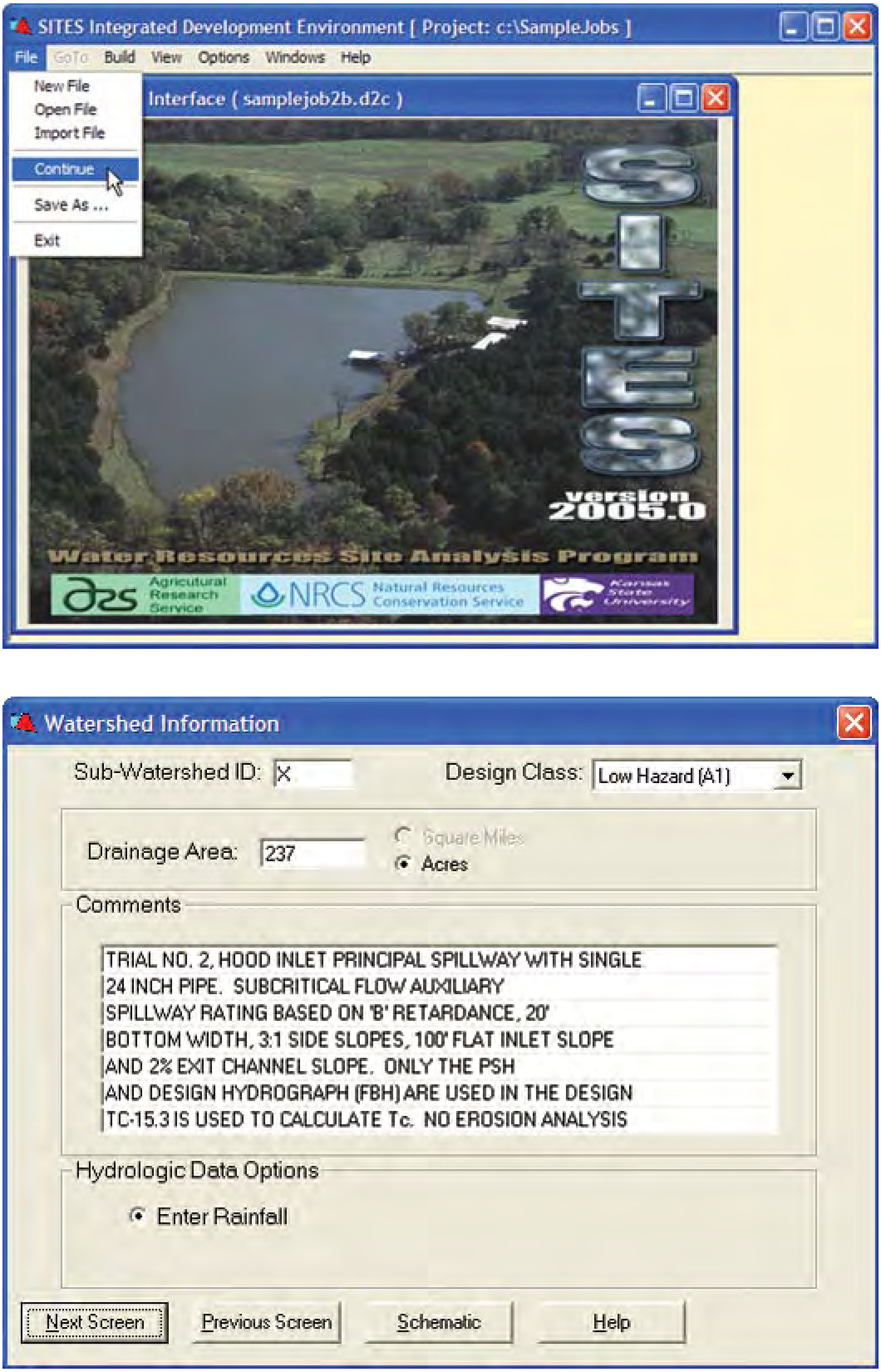


Figure C–2b Input data screens for sample job 2a modified to create sample job 2b—Continued

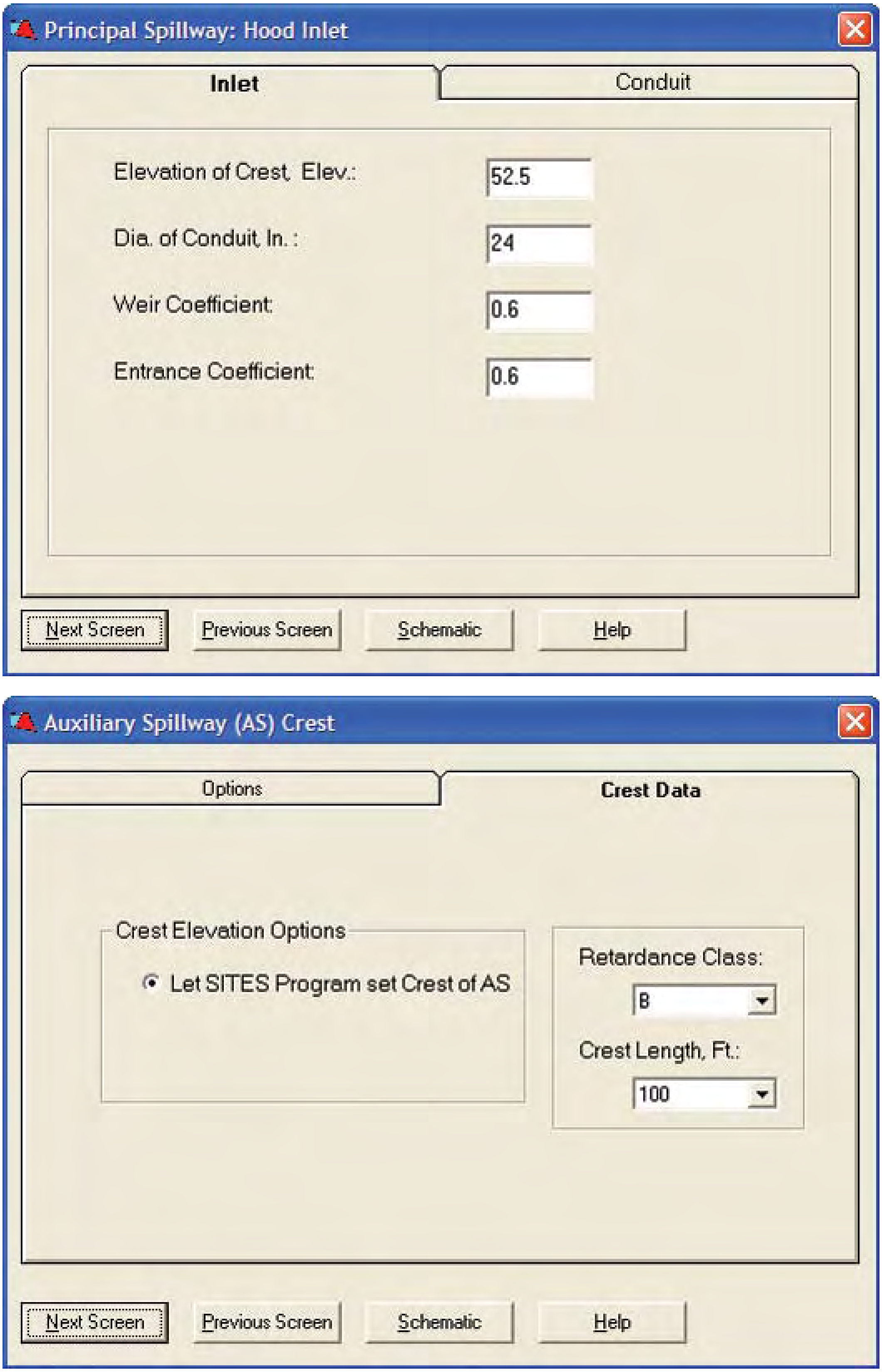
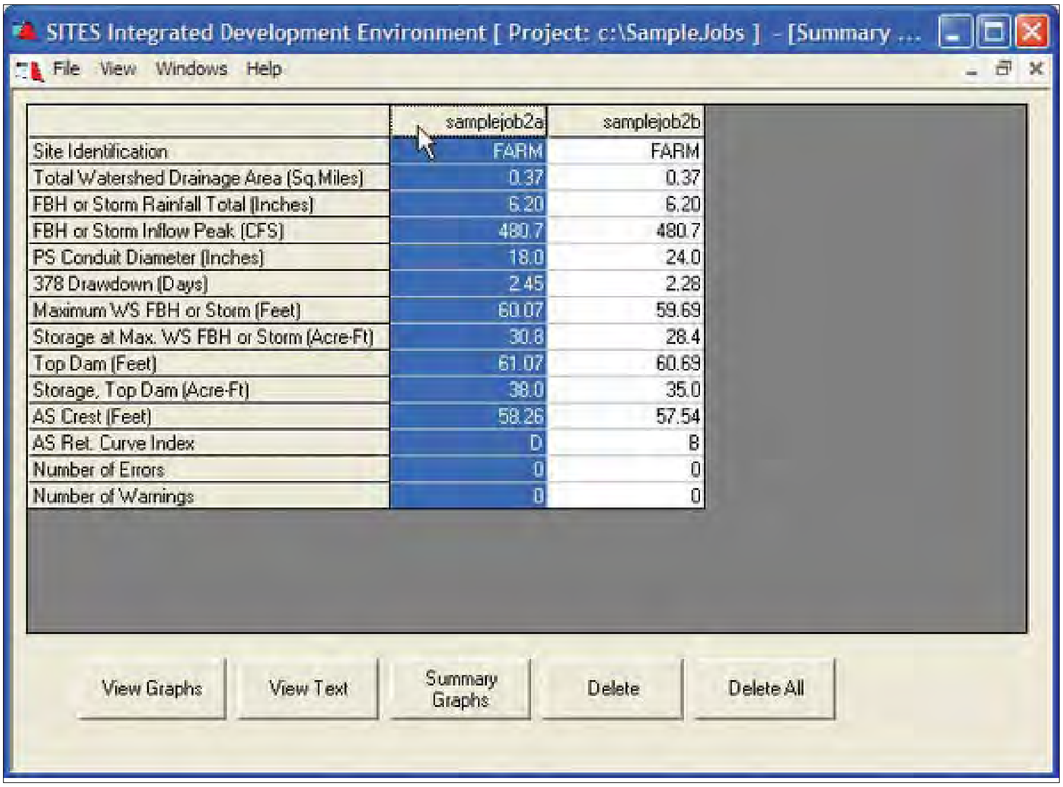


Figure C–2c Customized summary table from IDE comparing output from sample jobs



	samplejob2a	samplejob2b
Site Identification	FARM	FARM
Total Watershed Drainage Area (Sq.Miles)	0.37	0.37
FBH or Storm Rainfall Total (Inches)	6.20	6.20
FBH or Storm Inflow Peak (CFS)	480.7	480.7
PS Conduit Diameter (Inches)	18.0	24.0
378 Drawdown (Days)	2.45	2.28
Maximum WS FBH or Storm (Feet)	60.07	59.69
Storage at Max. WS FBH or Storm (Acre-Ft)	30.8	28.4
Top Dam (Feet)	61.07	60.69
Storage, Top Dam (Acre-Ft)	38.0	35.0
AS Crest (Feet)	58.26	57.54
AS Ret. Curve Index	D	B
Number of Errors	0	0
Number of Warnings	0	0

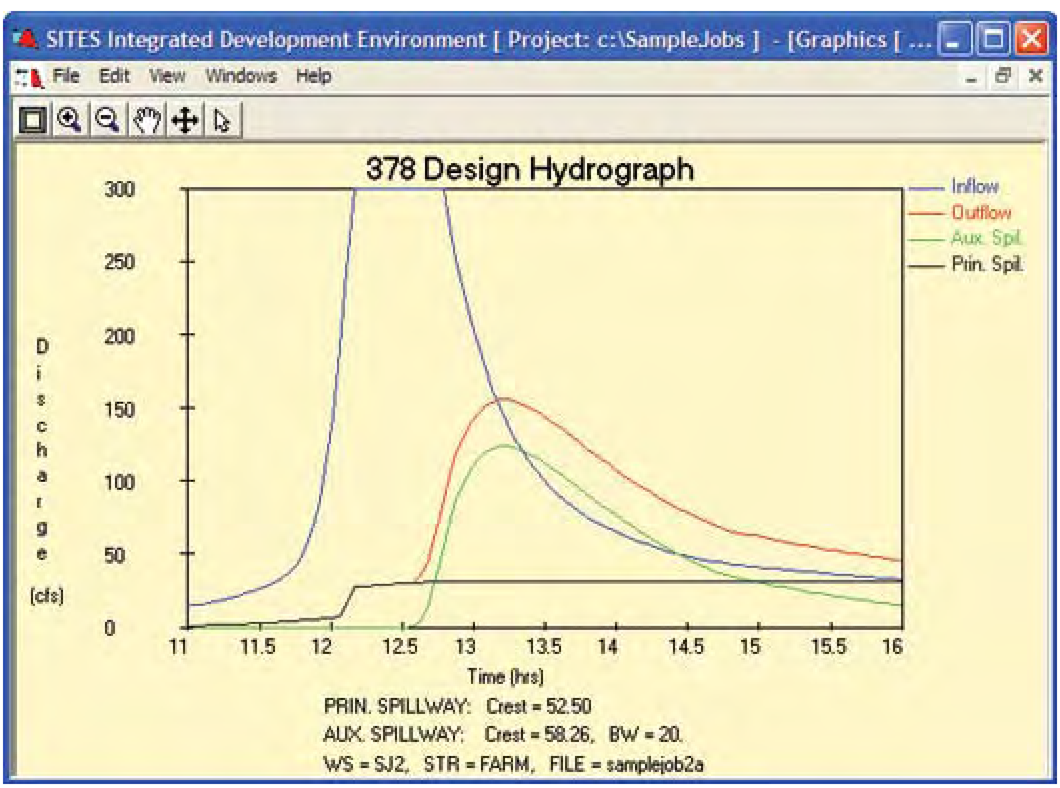


Figure C–2d Control file containing input for sample job 2a

```
SITES      01/01/2005SJ2       SAMPLE JOB 2, NHCP 378       0.3703125 H5
SAVMOV     0    101
SAVMOV     101  1                                                     1
*          TRIAL NO. 1, HOOD INLET PRINCIPAL SPILLWAY WITH SINGLE
*          18 INCH PIPE.  SUBCRITICAL FLOW AUXILIARY
*          SPILLWAY RATING BASED ON ‘D’ RETARDANCE, 20’
*          BOTTOM WIDTH, 3:1 SIDE SLOPES, 100’ FLAT INLET SLOPE
*          AND 2% EXIT CHANNEL SLOPE.  ONLY THE PSH
*          AND DESIGN HYDROGRAPH (FBH) ARE USED IN THE DESIGN
*          TC–15.3 IS USED TO CALCULATE Tc.  NO EROSION ANALYSIS
STRUCTURE FARM       YOUR COUNTY, ANY STATE
                     48        0
                     50        0.5
                     52        1.3
                     54        2.2
                     56        3.3
                     58        4.7
                     60        6.3
                     62        8.1
ENDTABLE
WSDATA     5A1X   AC 72        237       1930      2.0
PDIRECT    1.0       4.4                 .00       6.20
POOLDATA   ELEV      52.5      52.5                44.0                HD
PSHOOD     65        30        40.4      39.4      0.6       0.6       B
PSDATA     1                   18                  0.015     40.4
ASDATA     30D100                        3                   0.020     3
BTMWIDTH   FEET      20
GRAPHICS   I
GO,DESIGN  NL        TYPE2     24        TYPE2378  24
SAVMOV     2    101  1                   FARM
ENDJOB
ENDRUN
```

Sample Job 3—Typical simulation run

Inflow Data

Storm rainfall

Ratings

PS – Given in structure table
Aux – Given in structure table

Stage Storage Data

Elevation – Given
Storage Volume – Given

Special Features Demonstrated

Uniform auxiliary spillway cover (maintenance code of 1 for integrity analysis)
Existing auxiliary spillway surface defined by geology input

Output Features Demonstrated

Plot of predicted auxiliary spillway erosion

Figure C–3a Input data screens for sample job 3

Figure C–3a Input data screens for sample job 3—Continued

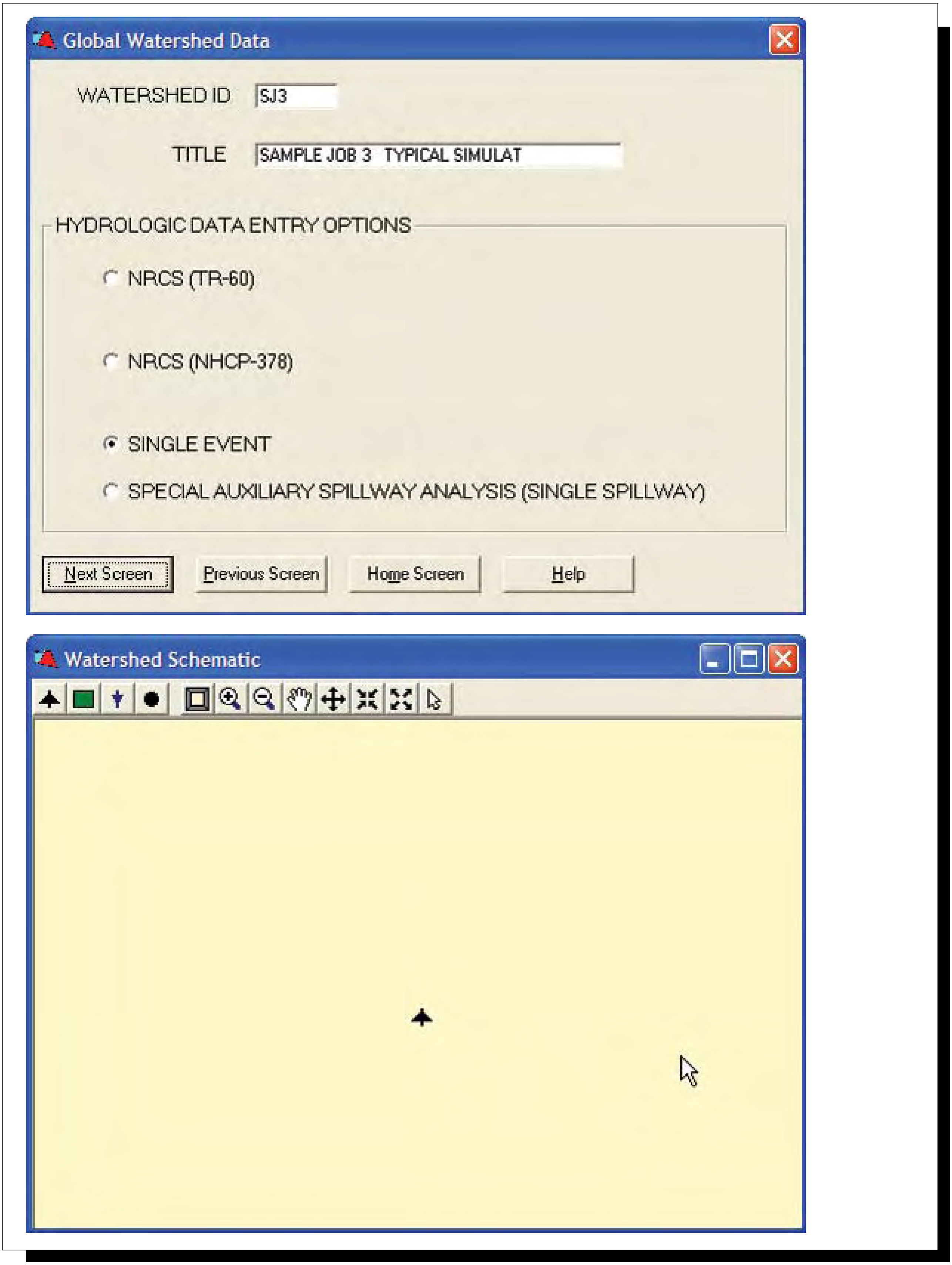


Figure C–3a Input data screens for sample job 3—Continued

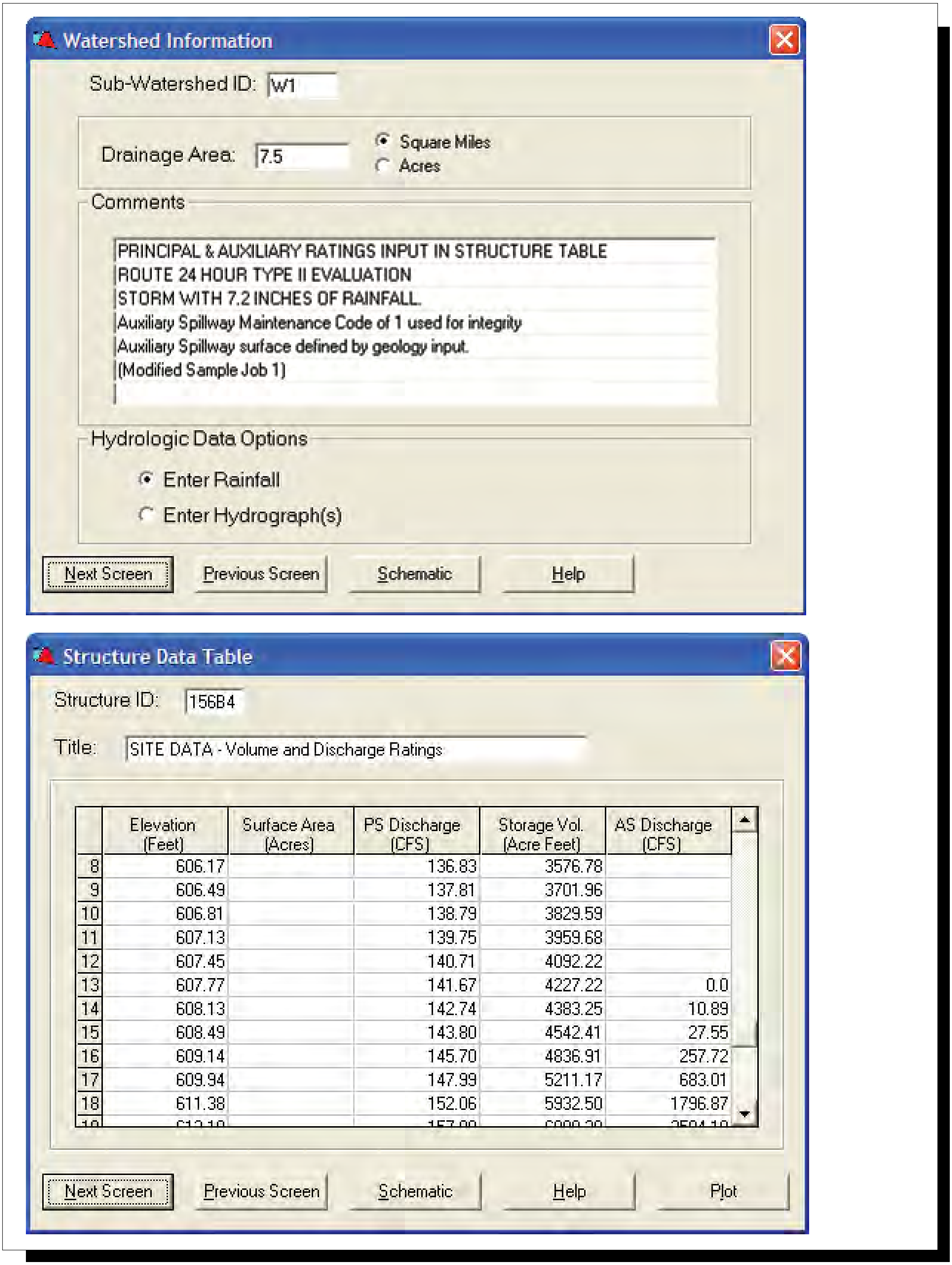


Figure C–3a Input data screens for sample job 3—Continued

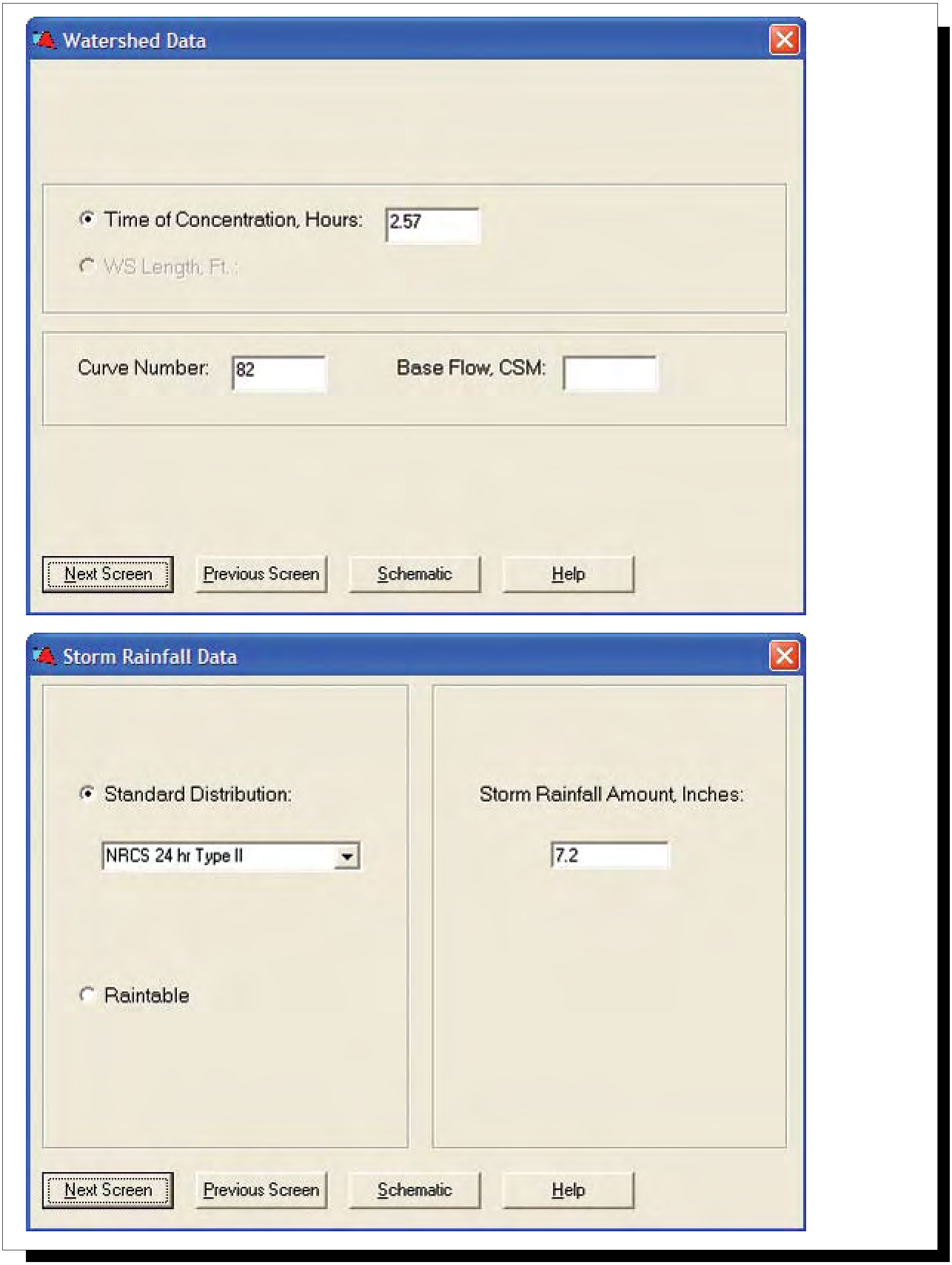


Figure C–3a Input data screens for sample job 3—Continued

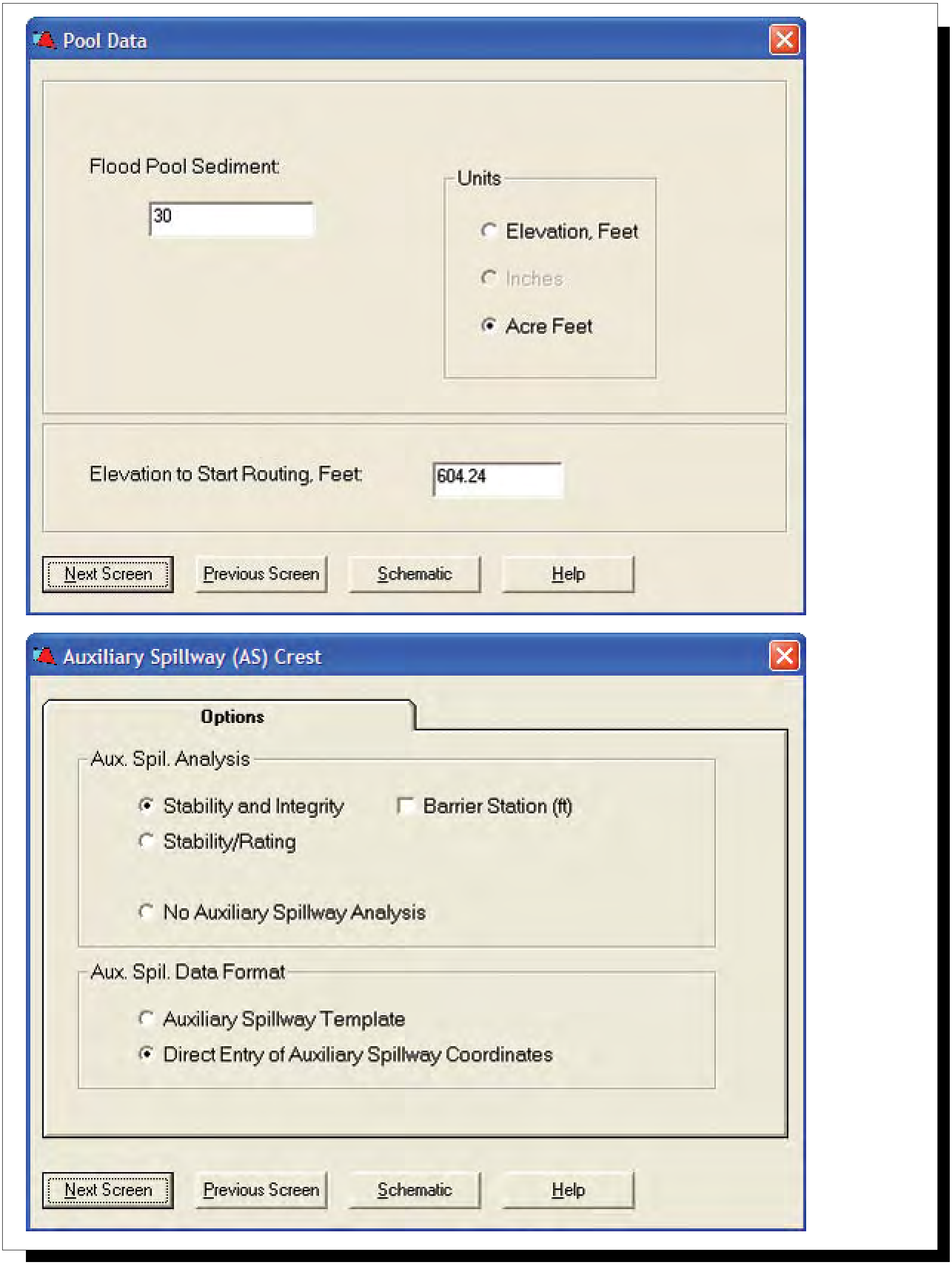
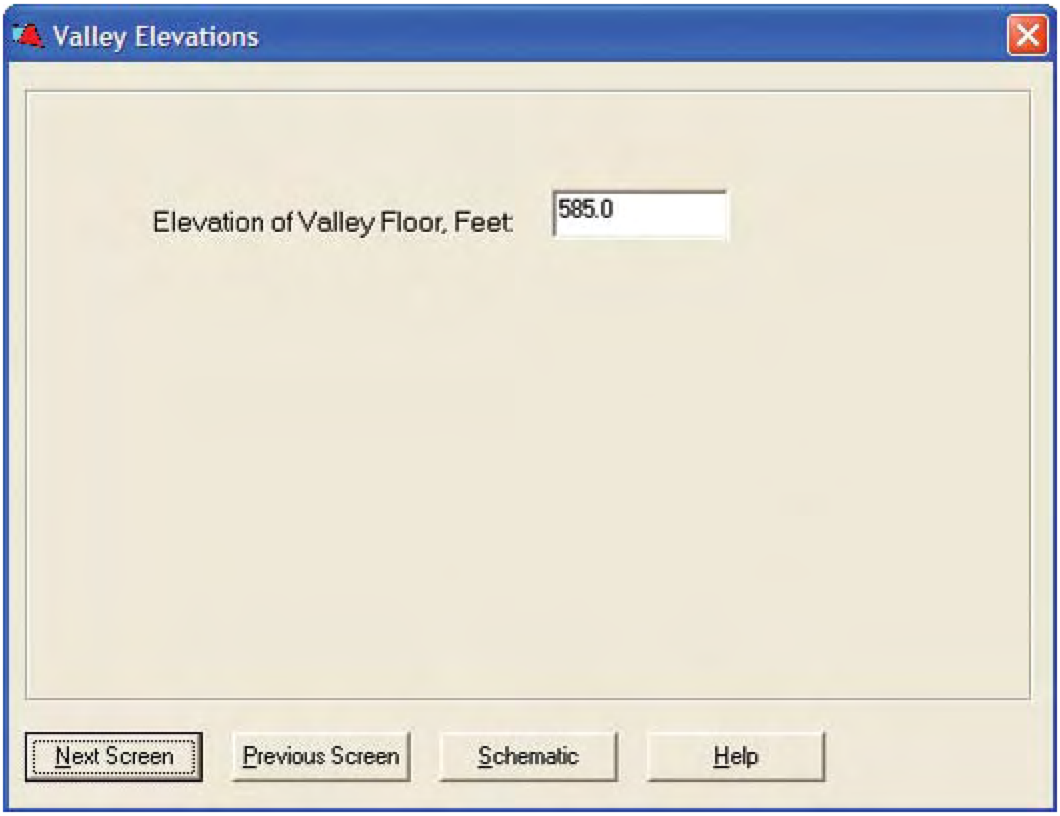


Figure C–3a Input data screens for sample job 3—Continued



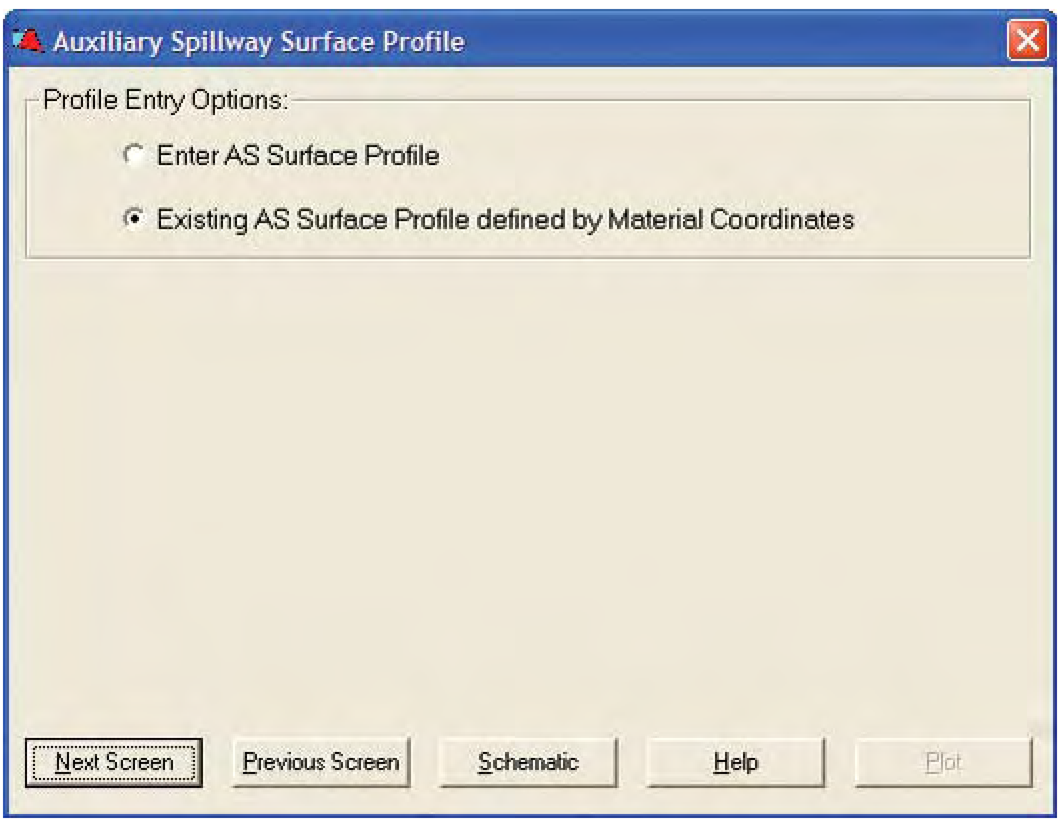


Figure C–3a Input data screens for sample job 3—Continued

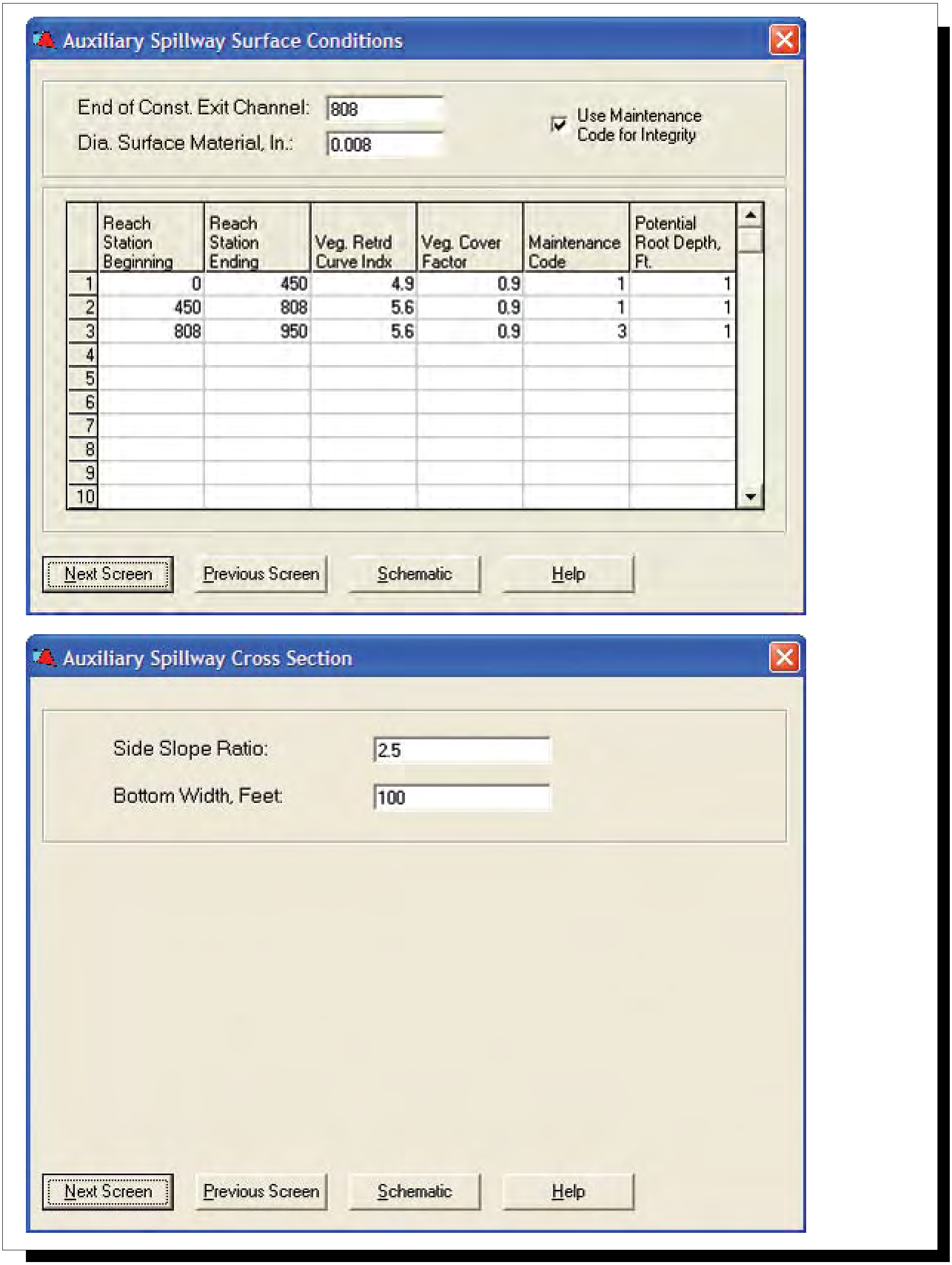


Figure C–3a Input data screens for sample job 3—Continued

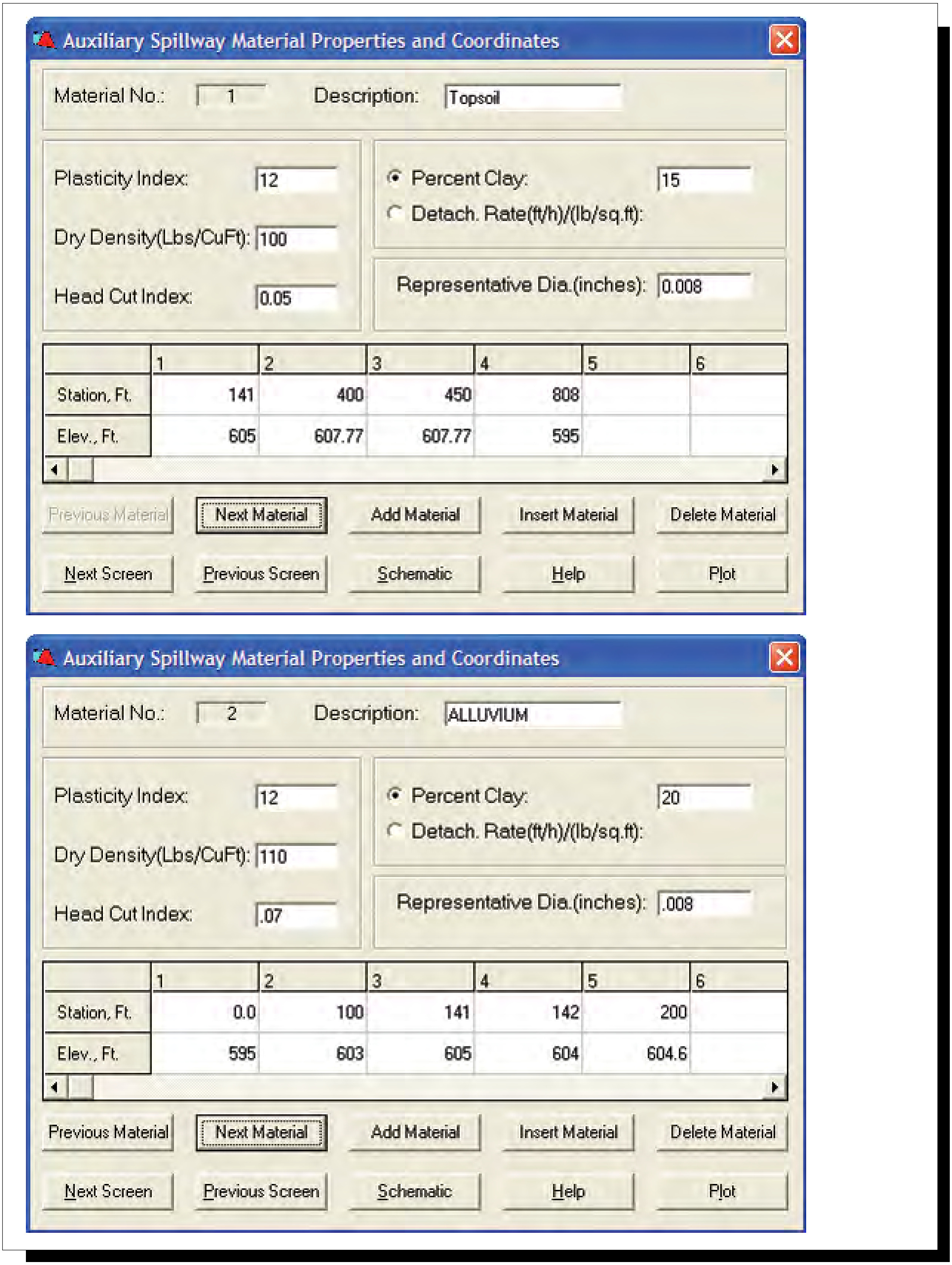


Figure C–3a Input data screens for sample job 3—Continued

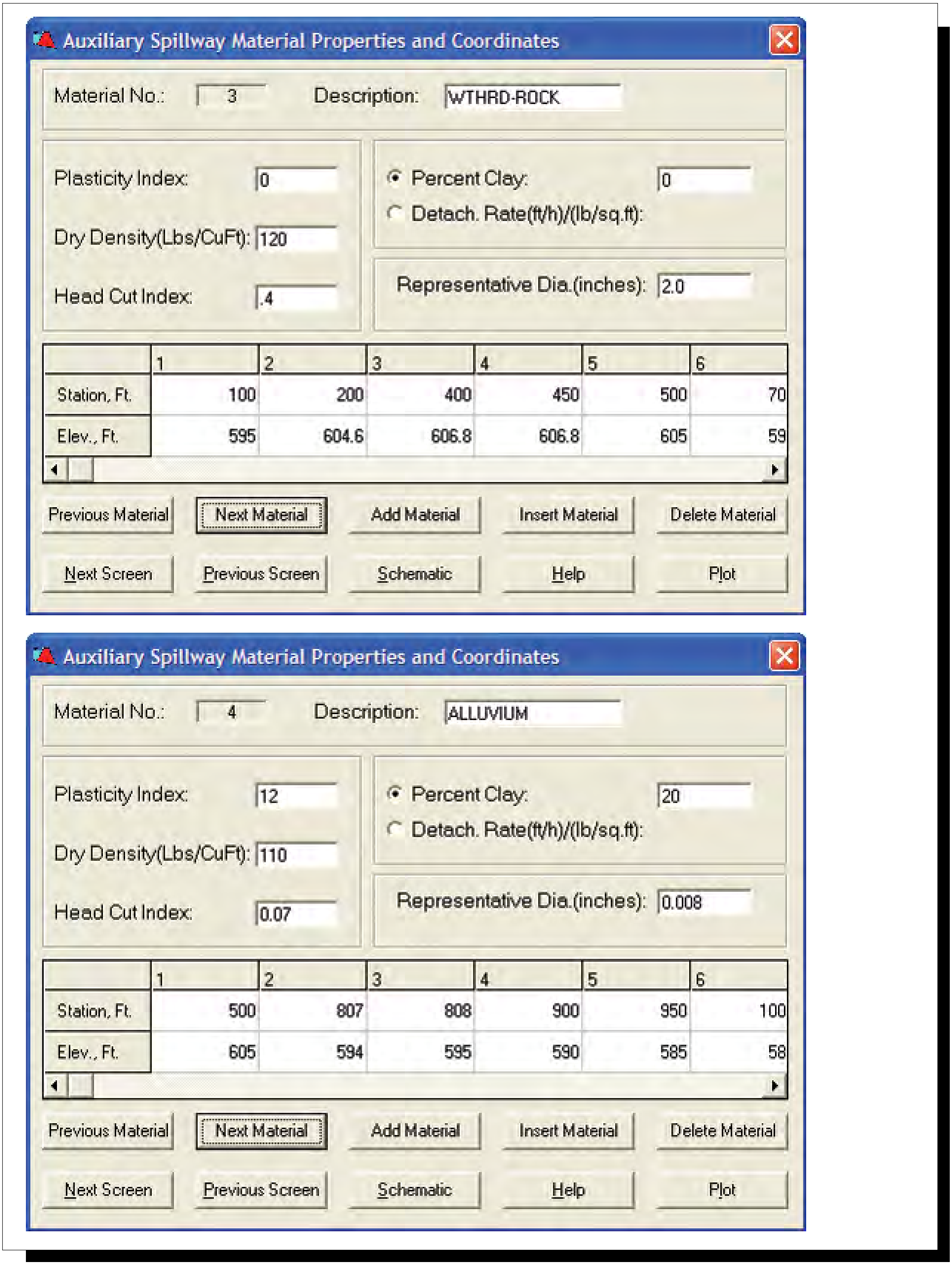


Figure C–3a Input data screens for sample job 3—Continued

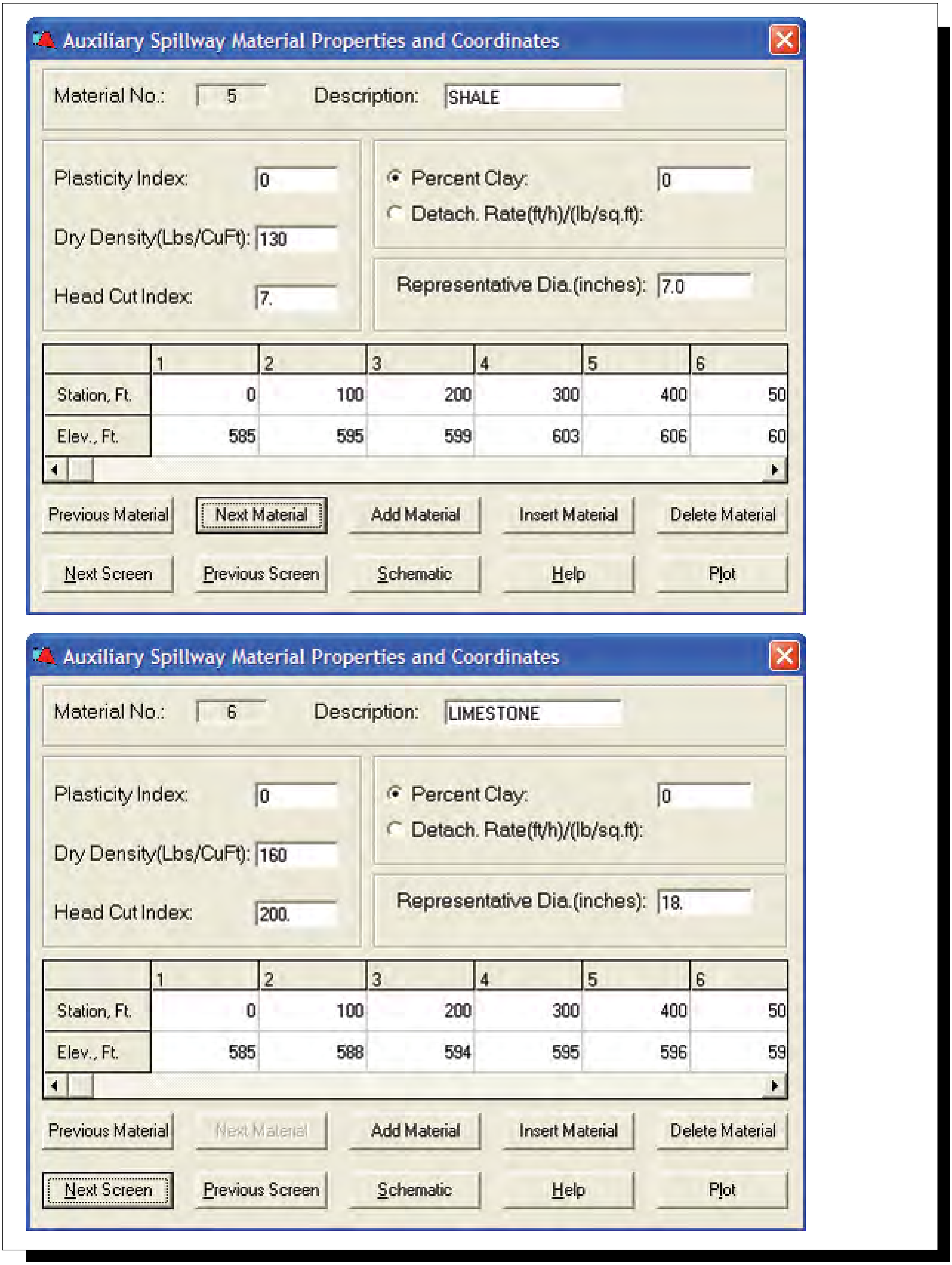


Figure C–3a Input data screens for sample job 3—Continued

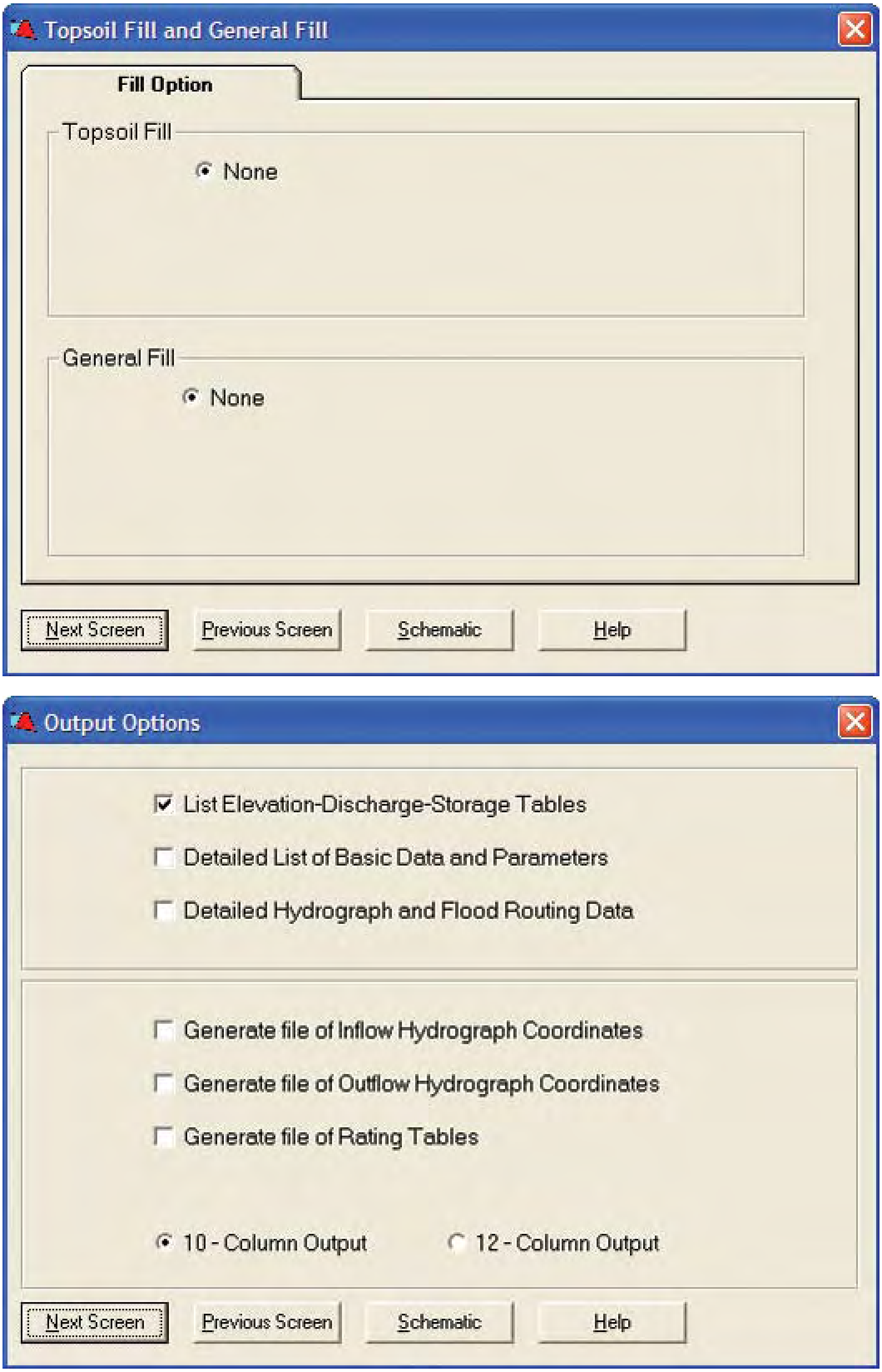
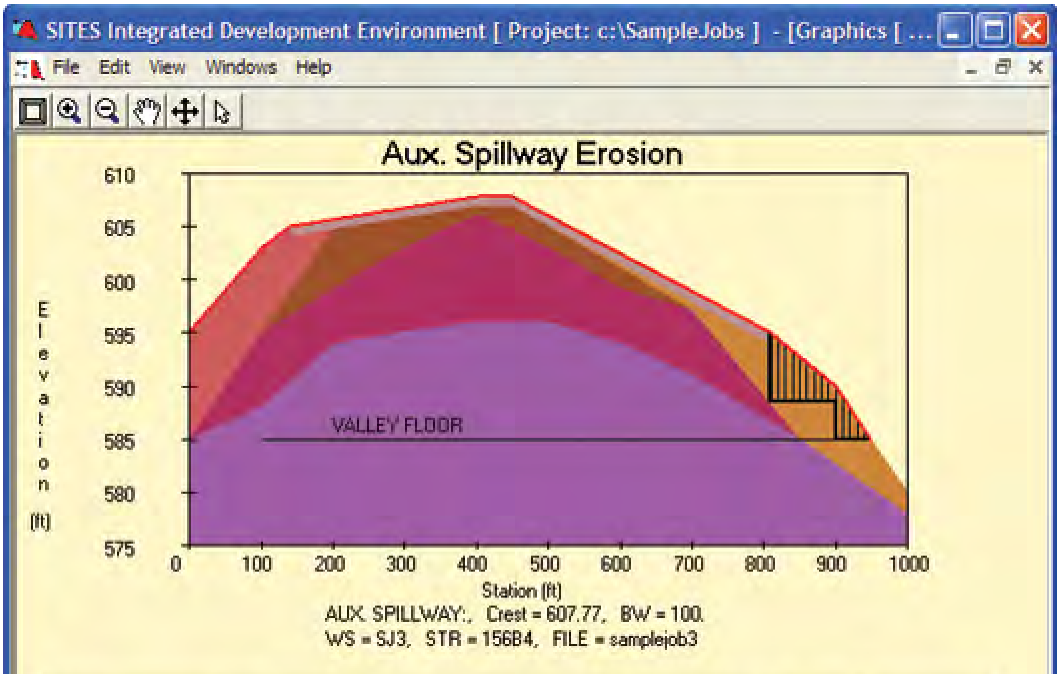


Figure C–3b Graphical output of predicted auxiliary spillway erosion for sample job 3



Material Description	Detach. Rate (ft/h)/(lb/sq ft)	Dry Density (lbs/cu ft)	Headcut Index (Kh)	Percent Clay	Plasticity Index	Rep. Diameter (in)
Topsoil	--	100.	0.05	15.0	12.	0.00800
ALLUVIUM	--	110.	0.07	20.0	12.	0.00800
WTHRD-ROCK	--	120.	0.40	0.0	0.	2.00000
ALLUVIUM	--	110.	0.07	20.0	12.	0.00800
SHALE	--	130.	7.00	0.0	0.	7.00000
LIMESTONE	--	160.	200.00	0.0	0.	18.00000
TS_FILL	--	100.	0.05	0.0	0.	0.05000
GEN_FILL	--	100.	0.05	15.0	12.	0.00800

Figure C–3c Control file containing input for sample job 3

```
SITES     01/01/2005SJ3       SAMPLE JOB 3   TYPICAL SIMULAT7.5       I8
SAVMOV    0    101
SAVMOV    101  1                                                      1
*         PRINCIPAL & AUXILIARY RATINGS INPUT IN STRUCTURE TABLE
*         ROUTE 24 HOUR TYPE II EVALUATION
*         STORM WITH 7.2 INCHES OF RAINFALL.
*         Auxiliary Spillway Maintenance Code of 1 used for integrity
*         Auxiliary Spillway surface defined by geology input.
*         (Modified Sample Job 1)
STRUCTURE 156B4     SITE DATA - Volume and Discharge Ratings
                    603.43              0.0                 2600.00
                    603.87              16.73               2746.66
                    604.32              47.33               2898.21
                    604.77              86.94               3054.65
                    605.22              133.86              3215.99
                    605.54              134.85              3333.80
                    605.86              135.84              3454.06
                    606.17              136.83              3576.78
                    606.49              137.81              3701.96
                    606.81              138.79              3829.59
                    607.13              139.75              3959.68
                    607.45              140.71              4092.22
                    607.77              141.67    0.0       4227.22
                    608.13              142.74    10.89     4383.25
                    608.49              143.80    27.55     4542.41
                    609.14              145.70    257.72    4836.91
                    609.94              147.99    683.01    5211.17
                    611.38              152.06    1796.87   5932.50
                    613.19              157.00    3584.18   6908.29
                    615.00              161.79    5797.84   7966.00
ENDTABLE
WSDATA    5S W1     82        7.5       2.57
STORM                         24
POOLDATA  AC-FT               2600.00   30        579.0     585.0
ASSURFACE 41        808       0.008
          0         450       4.9       0.9       1         1
          450       808       5.6       0.9       1         1
          808       950       5.6       0.9       3         1
ENDTABLE
ASDATA    41                            2.5                           1
BTMWIDTH  FEET      100
ASMATERIAL
          1         12        0.008     15        100       0.05
          2         12        .008      20        110       .07
          3         0         2.0       0         120       .4
          4         12        0.008     20        110       0.07
          5         0         7.0       0         130       7.
          6         0         18.       0         160       200.
ENDTABLE
ASCOORD    1        Topsoil   Y
          141       605       400       607.77    450       607.77
          808       595
ENDTABLE
```

Figure C–3c Control file containing input for sample job 3—Continued

```
ASCOORD    2         ALLUVIUM
           0.0       595       100       603       141       605
           142       604       200       604.6
ENDTABLE
ASCOORD    3         WTHRD-ROCK
           100       595       200       604.6     400       606.8
           450       606.8     500       605       700       597
ENDTABLE
ASCOORD    4         ALLUVIUM
           500       605       807       594       808       595
           900       590       950       585       1000      580
ENDTABLE
ASCOORD    5         SHALE
           0         585       100       595       200       599
           300       603       400       606       500       603
           600       599       700       597       850       585
ENDTABLE
ASCOORD    6         LIMESTONE
           0         585       100       588       200       594
           300       595       400       596       500       596
           600       594       700       591       850       585
           1000      578
ENDTABLE
GRAPHICS   I
GO,STORM   L         TYPE2     7.2       1                   604.24
SAVMOV     2    101  1                   156B4
ENDJOB
ENDRUN
```

Sample Job 4—Hydrograph routing only

Inflow Data

Reservoir inflow hydrograph

Ratings

PS – Given in structure table
Aux – Given in structure table

Stage Storage Data

Elevation – Given
Storage Volume – Given

Special Features Demonstrated

Flood simulation with minimum input data

Output Features Demonstrated

Plot of hydrographs

Figure C–4a Input data screens for sample job 4

Figure C–4a Input data screens for sample job 4—Continued

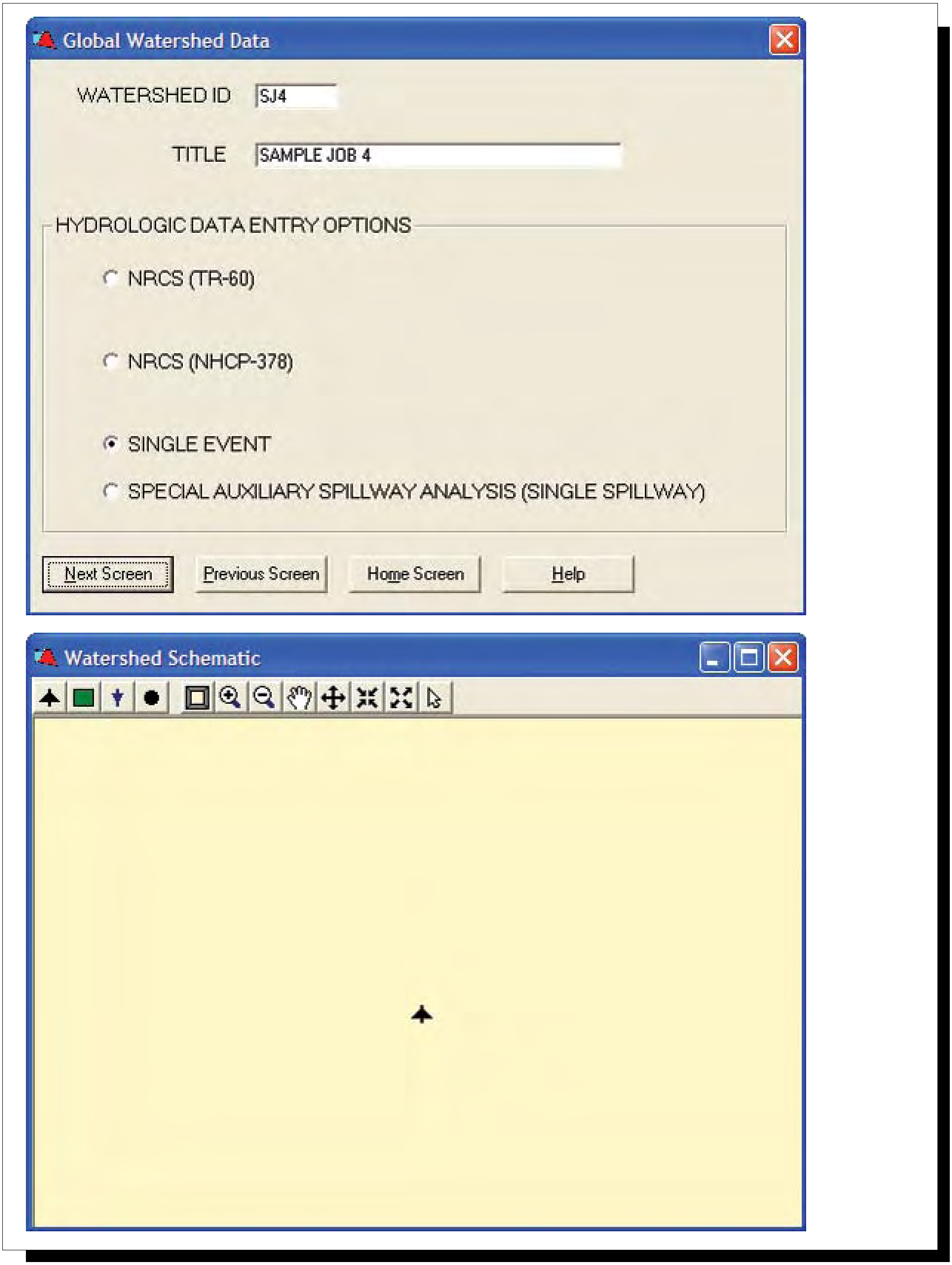
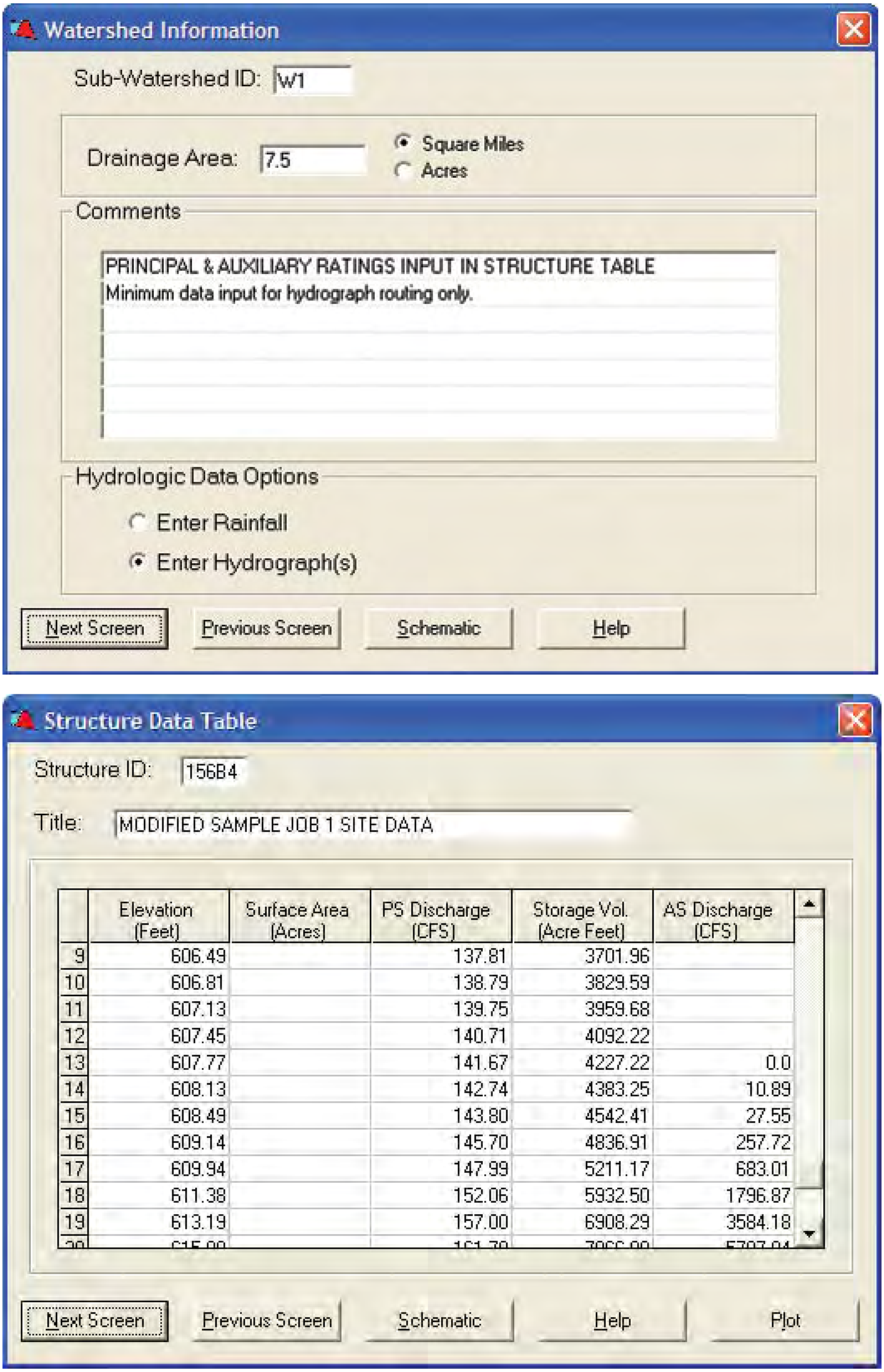


Figure C–4a Input data screens for sample job 4—Continued



Watershed Information

Sub-Watershed ID: W1

Drainage Area: 7.5

Square Miles

Acres

Comments

PRINCIPAL & AUXILIARY RATINGS INPUT IN STRUCTURE TABLE

Minimum data input for hydrograph routing only.

Hydrologic Data Options

Enter Rainfall

Enter Hydrograph(s)

Next Screen | Previous Screen | Schematic | Help

Structure Data Table

Structure ID: 156B4

Title: MODIFIED SAMPLE JOB 1 SITE DATA

	Elevation (Feet)	Surface Area (Acres)	PS Discharge (CFS)	Storage Vol. (Acre Feet)	AS Discharge (CFS)
9	606.49		137.81	3701.96	
10	606.81		138.79	3829.59	
11	607.13		139.75	3959.68	
12	607.45		140.71	4092.22	
13	607.77		141.67	4227.22	0.0
14	608.13		142.74	4383.25	10.89
15	608.49		143.80	4542.41	27.55
16	609.14		145.70	4836.91	257.72
17	609.94		147.99	5211.17	683.01
18	611.38		152.06	5932.50	1796.87
19	613.19		157.00	6908.29	3584.18

Next Screen | Previous Screen | Schematic | Help | Plot

Figure C–4a Input data screens for sample job 4—Continued

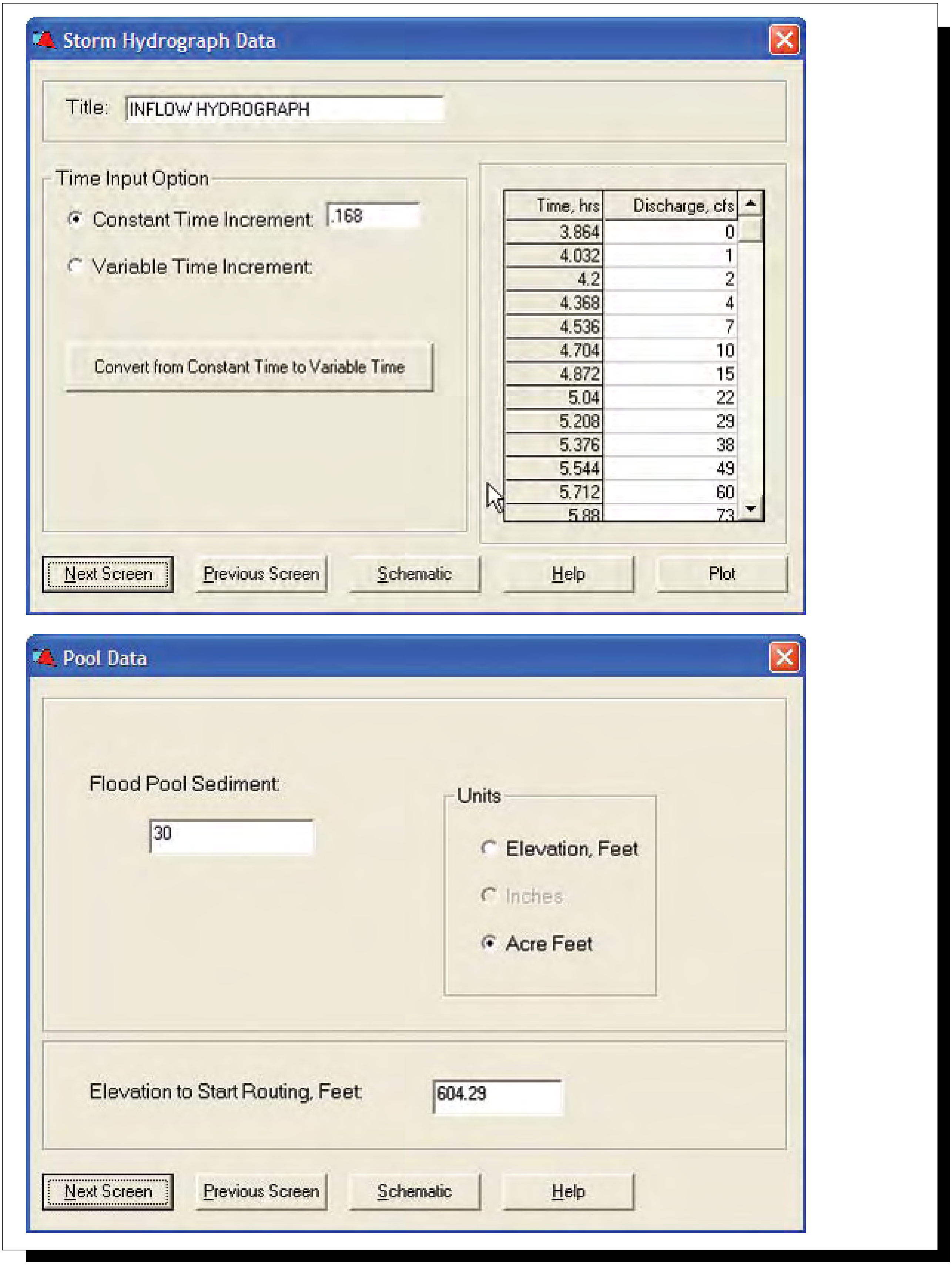


Figure C–4a Input data screens for sample job 4—Continued

Figure C–4b Graphical output of inflow and outflow hydrographs

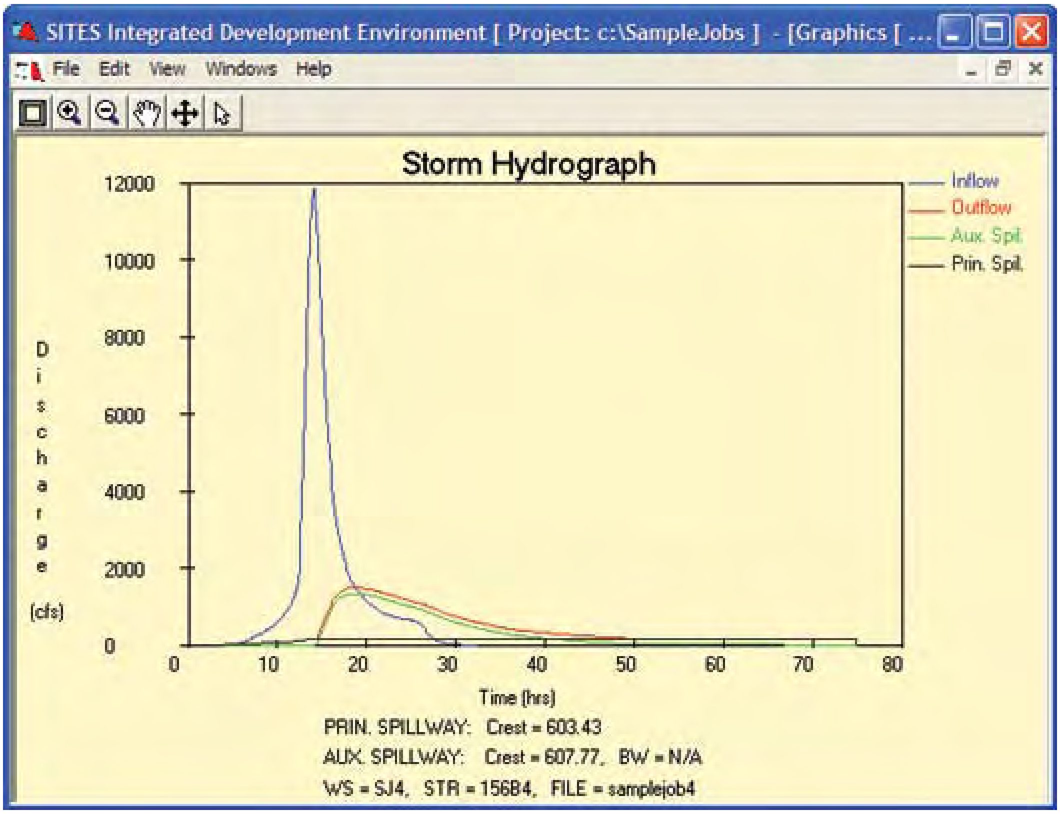


Figure C–4c Control file containing input for sample job 4

```
SITES     01/01/2005SJ4       SAMPLE JOB 4                 7.5       I8
SAVMOV    0    101
SAVMOV    101  1                                                     1
*         PRINCIPAL & AUXILIARY RATINGS INPUT IN STRUCTURE TABLE
*         Minimum data input for hydrograph routing only.
STRUCTURE 156B4     MODIFIED SAMPLE JOB 1 SITE DATA
                    603.43              0.0                2600.00
                    603.87              16.73              2746.66
                    604.32              47.33              2898.21
                    604.77              86.94              3054.65
                    605.22              133.86             3215.99
                    605.54              134.85             3333.80
                    605.86              135.84             3454.06
                    606.17              136.83             3576.78
                    606.49              137.81             3701.96
                    606.81              138.79             3829.59
                    607.13              139.75             3959.68
                    607.45              140.71             4092.22
                    607.77              141.67    0.0      4227.22
                    608.13              142.74    10.89    4383.25
                    608.49              143.80    27.55    4542.41
                    609.14              145.70    257.72   4836.91
                    609.94              147.99    683.01   5211.17
                    611.38              152.06    1796.87  5932.50
                    613.19              157.00    3584.18  6908.29
                    615.00              161.79    5797.84  7966.00
ENDTABLE
HYD       9                   INFLOW HYDROGRAPH
                    .168
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         1
                    2         4         7         10        15
                    22        29        38        49        60
                    73        87        101       117       133
                    150       168       187       205       225
                    245       265       286       307       329
                    351       373       397       421       447
                    474       504       538       573       612
                    654       698       744       793       846
                    903       966       1038      1120      1216
                    1329      1470      1682      2088      2774
                    3711      4898      6361      7994      9516
                    10695     11461     11823     11853     11559
                    11027     10341     9486      8505      7563
                    6772      6100      5514      5011      4568
                    4162      3802      3491      3218      2974
                    2757      2565      2391      2236      2100
                    1977      1867      1769      1680      1600
```

Figure C–4c Control file containing input for sample job 4—Continued

```
                    1528      1464      1406      1352      1305
                    1263      1223      1184      1147      1110
                    1075      1041      1008      980       955
                    931       908       885       864       843
                    823       805       788       772       758
                    745       734       723       713       705
                    697       689       682       676       669
                    664       658       652       647       640
                    629       615       595       567       532
                    491       446       399       352       306
                    264       225       190       160       135
                    115       98        83        70        60
                    51        43        36        31        26
                    22        18        16        13        11
                    9         8         6         5         4
                    4         3         2         2         2
                    1         1         1         0
ENDTABLE
WSDATA    2S W1     82        7.5       2.57
STORM                         24
POOLDATA  AC–FT               2600.00   30        579.0     585.0
GRAPHICS  I
GO,HYD    QL                                                604.29
SAVMOV    2    101  1                   156B4
ENDJOB
ENDRUN
```

Sample Job 5—Sites in series with subwatershed

Inflow Data

Areally corrected rainfall (all elements)

Ratings

PS – Given in structure table (upstream site 256B4)
Computed, single stage, circular conduit (design site 256B5)
Aux. – Given in structure table (upstream site 256B4)
Computed, profile template, vegetated surface (design site 256B5)

Stage Storage Data

Elevation – Given (both sites)
Surface Area – Given (both sites)
Storage Volume – Initial value given (both sites)

Special Features Demonstrated

Complex watershed data management
Reach routing within a watershed
Fixed coordinate to control auxiliary spillway inlet channel slope
Stress controlled auxiliary spillway width

Output Features Demonstrated

Summary graphics for display of parameter sensitivity

Figure C–5a Global input data screen and schematic for sample job 5

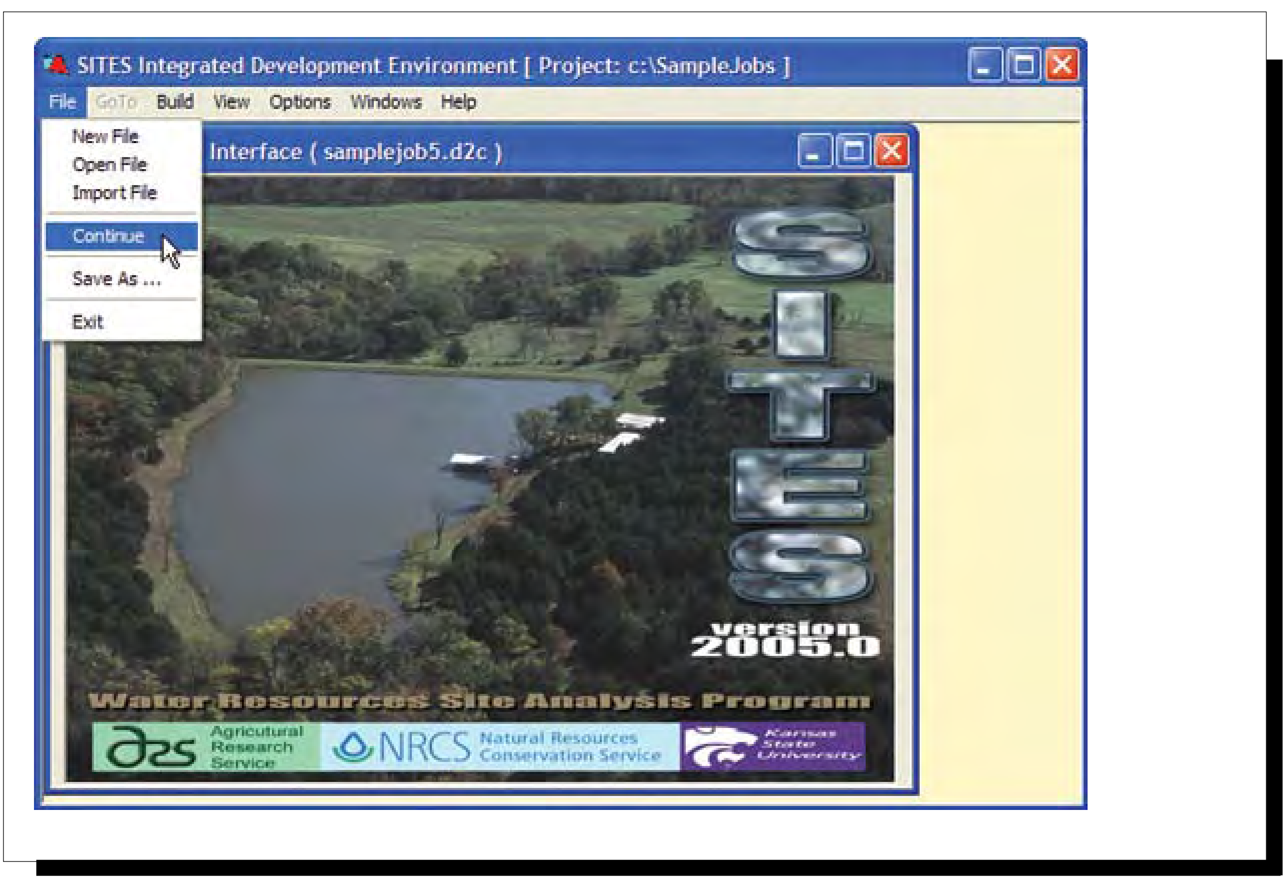
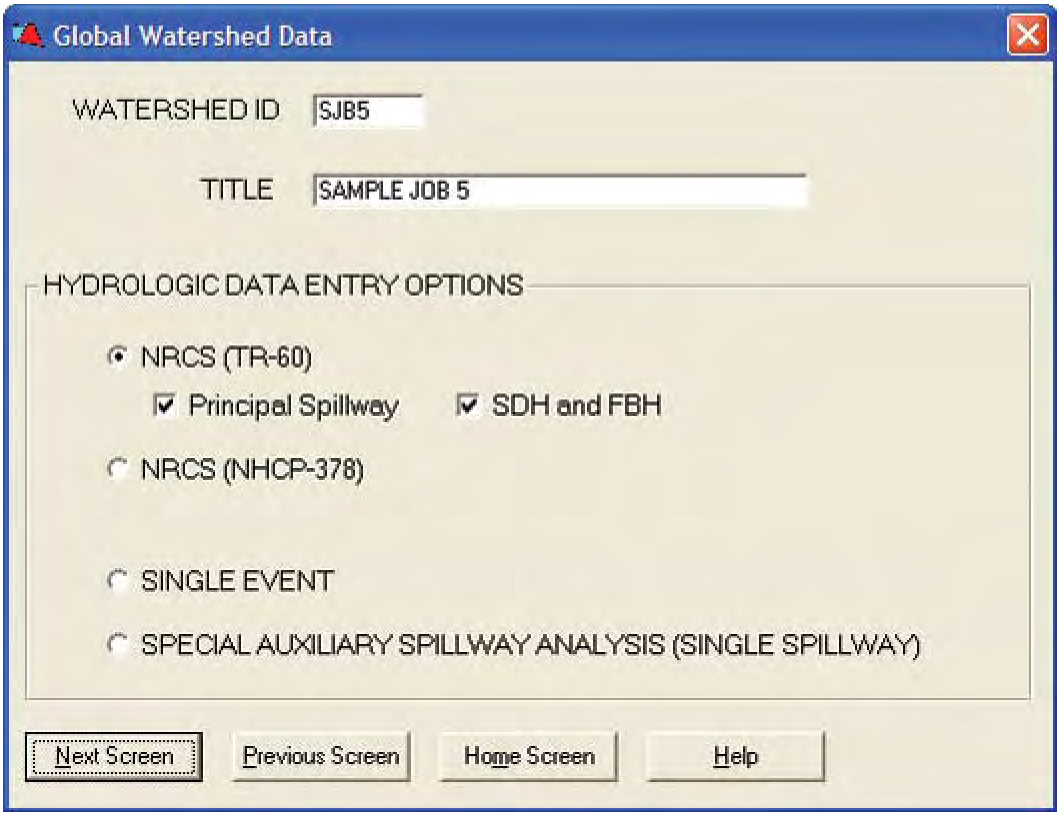


Figure C–5a Global input data screen and schematic for sample job 5—Continued



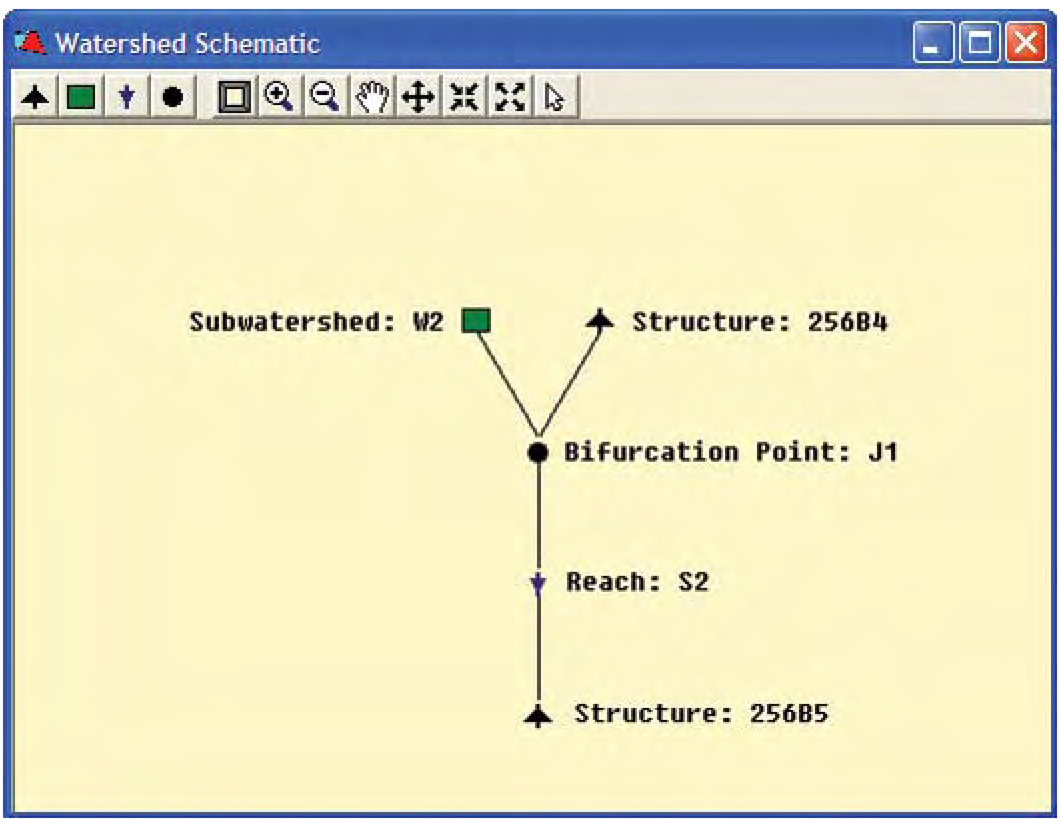


Figure C–5b Input data screens for sample job 5, subwatershed W2

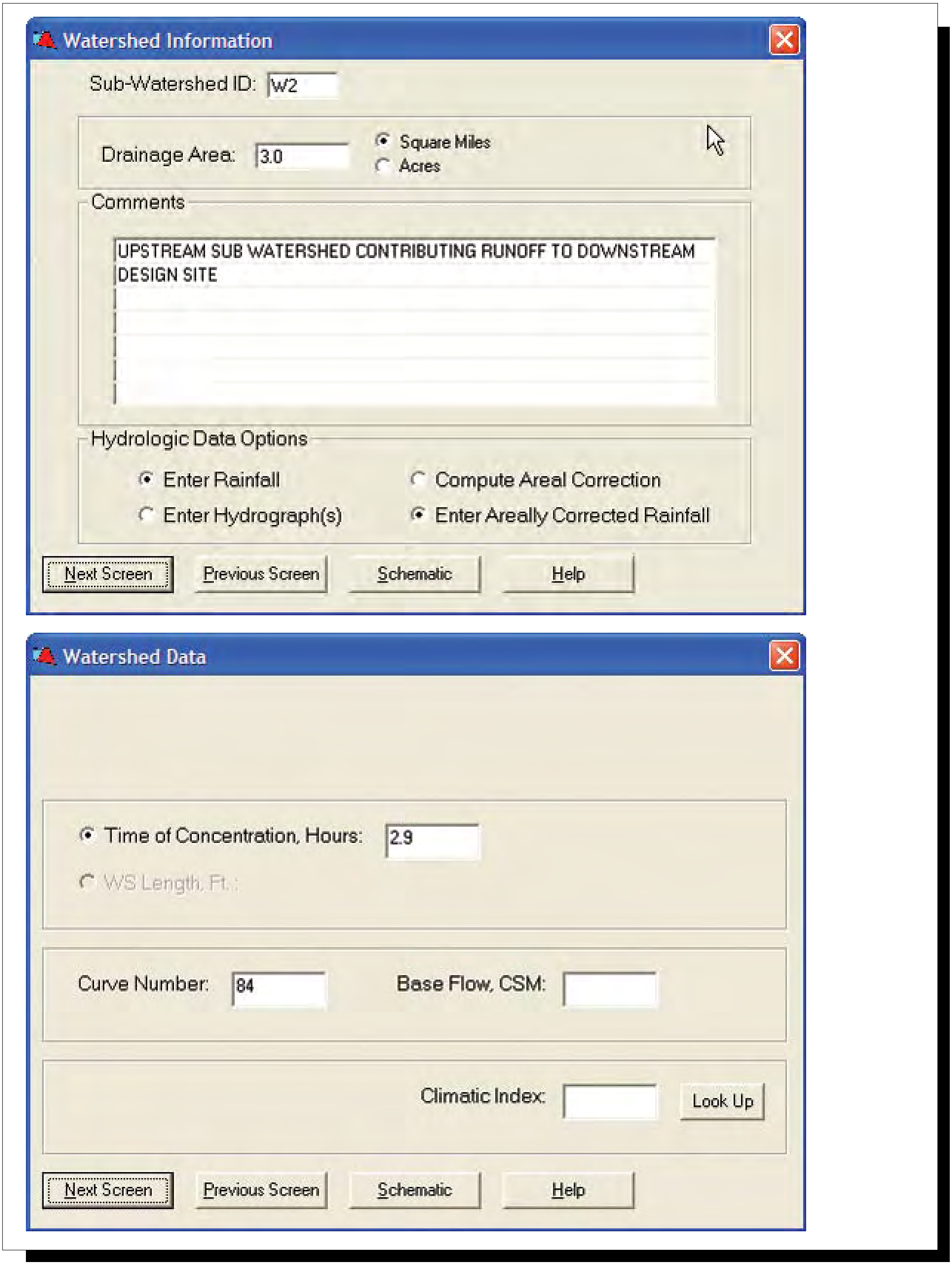


Figure C–5b Input data screens for sample job 5, subwatershed W2—Continued

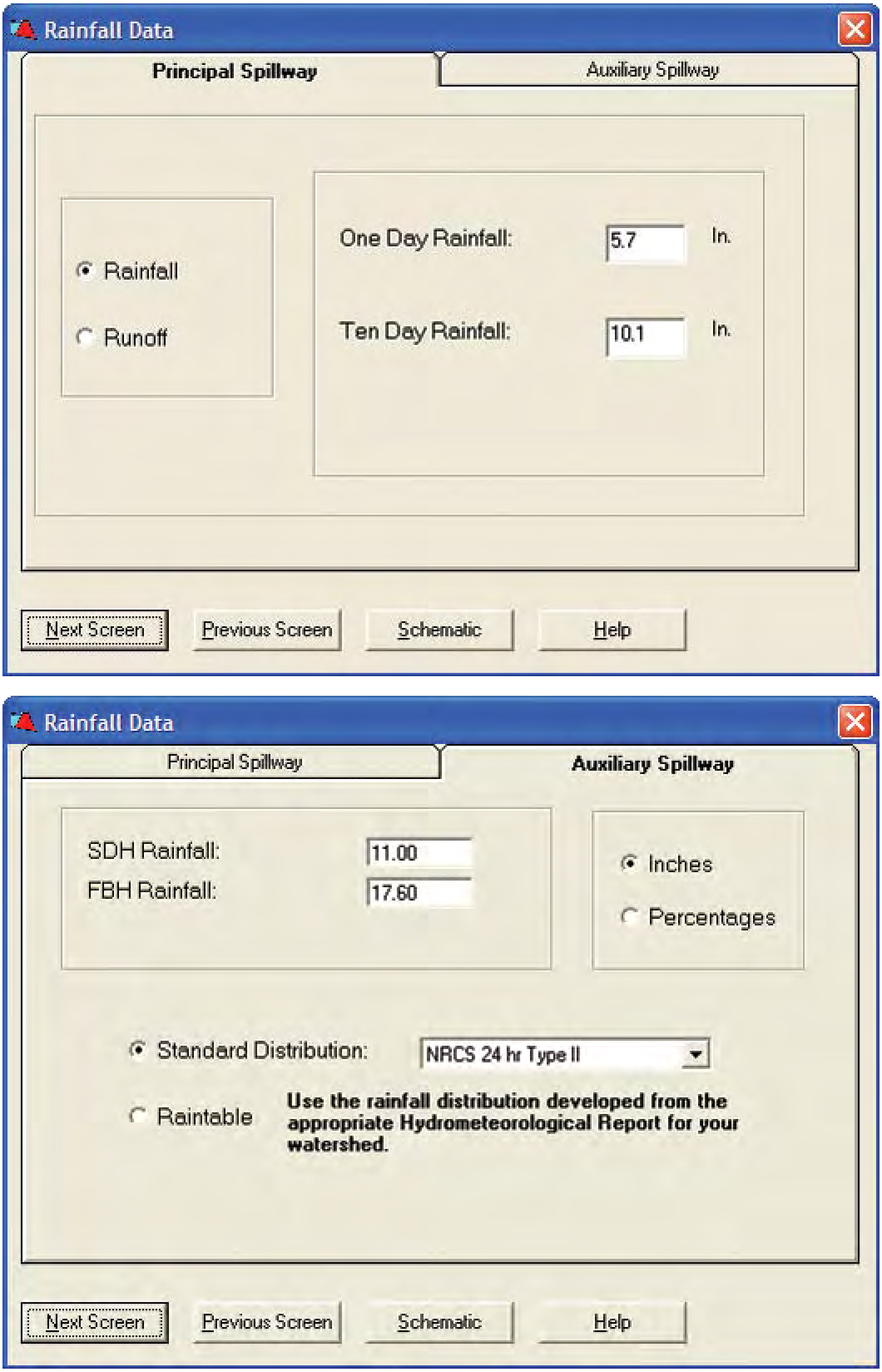


Figure C–5c Input data screens for sample job 5, Upstream Structure 256B4

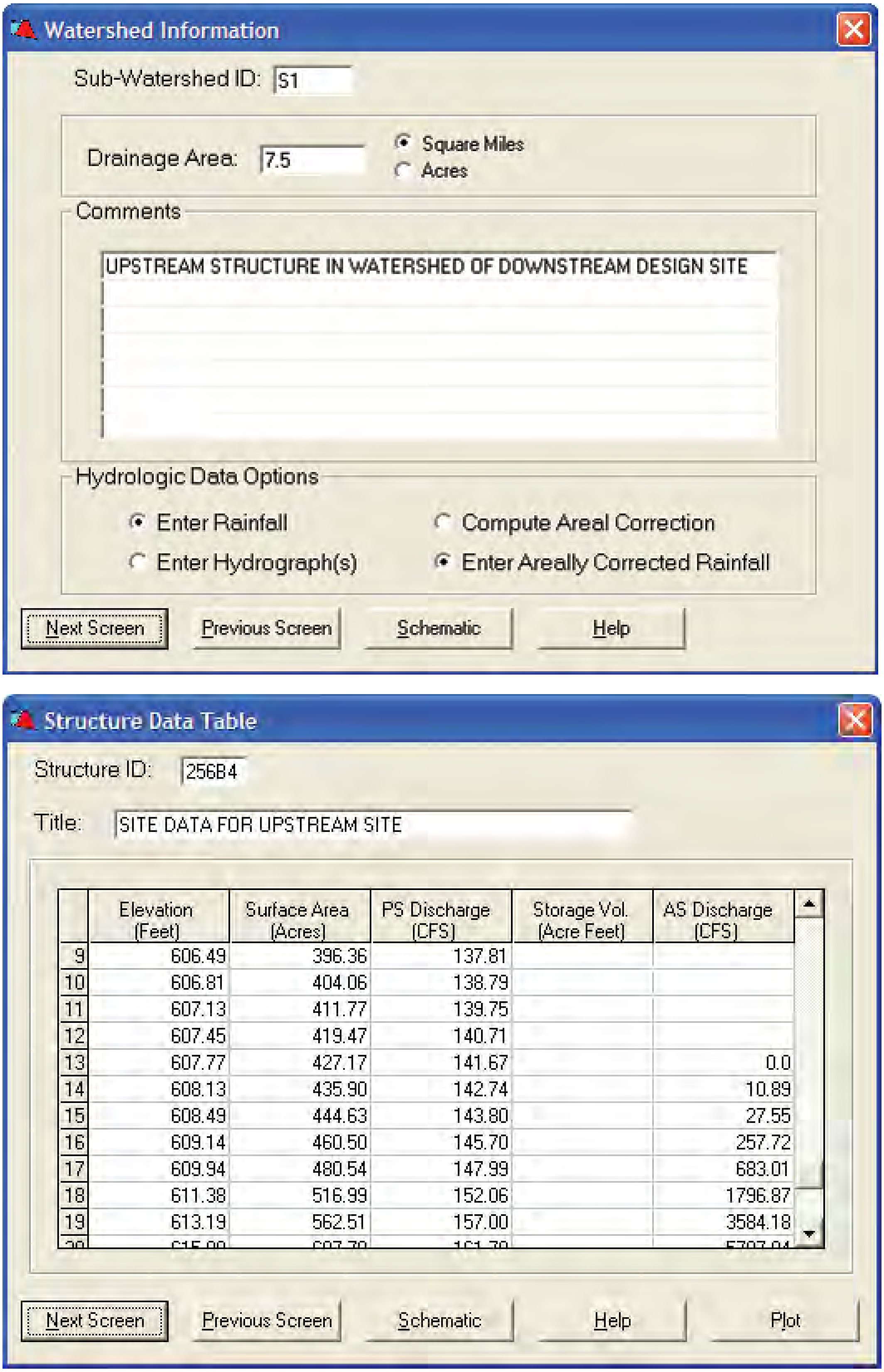


Figure C–5c Input data screens for sample job 5, Upstream Structure 256B4—Continued

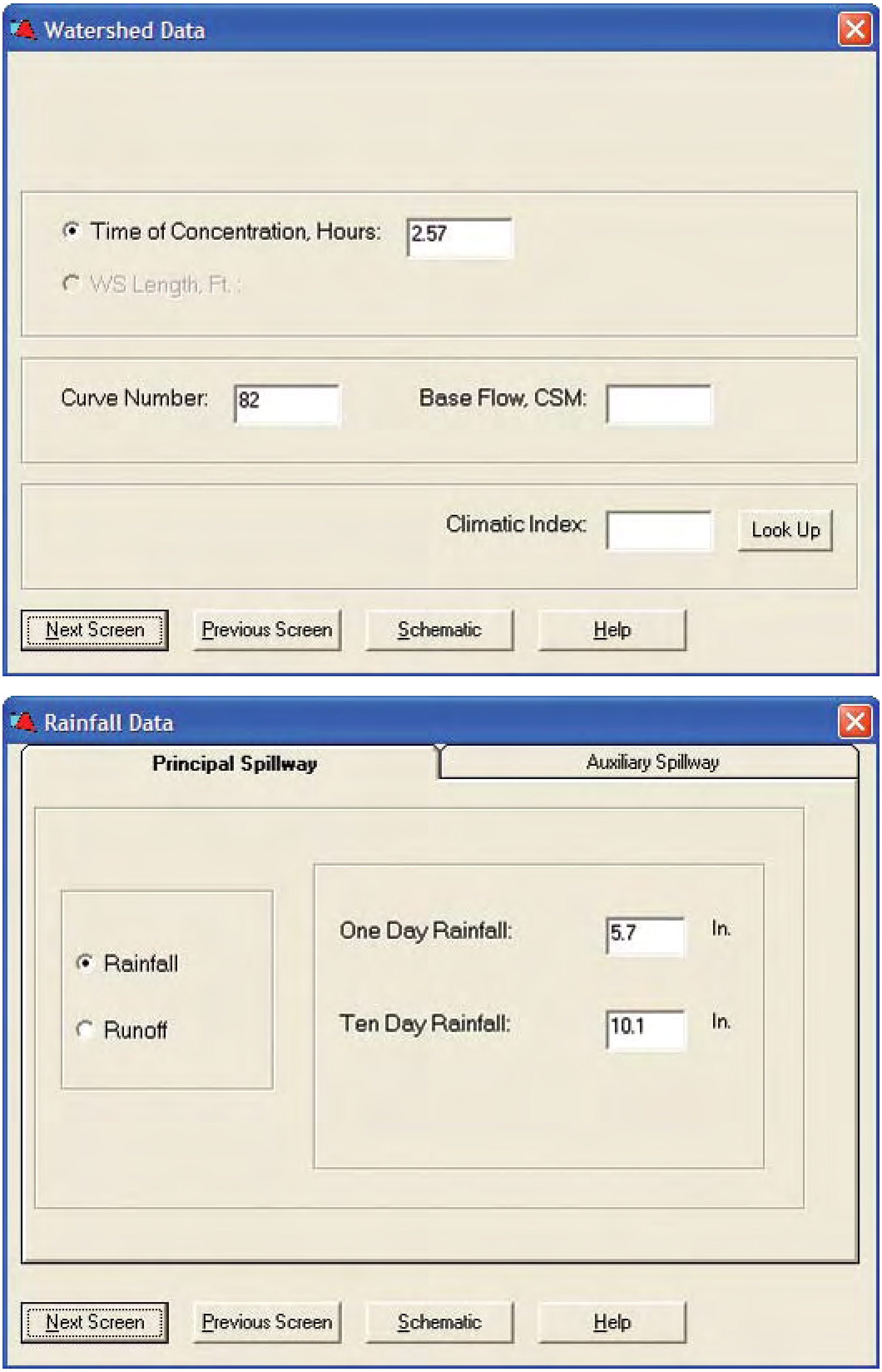


Figure C–5c Input data screens for sample job 5, Upstream Structure 256B4—Continued

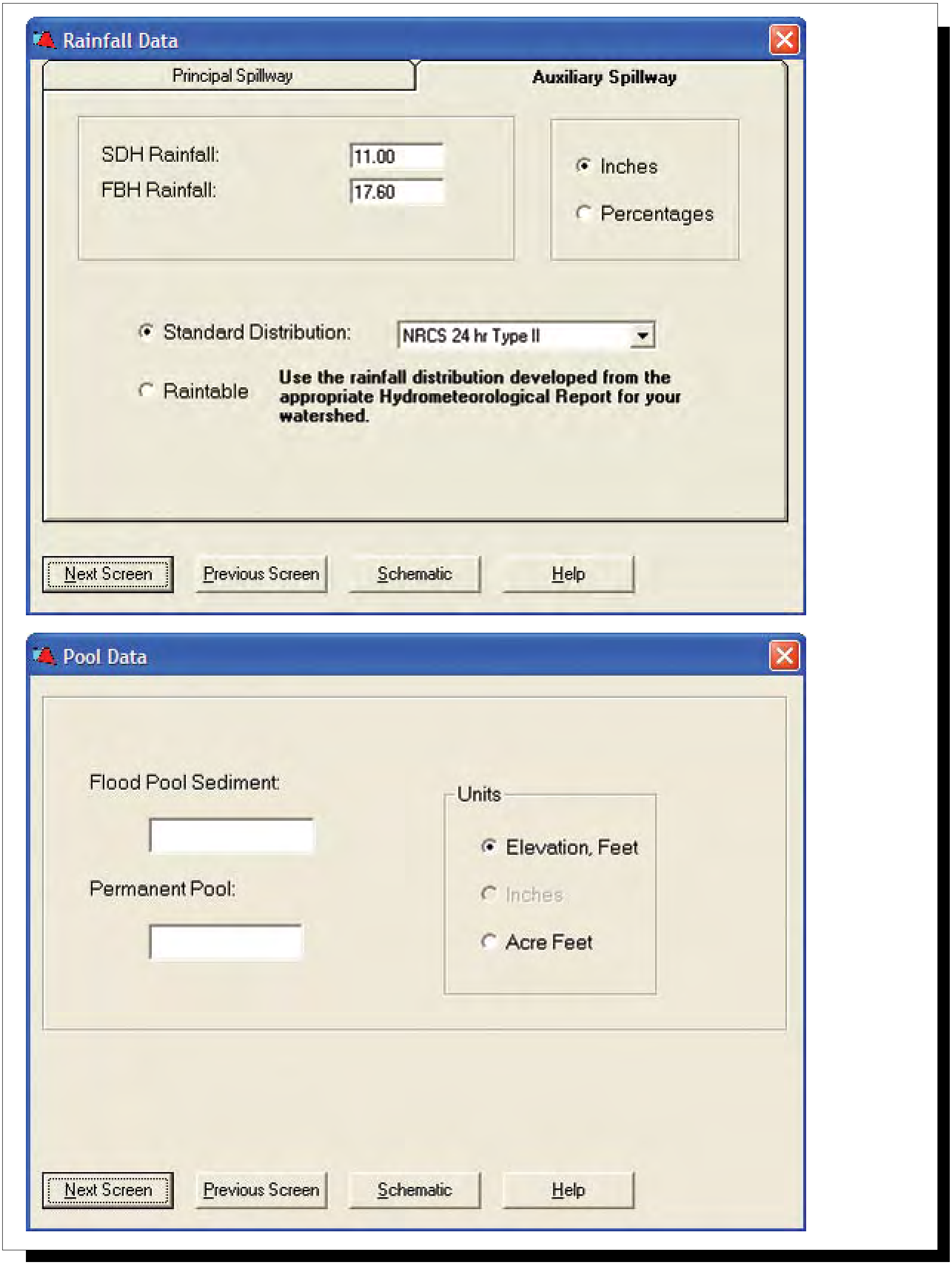


Figure C–5c Input data screens for sample job 5, Upstream Structure 256B4—Continued

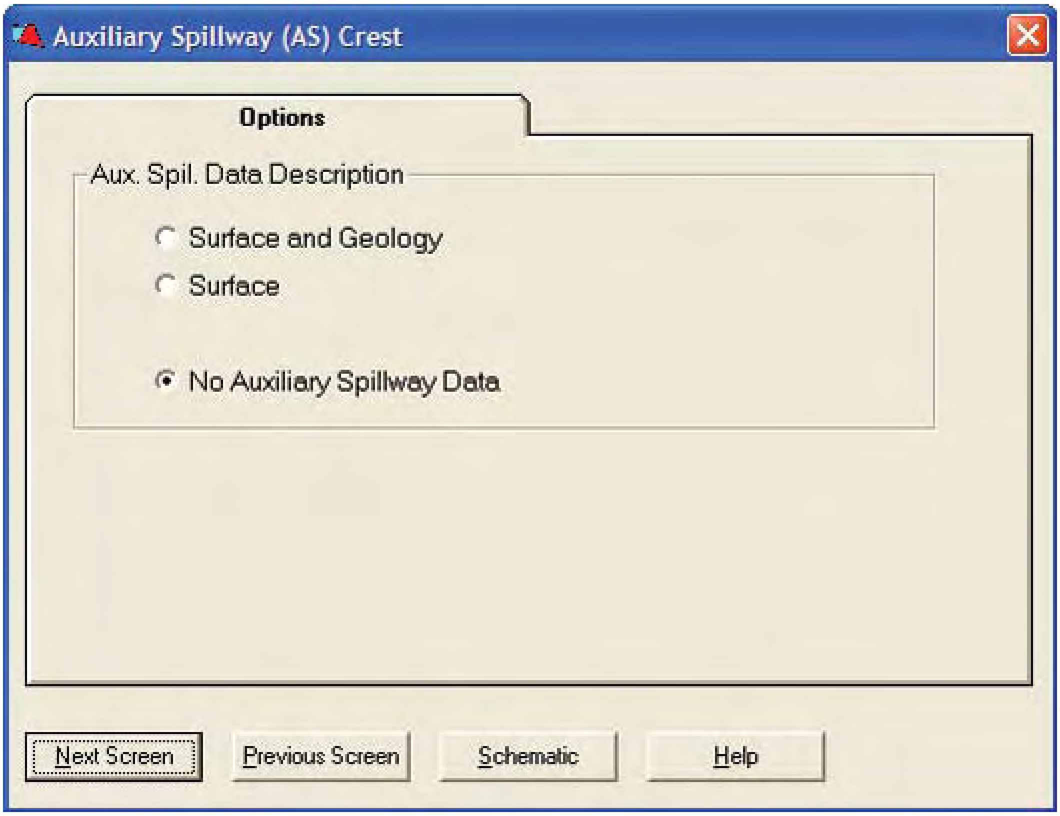


Figure C–5d Input data screens for sample job 5, Hydrograph Addition Node J1 (bifurcation point)

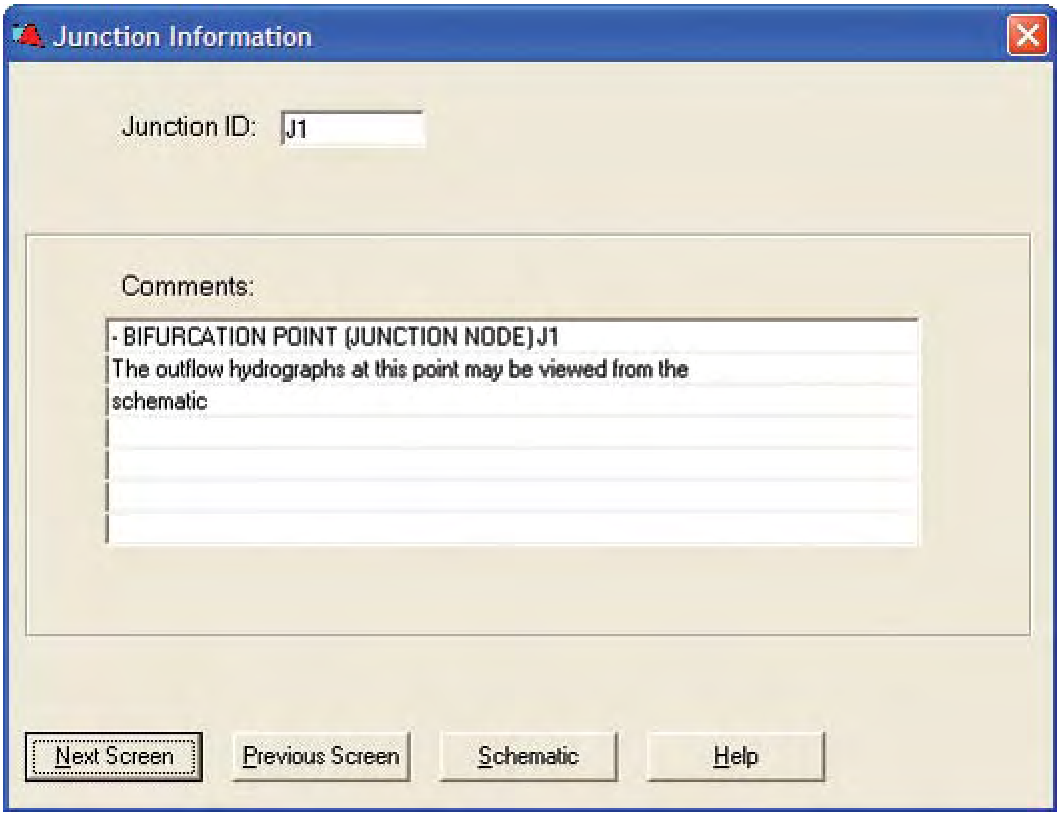


Figure C–5e Input data screens for sample job 5, Stream Reach S2

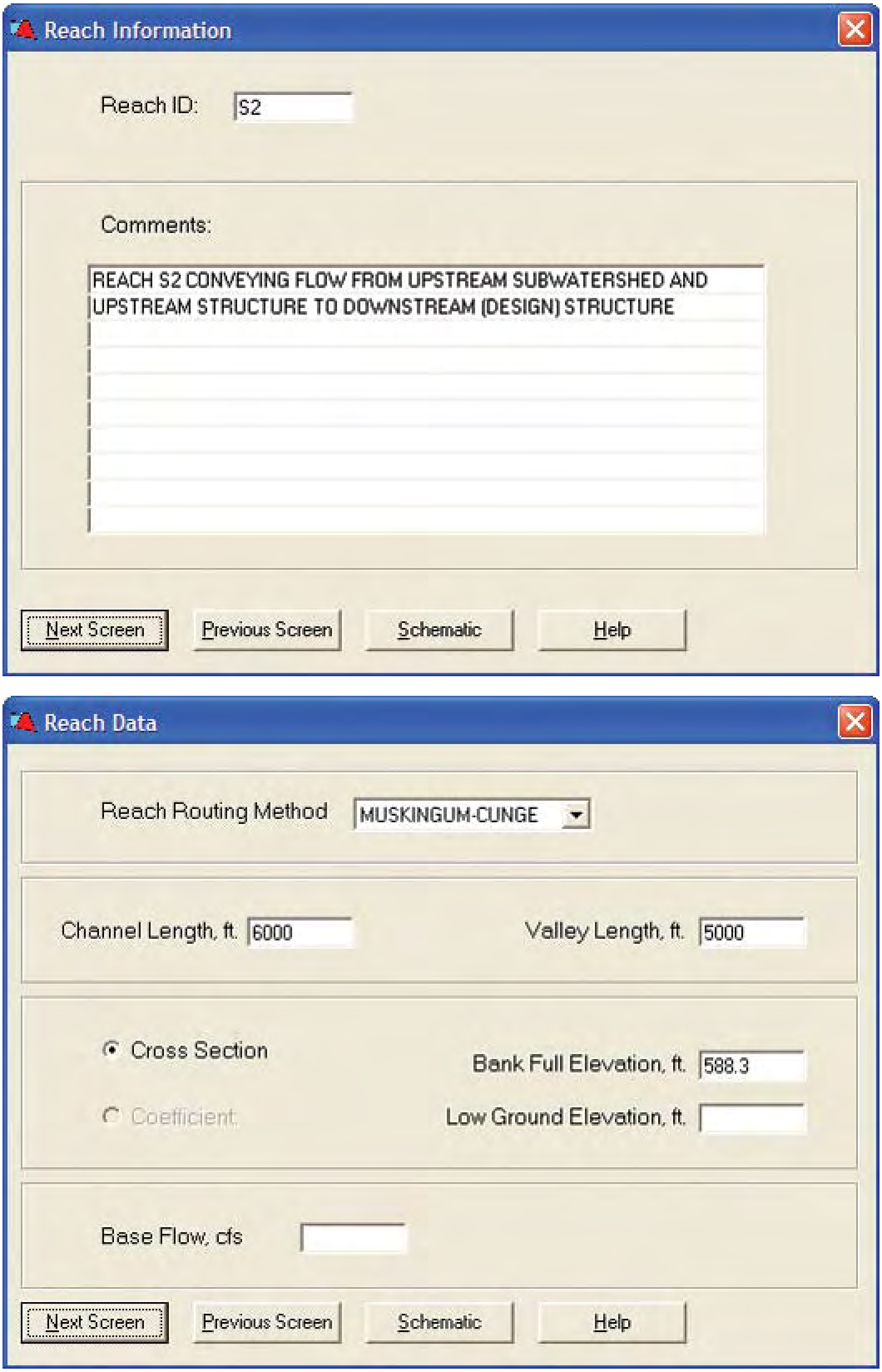
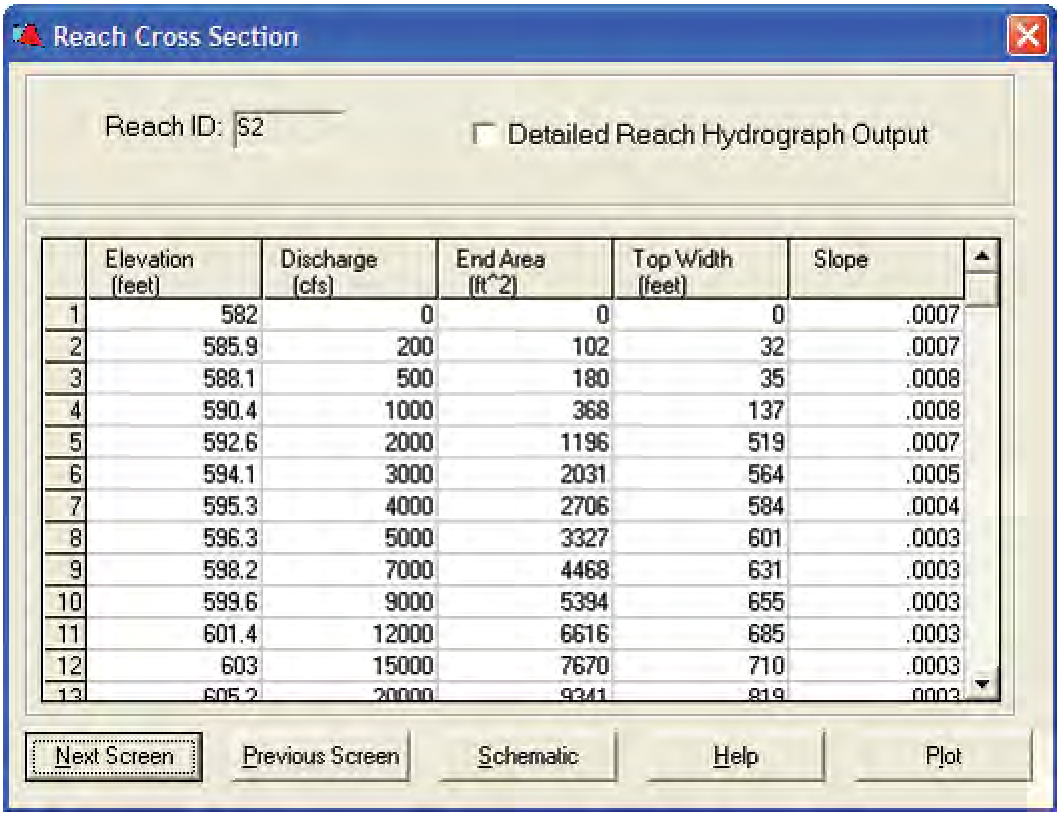


Figure C–5e Input data screens for sample job 5, Stream Reach S2—Continued



Reach Cross Section

Reach ID: S2

Detailed Reach Hydrograph Output

	Elevation (feet)	Discharge (cfs)	End Area (ft^2)	Top Width (feet)	Slope
1	582	0	0	0	.0007
2	585.9	200	102	32	.0007
3	588.1	500	180	35	.0008
4	590.4	1000	368	137	.0008
5	592.6	2000	1196	519	.0007
6	594.1	3000	2031	564	.0005
7	595.3	4000	2706	584	.0004
8	596.3	5000	3327	601	.0003
9	598.2	7000	4468	631	.0003
10	599.6	9000	5394	655	.0003
11	601.4	12000	6616	685	.0003
12	603	15000	7670	710	.0003
13	605.2	20000	9341	819	.0003

Next Screen | Previous Screen | Schematic | Help | Plot

Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5

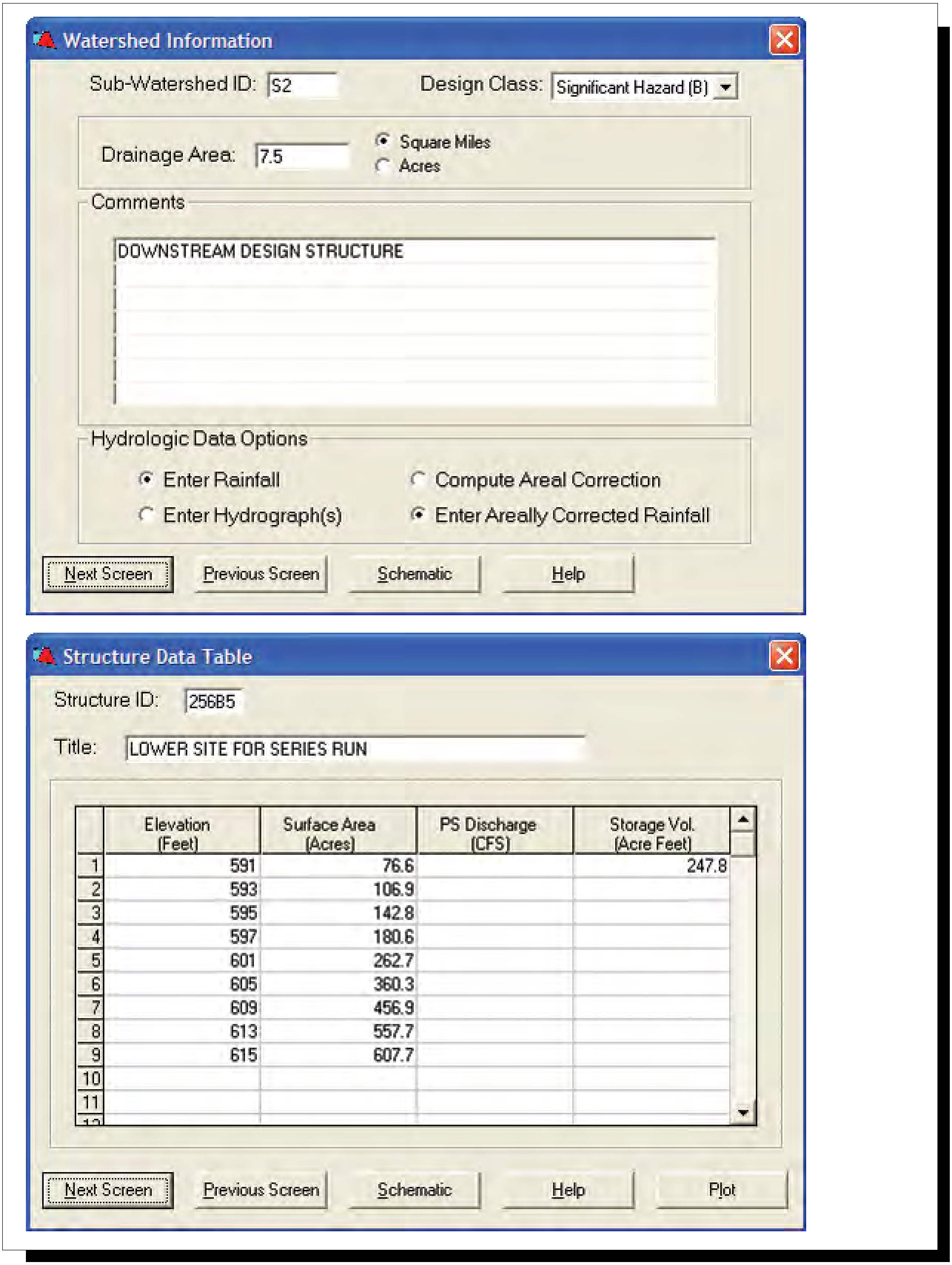


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

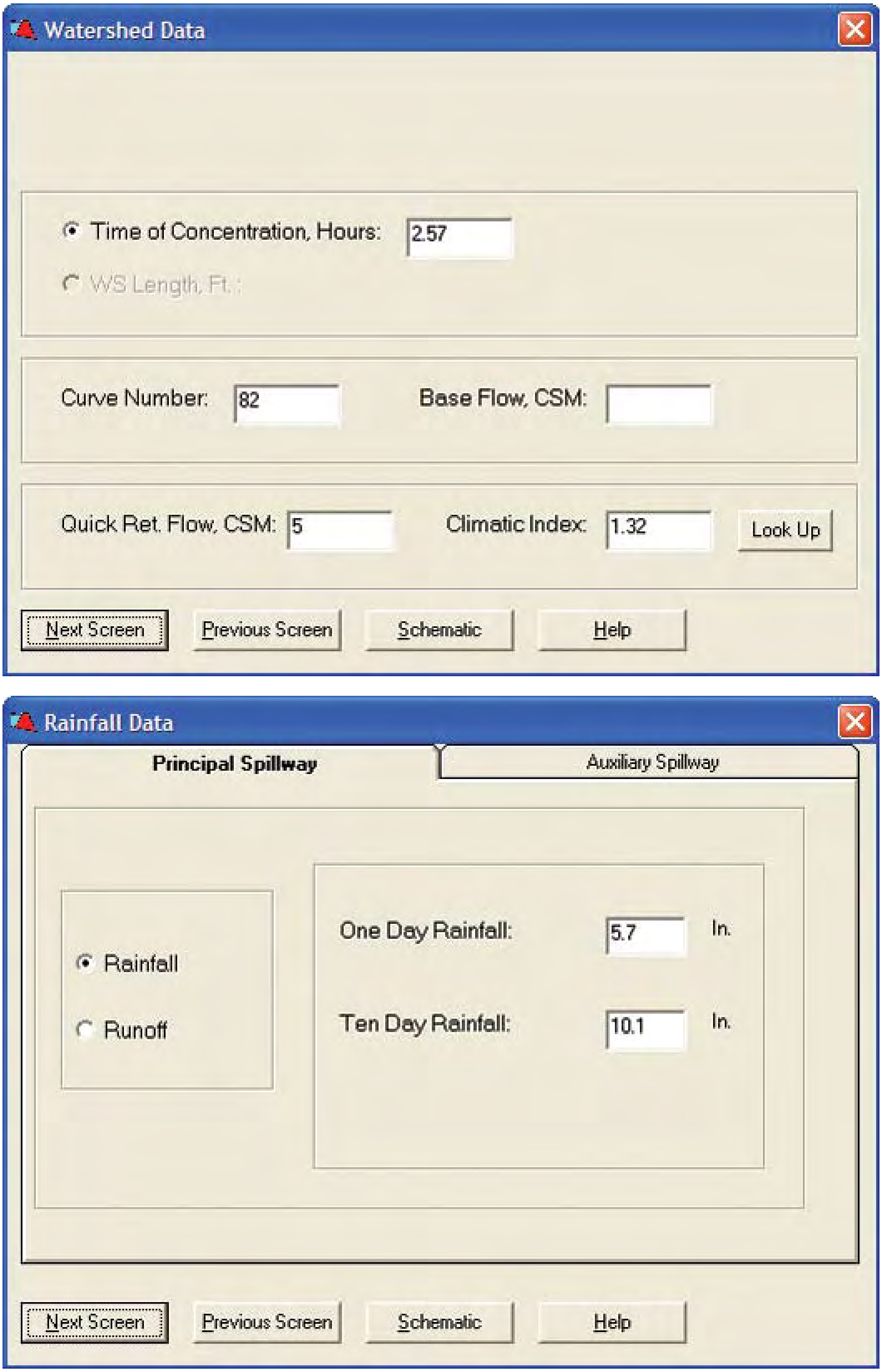
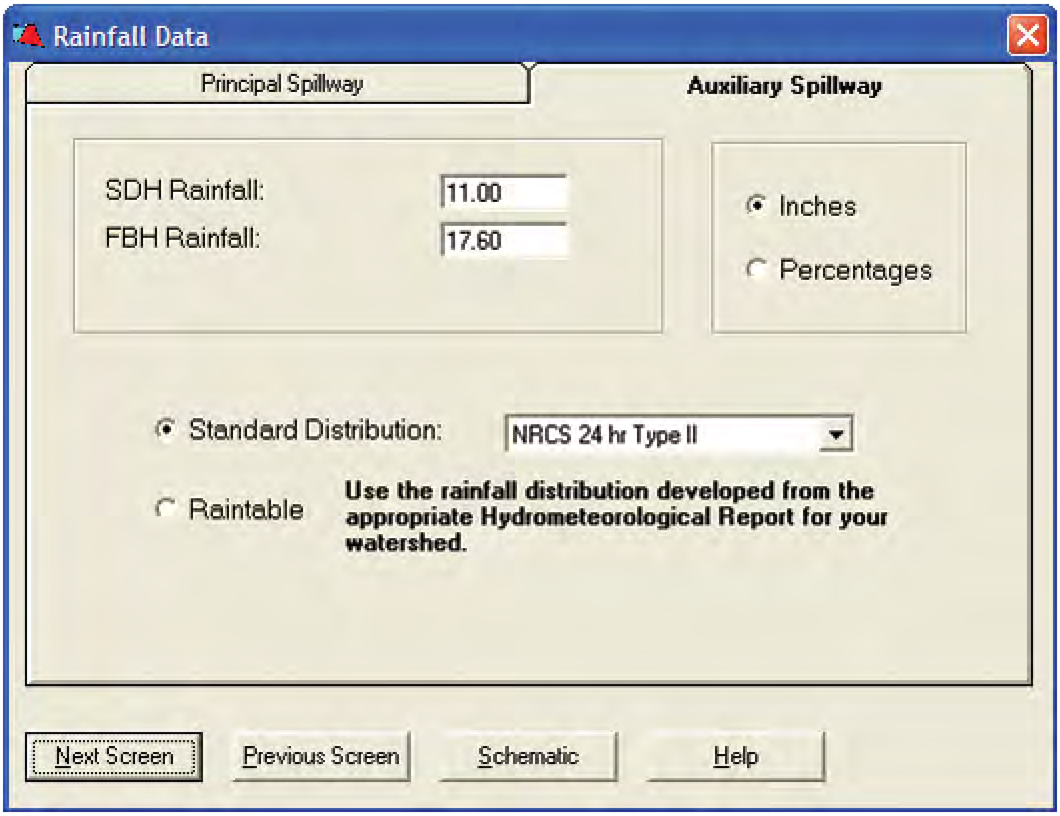


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued



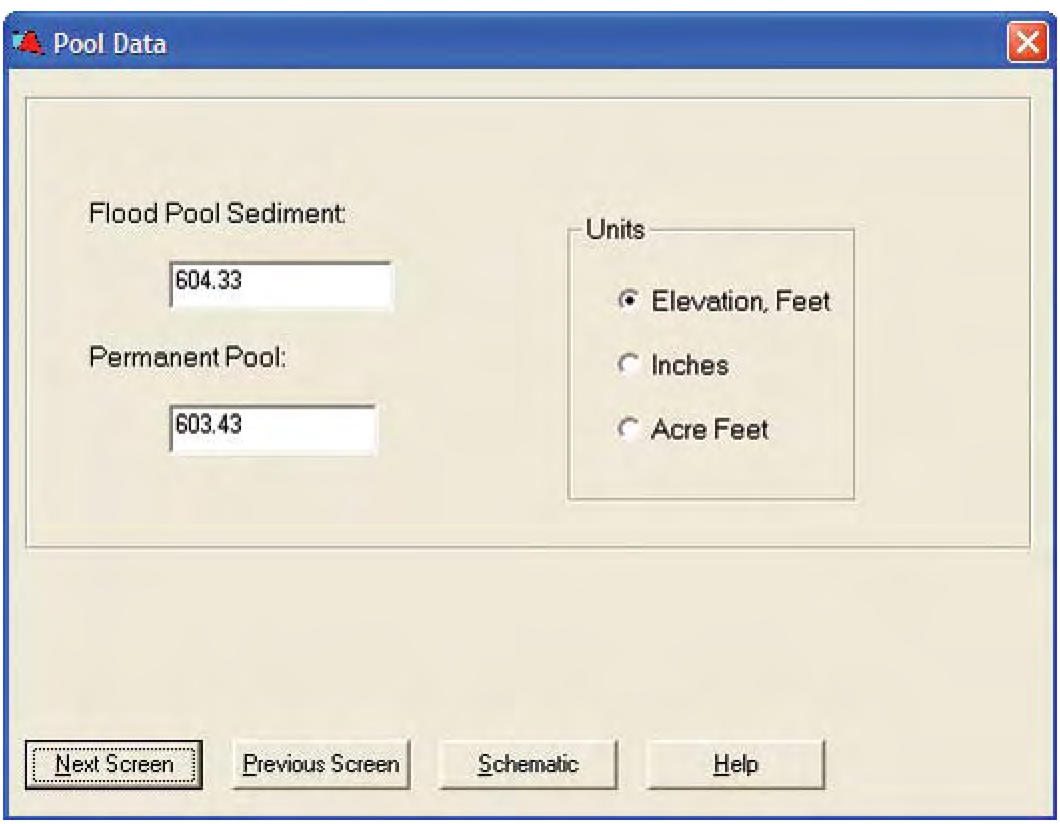


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

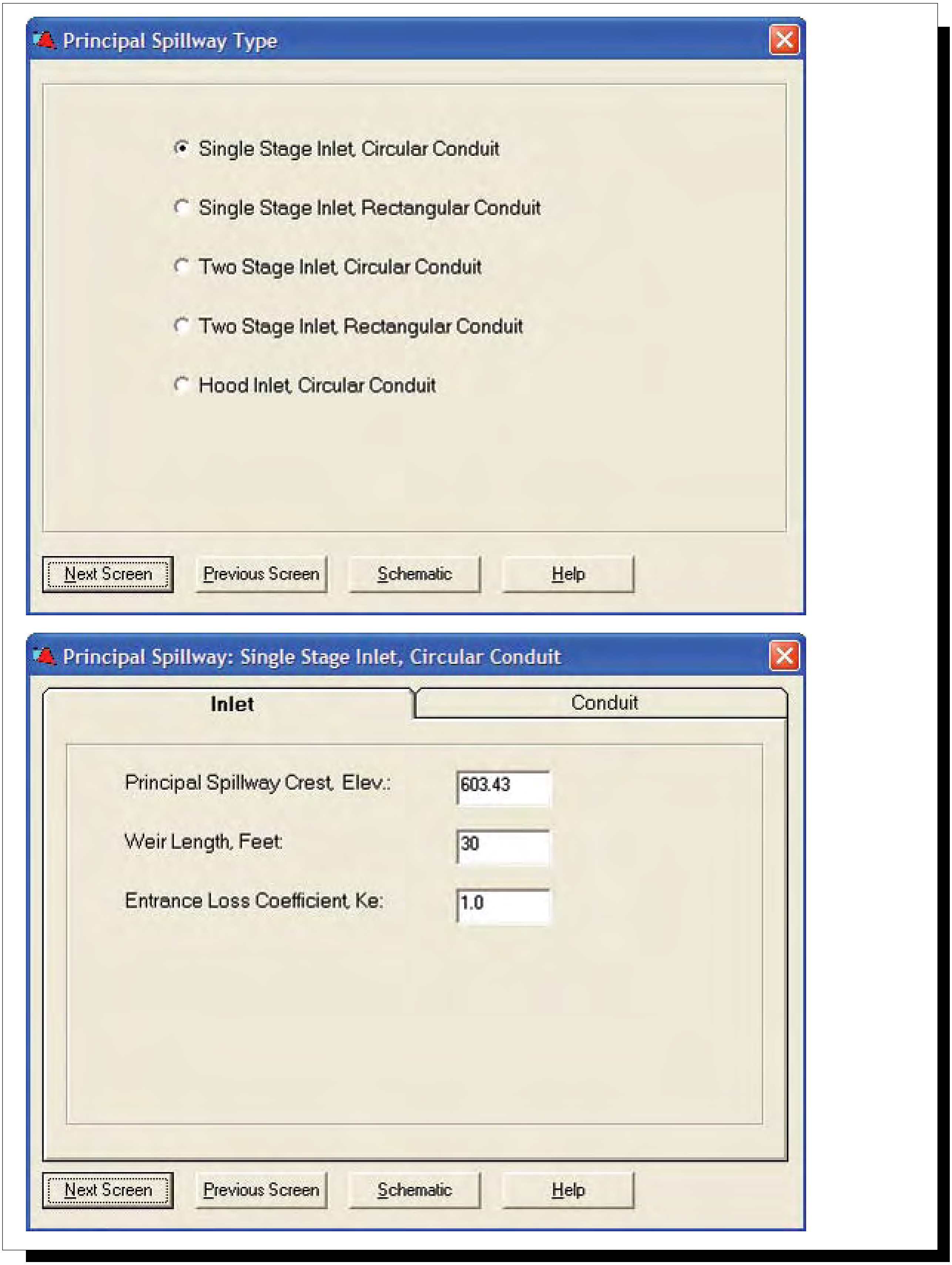


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

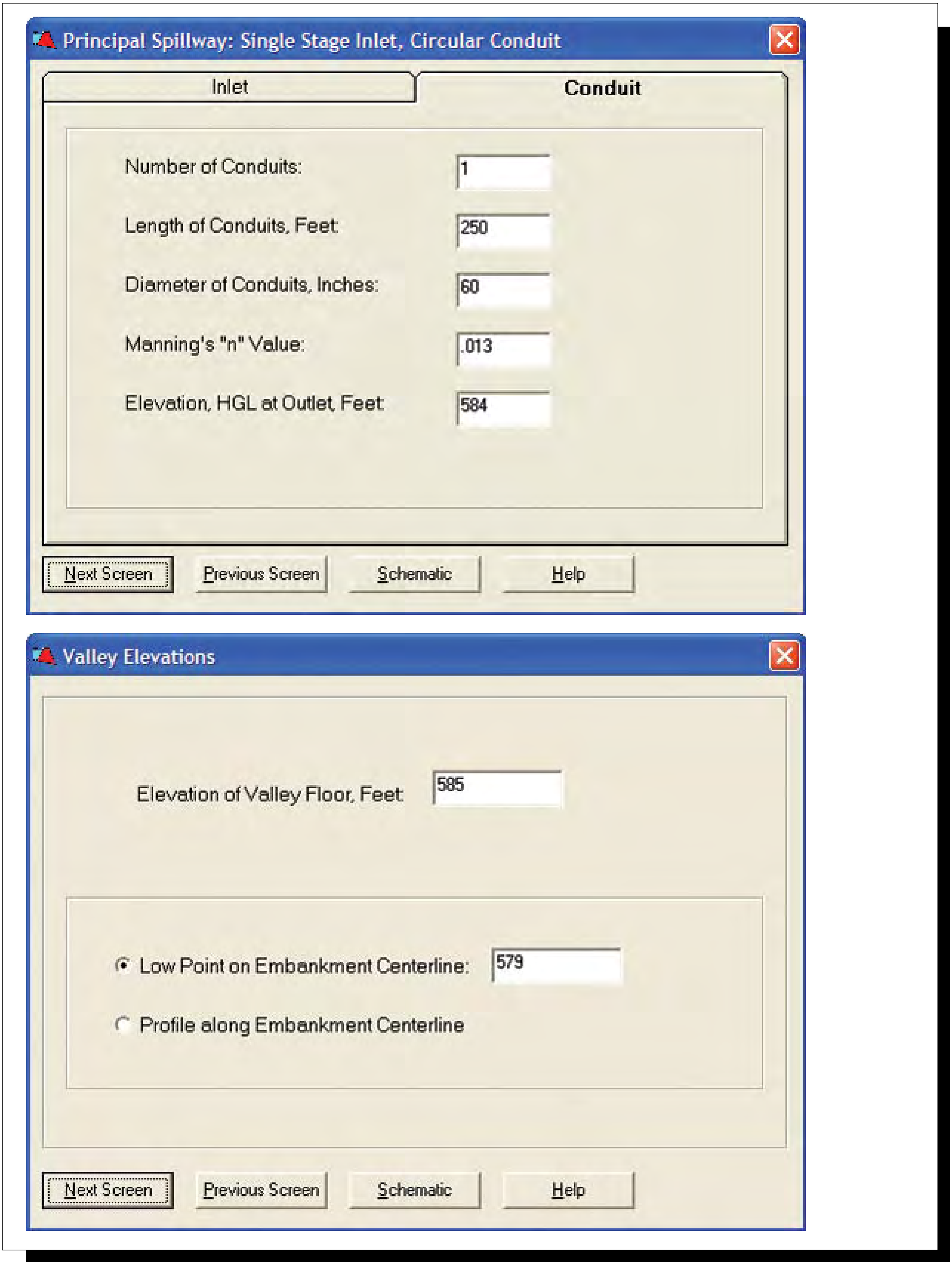
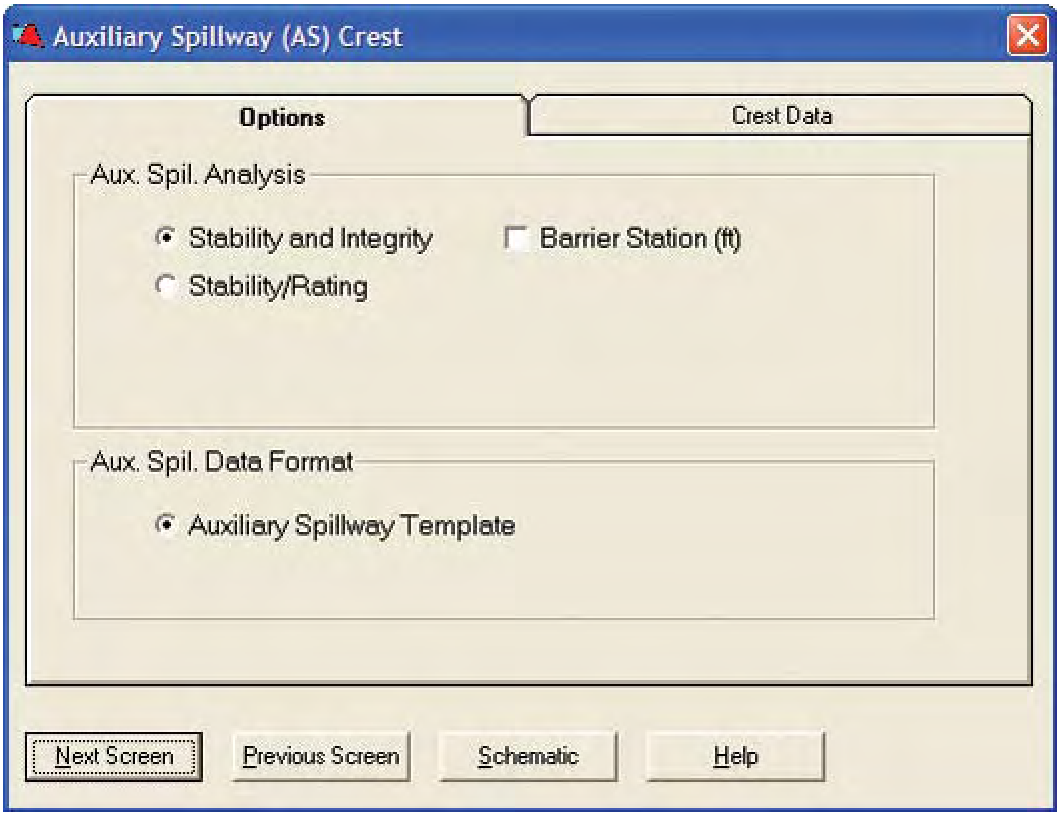


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued



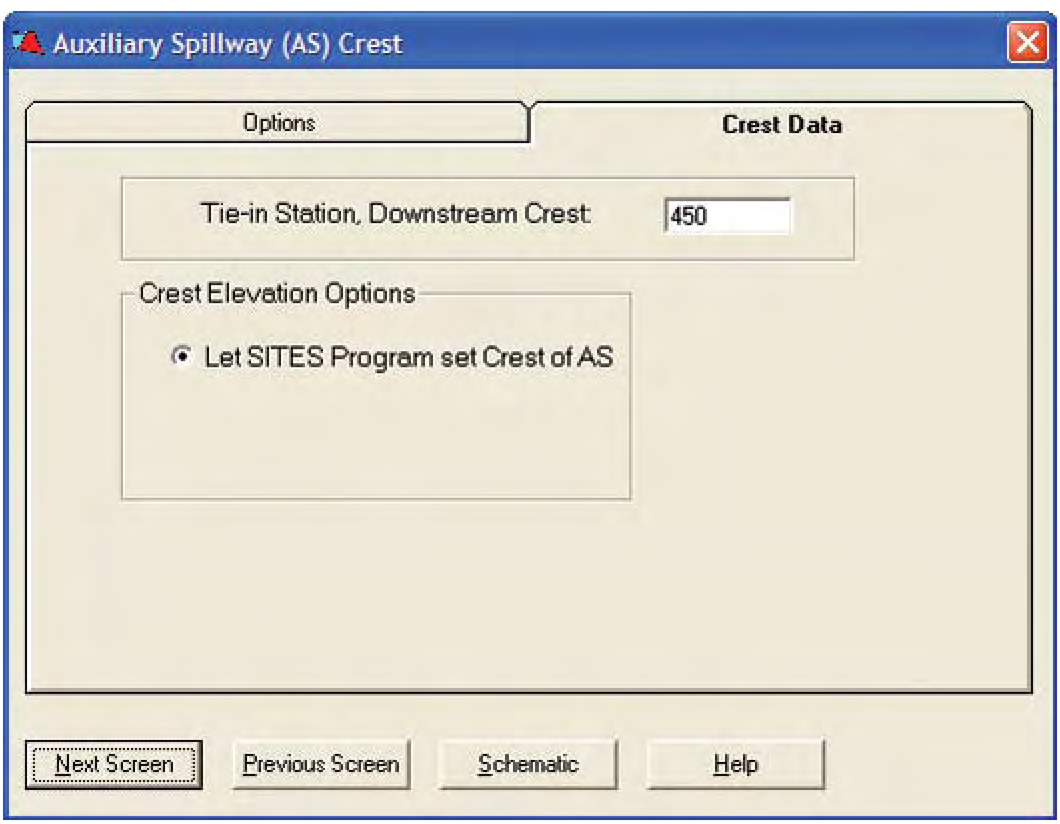


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

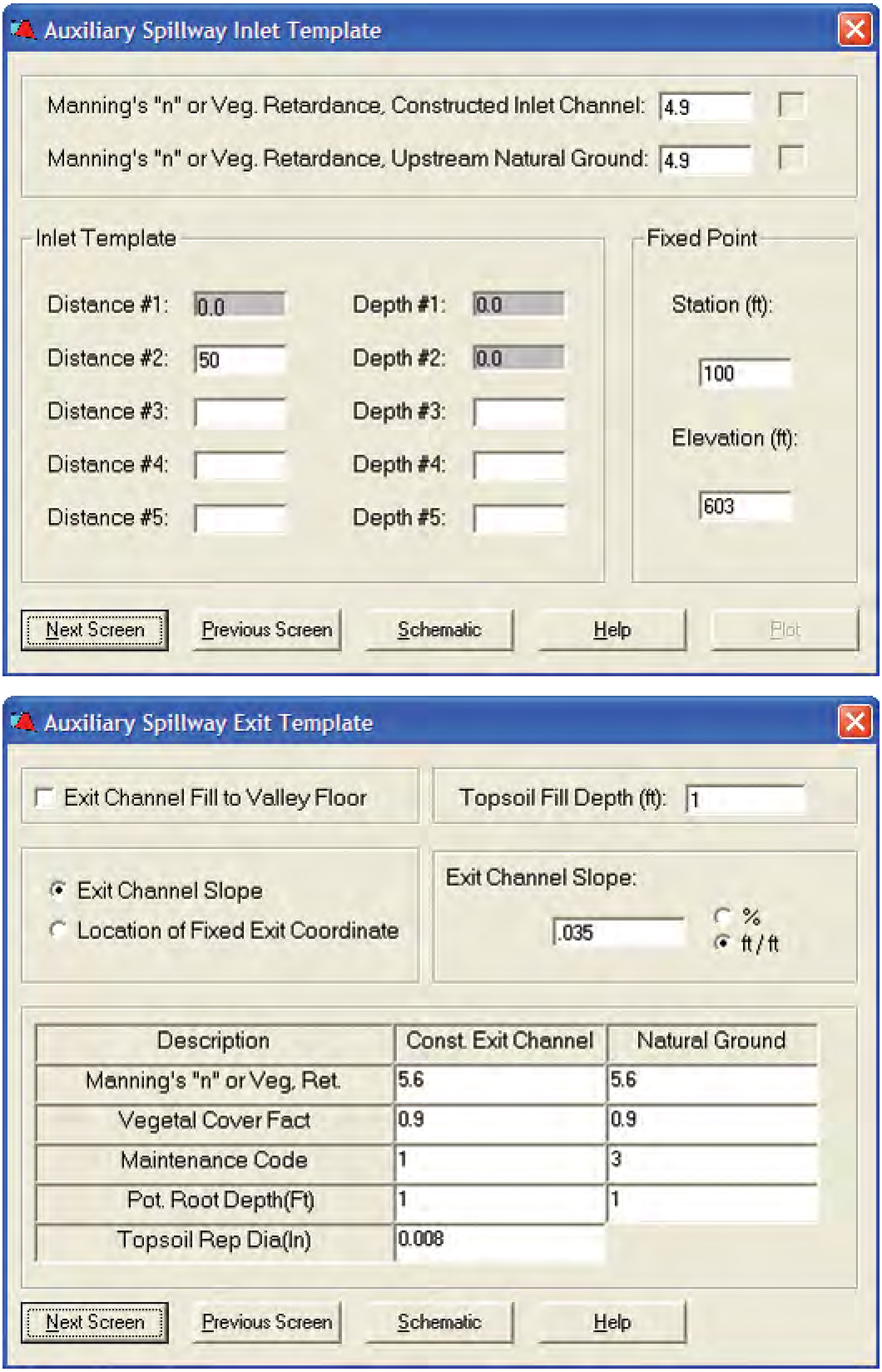


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

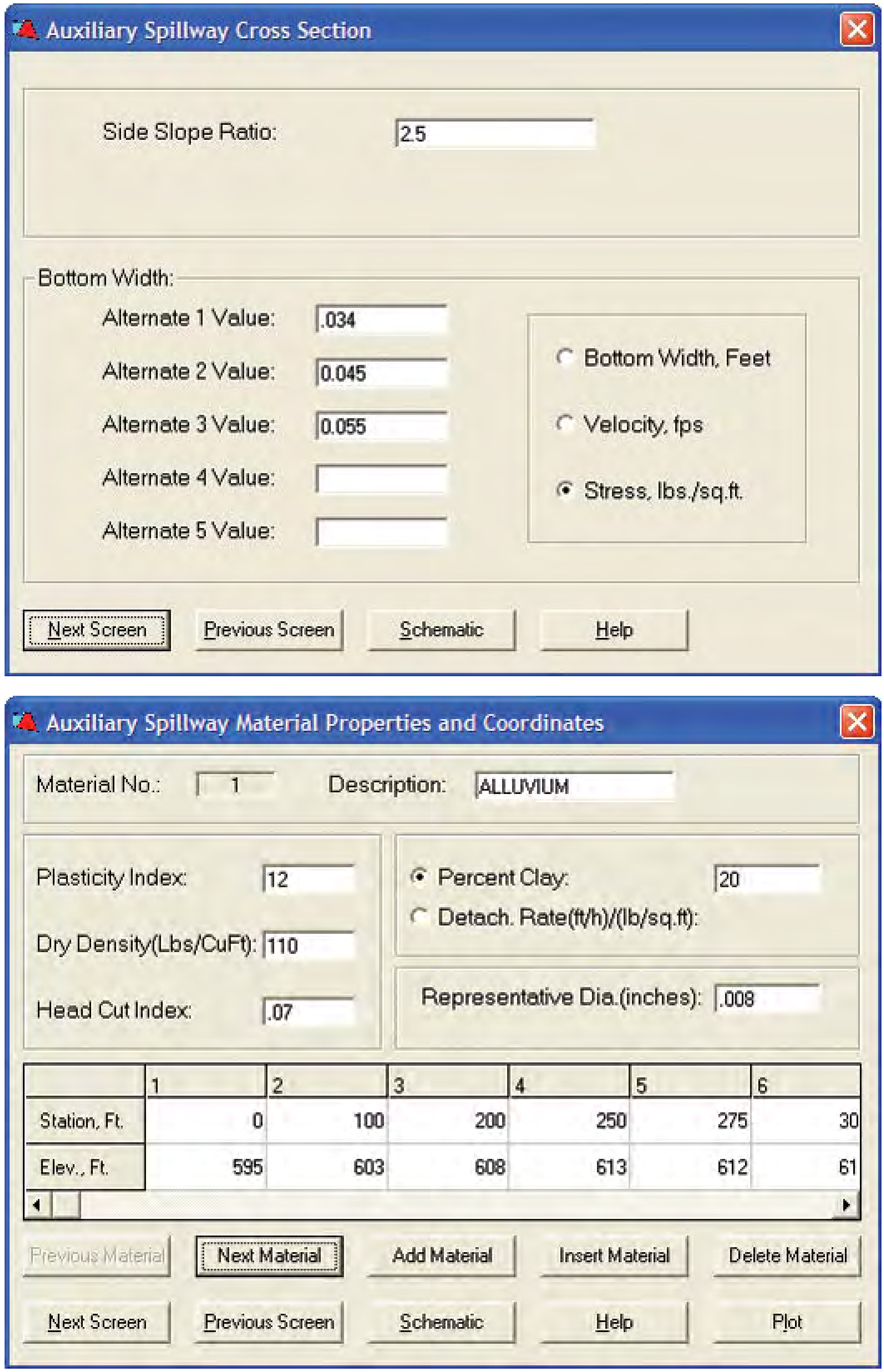


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

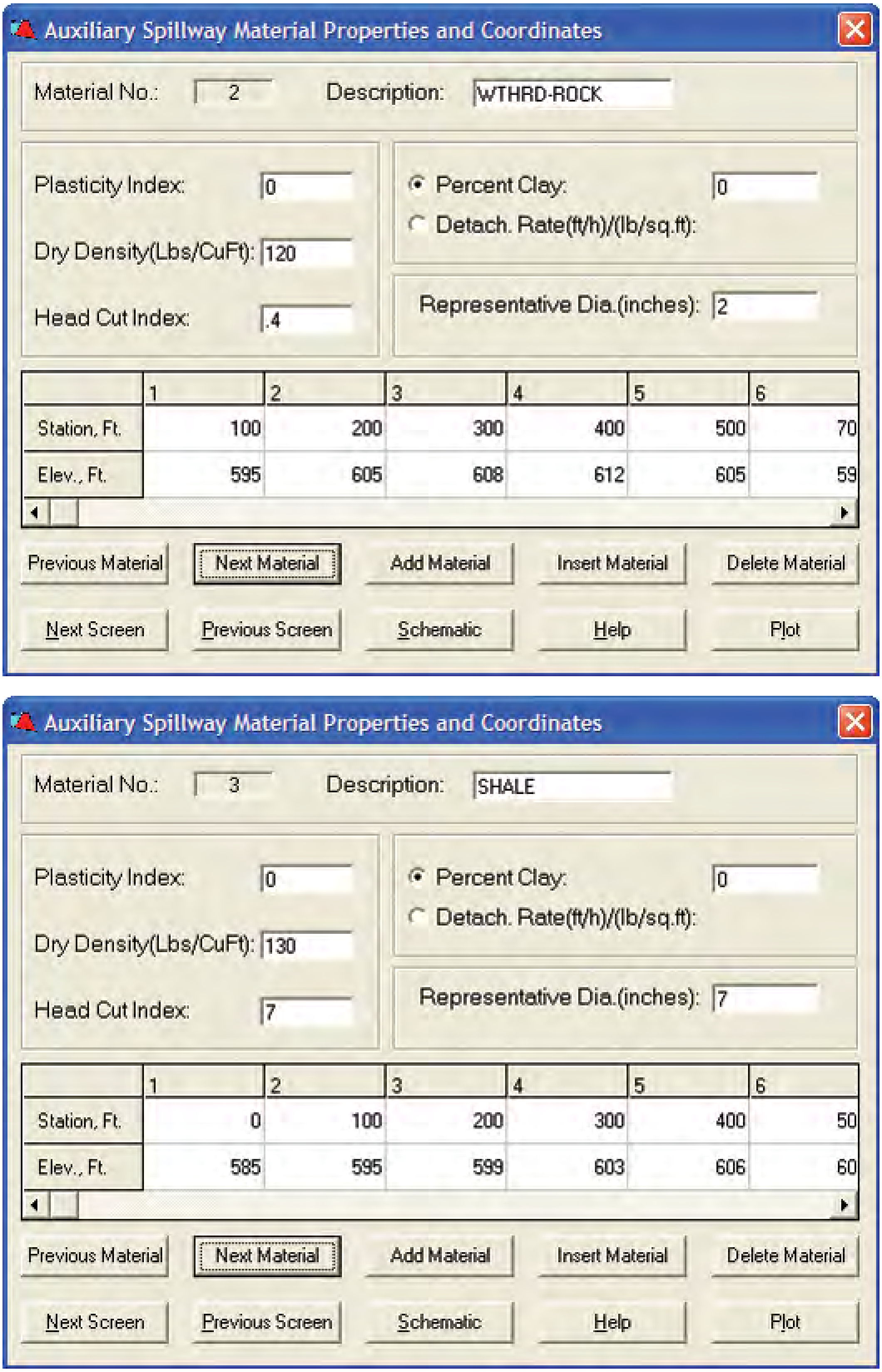


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

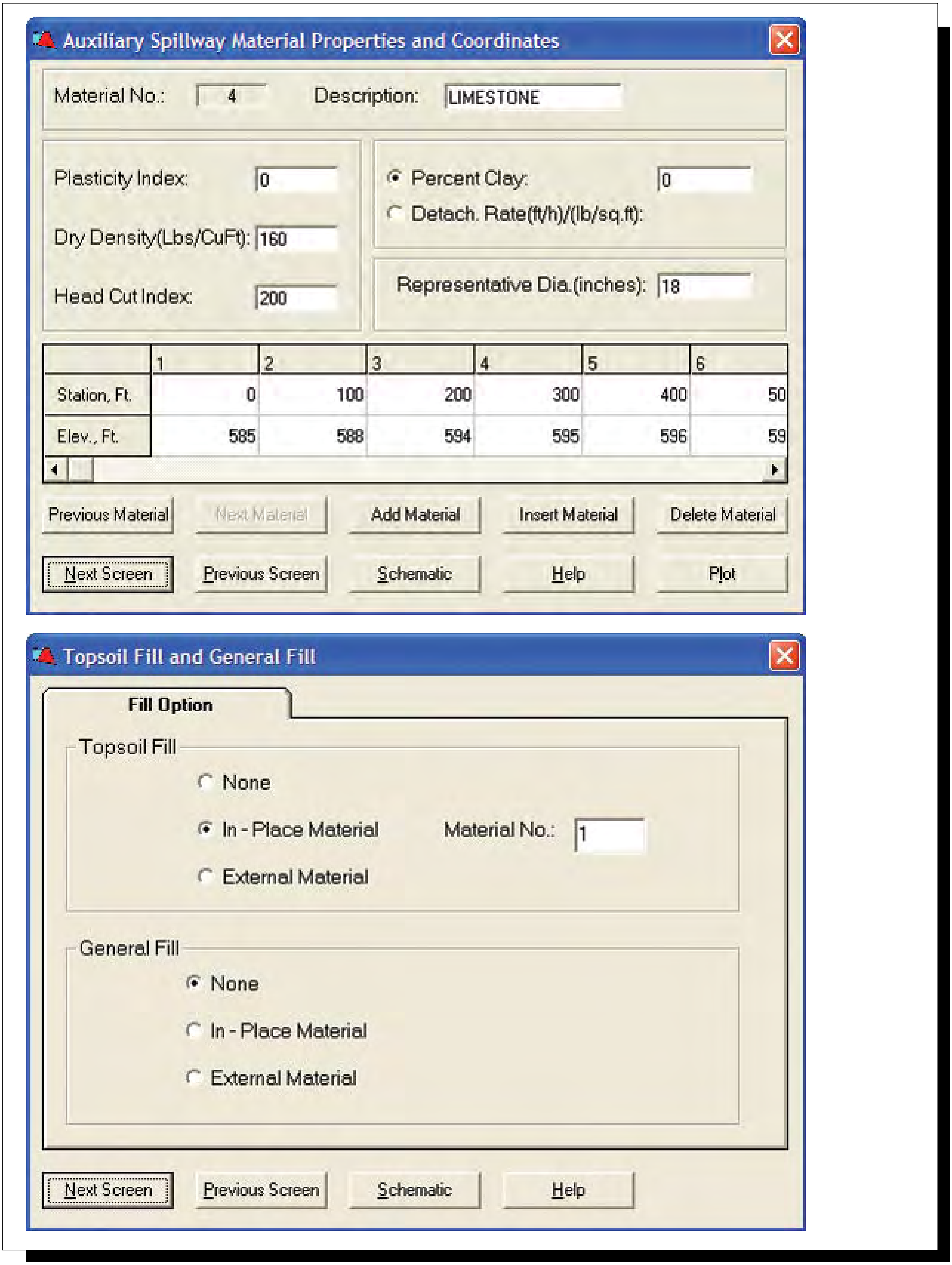


Figure C–5f Input data screens for sample job 5, Downstream Structure 256B5—Continued

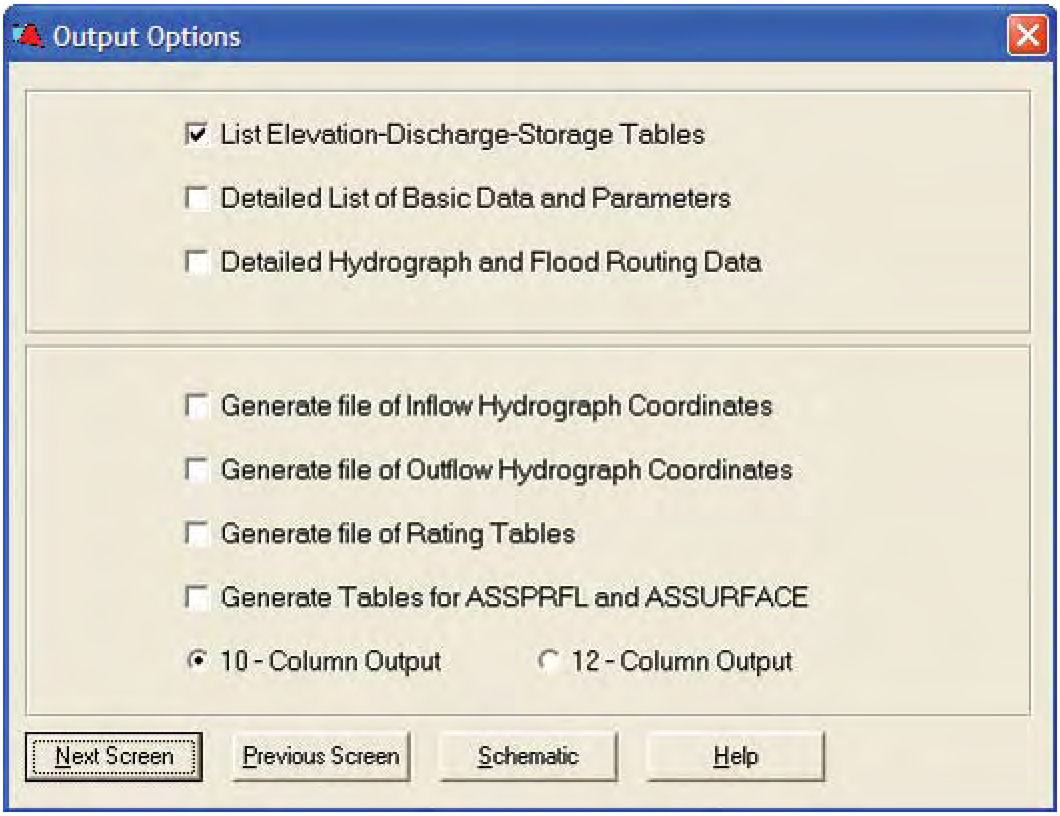
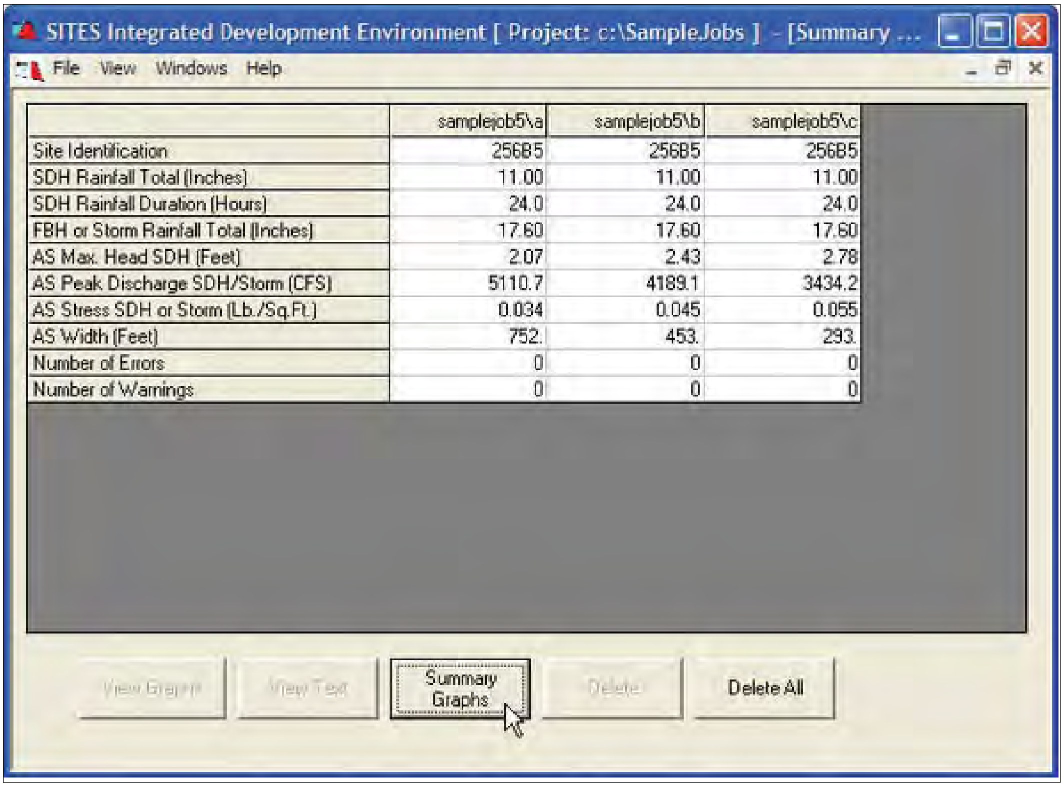


Figure C–5g Customized summary table and summary graph from IDE displaying sensitivity of auxiliary spillway width to erosionally effective stress



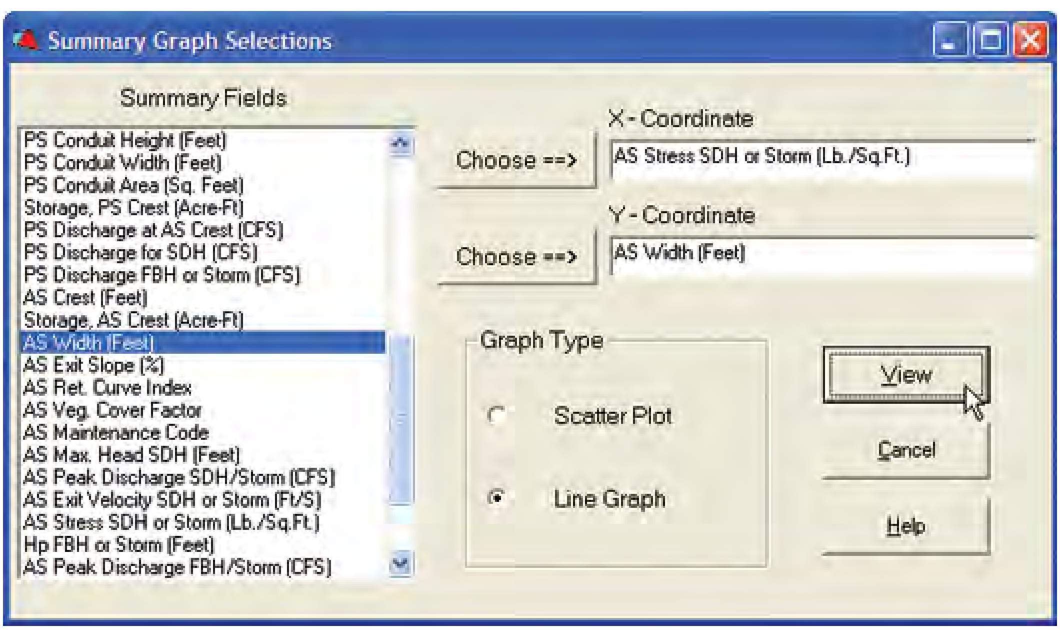


Figure C–5g Customized summary table and summary graph from IDE displaying sensitivity of auxiliary spillway width to erosionally effective stress—Continued

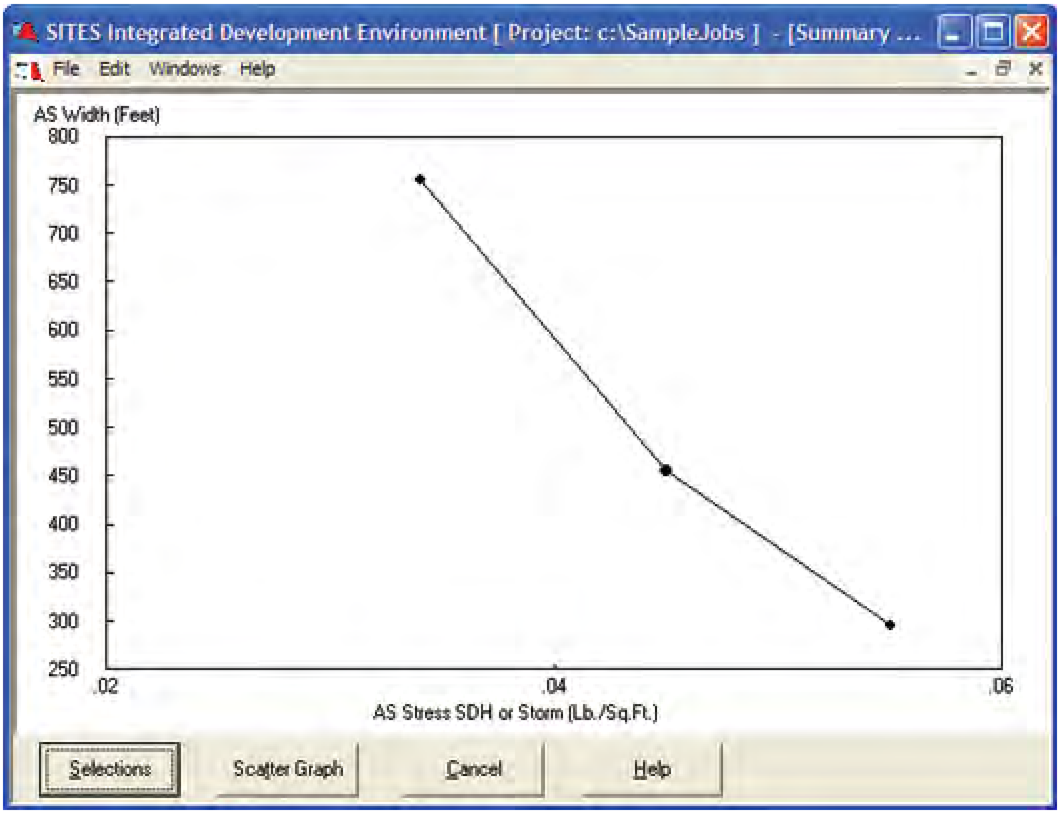


Figure C–5h Control file containing input for sample job 5

```
SITES      01/01/2005SJB5      SAMPLE JOB 5                  18        B3
SAVMOV     0    101
SAVMOV     101  1                                                      2
*          UPSTREAM SUB WATERSHED CONTRIBUTING RUNOFF TO DOWNSTREAM
*          DESIGN SITE
WSDATA     5  W21    84        3.0       2.9
PDIRECT              5.7       10.1      11.00     17.60
GO,DESIGN            TYPE2     24
SAVMOV     2    101  4                   W2
SAVMOV     0    101
SAVMOV     101  1                                                      1
*          UPSTREAM STRUCTURE IN WATERSHED OF DOWNSTREAM DESIGN SITE
STRUCTURE 256B4      SITE DATA FOR UPSTREAM SITE
                     603.43    321.89    0.0                 2600.00
                     603.87    332.82    16.73
                     604.32    343.75    47.33
                     604.77    354.68    86.94
                     605.22    365.56    133.86
                     605.54    373.26    134.85
                     605.86    380.96    135.84
                     606.17    388.66    136.83
                     606.49    396.36    137.81
                     606.81    404.06    138.79
                     607.13    411.77    139.75
                     607.45    419.47    140.71
                     607.77    427.17    141.67    0.0
                     608.13    435.90    142.74    10.89
                     608.49    444.63    143.80    27.55
                     609.14    460.50    145.70    257.72
                     609.94    480.54    147.99    683.01
                     611.38    516.99    152.06    1796.87
                     613.19    562.51    157.00    3584.18
                     615.00    607.70    161.79    5797.84
ENDTABLE
WSDATA     5S S12    82        7.5       2.57
PDIRECT              5.7       10.1      11.00     17.60
POOLDATA   ELEV                603.43
GO,DESIGN  QL        TYPE2     24
SAVMOV     2    101  5                   256B4
*          - BIFURCATION POINT (JUNCTION NODE) J1
*          The outflow hydrographs at this point may be viewed from the
*          schematic
ADDMOV     3                   J1                                      4
SAVMOV     101  2                                                      3
*          REACH S2 CONVEYING FLOW FROM UPSTREAM SUBWATERSHED AND
*          UPSTREAM STRUCTURE TO DOWNSTREAM (DESIGN) STRUCTURE
XSECTN     2         588.3
                     582       0         0         0         .0007
                     585.9     200       102       32        .0007
                     588.1     500       180       35        .0008
                     590.4     1000      368       137       .0008
                     592.6     2000      1196      519       .0007
```

Figure C–5h Control file containing input for sample job 5—Continued

```
                  594.1     3000      2031      564       .0005
                  595.3     4000      2706      584       .0004
                  596.3     5000      3327      601       .0003
                  598.2     7000      4468      631       .0003
                  599.6     9000      5394      655       .0003
                  601.4     12000     6616      685       .0003
                  603       15000     7670      710       .0003
                  605.2     20000     9341      819       .0003
                  607.3     25000     11108     846       .0003
                  609.2     30000     12773     872       .0003
ENDTABLE
GO,REACH  1    MS2  2         6000      5000
SAVMOV    2    101  2                   S2
SAVMOV    101  1                                                  1
*         DOWNSTREAM DESIGN STRUCTURE
STRUCTURE 256B5     LOWER SITE FOR SERIES RUN
                    591       76.6                          247.8
                    593       106.9
                    595       142.8
                    597       180.6
                    601       262.7
                    605       360.3
                    609       456.9
                    613       557.7
                    615       607.7
ENDTABLE
WSDATA    5B S2     82        7.5       2.57                5
PDIRECT   1.32      5.7       10.1      11.00     17.60
POOLDATA  ELEV      603.43    603.43    604.33    579       585       SC
PSINLET             1.0       30
PSDATA    1         250       60                  .013      584
ASDATA    41 450                        2.5                 .035      1
ASINSURF  41                  4.9       4.9
ASINLET   41        0.0       0.0       50        0.0
ENDTABLE
ASINLET   41        100       603
ASEXSURF  41                  5.6       5.6
                              0.9       0.9
                              1         3
                              1         1
                              0.008
ENDTABLE
ASEXIT    41        N         1
BTMWIDTH  STRESS    .034      0.045     0.055
ASMATERIAL1
          1         12        .008      20        110       .07
          2         0         2         0         120       .4
          3         0         7         0         130       7
          4         0         18        0         160       200
```

Figure C–5h Control file containing input for sample job 5—Continued

```
ENDTABLE
ASCOORD    1         ALLUVIUM  N
          0         595       100       603       200       608
          250       613       275       612       300       610
          350       613       400       615       450       612
          500       607       550       606       600       604
          700       601       800       595.7     900       590
          950       585       1000      580

ENDTABLE
ASCOORD    2         WTHRD-ROCK
          100       595       200       605       300       608
          400       612       500       605       700       597
ENDTABLE
ASCOORD    3         SHALE
          0         585       100       595       200       599
          300       603       400       606       500       603
          600       599       700       597       850       585
ENDTABLE
ASCOORD    4         LIMESTONE
          0         585       100       588       200       594
          300       595       400       596       500       596
          600       594       700       591       850       585
          1000      578
ENDTABLE
GRAPHICS  I
GO,DESIGN L         TYPE2     24
SAVMOV    2    101  1                   256B5
ENDJOB
ENDRUN
```

Sample Job 6—Auxiliary spillway evaluation

Inflow Data

Storm rainfall with raintable describing distribution

Ratings

PS – Computed, single stage, circular conduit
Aux. – Computed, actual coordinates, vegetated surface

Stage Storage Data

Elevation – Given
Surface Area – Given
Storage Volume – Initial value given

Special Features Demonstrated

Multiple reach auxiliary spillway exit channel
Barrier in auxiliary spillway
Raintable input

Output Features Demonstrated

Plot of predicted auxiliary spillway erosion

Figure C–6a Input data screens for sample job 6

Figure C–6a Input data screens for sample job 6—Continued

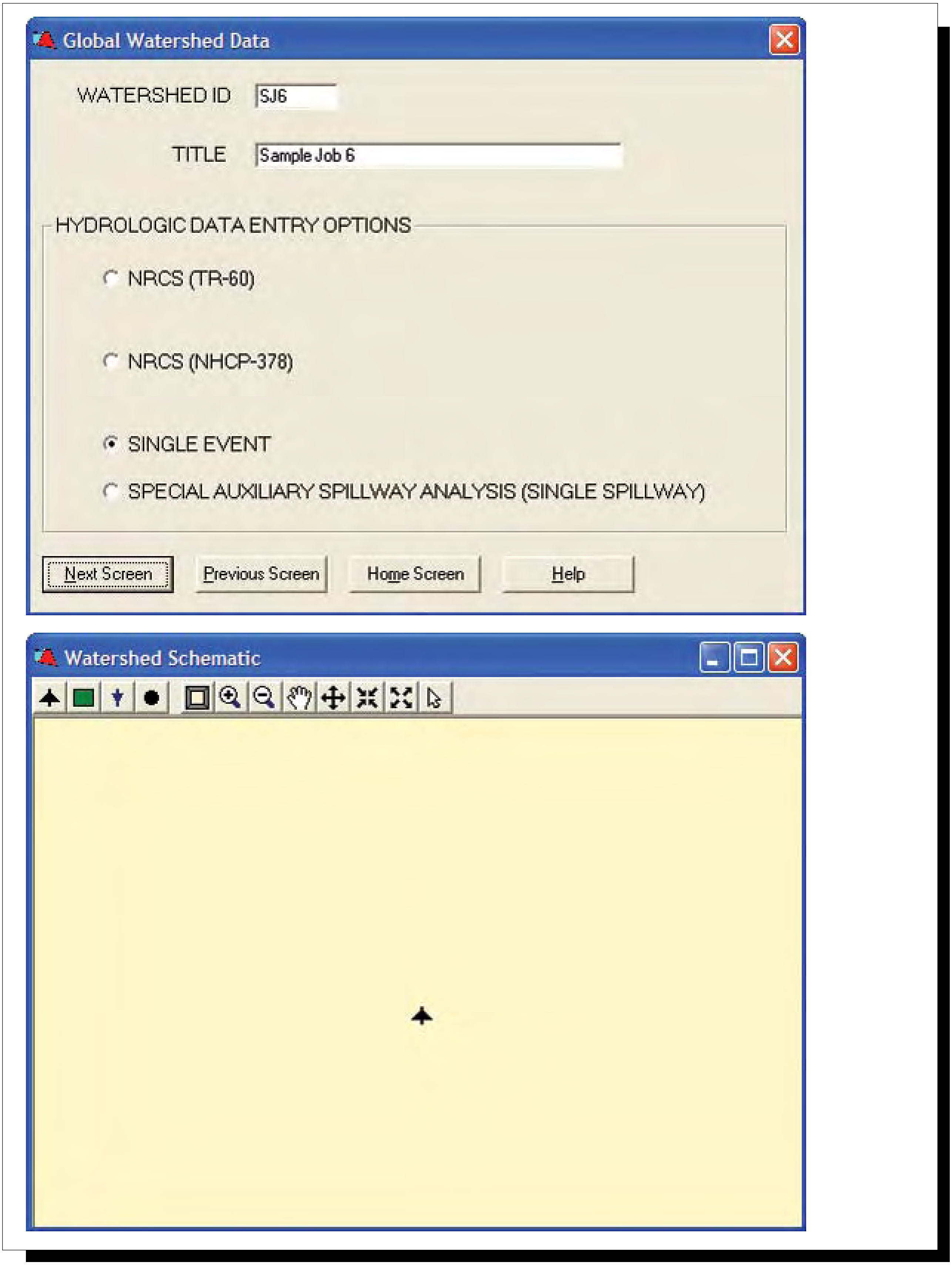
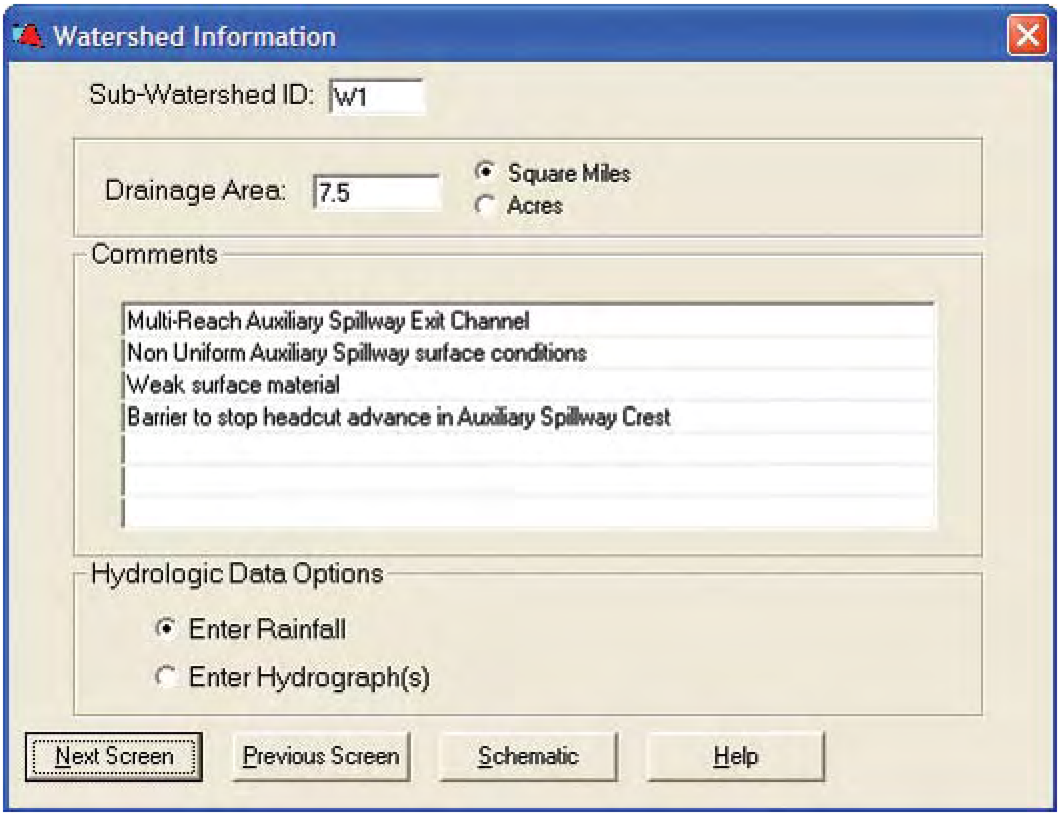


Figure C–6a Input data screens for sample job 6—Continued



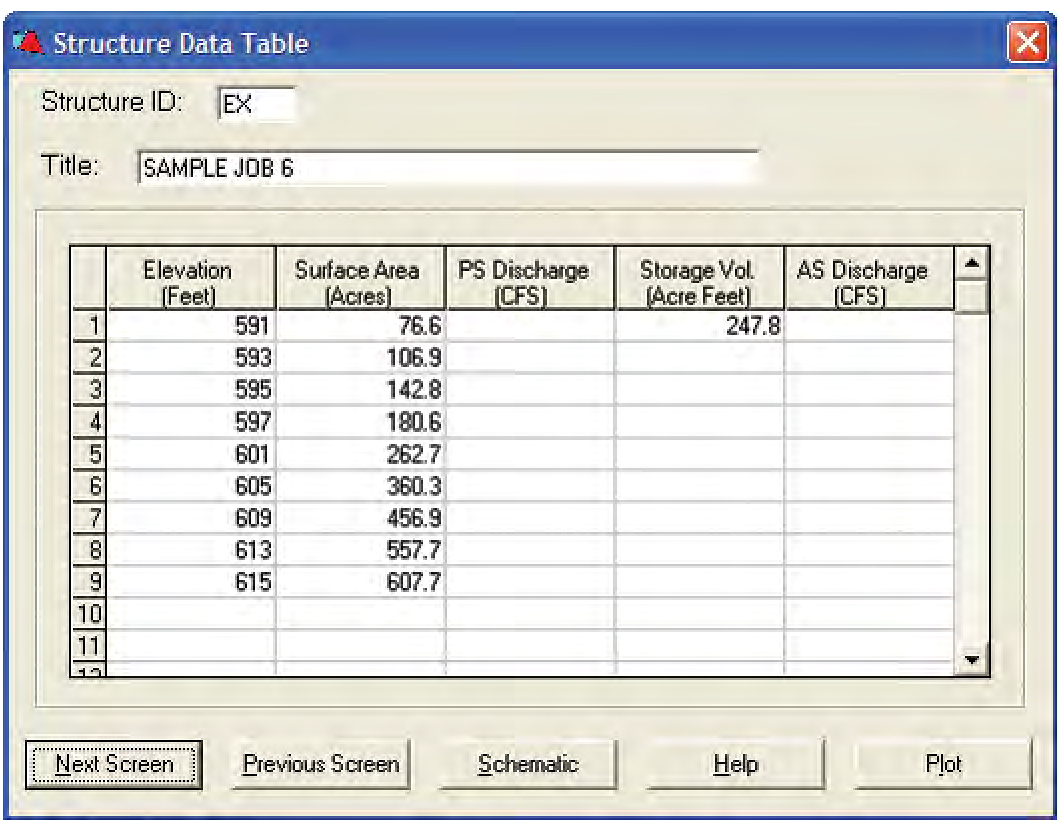


Figure C–6a Input data screens for sample job 6—Continued

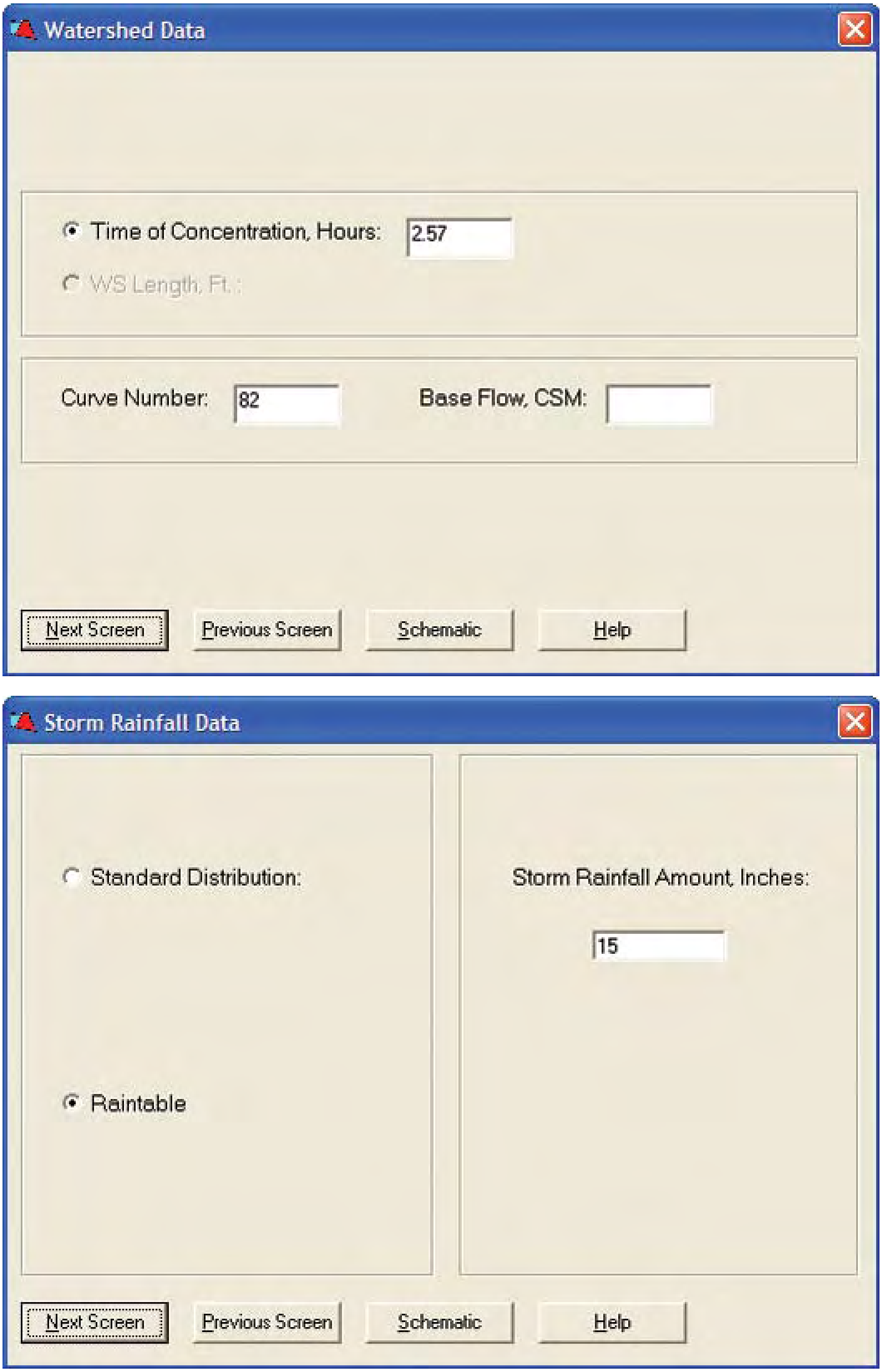
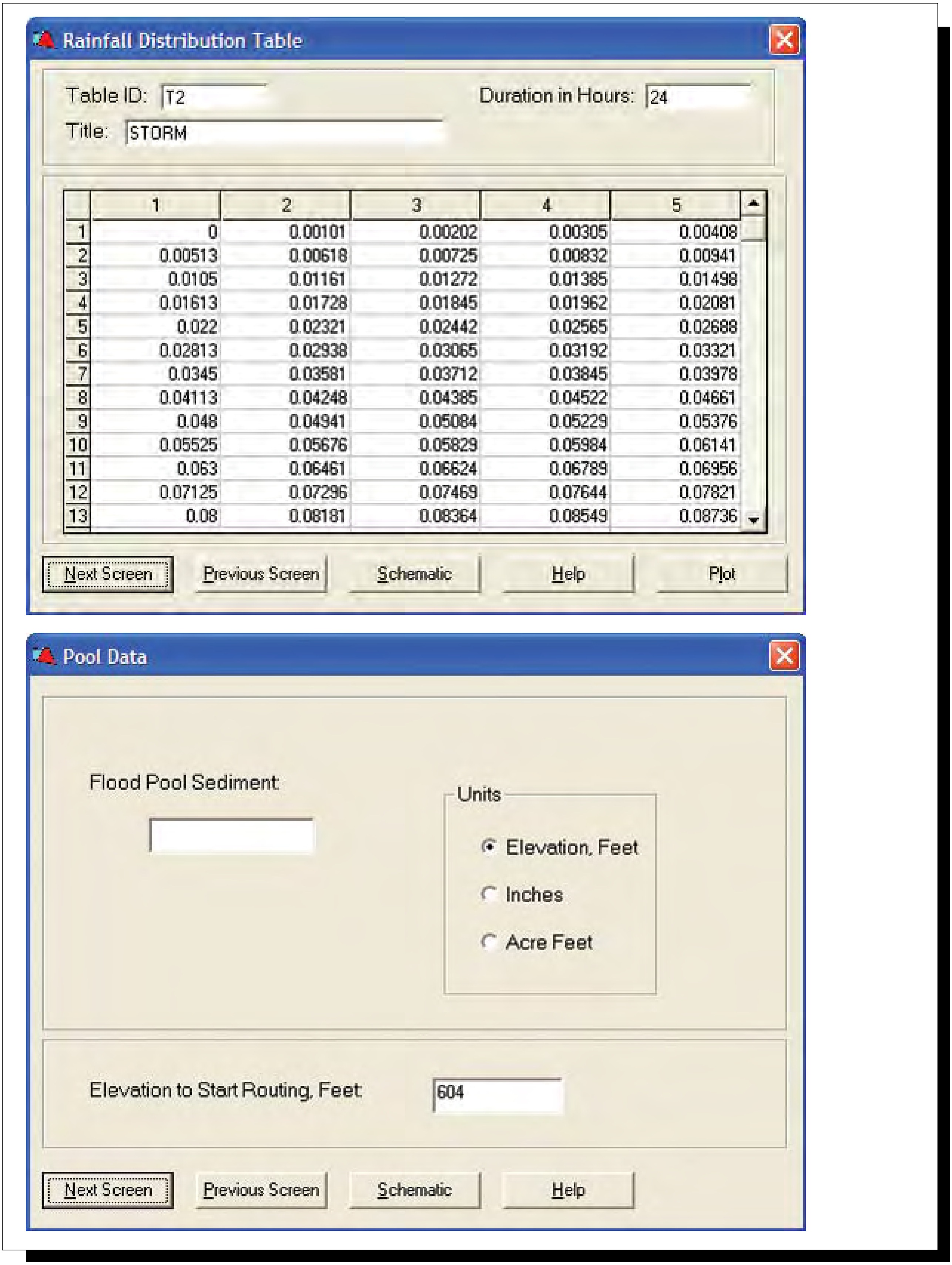


Figure C–6a Input data screens for sample job 6—Continued



	1	2	3	4	5
1	0	0.00101	0.00202	0.00305	0.00408
2	0.00513	0.00618	0.00725	0.00832	0.00941
3	0.0105	0.01161	0.01272	0.01385	0.01498
4	0.01613	0.01728	0.01845	0.01962	0.02081
5	0.022	0.02321	0.02442	0.02565	0.02688
6	0.02813	0.02938	0.03065	0.03192	0.03321
7	0.0345	0.03581	0.03712	0.03845	0.03978
8	0.04113	0.04248	0.04385	0.04522	0.04661
9	0.048	0.04941	0.05084	0.05229	0.05376
10	0.05525	0.05676	0.05829	0.05984	0.06141
11	0.063	0.06461	0.06624	0.06789	0.06956
12	0.07125	0.07296	0.07469	0.07644	0.07821
13	0.08	0.08181	0.08364	0.08549	0.08736

Figure C–6a Input data screens for sample job 6—Continued

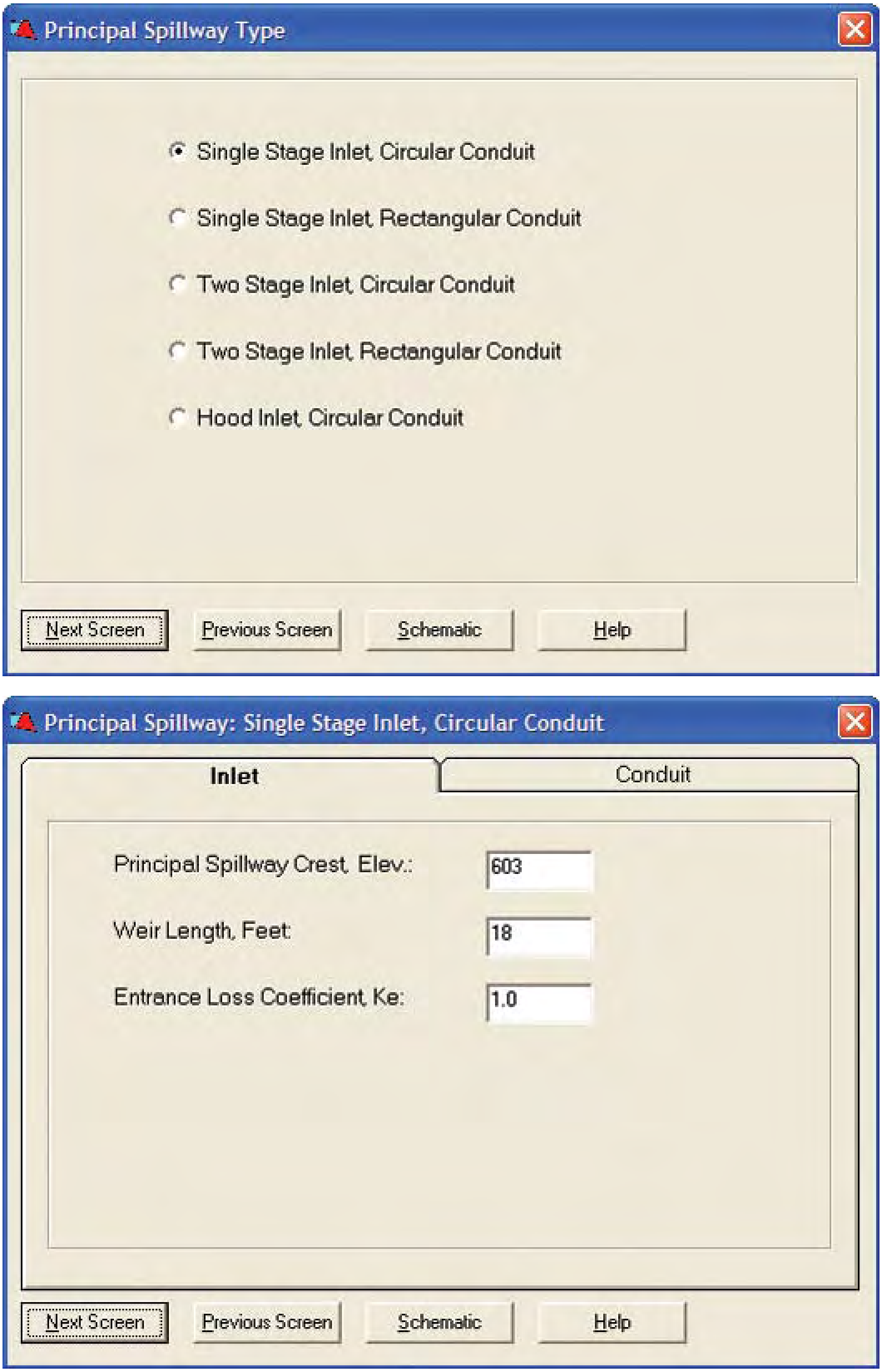


Figure C–6a Input data screens for sample job 6—Continued

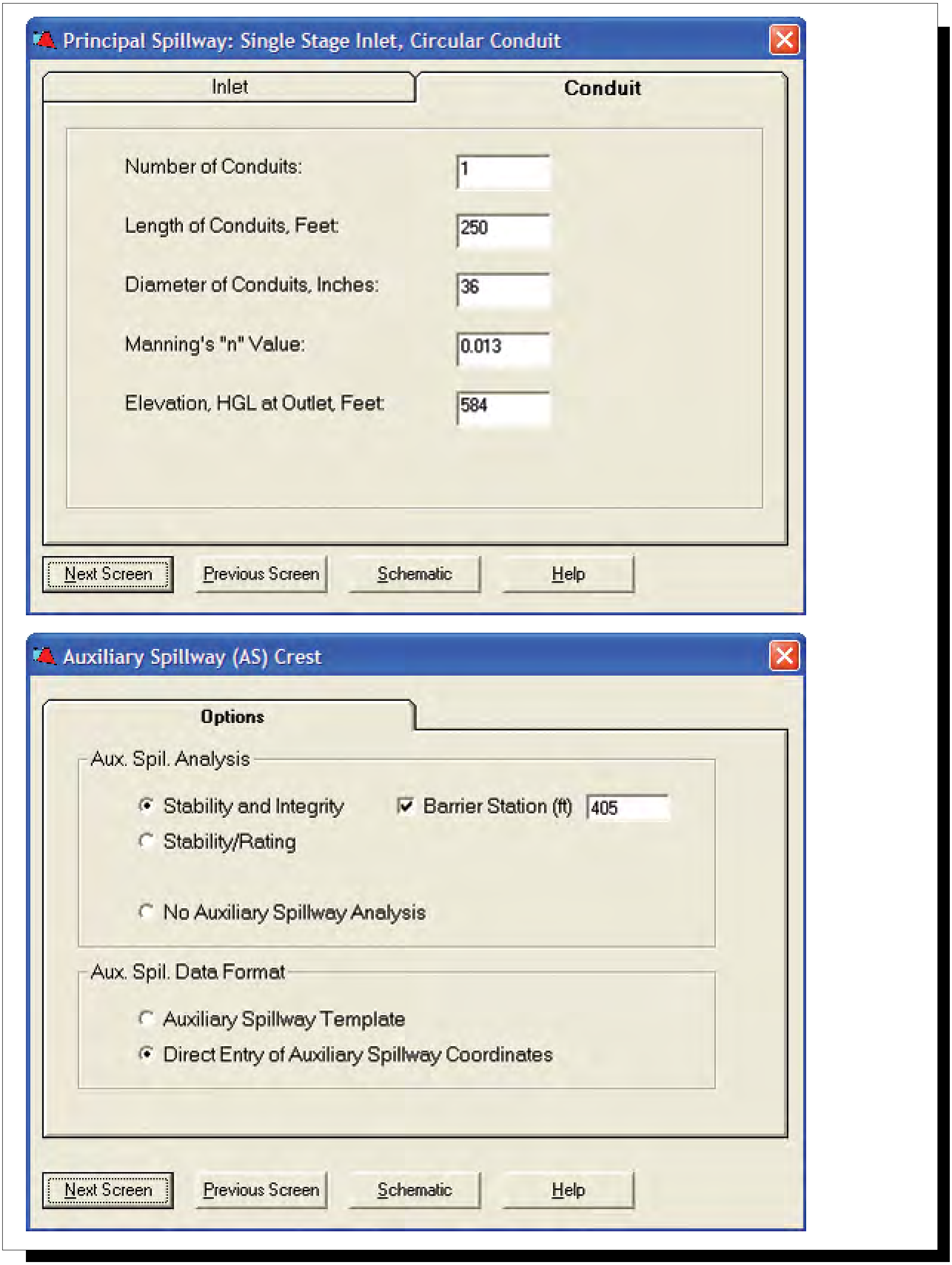


Figure C–6a Input data screens for sample job 6—Continued

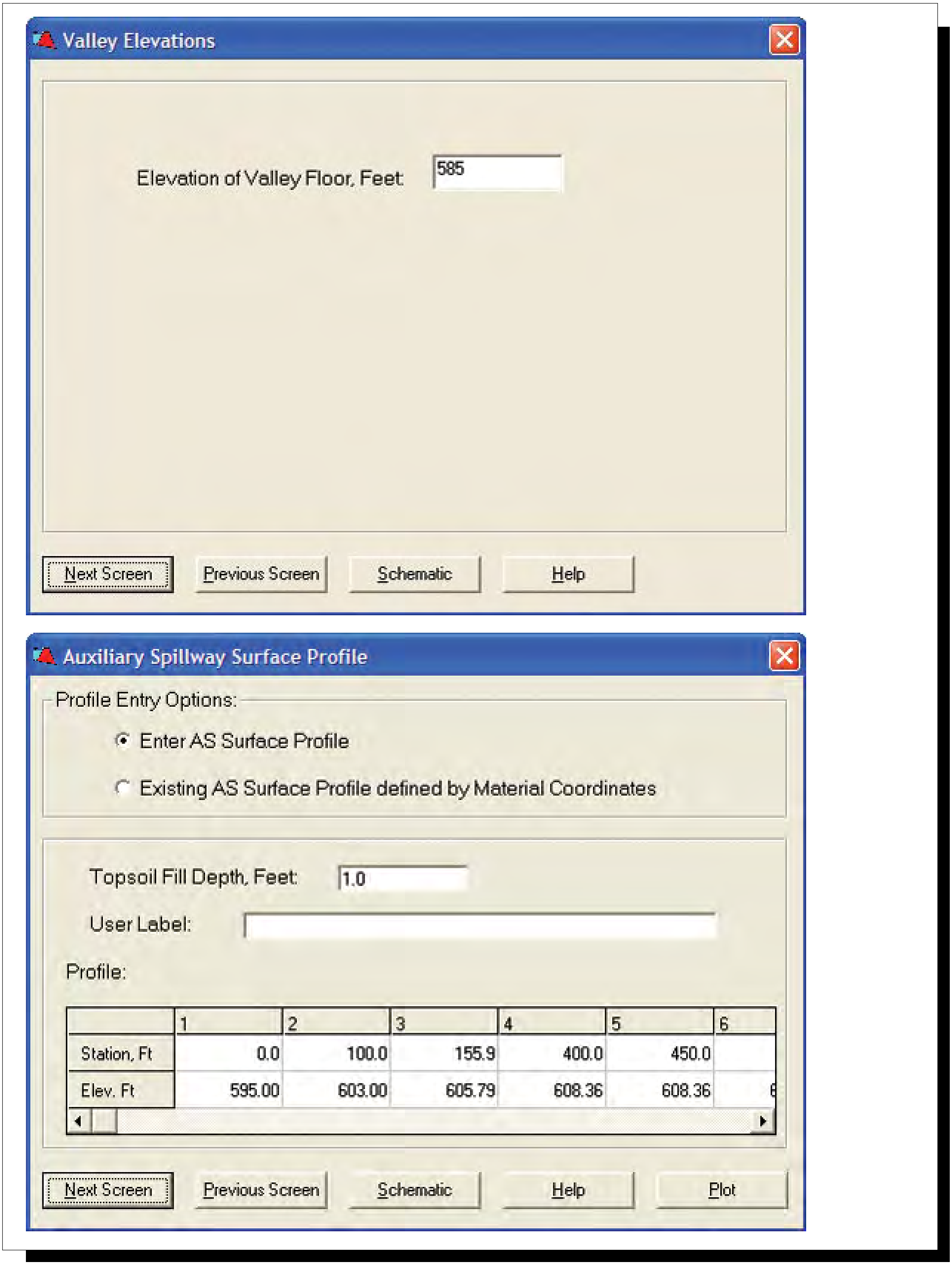
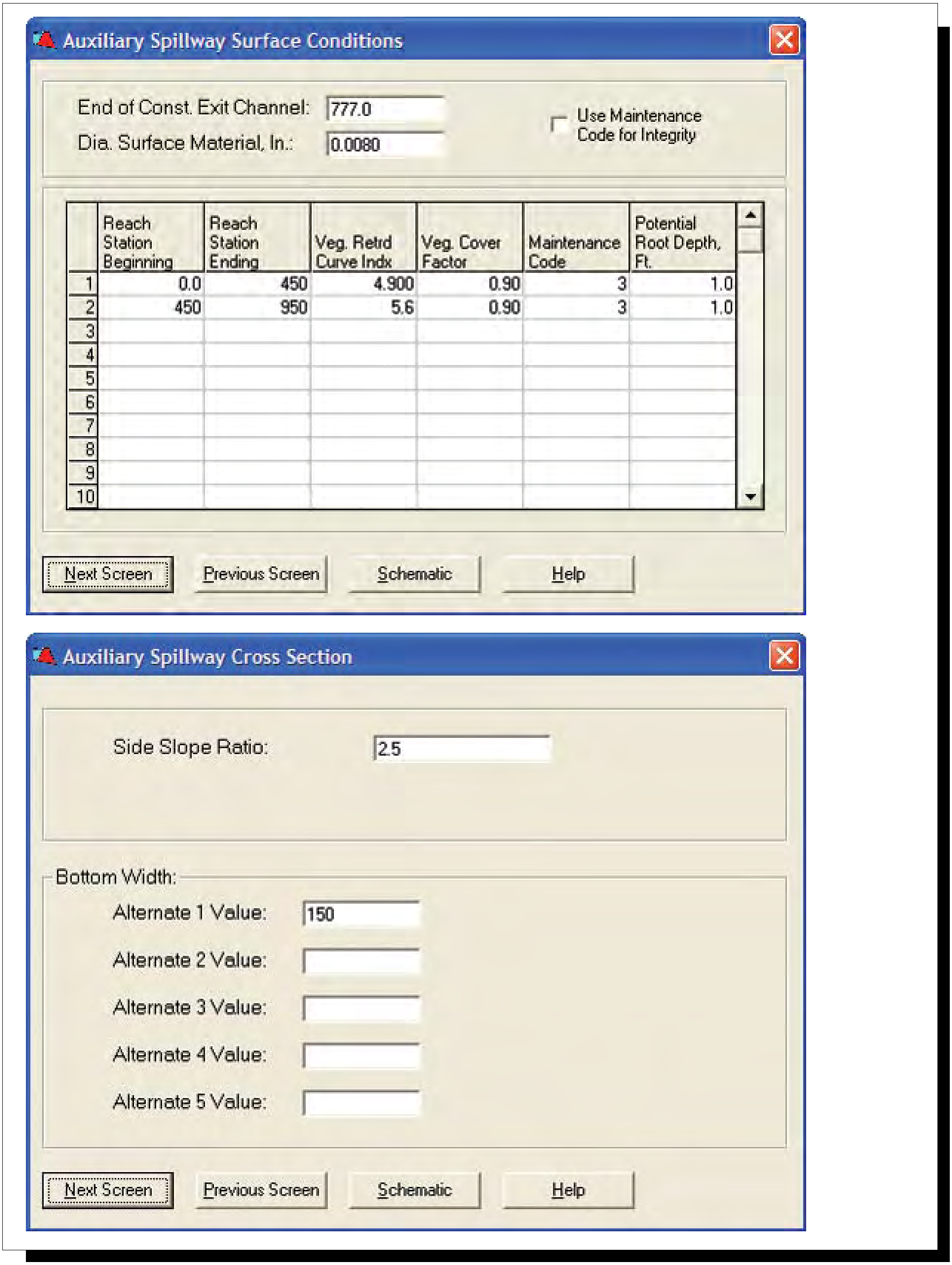


Figure C–6a Input data screens for sample job 6—Continued



Auxiliary Spillway Surface Conditions

End of Const. Exit Channel: 777.0

Dia. Surface Material, In.: 0.0080

Use Maintenance Code for Integrity

	Reach Station Beginning	Reach Station Ending	Veg. Retrd Curve Indx	Veg. Cover Factor	Maintenance Code	Potential Root Depth, Ft.
1	0.0	450	4.900	0.90	3	1.0
2	450	950	5.6	0.90	3	1.0
3						
4						
5						
6						
7						
8						
9						
10						

Next Screen | Previous Screen | Schematic | Help

Auxiliary Spillway Cross Section

Side Slope Ratio: 2.5

Bottom Width:

Alternate 1 Value: 150

Alternate 2 Value:

Alternate 3 Value:

Alternate 4 Value:

Alternate 5 Value:

Next Screen | Previous Screen | Schematic | Help

Figure C–6a Input data screens for sample job 6—Continued

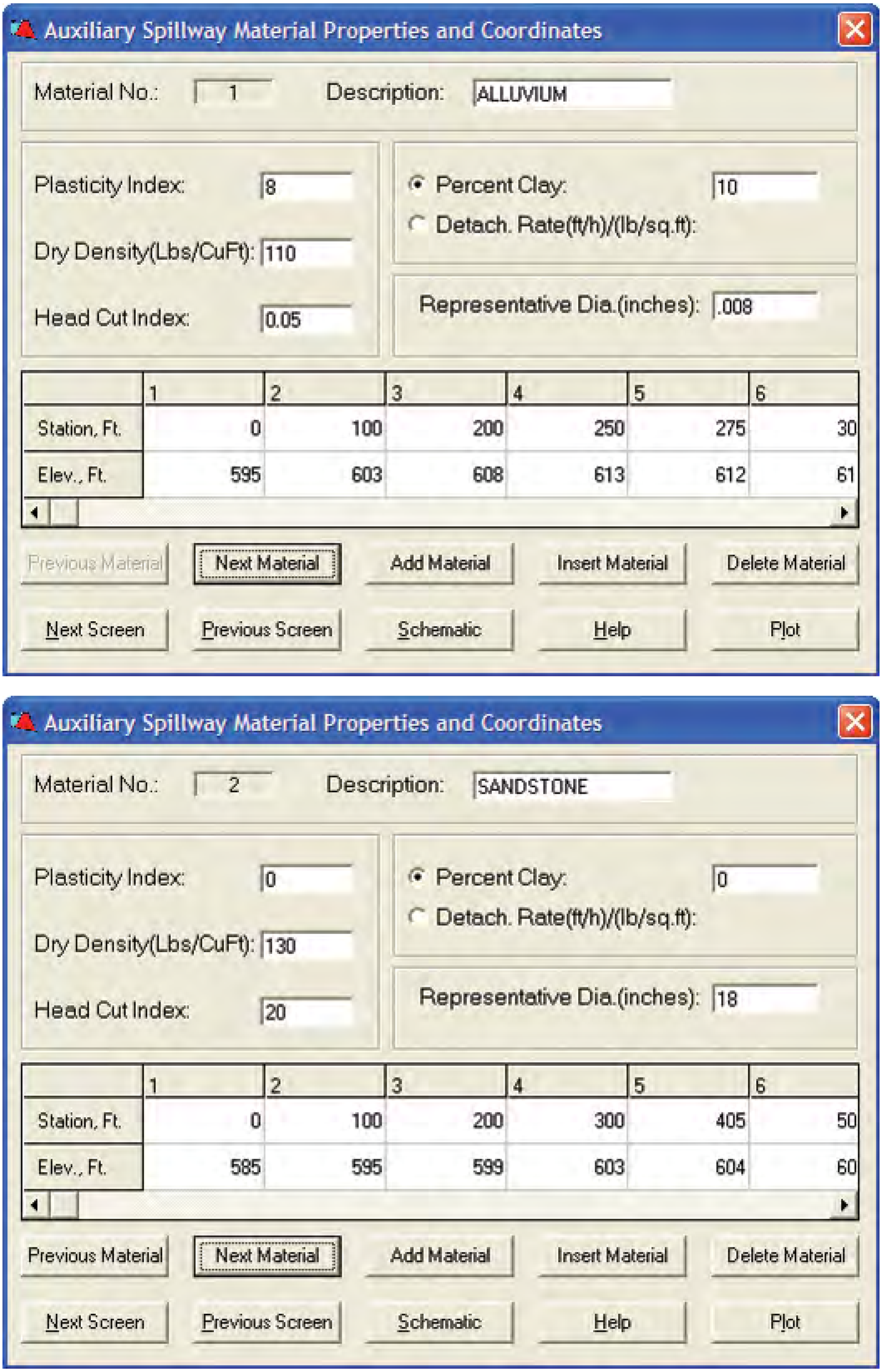


Figure C–6a Input data screens for sample job 6—Continued

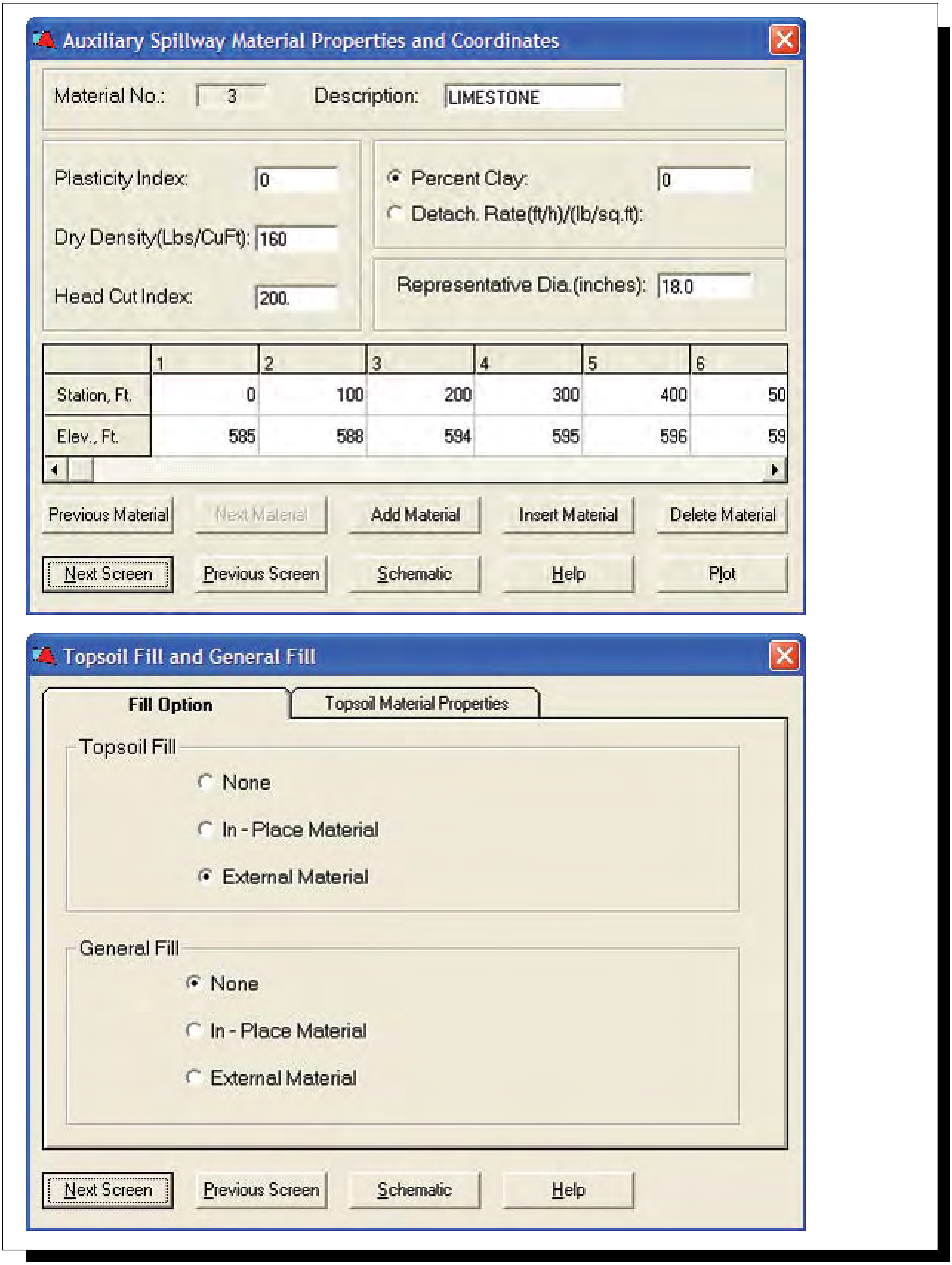


Figure C–6a Input data screens for sample job 6—Continued

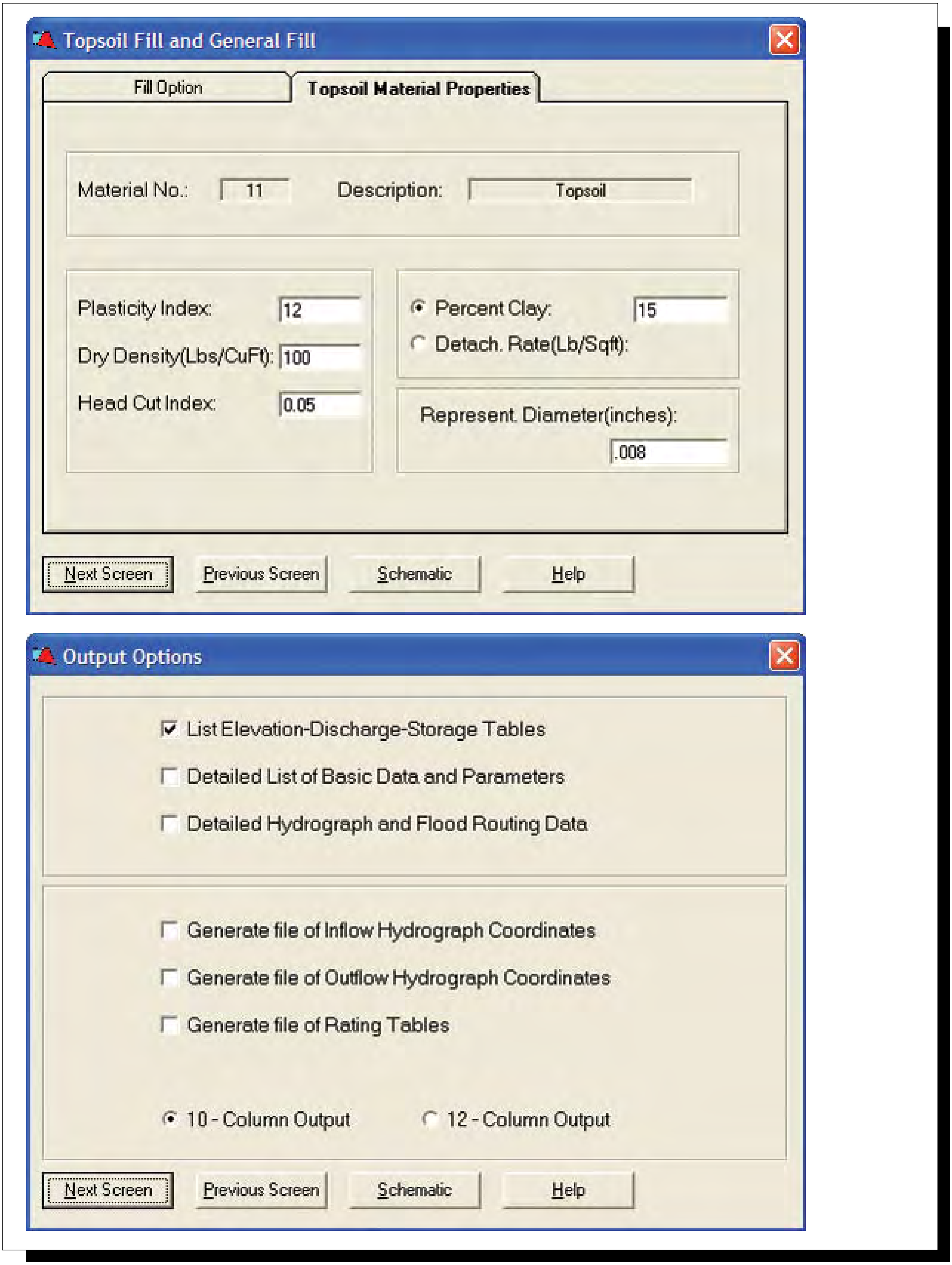
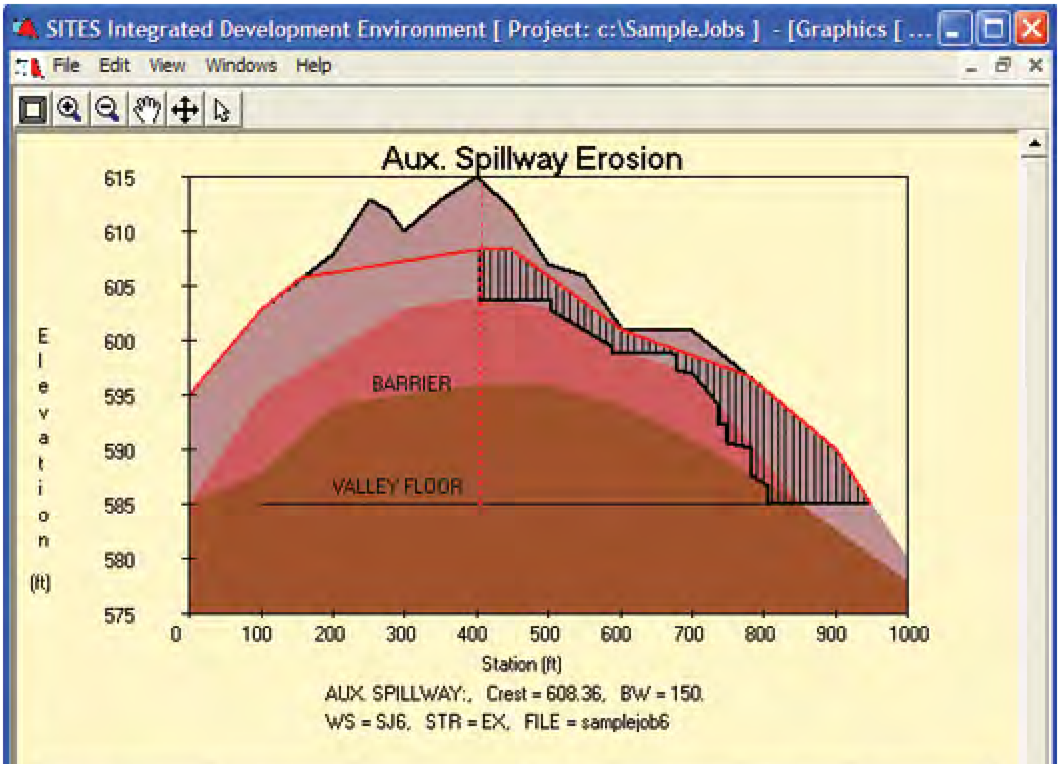


Figure C–6b Predicted auxiliary spillway erosion: headcut stopped by barrier



Material Description	Detach. Rate (ft/h)/(lb/sq ft)	Dry Density (lbs/cu ft)	Headcut Index (Kh)	Percent Clay	Plasticity Index	Rep. Diameter (in)
ALLUVIUM	--	110.	0.05	10.0	8.	0.00800
SANDSTONE	--	130.	20.00	0.0	0.	18.00000
LIMESTONE	--	160.	200.00	0.0	0.	18.00000
TS_FILL	--	100.	0.05	15.0	12.	0.00800
GEN_FILL	--	110.	0.05	10.0	8.	0.00800

Figure C–6c Control file containing input for sample job 6

```
SITES      01/01/2005SJ6       Sample Job 6                  7.5       I8
SAVMOV     0    101
SAVMOV     101  1                                                      1
*          Multi-Reach Auxiliary Spillway Exit Channel
*          Non Uniform Auxiliary Spillway surface conditions
*          Weak surface material
*          Barrier to stop headcut advance in Auxiliary Spillway Crest
STRUCTURE EX         SAMPLE JOB 6
                     591       76.6                          247.8
                     593       106.9
                     595       142.8
                     597       180.6
                     601       262.7
                     605       360.3
                     609       456.9
                     613       557.7
                     615       607.7
ENDTABLE
WSDATA     5S W1     82        7.5       2.57
STORM                          24
RAINTABLE T2         24        STORM
                     0         0.00101   0.00202   0.00305   0.00408
                     0.00513   0.00618   0.00725   0.00832   0.00941
                     0.0105    0.01161   0.01272   0.01385   0.01498
                     0.01613   0.01728   0.01845   0.01962   0.02081
                     0.022     0.02321   0.02442   0.02565   0.02688
                     0.02813   0.02938   0.03065   0.03192   0.03321
                     0.0345    0.03581   0.03712   0.03845   0.03978
                     0.04113   0.04248   0.04385   0.04522   0.04661
                     0.048     0.04941   0.05084   0.05229   0.05376
                     0.05525   0.05676   0.05829   0.05984   0.06141
                     0.063     0.06461   0.06624   0.06789   0.06956
                     0.07125   0.07296   0.07469   0.07644   0.07821
                     0.08      0.08181   0.08364   0.08549   0.08736
                     0.08925   0.09116   0.09309   0.09504   0.09701
                     0.099     0.10101   0.10304   0.10509   0.10716
                     0.10925   0.11136   0.11349   0.11564   0.11781
                     0.12      0.12225   0.1246    0.12705   0.1296
                     0.13225   0.135     0.13785   0.1408    0.14385
                     0.147     0.1502    0.1534    0.1566    0.1598
                     0.163     0.16628   0.16972   0.17332   0.17708
                     0.181     0.18512   0.18948   0.19408   0.19892
                     0.204     0.2094    0.2152    0.2214    0.228
                     0.235     0.24268   0.25132   0.26092   0.27148
                     0.283     0.30684   0.35436   0.43079   0.56786
                     0.663     0.68196   0.69864   0.71304   0.72516
                     0.735     0.74344   0.75136   0.75876   0.76564
                     0.772     0.77796   0.78364   0.78904   0.79416
                     0.799     0.8036    0.808     0.8122    0.8162
                     0.82      0.82367   0.82726   0.83079   0.83424
```

Figure C–6c Control file containing input for sample job 6—Continued

```
                    0.83763   0.84094   0.84419   0.84736   0.85047
                    0.8535    0.85647   0.85936   0.86219   0.86494
                    0.86763   0.87024   0.87279   0.87526   0.87767
                    0.88      0.88229   0.88455   0.88679   0.889
                    0.89119   0.89335   0.89549   0.8976    0.89969
                    0.90175   0.90379   0.9058    0.90779   0.90975
                    0.91169   0.9136    0.91549   0.91735   0.91919
                    0.921     0.92279   0.92455   0.92629   0.928
                    0.92969   0.93135   0.93299   0.9346    0.93619
                    0.93775   0.93929   0.9408    0.94229   0.94375
                    0.94519   0.9466    0.94799   0.94935   0.95069
                    0.952     0.9533    0.95459   0.95588   0.95716
                    0.95844   0.95971   0.96098   0.96224   0.9635
                    0.96475   0.966     0.96724   0.96848   0.96971
                    0.97094   0.97216   0.97338   0.97459   0.9758
                    0.977     0.9782    0.97939   0.98058   0.98176
                    0.98294   0.98411   0.98528   0.98644   0.9876
                    0.98875   0.9899    0.99104   0.99218   0.99331
                    0.99444   0.99556   0.99668   0.99779   0.9989
                    1         1         1         1         1
ENDTABLE
POOLDATA  ELEV                603                           585       SC
PSINLET             1.0       18
PSDATA    1         250       36                  0.013     584
CROWN     0.667
TEMPLATE            2.5       2.5       10.0
CLPROFILE           -0        STRUCTURE 156B4, SAMPLE JOB 1
          -1180     625       -1000     618       -750      609
          -500      601.5     -280      595       -150      591
          -50       589       200       588       600       589
          620       579       670       581       690       588
          1110      590       1360      596       1600      607
          1870      613       2010      617
ENDTABLE
ASSPRFL   41        1.0
          0.0       595.00    100.0     603.00    155.9     605.79
          400.0     608.36    450.0     608.36    604.0     601.00
          777.0     596.92    800.0     595.70    900.0     590.00
          950.0     585.00
ENDTABLE
ASSURFACE 41        777.0     0.0080
          0.0       450       4.900     0.90      3         1.0
          450       950       5.6       0.90      3         1.0
ENDTABLE
ASDATA    41                            2.5                           1
BTMWIDTH  FEET      150
ASMATERIAL11
          1         8         .008      10        110       0.05
          2         0         18        0         130       20
          3         0         18.0      0         160       200.
          11        12        .008      15        100       0.05
ENDTABLE
```

Figure C–6c Control file containing input for sample job 6—Continued

```
ASCOORD    1        ALLUVIUM  N         405                           Y
          0         595       100       603       200       608
          250       613       275       612       300       610
          350       613       400       615       450       612
          500       607       550       606       604       601
          700       601       800       595.7     900       590
          950       585       1000      580
ENDTABLE
ASCOORD    2        SANDSTONE
          0         585       100       595       200       599
          300       603       405       604       500       603
          600       599       700       597       850       585
ENDTABLE
ASCOORD    3        LIMESTONE
          0         585       100       588       200       594
          300       595       400       596       500       596
          600       594       700       591       850       585
          1000      578
ENDTABLE
GRAPHICS  IE
GO,STORM  EL        T2        15                            604
SAVMOV    2    101  1                   EX
ENDJOB
ENDRUN
```

Sample Job 7—Drawdown computations only
(Application of damsite computational routine outside of IDE for advanced users)

Inflow Data

None

Ratings

PS – Computed, single stage, drop inlet
Aux. – None required

Stage Storage Data

Elevation – Given
Surface Area – Given
Storage Volume – Initial value given

Special Features Demonstrated

Drawdown without inflow
Alternative spillway size (alternate input in single data file outside of IDE)

Figure C–7 Control file containing input for sample job 7

```
SITES     01/01/2005SJ7       SAMPLE JOB 7  DRAWDOWN COMPUTATIONS ONLY
STRUCTURE 156B4     MODIFIED SAMPLE JOB 1 DATA
                    591       76.6                          247.8
                    593       106.9
                    595       142.8
                    597       180.6
                    601       262.7
                    605       360.3
                    609       456.9
                    613       557.7
                    615       607.7
ENDTABLE
POOLDATA  AC–FT     2600      2600      30        574.0     574.0
PSDATA    1         250       36                  0.013     579.0
PSINLET             1.0       18
GRAPHICS  I
*
*         TRIALS -  COMPARISON DRAWDOWN USING 36 AND 72 INCH PIPE FOR
*                      PRINCIPAL SPILLWAY IN STRUCTURE 156B4.
*                      THE DRAWDOWN TIME IS COMPUTED STARTING AT THE
*                      MAX. ELEVATION OF THE ROUTED PSH (607.73) AND
*                      ENDING AT THE HIGHER OF EITHER THE SEDIMENT
*                      ACCUMULATION ELEVATION (603.52) OR THE
*                      BASEFLOW/QRF (34.6 CFS) ELEVATION.
*                      NOTE:  INFLOW IS NOT ADDED INTO THE COMPUTATION.
*
*         TRIAL NO. 1 - 36 INCH PIPE, SINGLE STAGE PRINCIPAL SPILLWAY
*
GO,TDD              607.73    603.52    34.6
PSDATA    1         250       72                  0.013     579.0
PSINLET             1.0       36
*
*         TRIAL NO. 2 - 72 INCH PIPE, SINGLE STAGE PRINCIPAL SPILLWAY
*
GO,TDD              607.73    603.52    34.6
ENDJOB
ENDRUN
```

Sample Job 8—Embankment computations only
(Application of damsite computational routine outside of IDE for advanced users)

Inflow Data

None

Ratings

None required

Stage Storage Data

None required

Special Features Demonstrated

Embankment quantities for a series of dam elevations
Adjustment to embankment height

Figure C–8 Control file containing input for sample job 8

```
SITES     01/01/2005SJ8       SAMPLE 8  EMBANKMENT COMPUTATIONS ONLY
CLPROFILE           -.5       STRUCTURE 156B4
          -1180     625       -1000     618       -750      609
          -500      601.5     -280      595       -150      591
          -50       589       200       588       600       589
          620       579       670       581       690       588
          1110      590       1360      596       1600      607
          1870      613       2010      617
ENDTABLE
*          EMB. RUN 1 - USING CLPROFILE AND THE STANDARD TEMPLATE,
*                       COMPUTE THE EMBANKMENT YARDAGE FOR TOP DAM
*                       AT ELEVATIONS 611, 613, AND 615 WITH WAVE
*                       BERM AT 603.5.  ADJUSTMENT OF 0.5 FOOT IS
*                       MADE TO ALL ELEVATIONS FOR STRIPPING.
*
GRAPHICS  E
GO,EMB              611       615       2.0       603.5
*
TEMPLATE            3         3         10.0
STABERM   8.0       10.0                8         15
CROWN     0.25
*          EMB. RUN 2 - SAME AS FIRST PASS, EXCEPT CHANGES MADE IN
*                       STANDARD DEFAULTS FOR SIDE SLOPES AND CROWN,
*                       AND SEPARATE U/S AND D/S STABILITY BERMS
*                       ARE ADDED.
*
GO,EMB              611       615       2.0       603.5
ENDJOB
ENDRUN
```

Sample Job 9—Drawdown added to routing
(Application of damsite computational routine outside of IDE for advanced users)

Inflow Data

Flood hydrograph

Ratings

PS – Given in a structure table
Aux. – Given in a structure table

Stage Storage Data

Elevation – Given
Surface Area – Given
Storage Volume – Given

Special Features Demonstrated

Modification of IDE-generated input file
Drawdown using GO,DRAW

Figure C–9 Control file containing input for sample job 9

```
SITES     01/01/2005SJ9       SAMPLE JOB 9 - DRAWDOWN       7.5       I8
*         USE GIVEN PRINCIPAL & AUXILIARY RATINGS
*         HYDROGRAPH FOR CHECK OF ROUTED ELEV.
STRUCTURE 156B4     SITE DATA
                    603.43              0.0                 2600.00
                    603.87              16.73               2746.66
                    604.32              47.33               2898.21
                    604.77              86.94               3054.65
                    605.22              133.86              3215.99
                    605.54              134.85              3333.80
                    605.86              135.84              3454.06
                    606.17              136.83              3576.78
                    606.49              137.81              3701.96
                    606.81              138.79              3829.59
                    607.13              139.75              3959.68
                    607.45              140.71              4092.22
                    607.77              141.67    0.0       4227.22
                    608.13              142.74    10.89     4383.25
                    608.49              143.80    27.55     4542.41
                    609.14              145.70    257.72    4836.91
                    609.94              147.99    683.01    5211.17
                    611.38              152.06    1796.87   5932.50
                    613.19              157.00    3584.18   6908.29
                    615.00              161.79    5797.84   7966.00
ENDTABLE
HYD       9                   STB DESIGN HYDROGRAPH
```

Figure C–9 Control file containing input for sample job 9—Continued

```
                    .168
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         0
                    0         0         0         0         1
                    2         4         7         10        15
                    22        29        38        49        60
                    73        87        101       117       133
                    150       168       187       205       225
                    245       265       286       307       329
                    351       373       397       421       447
                    474       504       538       573       612
                    654       698       744       793       846
                    903       966       1038      1120      1216
                    1329      1470      1682      2088      2774
                    3711      4898      6361      7994      9516
                    10695     11461     11823     11853     11559
                    11027     10341     9486      8505      7563
                    6772      6100      5514      5011      4568
                    4162      3802      3491      3218      2974
                    2757      2565      2391      2236      2100
                    1977      1867      1769      1680      1600
                    1528      1464      1406      1352      1305
                    1263      1223      1184      1147      1110
                    1075      1041      1008      980       955
                    931       908       885       864       843
                    823       805       788       772       758
                    745       734       723       713       705
                    697       689       682       676       669
                    664       658       652       647       640
                    629       615       595       567       532
                    491       446       399       352       306
                    264       225       190       160       135
                    115       98        83        70        60
                    51        43        36        31        26
                    22        18        16        13        11
                    9         8         6         5         4
                    4         3         2         2         2
                    1         1         1         0
ENDTABLE
WSDATA    2S W1     82        7.5       2.57
STORM                         24
POOLDATA  AC-FT     2600      2600.00   30        579.0     585.0
GRAPHICS  I
GO,HYD    QL                                              604.29
*         OBTAIN DRAWDOWN TIME
GO,DRAW   H
ENDJOB
ENDRUN
```

Sample Job 10—User controlled design computations
(Application of damsite computations routine outside of IDE for advanced users)

Inflow Data

PSH – QDIRECT (Site A)
PSH – P100,PMP (Site B)
PSH – PDIRECT (Site C)
SDH – PDIRECT (Sites A and C)
SDH – P100,PMP (Site B)
FBH – PDIRECT (Sites A and C)
FBH – P100,PMP (Site B)
Baseflow – Given (Sites A and C)
Transmission Losses – (Site B)
QRF – Given (Site C)

Ratings

PS – Computed, 2-stage, drop inlet (Site A)
PS – Computed, culvert (Site B)
PS – Given in STRUCTURE Table (Site C)
Aux. – Computed, Profile #41, Frictionless side slope (Site A)
Aux. – Given, ASRATING (Site B)
Aux. – Computed, Profile #1 WSPVRT (Site C)

Stage Storage Data

Elevation – Given (all three sites)
Surface Area – Given (all three sites)
Storage Volume – Initial value given, other values computed (all three sites)

Special Features Demonstrated

Changes in default water surface profile procedure – OFFWSPVRT (Site A)
Changes in default values – PSCOEFFS (Site B)
Changes in criteria, Class Code S–CLASS, MINDEPTH, MINDISCH (Site B)
Changes in criteria – DDTEST (Site C)
Areal corrections – AREACRCT (Site C)
Multiple Aux. Crests and bottom widths (Site C)
Second pass to obtain bottom width based on exit velocity (Site C)
Use of modified Att-Kin reach routing

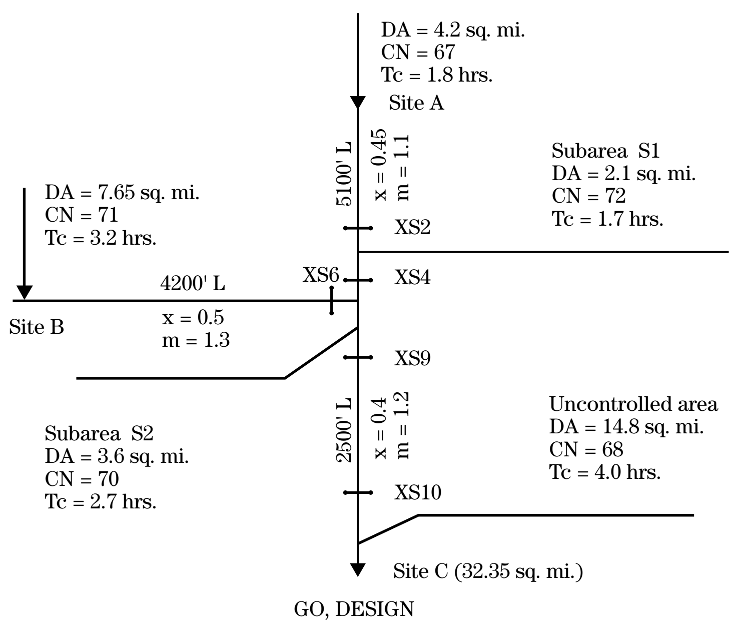


Figure C–10 Control file containing input for sample job 10

```
SITES     01/01/2005SJ10      SAMPLE JOB 10  COMPLEX SERIES ROUTING
*
*         THE PURPOSE OF THIS SAMPLE JOB IS TO SHOW THE GENERAL
*         FRAMEWORK OF A COMPLEX WATERSHED WHILE DEMONSTRATING MANY
*         OF THE NON-TYPICAL DESIGN CONTROL WORDS AND PROCEDURES.
*         THE INDIVIDUAL SITE INPUTS ARE FOR EXAMPLE ONLY AND
*         SHOULD NOT BE CONSTRUED AS USING VALID TR-60 DESIGN
*         CRITERIA.  THE EXAMPLE SHOWS THE DESIGN OF A LOWER SITE IN
*         SERIES WITH TWO UPSTREAM STRUCTURES AND TWO
*         UNCONTROLLED SUBAREAS.
*
*         SITE A    UPPER SITE 2-STAGE PS, GIVEN ASINLET & BOTTOM
*                      WIDTH TO COMPUTE AUXILIARY SPILLWAY RATING,
*                      USE QDIRECT FOR PRINCIPAL SPILLWAY HYDROGRAPH
*                      AND PDIRECT FOR DEVELOPMENT OF STABILITY
*                      DESIGN AND FREEBOARD HYDROGRAPHS.
*
STRUCTURE ID=A      UPPER SITE A, 2-STAGE PS, ASINLET, & EXIT SLOPE
                    451.5     26.2                          163.0
                    452.0     27.7
                    456.0     39.1
                    460.0     53.6
                    464.0     67.8
                    468.0     85.9
                    472.0     105.3
                    476.0     127.9
ENDTABLE
WSDATA    1 C A2    67        4.2       1.8                 0.0
BASEFLOW            2.0
QDIRECT             4.0       8.0
PDIRECT   1.0                           15.1      33.1
POOLDATA  ELEV      451.5     451.5     451.7     435.0     435
PSDATA    1         220       36                  0.012     433.5
PSINLET   ELEV      1.0       16        456.0     1.5       6.0
ASCREST   ELEV      467.0
ASDATA    41 350    330       0.04      3.0       0.04      0.025
ASINLET   41        40        0.0       60        2.0
ASINLET             560       5.0
ENDTABLE
BTMWIDTH  FEET      700
OFFWSPVRT
GO,DESIGN L N       TYPE2     24
GO,REACH  0    A XS2          5100      0.45      1.1
WSDATA    1C S11    72        2.1       1.7                 0.0
BASEFLOW            2.0
PDIRECT   1.0       7.3       12.0      15.1      33.1      12.0
GO,DESIGN           TYPE2     24
GO,ADDHYD 0      XS4
*
```

Figure C–10 Control file containing input for sample job 10—Continued

```
*         SITE B,   CULVERT PS, ASRATING PROVIDED FOR AUXILIARY
*                       SPILLWAY, GIVEN SIZE RAINFALLS CALCULATED.
*                       DEMONSTRATES TRANSMISSION LOSSES, ADJUSTED
*                       PSCOEFFS, USER DEFINED CRITERIA, AND NEW
*                       MINDEPTH AND MINDISCH VALUES.
*
STRUCTURE ID=B      UPPER SITE B, CULVERT PS, ASRATING PROVIDED
                    351.5     0                             0.0
                    355.0     40
                    357.0     80
                    360.0     200
                    365.0     390
                    370.0     525
                    375.0     650
ENDTABLE
WSDATA    1 S B2    71        7.65      3.2                 0.0
P100,PMP  0.9       6.3       33.1      1.159     1.644
CLASS                                   0.0       .3282     1.0
POOLDATA  ELEV      351.5     351.5     352.2     344.0     344
PSDATA    0         300       4.0       5.0       0.013     342.5
PSCOEFFS                      0.65                8.0
PSINLET   ELEV      0.9       50        351.5     4.0       5.0
ASCREST   ELEV      363.0
ASDATA    42 350    250       0.04      2.0       0.04      4.0
ASRATING  42        1.0       TYPE 3 PROFILE
ASRATING  1.83      6.30      12.5      20.2      28.9      38.8
ASRATING  49.7      61.5      74.1      87.6      101.8     116.7
BTMWIDTH  FEET      500
MINDEPTH  1.0       4.0       1.0       2.0
MINDISCH  200       0.5       6.0
GO,DESIGN L N       TYPE2     24
GO,REACH  0    A XS6          4200      0.5       1.3
WSDATA    1C S21    70        3.6       2.7                 0.0
BASEFLOW            2.0
PDIRECT   1.0       7.3       12.0      15.1      33.1      12.0
GO,DESIGN           TYPE2     24
GO,ADDHYD 1      XS9
GO,REACH  2    AXS10          2500      0.4       1.2
*
*         SITE C,   GIVEN PS RATING, ASDATA AND SPILLWAY TEMPLATE
*                       USED TO COMPUTE AUXILIARY SPILLWAY RATING
*                       BY WSPVRT.  DEMONSTRATES PDIRECT WITH AREA
*                       CORRECTIONS, BASEFLOW, DDTEST.
*
STRUCTURE ID=C      LOWER SITE C, GIVEN PS RATING, ASDATA AND TEMPLATE
                    280       475       0.0                 9572
                    281       480       70
                    282       485       180
                    284       510       290
                    285.3     535       370
                    286.0     550       460
                    287.0     565       660
```

Figure C–10 Control file containing input for sample job 10—Continued

```
                    288       585       1040
                    292       650       1620
                    296       705       1720
                    298       735       1770
                    300       770       1810
                    304       845       1890
                    308       920       1950
END TABLE
WSDATA    4 C C     68        14.8      4.0                 4.5
BASEFLOW  281.5     2.0
PDIRECT   1.13      7.3       12.0      15.1      33.1      12.0
AREACRCT  4         1.0       1.0       1.0
POOLDATA  ELEV      280       280       0.0       260       260
DDTESTS   12.0      0.20
ASCREST   FEET                2.0
ASDATA    01 600                        2.0                 2.0
ASINSURF  01        CI        5.6       5.6
ASEXIT    01        N         1.
ASEXSURF  01        CI        5.6       5.6
                    CF        .9        .9
                    MC        1         3
                    RD        1         1
                    D75       .008
ENDTABLE
ASCOORD   1         ALLUVIUM  N
          0.0       285       100       293       200       298
          250       303       275       302       300       300
          350       303       400       305       450       302
          500       297       550       296       600       294
          700       291       800       285.7     900       280
          950       275       1000      270       1200      250
ENDTABLE
ASCOORD   2         WTHRD-ROCK
          100       285       200       295       300       298
          400       302       500       295       700       287
ENDTABLE
ASCOORD   3         SHALE
          0         275       100       285       200       289
          300       293       400       296       500       293
          600       289       700       287       850       275
ENDTABLE
ASCOORD   4         LIMESTONE
          0         275       100       278       200       284
          300       285       400       286       500       286
          600       284       700       281       850       275
          1000      268       1200      248
ENDTABLE
ASMATERIAL1                             CENTERLINE SPILLWAY
          1         12        .008      20        110       .07
          2         0         2.0       0         120       .4
          3         0         7.        0         130       7.
          4         0         18.0      0         160       200.
```

Figure C–10 Control file containing input for sample job 10—Continued

```
ENDTABLE
BTMWIDTH  FEET      600       800
GO,DESIGN L         TYPE2M    24
*
*           PASS 2  WITH VELOCITY LIMIT
*
BTMWIDTH  VELOCITY  7.50
GO,DESIGN L         TYPE2M    24
ENDJOB
ENDRUN
```

Appendix D Output Errors, Warnings, Messages, and Notes

Various output messages and explanations follow. This list should help determine the exact cause of a particular problem. The list groups the types of messages by errors, warnings, messages, and notes. The Notes section at the end of this appendix includes additional output information not included in the other message categories.

Errors (1–4)

Error messages are listed by error number. You can find the error quickly by referring to the numbers in parenthesis after the page heading.

1. **MUST HAVE EXIT CHANNEL SLOPE WITH PRECOMPUTED ASFILE RATINGS.**

   Remarks: SITES requires an exit slope to compute exit channel velocity when using precomputed subcritical flow ratings.

   Action: Enter an exit channel slope equal to 1% or greater.

2. **AUXILIARY SPILLWAY DESIGN (TR60) MUST BE BASED ON CRITICAL DEPTH AT THE CONTROL SECTION.**

   Remarks: Only class code Al or S structures can use precomputed subcritical flow ratings for design of the auxiliary spillway.

   Action: Use a water surface profile design procedure or enter own rating.

3. **EXIT CHANNEL SLOPE, <u>x.xxxx</u> CAN NOT BE LESS THAN 1 PERCENT WHEN USING PRECOMPUTED "ASFILE" RATING. RUN STOPPED.**

   Remarks: You entered profile reference number 30 with an exit channel slope less than 1%. This is outside of the range used to develop the precomputed ratings.

   Action: Increase slope or develop new rating using different profile reference number.

4. **QUICK RETURN FLOW ENTERED BY "WSDATA" IS ONLY APPROPRIATE FOR THE LOWEST SITE. RUN STOPPED.**

   Remarks: An upper site or subarea has a QRF value. Add QRF only to the site being designed.

   Action: Enter zero or leave blank the QRF values on all but the lower site. The program uses the total accumulated drainage area to compute the QRF.

Errors (5–9)

5. NO AREA OR VOLUME DATA GIVEN FOR THE SITE. PASS STOPPED.

Remarks: Each pass must have area or volume data available from STRUCTURE data. If you give neither, the program triggers this message. Actually, zero or blanks in both the area and volume columns for the last input elevation triggers message.

Action: Supply area or volume data in STRUCTURE data.

6. STRUCTURE DATA PRINCIPAL SPILLWAY CREST INFORMATION IS NOT IN AGREEMENT WITH POOL DATA. STRUCTURE DATA CREST = <u>xxxxx.xx</u>, POOLDATA CREST = <u>xxxxx.xx</u>. RUN STOPPED.

Remarks: The first elevation in the STRUCTURE table, when you give the PS rating, must be within 0.05 foot in elevation of the PS crest given on the POOLDATA record and the associated discharge must be zero.

Action: Correct the STRUCTURE table or the POOLDATA record.

7. ELEVATION OF SECOND STAGE IS LOWER THAN CREST OF PRINCIPAL PLUS ORIFICE HEIGHT.

Remarks: Based on given information, the dimensions of the two-stage principal spillway riser are not feasible.

Action: Change orifice dimensions and/or increase high stage weir elevation or use a single stage principal spillway.

8. "GO,TDD" NOT VALID FOR A NULL SITE, SEE CODE IN COLUMN 16 OF "WSDATA" CONTROL RECORD.

Remarks: GO,TDD (execute drawdown computations) is not valid for a null site. Check the code in column 16 of the WSDATA record to make sure a null site was intended. A GO,TDD run does not require WSDATA.

Action: Check user's guide for data required for GO,TDD run.

9. "GO,TDD" NOT VALID WITHOUT PRINCIPAL SPILLWAY DATA OR GIVEN RATING.

Remarks: A GO,TDD run requires a principal spillway rating, computed or given.

Action: Insert a STRUCTURE table and PSDATA plus the correct inlet records as needed.

Errors (10–14)

10. INITIAL FLOOD ROUTING ELEVATION xxxxx.xx FEET IS HIGHER THAN MAXIMUM GIVEN IN STRUCTURE DATA OF xxxxx.xx FEET.

Remarks: The initial elevation, col. 11–20 on the BASEFLOW control word, is out of range of the STRUCTURE data table.

Action: If the initial elevation is reasonable, increase the STRUCTURE table elevations. However, if the discharge associated with the initial elevation is higher than the peak of the inflow hydrograph, the initial elevation may not show on the line plot.

11. "GO,DESIGN" WITHOUT PRINCIPAL SPILLWAY DATA OR GIVEN PS RATING REQUIRES AUX. CREST ELEVATION TO BE GIVEN. USE COLUMNS 21–30 OF "ASCREST" CONTROL RECORD.

Remarks: Unable to compute auxiliary spillway crest without a principal spillway rating because col. 21–30 blank on ASCREST.

Action: Put auxiliary spillway crest in col. 21–30 of ASCREST or provide principal spillway rating data.

12. PRINCIPAL SPILLWAY HYDROGRAPH DID NOT HAVE RAINFALL OR RUNOFF VALUES, OR NO PSH HYDROGRAPH GIVEN. RUN STOPPED.

Remarks: User requested a principal spillway hydrograph routing, but the required input was not available.

Action: Provide required input.

13. ASFILE RECORD (ref. no.) HAS NOT BEEN LOADED.

Remarks: The indicated profile record is missing from the ASFILE input data.

Action: Include or correct the profile reference number and associated discharge data in the ASFILE input data.

14. TRIAL AND ERROR BOTTOM WIDTH SOLUTION NOT VALID FOR NHCP–378 RUN USING RETARDANCE WITH ASFILE RATING.

Remarks: User instructed the program to compute an auxiliary spillway bottom width based upon velocity during passage of the auxiliary spillway hydrograph. The program does not contain this option for NHCP–378.

Action: Input an auxiliary spillway bottom width using the FEET option on the BTMWIDTH control word.

Errors (15–20)

15. **HYDROGRAPH TYPE CODE IN COLUMNS 11–20 OF "HYD" CONTROL SHOULD BE AN S OR 9 FOR A STORM HYD.**

Remarks: SITES did not recognize the hydrograph type code as a storm hydrograph. The code must be a S or 9 with a GO,HYD control word or 1, 3, or 5 with GO,DESIGN. See HYD control word in the user's guide.

Action: Correct type code or use appropriate GO, control word.

16. **VELOCITY OPTION ON "BTMWIDTH" CONTROL CAN NOT BE USED FOR AN EXISTING SITE (SITE CODE = 2).**

Remarks: SITES requires a bottom width in feet for simulation runs.

Action: Enter bottom width in feet instead of velocity.

17. **"GO,DESIGN" WITH AUX. RATING GIVEN ON THE "STRUCTURE" CONTROL AND CREST BLANK ON THE "ASCREST" CONTROL.**

Remarks: Since the auxiliary spillway crest must be known to enter the rating in the STRUCTURE table, the program requires it on the ASCREST record in columns 21–30.

Action: If the STRUCTURE rating is correct, enter the elevation where the rating starts in columns 21–30 of the ASCREST record.

18. **ASCOORD TABLE OUT OF SEQUENCE OR MATERIAL NUMBER xx OUT OF RANGE. MATERIAL NUMBERS MUST START AT 1 AND CONTINUE SEQUENTIALLY TO A MAXIMUM OF 10.**

Remarks: ASCOORD tables must be numbered 1 to 10 in sequence, with a maximum of ten tables.

Action: Renumber tables correctly.

19. **DISTANCES DECREASING IN ASCOORD MATERIAL xx TABLE. CHECK POINT xx IN TABLE.**

Remarks: Distances should increase in ASCOORD table.

Action: Check and correct points shown and rerun.

20. **NUMBER OF POINTS, xx ON ASCOORD MATERIAL xx TABLE OUTSIDE OF RANGE 2 TO 21 POINTS.**

Remarks: Too few or too many points in ASCOORD table.

Actions: Add or delete as necessary.

Errors (21–25)

21. "AREACRCT" CONTROL IS REQUIRED WITH CLIMATE ZONE 4 (COLUMN 11 – "WSDATA" CONTROL).

Remarks: Climate zone 4 indicates you will enter areal rainfall correction factors with an AREACRCT control word.

Action: Enter an AREACRCT record with required correction factors.

22. ILLEGAL CHARACTER FOUND IN THE FOLLOWING RECORD:

Remarks: Program looked for numeric data, but it encountered a non-numeric, nonblank character. The program printed the offending record below the above error with a "$" indicating the field causing the error.

Action: Check input data and insure that numeric data is in the fields where it is required.

23. NEGATIVE NUMBER NOT ALLOWED IN THE INDICATED DATA FIELD:

Remarks: SITES found negative data in a field where data must be positive. The program printed the record below the above error with a "$" indicating the field where the error occurs.

Action: Check input data and input a positive value.

24. ESSENTIAL DATA IS MISSING IN THE FOLLOWING RECORD:

Remarks: SITES found a blank in a data field where the user must enter essential data. The program printed the data record below the above error with the missing data field indicated with a "$."

Action: Reread control word description and insert required value.

25. MATERIAL xx IN THE ASMATERIAL TABLE DOES NOT AGREE WITH MATERIAL NUMBERS FROM THE xx ASCOORD TABLES.

Remarks: The program found a wrong number in either the ASMATERIAL table or in the ASCOORD tables.

Action: Check numbers between tables for consistency.

Errors (26–30)

26. PASS STOPPED. SUPERCRITICAL FLOW IN RETARDANCE COMPUTATIONS WITH RATING FROM ASFILE.

Remarks: The retardance procedure will not allow supercritical flow in the auxiliary spillway exit channel. The slope of the exit channel is too steep.

Action: Decrease slope of exit channel or widen the spillway.

27. EXIT CHANNEL SLOPE OR BOTTOM WIDTH OUT OF RANGE, EXIT CHANNEL DEPTH xxx.xx SHOULD BE LESS THAN HP – PASS STOPPED.

Remarks: Computed auxiliary spillway exit channel depth is greater or equal to the H_p. Probably, the exit channel is too flat or the bottom width is outside of the range used in the development of the precomputed ratings. (See ASFILE, note 4.)

Action: Steepen exit slope and/or change bottom width to be within range 8 to 200 feet.

28. INVALID INPUT PROFILE NUMBER (xx), MUST NOT BE OVER 50 OR EQUAL TO 30.

Remarks: The given profile number is not a valid number.

Action: Replace with a valid profile number.

29. DISTANCES IN ASSPRFL TABLE MUST INCREASE IN THE DOWNSTREAM DIRECTION. CHECK POINT xx.

Remarks: Distances decrease in the downstream direction in the ASSPRFL table.

Action: Correct table so the distances increase going downstream.

30. MINIMUM OF TWO POINTS IS REQUIRED IN ASSPRFL TABLE.

Remarks: There is only one valid point in the ASSPRFL table.

Action: Add at least one more point to the table or correct invalid points.

Errors (31–35)

31. PROGRAM REVISION INPUT DATE NOT COMPATIBLE WITH USER INPUT DATE ON SITES CONTROL. FATAL ERROR.

or

31. ON SITES CONTROL, USE xx/xx/xxxx FOR DATE.

Remarks: The current program revision input date, as given in the following line, must be in the format —/—/— and identical to that in the current program version.

Action: Revise date on SITES control word and make other input changes as required.

32. JOB MUST START WITH THE "SITES" OR "DAMS2" CONTROL WORD.

Remarks: The first record of a job is required to have SITES or DAMS2 in columns 1 to 10. The above note is followed by a longer paragraph in the output that explains the program revision date needed to make a successful run.

Action: Use the SITES or DAMS2 control word as the first record of a job. Include the correct program revision date, watershed ID, and job title on it, and rerun.

33. MINIMUM OF ONE SURFACE RECORD IS REQUIRED IN ASSURFACE TABLE.

Remarks: ASSURFACE needs at least one surface record describing reach conditions.

Action: Enter at least one surface record describing reach conditions in the table.

34. ALL STRUCTURE TABLE VALUES MUST BE IN INCREASING ORDER.

Remarks: The surface area, discharge, and volume must increase with elevation on all STRUCTURE records.

Action: Inspect all STRUCTURE data fields to find problem with increasing order from top to bottom. Revise table and rerun.

35. INVALID DESIGN CLASS, MUST BE A1, A2, A3, B, C, OR S.

Remarks: The indicated class code is not one of the six approved class codes. Note that an "A" class code is defaulted to an A2 class code.

Action: On WSDATA record, columns 12–13, insert proper class code.

Errors (36–41)

36. PROFILE NUMBER MUST BE BETWEEN 01–50 IN COLUMNS 11–12 OF "ASDATA" RECORD. PROFILE NUMBER GIVEN WAS xx.

Remarks: The program found a profile reference number outside the range of 1 to 50 on the ASDATA record.

Action: Use a profile reference number between 1 and 50 in columns 11–12 on the ASDATA record.

37. ASSPRFL TABLE EXCEEDS 21 POINT LIMIT. RUN STOPPED.

Remarks: The program found too many points in ASSPRFL table.

Action: Reduce number of points to 21 maximum.

38. GIVEN AUX. SPILLWAY RATING ("ASRATING") REQUIRES A POSITIVE VALUE FOR THE ELEVATION INCREMENT AND 12 DISCHARGE VALUES.

Remarks: SITES requires three ASRATING records together. The program requires the elevation increment and all 12 discharge per foot bottom width values and no negative or zero values of discharge or of the elevation increment.

Action: Review the input and revise as necessary.

39. THE GIVEN RAINTABLE HAS NO VALID TABLE POINTS.

Remarks: The program requires a minimum of two unequal points for the RAINTABLE distribution.

Action: Increase number of points, but do not duplicate the last point.

40. SURFACE PARAMETERS RELATED TO ASEXSURF EXIT CHANNEL INPUT REQUIRE 4 or 5 INPUT RECORDS PLUS AN ENDTABLE.

Remarks: The program requires more records in the ASEXSURF table or the program requires the ENDTABLE and it is missing.

Action: Add the required records and/or add ENDTABLE if needed.

41. NO "ENDTABLE" CONTROL COMMAND GIVEN AT END OF TABULAR DATA.

Remarks: SITES requires an ENDTABLE after tabular data.

Action: Enter an ENDTABLE after the tabular data.

Errors (42–46)

42. THE DIMENSIONLESS HYDROGRAPH TABLE MUST CONTAIN MORE THAN ONE INPUT POINT. CHECK "DIMHYD" INPUT.

Remarks: SITES requires DIMHYD to have more than one point.

Action: Enter new DIMHYD table or use standard DIMHYD default table already in program with factor = 484.

43. TIE–IN STATION FOR THE DOWNSTREAM EDGE OF THE AUXILIARY SPILLWAY CREST IS REQUIRED INPUT ON ASDATA RECORD.

Remarks: Tie-in station is missing or unrecognizable.

Action: Enter tie-in station in columns 14–20 on ASDATA.

44. INVALID INPUT PROFILE NUMBER (xx), MUST BE BETWEEN 41 AND 50.

Remarks: The program reserves profile reference numbers 1–40 for program defined profiles. User input profile numbers must be between 41 and 50. The program will ignore the entire input profile. This may trigger another fatal message (# 13): AS RECORD (ref. no.) HAS NOT BEEN LOADED.

Action: Input on ASDATA and ASINLET records a profile reference number between 41 and 50.

45. TOTAL DISTANCES FROM THE CONTROL SECTION MUST BE USED TO DEFINE THE AUXILIARY SPILLWAY PROFILE ON THE ASINLET RECORDS.

Remarks: The program requires the total upstream distances from the control section on ASINLET, not the incremental distances.

Action: Revise the profile points so distances are increasing.

46. VALLEY FLOOR ELEVATION IS REQUIRED INPUT ON POOLDATA RECORD WITH INTEGRITY ANALYSIS.

Remarks: The program requires a valley floor elevation on POOLDATA.

Action: Enter a valley floor elevation.

Errors (47–51)

47. AREAL CORRECTION ZONE NUMBER MUST BE LESS THAN OR EQUAL TO 4.

Remarks: The Areal Correction Climate Zone Number in columns 11–20 of AREACRCT must be blank or less than or equal to 4. If less than 4, the program sets it to 4.

Action: Use a zone number of 4 in columns 11–20 of the AREACRCT record.

48. FOR (NHCP378) DESIGN RUNS, THE EXIT CHANNEL SLOPE FOR THE AUXILIARY SPILLWAY MUST BE ENTERED USING THE "ASDATA" COMMAND WHEN ASFILE IS USED FOR THE RATING. RUN STOPPED.

Remarks: For an NHCP–378 run based on subcritical flow the program requires the exit slope. If not an NHCP–378 run, col. 46–50 of the GO,DESIGN record must be blank.

Action: Enter appropriate data on the ASDATA record for NHCP–378 run with the ASFILE: reference number 30, columns 11–12; retardance class, column 13; and exit slope, columns 61–70.

49. DURATION OF STORM MUST BE GIVEN ON EITHER THE RAINTABLE OR THE GO,DESIGN CONTROL.

Remarks: The program found a RAINTABLE without the storm duration. It requires the duration on either the table or GO,DESIGN.

Action: Enter the duration of rainfall in hours and rerun.

50. THE RAINFALL TABLE " ID" REQUESTED FOR PRINCIPAL SPILLWAY HYDROGRAPH ON "GO" COMMAND WAS NOT FOUND. RUN STOPPED.

Remarks: The RAINFALL table ID in columns 11–15 did not match exactly the table ID in columns 41–45 of the GO,DESIGN record.

Action: Check for a blank field or a spelling error.

51. RAINTABLE "<u>ID</u>, " REQUESTED FOR AN AUXILIARY SPILLWAY OR STORM HYDROGRAPH WAS NOT FOUND. CHECK SPELLING IN COLUMNS 21–25 ON THE "GO" COMMAND.

Remarks: The RAINFALL table ID in columns 11–15 did not match exactly the table ID in columns 21–25 of the GO, record.

Action: Check for a blank field or a spelling error.

Errors (52–55)

52. ONLY ONE DESIGN SITE IS ALLOWED FOR SITES IN SERIES RUNS. ROUTING CODES ARE: SITE TYPE = xxx, OPERATION CONTROL NUMBER = xxx. RUN STOPPED.

Remarks: The site type NOROUT, col. 16 on the WSDATA control word (or record 2, columns 11–20 of HYD), must be zero for the site being designed. This is the lowest site in a series of sites.

Action: Make separate design runs for upper sites, then rerun as existing structures with site type = 2. Also check operation control numbers (NADD) (column 11 in GO,ADDHYD or GO,REACH) for proper use.

53. CONVEX REACH ROUTING REQUESTED. NO CROSS SECTION DATA OR CONVEX ROUTING COEFFICIENTS GIVEN. RUN STOPPED.

Remarks: The GO,REACH record has a blank section number in columns 21–30 instructing the program to use a routing coefficient, but in columns 41–50 the coefficient was also blank.

Action: Either enter a routing coefficient in columns 41–50 or supply section data and indicate section number on the GO,REACH record.

54. CROSS SECTION DATA NOT ENTERED FOR "GO,REACH" REQUEST. MUST ENTER COEFFICIENTS OR SECTION DATA.

Remarks: The cross section number indicated in columns 21–30 of the GO,REACH record has not been previously supplied using XSECTN or 2XSECTN table records.

Action: Supply the required section data prior to the GO,REACH record.

55. ILLEGAL CHARACTER FOUND IN "ADDHYD" OPERATION FIELD. RUN STOPPED.

Remarks: The program found an illegal operation control character in col. 11 of GO,ADDHYD record.

Action: Change to correct number, 0 or blank, 1, or 2. See GO,ADDHYD instructions.

Errors (56–61)

56. DEPTHS IN AUXILIARY SPILLWAY INLET CHANNEL CAN NOT DECREASE GOING UPSTREAM ON THE ASINLET RECORDS.

Remarks: Depths are decreasing in the inlet channel.

Action: Examine the depths of the channel bed below the crest, and enter ones which do not decrease going upstream.

57. CROSS SECTION NUMBER IS NOT WITHIN ACCEPTABLE RANGE (1–200). CHECK "XSECTN" OR "2XSECTN" INPUT.

Remarks: The program found a section number outside of the range 1–200 on a XSECTN or 2XSECTN record.

Action: Keep section numbers in the range 1–200.

58. ALLOWABLE EFFECTIVE STRESS OF <u>xx.xxx</u> ON BTMWIDTH RECORD EXCEEDED 15, THE MAXIMUM ALLOWED UNVEGETATED VALUE.

Remarks: Stress value on BTMWIDTH is too high.

Action: Reduce the stress value on BTMWIDTH to 15 or less.

59. LESS THAN 3 RATING INFORMATION POINTS IN CROSS SECTION <u>xxx</u>.

Remarks: The program requires at least two points above the zero discharge point to define the cross section used in reach routing.

Action: Increase the number of points in the rating table.

60. CROSS SECTION <u>xxx</u> RATING INFORMATION NOT ALL INCREASING. LIST OF DATA FOLLOWS.

Remarks: The elevation, discharge, and end area values must increase with the elevation at each point in the table that follows this message. Only the first point may have zero values.

Action: Correct the cross section table.

61. INVALID INPUT PROFILE NUMBER (<u>xx</u>), MUST BE BETWEEN 1 AND 50.

Remarks: Profile number is out of range; see guide for acceptable input profile number.

Action: Change profile number to acceptable value between 1 and 50.

Errors (62–66)

62. ILLEGAL CHARACTER FOUND IN "2XSECTN" INPUT FIELD.

Remarks: SITES found a non-numeric character in one of the data fields of the 2XSECTN table records.

Action: Inspect 2XSECTN records for non-numeric data and correct.

63. AN ILLEGAL CHARACTER WAS FOUND IN HYDROGRAPH STORAGE MOVE LOCATION ON "SAVMOV" COMMAND. RUN STOPPED.

Remarks: The program found a non-numeric value in the "from" or "to" location (columns 11–15 and 16–20) on the SAVMOV record.

Action: Inspect the SAVMOV RECORD and correct.

64. A BLANK FIELD WAS FOUND IN HYDROGRAPH STORAGE LOCATION ON "SAVMOV" COMMAND. RUN STOPPED.

Remarks: SITES found a blank field in the "from" or "to" location (columns 11–15 and 16–20) on the SAVMOV record.

Action: Inspect the SAVMOV RECORD and correct.

65. HYDROGRAPH MOVED TO xx FROM xx. THIS IS NOT AN INFLOW HYDROGRAPH STORAGE LOCATION. RUN STOPPED.

Remarks: Hydrograph storage array numbers on the SAVMOV control word in the "from" field (columns 11–15) must be between 1–15 and in the "to" field (columns 16–20) must be between 1–7 or 9–15.

Action: Change the array numbers to allowable values.

66. LOCATION TO MOVE HYDROGRAPH IS OUTSIDE THE ACCEPTABLE RANGE OF 1–15. RUN STOPPED.

Remarks: Hydrograph storage array numbers on the SAVMOV record must actually be between 1–15, but moving a hydrograph into 13–15 will wipe out any accumulated hydrograph stored in these locations.

Action: Correct the array numbers to within the acceptable range.

Errors (67–71)

67. AN ILLEGAL CHARACTER WAS FOUND IN THE HYDROGRAPH STORAGE LOCATION ON TR20 HYDROGRAPH INPUT. USE NUMBER FROM 1–9. RUN STOPPED.

Remarks: The program found a non-numeric value in column 17 of the 7READHD record. The acceptable inflow hydrograph storage array numbers are 1, 3, 5, 7, or 9.

Action: Change character to an acceptable value.

68. BLANK FIELD WAS FOUND ON TR20 HYDROGRAPH INPUT (7READHD) ON WHERE TO STORE THE HYDROGRAPH. USE A LOCATION FROM 1–9. RUN STOPPED.

Remarks: SITES found a blank field in column 17 of the 7READHD record. The acceptable inflow hydrograph storage array numbers are 1, 3, 5, 7, or 9.

Action: Enter an acceptable array number in column 17.

69. HYDROGRAPH STORAGE LOCATION GIVEN ON TR20 HYDROGRAPH INPUT IS OUTSIDE THE ACCEPTABLE RANGE (1–9). RUN STOPPED.

Remarks: The program found an out of range number in column 17 of the 7READHD record. The acceptable inflow hydrograph storage array numbers are 1, 3, 5, 7, or 9.

Action: Enter an acceptable array number in column 17.

70. ILLEGAL CHARACTER FOUND IN HYDROGRAPH TIME INCREMENT FIELD, TR20 HYDROGRAPH INPUT. RUN STOPPED.

Remarks: The program found a non-numeric character in the time increment field in columns 25–26 of the second data record of a 7READHD table.

Action: Inspect and correct the time increment.

71. A BLANK FIELD WAS FOUND FOR THE HYDROGRAPH TIME INCREMENT IN THE TR20 HYDROGRAPH INPUT. RUN STOPPED.

Remarks: The program found a blank field for the time increment, columns 25–26 of the second data record of a 7READHD table.

Action: Enter the hydrograph time increment.

Errors (72–76)

72. ILLEGAL CHARACTER IN HYDROGRAPH DATA FIELD FOR TR20 INPUT. RUN STOPPED.

Remarks: The program found a non-numeric character in one or more of the discharge fields of a 7READHD table.

Action: Inspect and correct the discharge fields.

73. ANALYSIS REQUIRES AN ASEXSURF TABLE FOR ENTRY OF CF AND MC EXIT CHANNEL VALUES. THE CI ("n") MAY BE ON THE ASDATA.

Remarks: SITES requires an ASEXSURF table for stability and/or integrity analysis, but the C_I or "n" values may be left blank if given on ASDATA for the exit channel.

Action: Add ASEXSURF with required data.

74. RAINTABLE ID VALUES ARE ACCUMULATIVE. VALUES MUST NOT DECREASE. ONLY BLANK VALUES ARE CHANGED TO PRECEDING VALUE. ERROR FOLLOWS VALUE <u>xxxx.xxxxx</u>. CORRECT TABLE AND RERUN.

Remarks: Rainfall values in a RAINTABLE are accumulative with time. Each value must be greater or equal to its proceeding value within the table. The program assumes blanks to be equal to the preceding values.

Action: Inspect and revise rainfall values as needed.

75. RUN OPTION 'S' MUST BE GIVEN ON A GO,STORM; GO,RAINS; OR GO,HYD CONTROL WHEN THE AUXILIARY SPILLWAY CREST IS BLANK.

Remarks: SITES expects a principal spillway only pass in this non-design situation.

Action: Enter an 'S' in column 11–20 of the GO, control or do not leave column 21–30 of ASCREST blank.

76. CREST OF AUX. SPILLWAY IS BELOW OR AT THE COMPUTED ELEVATION FOR THE WEIR–SLUG FLOW INTERSECTION OF THE HOOD INLET (<u>xxxxx.xx</u> FT); PASS STOPPED.

Remarks: SITES is not programmed to rate a hood inlet with this inefficient design. A hood inlet pipe should flow full below the auxiliary spillway crest.

Action: Determine if an input error occurred or if correct enter rating in the STRUCTURE table and rerun.

Errors (77–80)

77. HOOD INLET, VALUES MISSING ON THE INPUT RECORD.

Remarks: The program found a blank or zero in an essential data field on the PSHOOD record.

Action: Inspect the PSHOOD record for missing data and correct.

78. DRAINAGE AREA GIVEN IN TWO PLACES FOR THIS PASS, ON THE WSDATA AND HYD CONTROLS.

Remarks: Check for the correct drainage area if the two entries differ. Determine if the WSDATA control word is needed, because you may insert in the HYD table the only information required to enter a hydrograph.

Action: Delete WSDATA if not needed, or remove the drainage area from columns 21–30 of the first record of the HYD table.

79. ATT–KIN ROUTING MUST HAVE BOTH X AND M VALUES, OR A CROSS SECTION GIVEN.

Remarks: You must enter either a cross section ID or both Att-Kin coefficients (x and m values) in the proper data fields on the REACH record when using the Modified Att-Kin reach routing procedure.

Action: Revise the REACH record as needed. If giving a cross section ID, provide a XSECTN or 2XSECTN table with the same ID.

80. INVALID DATA FOR SITE TYPE ON "HYD" OR "7READHD" COMMANDS. RUN STOPPED.

Remarks: The site type code must be blank or 0, 1, or 2 on the second HYD table record columns 11–20 or on the first 7READHD record in column 25. It can be left blank if given on WSDATA in column 16.

Action: Enter the correct site type code where appropriate.

Errors (81–84)

81. IN COMPUTING PRINCIPAL SPILLWAY RATING CURVE — HEAD ON ORIFICE, WEIR, OR PIPE IS NEGATIVE OR ZERO. CHECK STRUCTURE TAILWATER INPUT — RUN STOPPED.

ERROR OCCURRED BETWEEN RATING TABLE POINTS xx AND xx, WITH COEFFICIENT = x.xxx AND EXPONENT = xx.xxx; HEAD IS BETWEEN ELEVATIONS xxxxx.xx FT AND xxxxx.xx FT.

Remarks: A negative or zero head occurring where indicated caused an error in the computation of the principal spillway discharge.

Action: Check tailwater elevation in columns 61–70 of PSDATA to see if it is below principal spillway inlet elevation. Also check two stage inlets to see that the high stage weir crest is between the PS and AS (if specified) crests.

82. TRAPW METHOD NOT VALID FOR OTHER THAN ASDATA INPUT SEQUENCE.

Remarks: You must enter an ASDATA record. The program may also need ASINLET for computation of auxiliary spillway water surface profiles by the TRAPW method.

Action: Enter essential data on ASDATA.

83. CREST OF AUX. (xxxx.xx) EQUALS OR EXCEEDS MAXIMUM INPUT ELEVATION (xxxx.xx).

Remarks: The given auxiliary spillway crest elevation, within the first set of parentheses, is higher than the maximum input elevation in the STRUCTURE data.

Action: Increase the elevation range covered by the STRUCTURE data, or if the error occurs when trying to obtain full pipe flow, increase weir length or orifice size.

84. PSH RAINFALL OR RUNOFF MUST BE GIVEN FOR THIS CLASS DAM — RUN STOPPED.

Remarks: Principal spillway rainfalls or runoffs were not input. The program can compute rainfalls for only class code C or S dams. Use a CLASS control word as input with class code.

Action: Input PDIRECT or QDIRECT or a CLASS record with class code S.

Errors (85–89)

85. PROFILE IN AUX. INLET IS SUPERCRITICAL FOR D = <u>xx.xx</u>.

Remarks: TRAPW water surface profile starting at depth indicated is in supercritical flow in the inlet channel.

Action: Check input for ASINLET (ASPROFILE) and/or ASDATA errors and alter data to ensure subcritical flow in the inlet channel, or use WSPVRT to compute the spillway rating.

86. TRIAL/ERROR PROCEDURE FOR FULL ORIFICE FLOW ELEVATION FAILED. CHECK INPUT, RUN STOPPED.

Remarks: SITES stopped the trial and error procedure for computation of the full orifice flow elevation at 1000 trials because the standard accuracy of .01 foot was not reached.

Action: Inspect input related to orifice flow and correct or revise.

87. TRIAL/ERROR PROCEDURE FOR FULL PIPE FLOW ELEVATION FAILED. CHECK INPUT, RUN STOPPED.

Remarks: SITES stopped the trial and error procedure for computation of the full pipe flow elevation at 1000 trials because the standard accuracy of .01 foot was not reached.

Action: Inspect input related to pipe flow and correct or revise.

88. TRIAL/ERROR PROCEDURE FOR FULL PIPE FLOW ELEVATION BELOW SECOND STAGE WEIR FAILED. CHECK INPUT, RUN STOPPED.

Remarks: SITES stopped the trial and error procedure for computation of the full pipe flow elevation below a second stage weir at 1000 trials because the standard accuracy of .01 foot was not reached.

Action: Inspect input related to pipe flow and the second stage weir flow. Correct or revise as necessary.

89. FULL ORIFICE FLOW ELEV. LESS THAN ORIFICE CREST ELEVATION. RUN STOPPED.

Remarks: Computed elevation of full orifice flow is less than or equal to the elevation of the orifice crest resulting in 0.0 or negative head on the orifice.

Action: Inspect and revise principal spillway input data.

Errors (90–94)

90. FULL PIPE FLOW ELEV. LESS THAN ORIFICE CREST ELEVATION. RUN STOPPED.

Remarks: Computed elevation of full pipe flow is less than or equal to the elevation of the orifice crest resulting in 0.0 or negative head on the orifice.

Action: Inspect and revise principal spillway input data.

91. FULL PIPE FLOW ELEV. LESS THAN TAILWATER ELEVATION. RUN STOPPED.

Remarks: Computed elevation of full pipe flow is less than or equal to the tailwater elevation resulting in 0.0 or negative head on the orifice.

Action: Inspect and revise principal spillway input data.

92. DRAINAGE AREA GIVEN IN TWO PLACES FOR THIS PASS, ON THE "WSDATA" AND "7READHD" CONTROLS. RUN STOPPED.

Remarks: Check for the correct drainage area if the two entries differ. Determine if the WSDATA record is needed, since you may insert in 7READHD the only information required to enter a hydrograph.

Action: Delete the WSDATA record if not needed, or remove the drainage area in column 37–48 from the second record of the 7READHD table.

93. ILLEGAL CHARACTER FOUND IN DRAINAGE AREA ON "7READHD" SECOND RECORD. RUN STOPPED.

Remarks: The program found a non-numeric character in columns 37–48 of the second record in the 7READHD table.

Action: Inspect and revise drainage area if needed. See error 92.

94. SPILLWAY SURFACE COMPUTED TO HAVE ONLY <u>xx</u> POINTS, CHECK INPUT.

Remarks: Spillway surface must be defined by at least 2 points.

Action: Examine input data defining profile of auxiliary spillway surface.

Errors (95–99)

95. HOOD INLET, MITER ELEVATION IS BELOW OUTLET ELEVATION.

Remarks: The pipe elevation at the miter bend (columns 31–40) must be higher then the outlet elevation (columns 41–50) to prevent a negative pipe slope.

Action: Correct the PSHOOD elevation data and rerun.

96. INTEGRITY ANALYSIS REQUIRES ASCOORD, ASMATERIAL, AND ASSURFACE TABLES.

Remarks: The program requires data from these tables to perform auxiliary spillway integrity analysis.

Action: Add the missing table(s).

97. THIS ANALYSIS REQUIRES AN ASSURFACE TABLE TO BE ENTERED. CI OR "n" VALUES ARE REQUIRED.

Remarks: The program requires parameters describing the surface characteristics of the auxiliary spillway.

Action: Add ASSURFACE table.

98. UNABLE TO RE–ORDER MATERIALS SO NO LOWER NUMBERED MATERIAL IS BELOW A HIGHER ONE. PROBLEM APPEARS TO INVOLVE MATERIALS NO. xx AND xx IN THE VICINITY OF X–DISTANCE = xxxxx; ATTEMPTED xxx REORDERING TRIALS BEFORE EXITING.

Remarks: Program could not satisfactorily order data from ASCOORD tables to define location of geologic materials. It is probable that lines defining material surfaces cross.

Action: Correct ASCOORD tables and rerun.

99. POINTS xx AND xx OF MATERIAL NO. xx DO NOT SATISFY REQUIREMENTS FOR INCREASING X–DISTANCE.

Remarks: ASCOORD table points named in error statement do not increase in x-coordinate. Points must be entered sequentially with increasing horizontal coordinates (stations).

Action: Correct table entries for the material number shown and rerun.

Errors (100–104)

100. WSPVRT WATER SURFACE PROFILE PROCEDURE WHEN USED ALONE REQUIRES ASCOORD TABLE FOR EXISTING SURFACE (MATERIAL 1).

Remarks: The ASCOORD table has been indicated as the source of the auxiliary spillway surface profile, but the table has not been entered.

Action: Add an ASCOORD table for existing surface of the spillway.

101. ELEVATION VALLEY FLOOR xxxxx.xx IS HIGHER THAN MAXIMUM POINT OF THE EXISTING SURFACE xxxxx.xx.

Remarks: The program found a discrepancy in elevations. The problem is probably a data entry error in the points.

Action: Correct discrepancy in elevations and rerun.

102. AUXILIARY SPILLWAY SURFACE NOT COMPUTED FROM ASCOORD TABLES. UNABLE TO REORDER MATERIALS (SEE ERROR 98); OR DISTANCES NOT INCREASING (SEE ERROR 99); OR LESS THAN 2 POINTS ON THE SURFACE (SEE ERROR 109).

Remarks: The program's initial attempt to compute the auxiliary spillway surface disclosed a problem. At this stage in the program, it could be any one or a combination of the three identified errors.

Action: Figure out which error applies, correct the table entries, and rerun.

103. ADVERSE SLOPE FOUND IN EXIT CHANNEL OF EXISTING AUX. SPLWY STARTING AT X = xxxxx, Y = xxxxx.xx; NEXT Y = xxxxx.xx.

Remarks: The program does not allow adverse slopes downstream of the spillway crest.

Action: Revise input to change slope.

104. TIE–IN STATION xxxxx. IS OUTSIDE OF EXISTING SURFACE RANGE OF X–DISTANCES, xxxxxx. AND xxxxxx. FT.

Remarks: Tie-in station is not within the range of x-distances defined by other data entries.

Action: Relocate the tie-in station or revise the data range to include its location.

Errors (105–110)

105. LAST SURFACE POINT, ELEVATION xxxxx.x DID NOT REACH THE VALLEY FLOOR ELEVATION xxxxx.x. PASS STOPPED.

Remarks: Geologic surface should be defined to the valley floor elevation.

Action: Extend surface to the valley floor.

106. VELOCITY OPTION ON BOTTOM WIDTH CONTROL VALID ONLY FOR GO,DESIGN RUNS.

Remarks: GO,STORM, GO,RAINS, AND GO,HYD are simulation type runs, and you must give the bottom width in feet.

Action: Run as GO,DESIGN to obtain the bottom width desired, then use it for the simulation run.

107. ELEVATION VALLEY FLOOR, xxxxx.xx, ABOVE OR AT AUXILIARY SPILLWAY CREST ELEVATION, xxxxx.xx.

Remarks: The valley floor elevation given is at or above the crest elevation. This implies that erosion will not occur.

Action: Check elevation data for entry errors.

108. AUX. SPLWY PROFILE UNDEFINED, NO INLET CHANNEL INPUT.

Remarks: The computations related to the auxiliary spillway require that an inlet channel profile be defined.

Action: Add data describing the auxiliary spillway inlet channel.

109. SPILLWAY SURFACE HAS xx POINT(S), RUN STOPPED.

Remarks: There are less than 2 surface points in the ASCOORD tables.

Action: Enter two or more points to define the auxiliary spillway surface.

110. WSPVRT STANDARD STEP METHOD FAILED TO CONVERGE IN ROUTINE QHEAD. FATAL ERROR STOPPED PASS!

Remarks: The program failed to successfully compute an auxiliary spillway rating using the WSPVRT procedure.

Action: Examine input data defining the spillway surface profile and flow resistance. Try an alternate water surface profile procedure, if necessary.

Errors (111–114)

111. INTEGRITY ANALYSIS TERMINATED.

Spillway has either no crest reach or no exit channel reach.

or

Auxiliary spillway crest at or below valley floor.

or

Cannot locate intersection of eroded and original surfaces: logic error.

or

Too many possible headcuts or too many points in eroded surface. Program array dimensions exceeded.

or

Adverse slope reach or vertical with negligible drop downstream of crest.

Remarks: Program has been unable to perform auxiliary spillway integrity analysis for the reason(s) indicated.

Action: Examine input and correct problem indicated. If a logic error is indicated or program dimensions are exceeded, attempt to simplify input by lumping geology and/or approximating the spillway surface with fewer reaches.

112. PERCENT CLAY OF <u>xxx.</u>% FOR MATERIAL <u>xx</u> OUT OF RANGE.

Remarks: The given percent of clay is outside the input range for this material. See ASMATERIAL, note 4.

Action: Correct entry of percent clay or material.

113. VEGETAL COVER FACTOR OF <u>xxx.x</u> ON <u>name</u> REACH <u>xx</u> IS OUT OF RANGE.

Remarks: Given vegetal cover factor on control word named is not a proper C_F value. C_F ranges between 0 and 1.0.

Action: Correct entry of vegetal cover factor.

114. VEGETAL RETARDANCE CURVE INDEX OF <u>xxx.x</u> ON <u>name</u> REACH <u>xx</u> IS OUT OF RANGE.

Remarks: Given vegetal retardance curve index on control word named is greater than 15. This is not a proper C_I value.

Action: Correct entry of C_I value.

Errors (115–119)

115. INTEGRITY ANALYSIS REQUIRES ASCOORD AND ASMATERIAL TABLES WITH AN ASEXSURF TABLE AS THE MINIMUM.

Remarks: A description of the auxiliary spillway surface and the geologic materials in the spillway are required for spillway integrity analysis.

Action: Supply data with appropriate control words.

116. PLASTICITY INDEX OF xxx.x FOR MATERIAL xx OUT OF RANGE.

Remarks: Incorrect plasticity value given. See ASMATERIAL, note 4.

Action: Correct plasticity value or change material.

117. REPRESENTATIVE DIAMETER OF xxx.x FOR MATERIAL xx OUT OF RANGE.

Remarks: The representative diameter given for the indicated material is out of the accepted range for that material. See ASMATERIAL, note 4.

Action: Enter correct value for material.

118. INLET CHANNEL INTERSECTS VALLEY FLOOR AT STATION xxxxx. BEFORE REACHING FIRST POINT NATURAL GROUND, STATION xxxxx.

Remarks: The auxiliary spillway inlet channel reaches the valley floor elevation before intersecting the ground surface or the beginning of geologic data input.

Action: Examine and adjust data describing the auxiliary spillway.

119. STRESS OPTION ON BOTTOM WIDTH CONTROL VALID ONLY FOR GO,DESIGN RUNS.

Remarks: GO,STORM, GO,RAINS, and GO,HYD are simulation type runs and you must give the auxiliary spillway bottom width in feet.

Action: Run as GO,DESIGN to obtain the bottom width desired, then use it for the simulation run.

Errors (120–123)

120. ASSURFACE TABLE, REFERENCE NO. xx, MUST NOT BE IN SAME PASS AS ______name_______ WITH REFERENCE NUMBER xx.

Remarks: User entered conflicting surface parameter tables. ASSURFACE applies to a given auxiliary spillway profile while ASINSURF and ASEXSURF apply to a floating spillway template.

Action: Select which table(s) apply and remove the others to another pass, if needed.

121. ASSPRFL TABLE, REFERENCE NO. xx, MUST NOT BE IN SAME PASS AS ______name_______ WITH REFERENCE NUMBER xx.

Remarks: User entered conflicting coordinate tables. ASSPRFL applies to a given auxiliary spillway profile while ASINLET and ASEXIT apply to a floating spillway template.

Action: Select which table(s) apply and remove the others to another pass, if needed.

122. ASSURFACE TABLE SHOULD BE USED ONLY WITH ASSPRFL OR WITH A SPILLWAY SURFACE DEFINED BY THE ASCOORD TABLES.

Remarks: The program requires ASSPRFL or ASCOORD tables with an ASSURFACE table.

Action: Use a consistent form for spillway profile and surface entries. Use ASINSURF and ASEXSURF tables to describe surface conditions when a spillway template is used.

123. TRAPW PROCEDURE USES ONLY MANNING'S "n" VALUES IN THE INLET CHANNEL, CI VALUES 1.0 OR GREATER ARE GIVEN.

Remarks: The TRAPW water surface profile procedure will not accept C_I values in the inlet channel. You may enter C_I values for determining the exit channel velocity.

Action: Use Manning's "n" for inlet channel computations or use WSPVRT procedure to compute spillway rating.

Errors (124–128)

124. FRICTIONLESS SIDE SLOPE WSP PROCEDURE USES ONLY MANNING'S "n" VALUES IN THE INLET CHANNEL, CI VALUES 1.0 OR GREATER ARE GIVEN.

Remarks: The frictionless side slope water surface profile procedure will not accept C_I values in the inlet channel. You may enter C_I values for determining the exit channel velocity.

Action: Use Manning's "n" for inlet channel computations or use WSPVRT procedure to compute spillway rating.

125. ASCOORD AND ASMATERIAL TABLES ARE REQUIRED FOR AN INTEGRITY ANALYSIS.

Remarks: The program requires these tables for the integrity analysis.

Action: Add ASCOORD and ASMATERIAL tables to the input data.

126. ASSURFACE TABLE IS REQUIRED WITH EXISTING SITE FOR INTEGRITY ANALYSIS.

Remarks: Integrity analysis of an auxiliary spillway profile specified by a "Y" on the ASCOORD table requires an ASSURFACE table.

Action: Add ASSURFACE table. Remove ASINSURF and ASEXSURF from pass, if given.

127. ASSURFACE TABLE IS REQUIRED IN COMBINATION WITH AN ASSPRFL TABLE.

Remarks: An ASSPRFL table requires an ASSURFACE table. The ASSURFACE table is missing.

Action: Add ASSURFACE table. Remove ASINSURF and ASEXSURF from pass, if given.

128. INVALID INPUT PROFILE NUMBER (<u>xx</u>): 30 TO 40 ARE RESERVED.

Remarks: The program uses profile number 30 for precomputed NHCP–378 ratings (see ASFILE). Numbers 31 to 40 are reserved for future programming use.

Action: Use input profile number within correct range (1 to 29 or 41 to 50).

Errors (129–131)

129. INVALID INPUT PROFILE (NUMBER xx): TOO MANY ZERO VALUES.

Remarks: The ASINLET profile has no values or starts with too many zero distances and elevations. Check for proper format of ASINLET.

Action: Enter the input profile in the correct format for ASINLET.

130. HOOD INLET DATA ERROR
HORIZONTAL INLET PIPE LENGTH OF xxxx.x
PIPE OUTLET ELEVATION OF xxxxxx.x IS LESS GREATER THAN INLET, xxxxxx.x
PIPE BEND ELEVATION OF xxxxxx.x IS LESS GREATER THAN INLET, xxxxxx.x
PIPE OUTLET ELEVATION OF xxxxxx.x IS LESS GREATER THAN BEND, xxxxxx.x
PIPE TAILWATER ELEVATION OF xxxxxx.x IS LESS GREATER THAN INLET, xxxxxx.x
PIPE MANNING n VALUE OF xx.xx
HOOD INLET CREST ELEVATION OF xxxxxx.x IS GREATER THAN TOD xxxxxx.x
HOOD INLET CREST ELEVATION OF xxxxxx.x GREATER THAN AS CREST, xxxxxx.x

Remarks: The hood inlet data value indicated represents an unreal or unacceptable condition. The program cannot generate a rating for the principal spillway using this data.

Action: Check and correct indicated data. If data is correct, rate spillway external to program and enter rating through the structure table.

131. MUSKINGUM–CUNGE ROUTING MUST HAVE A BANKFULL ELEVATION FOR SECTION xxxx.

Remarks: The Muskingum-Cunge routing requires bankfull information for the cross section. The bankfull elevation is that elevation above which the banks are overtopped.

Action: Provide the requested data for the section.

Errors (132–134)

132. AUXILIARY SPILLWAY RATING MUST BE GIVEN WHEN THE "Q" OPTION IS SPECIFIED.

Remarks: When the Q option is specified on the GO, XXXXX record, the auxiliary spillway rating must be entered through the structure table.

Action: Add auxiliary spillway rating to the structure table, or use a different option on the GO,XXXXX record.

133. QRF OF <u>xxxxx.xx</u> CFS IS GREATER THAN THE MAX. PS RATING OF <u>xxxxx.xx</u> CFS.

Remarks: The quick return flow is greater than the capacity of the principal spillway. The program cannot perform requested drawdown computations for this condition.

Action: Increase the capacity of the principal spillway to accommodate the magnitude of the quick return flow.

134. ERROR 134 - GO,XXXXX RECORD MUST HAVE A “Q” IN COL. 11-20

Remarks: There is insufficient information entered to develop an auxiliary spillway rating or to perform spillway stability analysis. Use of the Q option allows the flow to be routed through the reservoir if the auxiliary spillway rating is given in the structure table.

Action: Use the “Q” option on GO,XXXXX record or provide sufficient spillway data to allow the desired analysis.

Warnings (A)

The warning messages are listed alphabetically. To help you quickly locate the warning message, the first letter of the warnings on each page are shown with the heading.

- **ARRAY __________name___________WAS EXCEEDED. ALL OVERFLOW VALUES WERE IGNORED.**

  Remarks: Certain storage arrays trigger this message if you enter an excessive amount of data. For example, the program limits BTMWIDTH (auxiliary spillway bottom width selections) to five values per pass. If you enter more than five values, the program prints the message and ignores all values beyond the first five.

  Action: Check data under array name to insure that all input values are required. Modify data to meet the array size limits.

- **A STRUCTURE TABLE ELEVATION DIFFERENCE WAS FOUND TO BE GREATER THAN TWENTY (20.) FEET.**

  Remarks: The vertical elevation difference between two adjacent points exceeds 20 feet.

  Action: Do nothing if data is correct and representative. Correct or insert elevations, if necessary.

- **ASCREST CONTROL CONTAINS NO ELEVATIONS OR UNITS COMPATIBLE WITH THE CREST GIVEN ON THE name RECORDS.**

  Remarks: The profile of the auxiliary spillway profile was specified in terms of actual coordinates. Only the crest elevation corresponding to the maximum elevation of the coordinates entered is analyzed. None of the other crest entries on ASCREST are usable.

  Action: Review auxiliary spillway profile and ASCREST input data and rerun.

- **ASEXIT USE NOT COMPATIBLE WITH SURFACE FROM name RECORDS.**

  Remarks: The ASEXIT control word is used in combination with ASINLET to specify a spillway template. Use of these control words is not compatible with specification of the spillway surface in actual coordinates (ASCOORD or ASSPRFL). If sufficient information is available, program execution will proceed, but redundant information entered with the ASEXIT control word will be ignored.

  Action: Review input and select a consistent format for auxiliary spillway data entry (see instructions for ASEXIT).

Warnings (A)

- **ASEXSURF USE NOT COMPATIBLE WITH SURFACE FROM <u>name</u> RECORDS.**

Remarks: The ASEXSURF control word is used to enter surface conditions for the auxiliary spillway exit channel when the template form of spillway surface entry is selected. Its use is not consistent with entry of spillway surface in actual coordinates.

Action: Review input and select a consistent format for auxiliary spillway data entry (see instructions for ASEXSURF and ASSURFACE).

- **ASFILE DATA MUST BE LOADED AHEAD OF SITES CONTROL.**

Remarks: An ASFILE has been loaded following the SITES control word. The ASFILE must be loaded before the SITES control. Data in the ASFILE loaded after SITES will be ignored.

Action: Reorder data or use alternative form of auxiliary spillway rating.

- **ASFILE HAS ALREADY BEEN LOADED. ONLY ONE PER RUN PERMITTED.**

Remarks: You entered a second ASFILE. The program accepted the first ASFILE. The program ignores the second ASFILE.

Action: Incorporate ASFILE data into one file or convert into ASRATING data.

- **ASFILE RECORD FOR PROFILE <u>ref. no.</u> NOT LOADED.**

Remarks: The program has tried unsuccessfully to access an ASFILE record with the profile number shown for the auxiliary spillway rating.

Action: Make appropriate ASFILE available or use alternative form of auxiliary spillway rating.

- **ASINC OF (<u>xx.xx</u>) WILL EXTRAPOLATE THE AUX. RATING ABOVE THE MAXIMUM STRUCTURE TABLE INPUT.**

Remarks: The WSPVRT water surface profile has used ASINC to increase the computational range of the auxiliary spillway. Because only 13 points usually define the spillway rating, all points should be within the working range.

Action: Compare with run using a higher maximum STRUCTURE table elevation without the ASINC adjustment.

Warnings (A)

- **ASINLET USE NOT COMPATIBLE WITH SURFACE FROM <u>name</u> RECORDS.**

  Remarks: The ASINLET control word is used in combination with ASEXIT to specify a spillway template. Use of these control words is not compatible with specification of the spillway surface in actual coordinates (ASCOORD or ASSPRFL). If sufficient information is available, program execution will proceed, but redundant information entered with the ASINLET control word will be ignored.

  Action: Review input and select a consistent format for auxiliary spillway data entry (see instructions for ASINLET and ASEXIT).

- **ASINSURF USE NOT COMPATIBLE WITH SURFACE FROM <u>name</u> RECORDS.**

  Remarks: The ASINSURF control word is used to enter surface conditions for the auxiliary spillway inlet channel when the template form of spillway surface entry is selected. Its use is not consistent with entry of spillway surface in actual coordinates.

  Action: Review input and select a consistent format for auxiliary spillway data entry (see instructions for ASINSURF and ASSURFACE).

- **AUXILIARY CREST LOWER THAN LOW POINT IN SITE.**

  Remarks: The computed effective height of dam is zero or negative indicating an input error in the CLPROFILE table, column 51–60 of POOLDATA, or in the given or computed auxiliary spillway crest.

  Action: Correct data and rerun if necessary.

- **AUX. SPILLWAY BACKWATER COMPUTATIONS BASED ON MANNING’S "n" OF <u>xxx.xxx</u> FOR INLET CHANNEL.**

  Remarks: Inlet flow resistance data was entered in one of the reach formats consistent with the WSPVRT procedure, but a constant flow resistance backwater procedure (TRAPW or frictionless side slope) was requested. Therefore, the indicated value of Manning’s "n" was used for the backwater computations throughout the inlet.

  Action: None, if the indicated program behavior is what is desired. If variation of flow resistance by reach within the inlet is required, use the WSPVRT procedure to perform rating calculations.

Warnings (B, C)

- **BLANK FIELD IN "ADDHYD" OPERATION INPUT, DEFAULTED TO ZERO.**

  Remarks: The Operation Control Number, column 11 of the GO,ADDHYD record was blank and the program set it to zero (0). This means that another ADDHYD will follow this ADDHYD.

  Action: Check GO,ADDHYD instructions to see if Operation Control Number = 0 is correct for the watershed. If not, rerun with correct number, 1 or 2.

- **BLANK FIELD IN "GO,REACH" OPERATION FIELD, DEFAULTED TO ZERO.**

  Remarks: The Operation Control Number, column 11 of the GO,REACH record was blank and the program set it to zero (0). This means that another site or subarea will follow this reach routing and the program will route it to the same point and accumulate hydrographs.

  Action: Check GO,REACH instructions to see if Operation Control Number = 0 is correct for the watershed. If not, rerun with correct number, 1 or 2.

- **CHECK ACCURACY OF ROUTINGS, ELEVATION DIFFERENCE BETWEEN POINTS 10 AND 11 (<u>xx.xx</u>) IS LESS THAN AUXILIARY SPILLWAY INTERNAL RATING DEFINITION INCREMENT (<u>xx.xx</u>).**

  Remarks: Under the flow conditions dictated by the input, the PS conduit does not flow full at the AS crest (point 10). The elevation difference to point 11 on the rating curve is less than the internal time increment used in the computation of the auxiliary spillway rating. Rating curve point distances less than the internal increment are interpolated on a straight line between the internal increments. This tends to flatten the rating curve at shallow depths in the auxiliary spillway and overestimate the outflow at these depths.

  Action: This can be a problem if the principal spillway conduit flows full significantly above the auxiliary spillway crest and/or the highest elevation in the structure table is excessively high. If possible, change the PS conduit or raise the AS crest so the PS conduit flows full below the crest and remove the higher elevations not utilized from the structure table. More accuracy can also be obtained at the shallow depths by using the WSPVRT or TRAPW water surface profile procedures rather than the frictionless side slope procedure.

Warnings (C)

- **CLIMATIC INDEX (PDIRECT) VALUE GREATER THAN 1.0 APPROPRIATE ONLY FOR LOWER SITE. VALUE SET TO 1.0**

  Remarks: Climatic Index Values greater than 1.0 are used to compute Quick Return Flow. Quick Return Flow is computed for the lower site only. Entry of Climatic Index values greater than 1.0 for upstream sites or watersheds is, therefore, inappropriate.

  Action: Use only values of 1.0 or less for Climatic Index entries on upstream sites and watersheds.

- **CONSTRUCTED TOPSOIL DEPTH OF xx.x FT NOT USED WITH EXISTING SITE, DEPTH RESET TO 0.0 FT.**

  Remarks: A nonzero topsoil fill depth has been entered for an auxiliary spillway whose surface is specified to be the surface formed by the surface of the spillway geology input (input form consistent with an existing site). The topsoil fill depth entry has been ignored and the existing geology used in computations. Use of a nonzero topsoil fill depth normally implies overexcavation and replacement of materials.

  Action: Review input: check for redundant surface profile specification and correct as appropriate. Review instructions for ASCOORD, ASSPRFL, and ASEXIT.

- **CONSTRUCTED TOPSOIL FILL DEPTH xx.x EXCEEDS 5 FT.**

  Remarks: Topsoil fill depth normally implies overexcavation and replacement of the material to the depth indicated. Depths exceeding 5 ft are considered unusually large.

  Action: Correct topsoil fill depth as appropriate. No action required if entered topsoil fill depth is that desired.

- **CONTROL WORD INVALID – FOLLOWING DATA RECORD IGNORED:**

  data record

  Remarks: The program prints the offending data record two lines below the message. The data appearing in columns 1–10 of the indicated record do not match one of the program control words. The program ignores the indicated record and attempts execution with the remaining data. If the program does not print a data record, an illegal blank record is indicated.

  Action: Check spelling of control word and correct to one of the program control words. Eliminate blank records in the data.

Warnings (C)

- **CREST AUXILIARY SPILLWAY ELEVATION xxxxx.xx ABOVE EXISTING GROUND SURFACE.**

  Remarks: The specified spillway crest elevation is above the maximum existing ground surface elevation computed from the geology data input. This implies that fill is required for the entire length of the crest in the section used for spillway analysis.

  Action: Check crest elevation and geology data.

- **CREST AUXILIARY SPILLWAY ABOVE EXISTING NATURAL SURFACE. MAXIMUM REQUIRED FILL OF xxxx.x FT AT STATION xxxxx. TO CREST ELEVATION OF xxxxx.xx FT.**

  Remarks: The specified spillway crest elevation is above the existing ground surface elevation computed from the geology data input within the crest reach. This implies that fill is required in the section used for spillway analysis.

  Action: Check crest elevation and geology data. If fill is considered acceptable for this condition, no action is required.

- **CREST LENGTH ON ASINLET xxxxx. SHOULD BE VERIFIED.**

  Remarks: The indicated auxiliary spillway crest length is unusually short (<=0 ft) or unusually long (>1000 ft). A crest length greater than 0.0 is required for spillway integrity analysis.

  Action: Check auxiliary spillway crest length input. No action required if an unusually long crest length is correct. A short crest length should be lengthened to be greater than 0.0 foot if you want the spillway integrity analysis.

- **CREST OF AUXILIARY SPILLWAY xxxx.xx IS BELOW START ROUTING ELEVATION xxxx.xx.**

  Remarks: The crest is 1 foot or more below the start routing elevation. Usually caused by a too low trial auxiliary crest elevation. Routing could be questionable.

  Action: Check input and/or routing for reasonableness.

Warnings (D)

- **DENSITY VALUE OF <u>xxxxx.</u> lb/ft^3 (MATERIAL <u>xxx</u>) IS OUTSIDE OF THE USUAL RANGE.**

  Remarks: This warning is triggered by density values below 75 lb/ft^3 or above 350 lb/ft^3. It is unusual that materials would be outside these bounds.

  Action: Check input data to verify correct entry of density for the material in question.

- **DESIGN STRUCTURE CLASS "A" IS INVALID. IT HAS BEEN CHANGED IN THIS RUN TO "A2." THIS ASSUMES THAT THE PRODUCT OF STORAGE TIMES EFFECTIVE HEIGHT = 3000 TO 30000 AND IS NOT IN SERIES WITH OTHER DAMS.**

  Remarks: The WSDATA control word indicates a design class code A. This class code is not valid in this version of SITES. Program changed class code to A2.

  Action: Do nothing if class code A2 is acceptable. Otherwise, change WSDATA to correct class code and rerun.

- **DISTANCE TO ASCOORD POINT <u>xx</u>, MATERIAL <u>xx</u>, EXCEEDS 5,000 FT.**

  Remarks: The horizontal distance between entered coordinate points describing the surface of the indicated material exceeds 5,000 ft. This is considered to be an unusually long distance between points.

  Action: Check coordinate entries for the indicated material.

- **DOWNWARD SLOPE FOUND IN INLET CHANNEL OF EXISTING AUX. SPILLWAY STARTING AT X =<u>xxxxx.</u>, Y =<u>xxxxx.xx</u>; NEXT Y =<u>xxxxx.xx</u>.**

  Remarks: A reach with decreasing elevation in the downstream direction has been identified upstream of the maximum (crest) elevation for the auxiliary spillway. This is considered to be an unusual condition.

  Action: Check data entries describing the auxiliary spillway surface in the inlet reaches. If entries are correct, no action is necessary.

Warnings (D)

- **DRAINAGE AREA WAS ENTERED ON A PREVIOUS "HYD" COMMAND. DRAINAGE AREA NOT ACCUMULATED.**

  Remarks: The program has already added the drainage area from a previous HYD table (column 21–30 of the first record) to the accumulated drainage area. The program ignores the drainage area on this HYD table.

  Action: Check output to see if total accumulated drainage area is correct and revise input, if necessary.

- **DRAINAGE AREA WAS ENTERED ON A PREVIOUS "7READHD" OR "HYD" COMMAND. DRAINAGE AREA NOT ACCUMULATED.**

  Remarks: This is to avoid double counting of the drainage area when entering multiple design hydrographs.

  Action: Check accumulated drainage areas for correctness, revise input if needed.

- **DRAWDOWN CRITERIA MAY NOT BE MET.**
  TIME EXCEEDED NUMBER OF POINTS ON INFLOW HYDROGRAPH.
  INFLOW Q = <u>xxxxx.xx</u> CFS
  OUTFLOW Q= <u>xxxxx.xx</u> CFS
  AT TIME <u>xxxxx.xx</u> DAYS

  Remarks: The program did not add the inflow hydrograph into the drawdown computations beyond the cfs and time shown. This means upstream releases and baseflow drop to zero at the end of the 5000-point upstream hydrograph and are not accumulated with the uncontrolled area at the lower site.

  Action: Do nothing if drawdown criteria are satisfied, otherwise continue the drawdown by manual routing to reach the time limit or increase the capacity of the principal spillway to reduce the drawdown time.

- **DRAWDOWN INFLOW HYDROGRAPH POINTER (<u>xxx</u>) OUT OF RANGE. POINTER IS HYDROGRAPH POINT USED TO LOCATE START OF DRAWDOWN. DRAWDOWN MAY NOT BE CORRECT, RUN CONTINUING.**

  Remarks: The hydrograph point associated with the elevation at which drawdown should have started was zero or the discharge point was out of the range of the hydrograph points. Any output is questionable.

  Action: Inspect the input for a possible cause for this error and check the drawdown for reasonableness. Try DRAWDLIST to get detailed drawdown output if needed.

- **DRAWDOWN TIME LIMIT OF ZERO IS NOT PERMITTED, 10 DAY LIMIT SET.**

  Remarks: You entered the DDTEST control word but the time limit for drawdown (columns 11–20) was either zero or blank. The program will use a ten day limit as the default.

  Action: Enter desired time limit in DDTEST, if 10 days is not acceptable.

- **DURATION OF xxxx.xx HOURS GIVEN ON THE GO,DESIGN COMMAND WAS NOT USED IN THIS RUN.**

  Remarks: The program used the 10-day principal spillway storm instead of duration given in columns 51–60 of the GO,DESIGN record. RAINTABLE ID is blank or is not matched for retrieval in columns 41–50 of GO,DESIGN.

  Action: If default 10-day storm was not intended, check spelling of the principal spillway RAINTABLE ID on the table and on GO,DESIGN.

- **EFFECTIVE TRACTIVE STRESS (xx.xxx) ENTERED FOR BW COMPUTATION WITH D75 OF xxx.xx INCHES, MAY EXCEED RANGE OF APPLICABILITY FOR UNVEGETATED EXIT CHANNEL.**

  Remarks: The effective tractive stress value entered for control of bottom width appears to be large compared to the entered representative material diameter. It is also larger than would be expected for materials capable of supporting vegetation.

  Action: Review data input and/or criteria for stability design of channels.

- **ELEVATION DIFFERENCE BETWEEN TOP SURFACE AND VALLEY FLOOR EXCEEDS 10,000 FT. CHECK INPUT!**

  Remarks: The elevation difference between the upper surface of the geology profile in the area of the auxiliary spillway and the specified valley floor elevation exceeds 10,000 ft. Apparent error in input.

  Action: Check input data in ASCOORD tables and the valley floor elevation.

Warnings (E)

- **ELEVATION INCREMENT TO ASCOORD POINT xx, MATERIAL xx, EXCEEDS 50 FT.**

  Remarks: The vertical distance between entered coordinate points describing the surface of the indicated material exceeds 50 ft. This is considered to be an unusually large elevation change between points.

  Action: Check ASCOORD coordinate entries for the indicated material.

- **ELEVATION OF FULL PIPE FLOW (xxxx.xx) EQUALS OR EXCEEDS GIVEN CREST ELEVATION ON STRUCTURE TABLE (xxxx.xx). PS RATING NOT COMPUTED, PASS STOPPED.**

  Remarks: With the auxiliary spillway rating given in the STRUCTURE table, the computed principal spillway does not reach full flow below the given crest elevation. The program will probably not handle this type of combined rating adequately. The principal spillway rating is not recomputed to match the given elevations.

  Action: If input data is correct, enter principal spillway rating in the STRUCTURE table rather then having the program compute it and rerun.

- **ELEVATION OF FULL PIPE FLOW (xxxx.xx) EQUALS OR EXCEEDS MAXIMUM INPUT ELEVATION (xxxx.xx), PASS STOPPED.**

  Remarks: Total rating is to be computed, but principal spillway rating never reaches full pipe flow below the top elevation in the STRUCTURE table. The auxiliary spillway rating is skipped.

  Action: If input data is correct, raise the maximum input elevation in the STRUCTURE table and rerun.

- **ELEVATION VALLEY FLOOR xxxxx.xx IS HIGHER THAN HIGHEST POINT xxxxx.xx ON LOWEST MATERIAL IN THE ASCOORD TABLE.**

  Remarks: Because the specified valley floor elevation is above the highest point on the surface of the material, the material will not be considered in computing spillway erosion (integrity analysis).

  Action: Check valley floor elevation and/or geology surfaces input. NOTE, this may be a case of more information being entered than necessary. If so, no problem exists.

- **EMBANKMENT QUANTITIES NOT COMPUTED, NO VALID CLPROFILE ENTERED.**

  Remarks: Program option "E" requires input of a CLPROFILE table to compute embankment quantities.

  Action: Enter a CLPROFILE table and rerun.

- **ENERGY HEAD xx.xx UNUSUALLY LOW IN STABILITY CONTROL REACH WHICH STARTS AT STATION xxxxx.xx.**

  Remarks: The computed maximum available energy head for the flow is computed to be 2 ft or less for stability analysis.

  Action: Check input data, especially those for tailwater, top of dam, and/or maximum elevation in structure table.

- **EROSION RATE COEFFICIENT OF xxxx.xxx (MATERIAL xxx) IS UNUSUALLY LARGE.**

  Remarks: The erosion rate coefficient entered for the indicated material exceeds 10 (ft/hr)/(lb/ft^2), which is considered unusually large.

  Action: No action required if the entered erosion coefficient is correct.

- **EXCESSIVE TRIALS TO GIVEN (xx.xxx) EFFECTIVE TRACTIVE STRESS. STOPPED AFTER xxx TRIALS WITH STRESS = xx.xxx lb/ft^2.**

  Remarks: Search for auxiliary spillway bed width required to generate the desired erosionally effective stress for stability was stopped at the program's iteration limit. Stress may not be the appropriate controlling factor for bed width.

  Action: Check input and evaluate the parameters on BWDATA to see if they are appropriate for the site.

- **EXCESSIVE TRIALS TO GIVEN (xx.xxx) EXIT CHANNEL VELOCITY. STOPPED AFTER xxx TRIALS WITH VELOCITY = xx.xxx ft/sec.**

  Remarks: Search for auxiliary spillway bed width resulting in the desired exit channel velocity for stability was stopped at the program's iteration limit. Velocity may not be the appropriate controlling factor for bed width.

  Action: Check input and evaluate the parameters on BWDATA to see if they are appropriate for the site.

Warnings (E, F)

- **EXIT CHANNEL INTERSECTS VALLEY FLOOR AT STATION xxxxx. BEFORE REACHING LAST POINT OF NATURAL GROUND AT STATION xxxxx.**

  Remarks: The position of the auxiliary spillway exit channel template results in the exit channel intersecting the valley floor elevation within the geology profile (ground surface not intersected).

  Action: Review the template and its position relative to the geology profile. No action is necessary if the resulting profile is that which should be used in analysis.

- **EXIT SLOPE NOT INPUT DOWNSTREAM OF CREST AT STATION xxxxx. USED EXIT SLOPE OF xx.xx FOR VELOCITY COMPUTATIONS.**

  Remarks: No auxiliary spillway exit channel slope has been entered with the template. For any calculations requiring exit channel slope, the value indicated will be used.

  Action: Enter exit channel slope if utilizing any output from spillway analysis.

- **EXIT SLOPE NOT INPUT DOWNSTREAM OF CREST AT ELEVATION xxxxxx.x. USED EXIT SLOPE OF x.xxx FOR VELOCITY COMPUTATIONS.**

  Remarks: No auxiliary spillway exit channel slope coordinates have been entered. For any calculations requiring exit channel slope, the value indicated will be used.

  Action: Enter exit channel slope if utilizing any output from spillway analysis.

- **FEET OR BLANK UNIT ENTERED. VALUE xx.xxx SKIPPED ON BTMWIDTH RECORD IS LESS THAN 1.0, UNIT SHOULD BE STRESS OR VELOCITY.**

  Remarks: A bottom width of less than 1 ft is not considered reasonable for the auxiliary spillway. The entered value is ignored.

  Action: Enter appropriate value for width in feet or change units to velocity or stress as appropriate.

Warnings (F)

- **FIXED EXIT X,Y POINT (xxxxx., xxxxx.x) IS ABOVE OR UPSTREAM OF THE D/S EDGE OF THE CREST (xxxxx., xxxxx.x).**

  Remarks: The position of the auxiliary spillway template is such that the entered fixed point through which the exit channel should pass is above or upstream of the crest. Therefore, the fixed point cannot be used and is ignored.

  Action: Modify spillway template or location as appropriate.

- **FIXED INLET X,Y POINT (xxxxx., xxxxx.x) IS ABOVE OR DOWNSTREAM OF THE U/S EDGE OF THE CREST (xxxxx., xxxxx.x).**

  Remarks: The position of the auxiliary spillway template is such that the entered fixed point through which the inlet channel should pass is above or downstream of the beginning of the crest reach. Therefore, the fixed point cannot be used and is ignored.

  Action: Modify spillway template or location as appropriate.

- **FIXED POINT ELEVATION OF xxxxx.xx MUST BE GREATER THAN THE VALLEY FLOOR ELEVATION nnnnn.nn.**

  Remarks: The fixed-point elevation is equal to or less than the valley floor elevation.

  Action: Select a point above the valley floor elevation or use the option of direct entry of spillway inlet and exit channel slopes.

- **FLOW RESISTANCE INFORMATION ENTERED MORE THAN ONCE ON ASDATA RECORD, RETARDANCE CLASS (COL. 13) IGNORED IN name.**

  Remarks: The ASDATA record contains redundant or conflicting flow resistance entries. The flow retardance class entry in column 13 is therefore ignored. Redundant entries such as this should be avoided for clarity of I/O.

  Action: No action is required if the flow resistance value used is the correct value.

Warnings (G)

- **GAP FOUND BETWEEN MATERIALS AT SURFACE, xx POINTS INVOLVED INCLUDING X–DISTANCE xxxxx.xx. STANDARD FIXUP MADE. CHECK RESULTS, PROCESSING CONTINUED.**

  Remarks: As entered, the geologic profile does not produce a continuous existing surface. This may result in fill being assumed incorrectly within the profile.

  Action: Correct or add to entries in ASCOORD table so that points form a continuous ground surface.

- **GIVEN PRINCIPAL SPILLWAY MANNING'S "n" VALUE (xx.xxx) SHOULD BE VERIFIED.**

  Remarks: The Manning's roughness coefficient for the conduit is less than 0.0 or greater than 0.1. This is unrealistic, and may be a data entry error. See columns 51–60 of the PSDATA record.

  Action: Correct if necessary and rerun.

- **GIVEN STORM DURATION OF xxx.x HRS. DOES NOT AGREE WITH RAINTABLE DURATION. RAINTABLE DURATION OF xxx.x HRS. USED.**

  Remarks: The storm duration in columns 31–40 of the STORM record does not match the duration given in columns 21–30 of the first RAINTABLE record. A comparison is not made if the RAINTABLE duration is 1.0. The program uses the duration associated with the RAINTABLE ID in columns 21–25 of the GO,STORM record.

  Action: Inspect the input data to find which duration and RAINTABLE are correct. If the duration on the RAINTABLE is not correct, make necessary revisions and rerun.

- **GO, OPTIONS "N" AND "x" CONFLICT, OPTION "x" REMOVED.**

  Remarks: Program options "H" and "U" are in direct conflict with option "N." They are ignored when "N" (neither stability or integrity) is given.

  Action: Review program options in input to see if they will give desired output.

Warnings (H, I)

- **HEADCUT ERODIBILITY INDEX OF xxxxxx.x (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx.**

  Remarks: The headcut erodibility index for the indicated material is greater than 1.0 with a bulk dry density entry for the material less than 120 lb/ft^2. Low values of density are normally associated with lower values of the headcut erodibility index.

  Action: Verify material properties input.

- **HEADCUT ERODIBILITY INDEX OF xxxxxx.xxxx (MATERIAL xx) IS OUTSIDE OF THE USUAL RANGE.**

  Remarks: The entered value of the headcut erodibility index is greater than 100,000 or less than 0.001. It would be unusual for values to fall outside of this range.

  Action: Verify material properties input.

- **HYDROGRAPH TITLED - title of hydrograph IS STORED IN HYDROGRAPH LOCATION = xx. ONLY P OR 1, A OR 3, F OR 5, OR 7 AND 9 (STORM) ARE ACCEPTABLE STORAGE LOCATIONS.**

  Remarks: The hydrograph type code in columns 11–20 of the first record in the HYD table is not one of the standard input hydrograph codes. Thus, the program ignores the hydrograph in the computations unless you enter a SAVMOV.

  Action: Inspect the output to see if the program used the hydrograph as intended or change to an appropriate code and rerun.

- **ILLEGAL CHARACTER IN "GO,REACH" OPERATION FIELD. DEFAULTED TO THE LAST SITE IN SERIES, OPERATION CONTROL NO. = 2.**

  Remarks: Operation Control Number (NADD), column 11 of the GO,REACH record contains a non-numeric character when the program can only utilize a 0, 1, or 2. The program defaults to "2" – see description of GO,REACH control word.

  Action: Ensure that "2" is intended result.

Warnings (I)

- **ILLEGAL CHARACTER ON ________name________ RECORD IN SHORT DATA FIELD, CONTAINING xxxxxx DATA.**

Remarks: Data field on identified record contains an unrecognized character in the data shown. The data field is less then the standard 10 characters in length, thus the short data field designation.

Action: Check what should be on this input record and review the output to see how the illegal character was interpreted. Revise and rerun if necessary.

- **INPUT M OUTSIDE ACCEPTABLE RANGE, X = xxx.xx AND M = xx.xx USED FOR REACH id.**

Remarks: The program revised the computed "x" and "m" values to be within the acceptable range for the Modified Att-Kin reach routing.

Action: Inspect the routed hydrograph results with the revised values to see if the output is compatible with the input data.

- **INTERPOLATION ERROR – VALUES WERE THE SAME IN DENOMINATOR. CHECK INPUT, THE VALUES USED WERE xxxx.xxxxx AND xxxx.xxxxx.**

Remarks: Two consecutive array values are the same resulting in a zero in the denominator of a linear interpolation. Pass may continue but results may not be correct.

Action: Check STRUCTURE table, values should increase.

- **INVALID INPUT DATA. TOTAL NUMBER OF INPUT ERRORS NOW =xx.**

data record

$

xxxxxx.xxxx WAS SUBSTITUTED FOR FLAGGED DATA.

Remarks: The program indicates by a "$" below the data record the input data which is outside the expected range. The program made the substitution indicated.

Action: Change data if program substitution was not acceptable.

Warnings (I, L, M)

- **INTEGRITY LOAD FACTOR ENTERED (xx.xx) LESS THAN 1.0, OR GREATER THAN 8. USED 1.0 FOR THIS RUN.**

  Remarks: The coding for auxiliary spillway integrity analysis provides for potential use of a load (safety) factor. Use of values less than 1 are not advised, and values greater than 5 are considered unusually large. Use of load factors other than 1.0 (default) is not currently recommended.

  Action: Revise load factor to be within acceptable bounds.

- **LAST RECORD IN ASSURFACE TABLE SHOULD CONTAIN VALUES TO THE END OF THE EXIT CHANNEL.
  VALUES ON THE LAST RECORD ARE USED TO THE VALLEY FLOOR.**

  Remarks: The distance entries on the ASSURFACE table do not reach the end(s) of the auxiliary spillway. Surface conditions are assumed constant from the nearest specified point to the end of the spillway.

  Action: Check auxiliary spillway surface data. No action required if correct values have been used in computations.

- **MAINTENANCE CODE FOR ASSURFACE REACH RECORD xx IS OUT OF RANGE 1–3, VALUE OF x USED.**

  Remarks: The maintenance code must be the integer 1, 2, or 3. The entered value was not 1, 2, or 3. The value used by the program was the acceptable value nearest the entered value.

  Action: Check auxiliary spillway surface data. No action required if correct values have been used in computations.

- **MAINTENANCE CODE VALUE x.xx ON RECORD xx WAS ENTERED AS REAL NUMBER. CHECK INPUT, HAVE COLUMNS BEEN TRANSPOSED?**

  Remarks: The maintenance code must be the integer 1, 2, or 3. The entered value was not an integer. Check the surface summary table in the output to find value(s) used in computations.

  Action: Check auxiliary spillway surface data. No action required if correct values have been used in computations.

Warnings (M)

- **MANNING'S "n" VALUES BELOW 0.01 ADJUSTED TO PROGRAM MINIMUM (0.01).**

  Remarks: The minimum allowable value of Manning's "n" for the auxiliary spillway is 0.01. Entered values between 0. and 0.01 are set to 0.01 before proceeding with computations.

  Action: Review flow resistance entries for auxiliary spillway. A value of 0.01 is considered unusually low.

- **MANNING'S "n" OF <u>x.xxx</u> ENTERED AS VEGETAL RETARDANCE CURVE INDEX ON <u>name</u> REACH <u>xx</u> SEEMS HIGH, NEEDS VERIFICATION.**

  Remarks: The flow resistance value entered for the indicated reach of the auxiliary spillway is less than 1.0 and will, therefore, be interpreted as direct entry of Manning's "n." A value of Manning's "n" greater than 0.2 is considered unusually large.

  Action: Check auxiliary spillway flow resistance data entry.

- **MAXIMUM AUX. SURFACE PROFILE ELEVATION (<u>xxxxx.xx</u>) AND AUXILIARY CREST (<u>xxxxx.xx</u>) ELEVATION DO NOT MATCH. MAXIMUM AUX. SPILLWAY PROFILE ELEVATION USED IN WSPVRT PROCEDURE.**

  Remarks: The auxiliary spillway surface has been specified in actual coordinates. The high point of the profile does not agree with the crest elevation entered using the ASCREST control word. The ASCREST entry is ignored.

  Action: Check the spillway profile data.

- **MAXIMUM HEAD ENTERED IS NEGLIGIBLE. NO BACKWATER COMPUTED.**

  Remarks: The maximum reservoir elevation for which the auxiliary spillway rating is requested results in negligible flow through the spillway.

  Action: None, if maximum water surface is less than or equal to spillway crest. Review structure table inputs.

Warnings (M)

- **MAXIMUM RATING CURVE ELEVATION EXCEEDED THE MAXIMUM INPUT ELEVATION (xxxxx.xx) BY xxxx.x FT. ASINC RATIO WAS x.xx.**

  Remarks: The WSPVRT water surface profile procedure was used with the ASINC ratio shown. If difference between the maximum rating curve elevation and the maximum input elevation in the STRUCTURE table is significant, the extrapolation of the rating curve should be examined since a peak flow exceeded the maximum STRUCTURE table elevation.

  Action: If significant, rerun without the ASINC and a revised STRUCTURE table with the maximum elevation raised to include the peak flow.

- **MAXIMUM RATING POINT xxxxxx.xx (TOD) FOR HOOD INLET IS BELOW FULL PIPE FLOW, xxxxxx.xx. RATING EXTRAPOLATIONS MAY BE IN ERROR.**

  Remarks: The point of full pipe flow is not identified in the rating. If the rating is extrapolated, significant errors may be generated.

  Action: Verify input data. Add points to the structure table as appropriate.

- **MAXIMUM RATING POINT xxxxxx.xx (AS CREST) FOR HOOD INLET IS BELOW FULL PIPE FLOW, xxxxxx.xx. RATING INTERPOLATION/EXTRAPOLATIONS MAY BE IN ERROR.**

  Remarks: The point of full pipe flow is not identified in the rating. Discharge may be computed incorrectly in this region during routing. This condition is outside the recommended application range for the hood inlet.

  Action: Verify input data. Examine impact of rating inconsistency. If necessary, compute rating externally and enter through structure table.

Warnings (M, N)

- **MINIMUM CAPACITY OF AUXILIARY SPILLWAY PROCEDURE RESULTED IN A LOWER TOTAL FLOW (xxxxx.x CFS) THAN THE TOTAL PREVIOUS DESIGN FLOW. AN APPROXIMATION OF xxxxx.x CFS HAS BEEN SUBSTITUTED FOR THE TOTAL FLOW. THIS INCLUDES THE xxxxx.x CFS MINIMUM AUXILIARY SPILLWAY CAPACITY PLUS AN ESTIMATED PS FLOW.**

Remarks: This is a program procedure problem that may result if the principal spillway type was not recognized and zero PS outflow was added to the minimum auxiliary spillway capacity. This may not be important for the design if a subsequent minimum depth requires a deeper spillway with greater capacity.

Action: Review the approximated total capacity to determine if the estimated PS flow at the new elevation is satisfactory. If not, and the PS input data are verified, this problem should be reported to the NRCS Conservation Engineering Division.

- **MINIMUM MANNING'S "n" OF x.xxx USED IN PLACE OF GIVEN VEGETAL RETARDANCE CURVE INDEX OF x.xxxx ON ________name______ REACH xx.**

Remarks: The minimum allowable value of Manning's "n" for the auxiliary spillway is 0.01. Entered values between 0. and 0.01 are set to 0.01 before proceeding with computations.

Action: Review flow resistance entries for auxiliary spillway. A value of 0.01 used is considered unusually low.

- **MORE THAN ONE SITES OR DAMS2 CONTROLS FOUND IN THE SAME JOB. UPPER SUBAREAS OR STRUCTURES WILL NOT BE ADDED. IF THE RUN INCLUDES MULTIPLE JOBS, THE ENDJOB CONTROL MUST END EACH JOB.**

Remarks: Only one SITES or DAMS2 control is allowed in a job, and it must be the first record in the job.

Action: Remove all extra SITES or DAMS2 control records or if including multiple jobs in the same run, add the ENDJOB control between the jobs.

- **NO REACH ROUTING METHOD SELECTED. DEFAULTED TO MUSKINGUM–CUNGE REACH ROUTING.**

Remarks: Column 16 of GO,REACH must contain either an "M," a "C," or an "A." The input data contained another character (or a blank), and the program defaulted to use of the Muskingum-Cunge routing method.

Action: Ensure that the Muskingum-Cunge method is acceptable.

Warnings (N, O)

- **NEGATIVE VALUE <u>xx.xxx</u> ENTERED ON BTMWIDTH RECORD. ILLEGAL, VALUE SKIPPED.**

  Remarks: Negative values are not allowed on BTMWIDTH record for any of the available forms of auxiliary spillway bottom width entry. Negative value was ignored.

  Action: Review auxiliary spillway bottom width data.

- **NHCP–378 CRITERIA DOES NOT APPLY WHEN THE EFFECTIVE HEIGHT IS OVER 35 FEET OR THE PRODUCT IS 3000 OR GREATER.**

  Remarks: The criteria check indicates the site is too large for NHCP–378 criteria.

  Action: Revise input to stay within NHCP/TR–60 criteria or user defined criteria and rerun.

- **NO INLET SLOPE DATA GIVEN IN THE INPUT, ASSUME LEVEL CREST WITH PROFILE REFERENCE NUMBER 1.**

  Remarks: Data describing the inlet profile for the auxiliary spillway is incomplete. A level crest section to the intersection with natural ground or the specified length of inlet is assumed.

  Action: Review and complete spillway inlet data entry.

- **NO RETARDANCE HAS BEEN READ IN. RETARDANCE IS ASSUMED TO BE C. COMPUTATION CONTINUED.**

  Remarks: The program did not recognize the given retardance class, so it assumed "C."

  Action: Check value of retardance class, col. 13 of ASDATA. It must be between "A" and "E."

- **ONLY ONE AUXILIARY SPILLWAY CREST IS ALLOWED WITH A DEFINED ACTUAL <u>   name   </u> SPILLWAY PROFILE. ALL OTHER CRESTS IGNORED.**

  Remarks: The profile of the auxiliary spillway was specified in terms of actual coordinates. Only the crest elevation corresponding to the maximum elevation of the coordinates entered is analyzed. Other entered elevations for the crest are ignored.

  Action: Review auxiliary spillway profile input data.

Warnings (P)

- **PERCENT CLAY VALUE OF xx.xxxx (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx.**

  Remarks: A density value exceeding 145 lb/ft^3 is indicated for a material with a positive percent of clay. Such a high density value normally indicates a rock material (percent clay of 0).

  Action: Review geologic material parameters. No action required if parameters are correct.

- **PERCENT CLAY VALUE OF xxxx.x (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx. AND HEADCUT ERODIBILITY INDEX OF xxxxxx.x.**

  Remarks: The combination of density and headcut erodibility index indicated is more typical of a rock material (percent clay of 0) than a material with the indicated percent clay.

  Action: None, if the entered material parameters are correct.

- **PLASTICITY INDEX VALUE OF xxxx.x (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx.**

  Remarks: A density value exceeding 145 lb/ft^3 is indicated for a material with a positive plasticity index. Such a high density value normally indicates a rock material (plasticity index of 0).

  Action: Review geologic material parameters. No action required if parameters are correct.

- **PLASTICITY INDEX VALUE OF xxxx.x (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx. AND HEADCUT ERODIBILITY INDEX OF xxxxxx.x.**

  Remarks: The combination of density and headcut erodibility index indicated is more typical of a rock material (plasticity index of 0) than a material with the indicated plasticity index.

  Action: None, if the entered material parameters are correct.

- **PRINCIPAL SPILLWAY PIPE DIAMETER OF xxxx.x inches IS NEGLIGABLY SMALL. DISCHARGE IS RATED 0.**

  Remarks: The pipe diameter entered is too small for a rating to be developed. Therefore, principal spillway discharge will be zero for all heads.

  Action: Verify that the entered value is correct.

Warnings (P, Q, R)

- **PRINCIPAL SPILLWAY PIPE MANNING n OF xx.xxx IS LESS THAN xx.xxx. VERIFICATION SUGGESTED**

  Remarks: The value of n is outside the expected range.

  Action: Verify that the entered value of n is correct.

- **PRINCIPAL SPILLWAY PIPE WITH HOOD INLET DOES NOT HAVE WEIR FLOW AND SLUG FLOW REGIONS. RATING BELOW FULL PIPE APPROXIMATE.**

  Remarks: The principal spillway input values are outside of the range for which the hood inlet was designed. The rating generated for low flow regions is approximate.

  Action: Verify input data. If data is correct, and a precise rating is required, rate the spillway external to the program and enter the rating through the structure table.

- **PSDATA AND ASSOCIATED INLET DATA ARE OVERRIDDEN BY PS RATING DATA ENTERED IN THE STRUCTURE TABLE.**

  Remarks: The principal spillway rating given in the structure table is used in computations. For a rating to be developed using the principal spillway inlet and conduit data, the rating in the structure table must be deleted.

  Action: None, if the structure table rating is the correct rating.

- **Q10–DAY TO Q24–HR RATIO LESS THAN 1.0, USED 1.0.**

  Remarks: Ten-day runoff cannot be less than 1-day runoff, so the ratio is set to its minimum of 1.0. This assumes they are equal.

  Action: Review PDIRECT or QDIRECT input for principal spillway rainfall/runoff amounts. Correct as necessary and rerun.

- **RATING CURVES SHOULD BE DEVELOPED BY THE WSPVRT PROCEDURE FOR CONSISTENCY WITH THE INTEGRITY AND STABILITY ANALYSIS.**

  Remarks: The auxiliary spillway integrity and stability analyses utilize the same base relations for flow resistance as the WSPVRT procedure. Other water surface profile procedures do not allow use of vegetal flow resistance, variation of flow resistance by reach, and/or subcritical flow in the exit channel.

  Action: None, if the rating used is correct and consistent with analyses requested.

Warnings (R)

- **REACH id , INFLOW EXCEEDS MAX. TABLE DISCHARGE, EXTRAPOLATION USED.**

  Remarks: The cross section rating curve when extrapolated may not be representative of these high flow conditions. Other problems may cause an unreasonably large inflow peak which may also trigger this warning.

  Action: Inspect input and results for other problems and make corrections. Otherwise, add a higher value to the cross section table and rerun.

- **REACH id , INSUFFICIENT LOW FLOW RATING, PEAK FLOW LESS THAN 2ND TABLE VALUE.**

  Remarks: The cross section rating curve may not provide enough definition between zero discharge and the second discharge, on a log scale, to obtain a satisfactory Att-Kin routing.

  Action: Add at least one additional cross section low flow value below the peak value to avoid this warning.

- **REACH id , K* EXCEEDS 10. VALUE SET TO 10. DIVIDE REACH.**

  Remarks: Att-Kin routing may not be satisfactory with this long reach length.

  Action: Divide the reach length. If representative, use the same cross section data with a second GO,REACH.

- **REACH id , REACH INFLOW HYDROGRAPH TRUNCATED AT xxxxxx. CFS (xxx. % OF PEAK).**

  Remarks: The program truncated the inflow hydrograph peak to the reach, usually at the 5000 point limitation. The last point is greater than 20 percent of the peak. In sites in series, truncated routed hydrographs from upper subwatersheds may not add properly at downstream locations.

  Action: Inspect the results to see if truncations will have an effect on peaks. If needed, revise input, lengthen reaches, etc.

Warnings (R)

- **REACH xx, control word VALUES ARE NOT CONSISTENT FOR ROCK.**

Remarks: Surface conditions for the indicated reach of the auxiliary spillway do not appear consistent. Either the vegetal cover factor is greater than zero (implying vegetation) with direct entry of Manning's "n" and a rooting depth of less than 0.5 ft (implying no vegetation), or the rooting depth is greater than 0.5 ft (implying vegetation) with direct entry of Manning's "n" and a cover factor of 0 (implying no vegetation). The reference to rock is the result of the fact that a complete lack of vegetation normally implies rock at the surface.

Action: Check surface conditions entered with the indicated control word.

- **REACH xx, control word VALUES ARE NOT CONSISTENT FOR SOIL.**

Remarks: Surface conditions for the indicated reach of the auxiliary spillway do not appear consistent. The vegetal cover factor is greater than zero (implying vegetation) with direct entry of Manning's "n" less than or equal to 0.02 (implying no vegetation). The reference to soil is the result of the fact that the presence of vegetation implies soil.

Action: Check surface conditions entered with the indicated control word.

- **REACH ROUTINE EXTRAPOLATED THE SECTION TABLE.**

Remarks: The routed discharge exceeds the given cross section data. The program linearly extrapolated to obtain the cross sectional area.

Action: Check if extrapolation is valid. If not, increase range of data in cross section table and rerun.

- **REACH SLOPE WAS NEGATIVE OR ZERO IN STABILITY CONTROL REACH WHICH STARTS AT STATION xxxxx.xx. NO STABILITY STRESS COMPUTED.**

Remarks: No positive slope reaches of the auxiliary spillway exit channel were identified for stability analysis (velocity or stress) computations. If profile is correct, stability analysis based on normal flow depth is not appropriate.

Action: Review auxiliary spillway profile.

Warnings (R)

- **REPRESENTATIVE DIAMETER OF xx.xxxx in (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx.**

  Remarks: A bulk dry density in excess of 145 lb/ft^3 is indicated with a representative material diameter of less than 1 inch. Such a high density value normally implies a more massive material.

  Action: Check material property entries. No action if entries are correct.

- **REPRESENTATIVE DIAMETER OF xx.xxxx in (MATERIAL xx) APPEARS INCONSISTENT WITH DENSITY OF xxxxx. AND HEADCUT ERODIBILITY INDEX OF xxxxxx.x.**

  Remarks: Either a large material diameter (>12") has been entered when other material properties suggest a soil, or a small diameter (<1") has been entered when other properties suggest rock.

  Action: Check material property entries. No action, if entries are correct.

- **REPRESENTATIVE DIAMETER OF xxxxx. in (MATERIAL xx) IS UNUSUALLY LARGE.**

  Remarks: A representative diameter in excess of 10 ft indicates an unusually massive material. For large diameter materials, the representative diameter should be an indication of the size of "particle" detached during erosion if erosion occurs.

  Action: None, if representative diameter is correct.

- **ROOTING DEPTH OF xxx.x NOT APPROPRIATE: ASSURFACE REACH xx.**

  Remarks: A nonvegetated surface condition has been indicated for an ASSURFACE reach of the auxiliary spillway by direct entry of Manning's "n" and entry of a vegetal cover factor value of 0. Entry of a rooting depth for a nonvegetated surface is not appropriate.

  Action: Check surface condition entries.

Warnings (R, S)

- **ROOTING DEPTH OF xxx.x NOT APPROPRIATE: ASEXSURF ENTRY xx.**

  Remarks: A nonvegetated surface condition has been indicated for an ASEXSURF reach of the auxiliary spillway by direct entry of Manning's "n" and entry of a vegetal cover factor value of 0. Entry of a rooting depth for a nonvegetated surface is not appropriate.

  Action: Check surface condition entries.

- **ROUTING COEFFICIENT (C) (xx.xxxxxxx) BELOW MINIMUM VALUE, 0.0001 USED IN ROUTING REACH id .**

  Remarks: The program changed the computed coefficient to the minimum allowable value which is shown for the reach routing.

  Action: Inspect the routed hydrograph results with the revised minimum coefficient to see if the output is compatible with the input data.

- **SLUG FLOW COEFFICIENT OF x.xxx ENTERED, BUT VALUE IS OUT OF RANGE 1.0 TO 1.6. DEFAULT VALUE USED BASED ON PIPE ROUGHNESS.**

  Remarks: In developing the principal spillway rating for a hood inlet, the slug flow coefficient was input directly. The value is outside of the recommended range so the default value based on pipe roughness was used. See PSCOEFFS for the default values.

  Action: Review input on PSHOOD and PSCOEFFS, correct if necessary and rerun.

- **SOD STRIPPING WILL PROBABLY OCCUR DUE TO GROSS STRESS LIMIT IN STABILITY CONTROL REACH WHICH STARTS AT STATION xxxxx.xx.**

  Remarks: The computed maximum gross stress for stability analysis of the auxiliary spillway is likely sufficient to result in direct destruction of the vegetal cover. The usual form of this destruction is stripping of a shallow rooted (<1 ft) sod from a material that the roots are unable to penetrate.

  Action: Stability design on the basis of vegetative cover may be inappropriate for this channel, and it may be preferable to analyze stability based on the underlying material.

Warnings (S, T)

- **SOLUTION EXCEEDED MAX. INPUT ELEVATION (xxxxx.xx) BY xxx.xx FT.**

  Remarks: A routed hydrograph peaked above the maximum elevation input in the STRUCTURE table. The program uses a linear extrapolation of the last two surface area points in the STRUCTURE table.

  Action: Do nothing, if program extrapolation is acceptable. Input more elevations in STRUCTURE table if extrapolations are not acceptable.

- **STABILITY BERM ELEVATION (xxxxxxx.xx) IS ABOVE TOP OF DAM. U or D/S BERM IS OMITTED FROM FILL VOLUME.**

  Remarks: Computed elevation of the designated stability berm based on the STABERM control input data is higher then the top of the dam, so no fill is computed. This can occur for either the upstream (U/S) or downstream (D/S) stability berm or for both.

  Action: Review CLPROFILE and STABERM input to see if revisions are needed.

- **SURFACE OF ASCOORD TABLES NOT DESIGNATED AS TO TYPE. ASSUMED TO BE NATURAL GROUND (N).**

  Remarks: The surface formed by the upper coordinates of the geologic materials entered in the ASCOORD tables may be designated to be either a natural surface or the auxiliary spillway surface. No designation was made (first ASCOORD table). Alternative entry of the spillway surface is, therefore, required.

  Action: None, if alternative form of spillway surface entry is used.

- **TC MINIMUM VALUE OF 0.05 HRS. WAS USED IN THIS RUN. CHECK INPUT DATA ON WSDATA CONTROL IF NOT ACCEPTABLE.**

  Remarks: The program changed the given T_c to the minimum value.

  Action: Inspect given T_c on WSDATA and correct if necessary.

- **TC WAS COMPUTED AS xx.xxxx, THEN RESET TO A MINIMUM OF 0.05 HRS. CHECK INPUT DATA ON WSDATA CONTROL IF NOT ACCEPTABLE.**

Remarks: The program changed the computed T_c to the minimum value.

Action: Inspect T_c data on WSDATA record and correct if necessary.

- **THIS SOLUTION EXCEEDED MAXIMUM RATING CURVE ELEVATION xxxxx.xx BY xxxx.x FT. ASINC RATIO OF x.xx USED.**

Remarks: The WSPVRT water surface profile procedure was used with the ASINC ratio shown to develop the auxiliary spillway rating. Extrapolation of the computed rating to reach this solution should be examined.

Action: Consider rerunning without the ASINC ratio and a revised STRUCTURE table with the maximum elevation raised to include the maximum solution.

- **TOP ELEVATION (xxxxx.xx) IS LESS THAN LOWEST ELEVATION (xxxxx.xx) ON CLPROFILE. NO EMBANKMENT QUANTITIES COMPUTED.**
  title of centerline profile

Remarks: The top elevation of the dam is lower than the lowest elevation on the centerline profile.

Action: Check CLPROFILE elevation data in relation to STRUCTURE elevation data.

- **TOP OF DAM EXCEEDS CLPROFILE ENDPOINT –**
  title of centerline profile

Remarks: The top of dam elevation for embankment computations exceeded the highest elevation input in the CLPROFILE data.

Action: Do nothing if extrapolation is acceptable. If not acceptable, input higher elevation-station data in CLPROFILE table.

Warnings (T, U)

- **TOPSOIL AND GEN. FILL MATERIAL NUMBERS MUST BE FROM 1 TO 99. MATERIAL NUMBER xx CHANGED TO 11 IF TOPSOIL, 12 IF GEN. FILL.**

  Remarks: Topsoil or fill material properties have been referenced with a number outside of the acceptable range. Reference numbers have been changed as indicated for the run. The preferred form of entry is to use sequential numbers from 1 to 10 for in-situ geologic materials and to continue the numbering sequence for topsoil and fill materials if different from the in-situ materials.

  Action: None required. Check for data entry errors as appropriate.

- **TR–20 HYDROGRAPH IN STORAGE LOCATION = xx SHOULD BE MOVED TO AN INFLOW HYDROGRAPH LOCATION. ONLY 1(PSH), 3(SDH), 5(FBH), OR 7 AND 9 (STORM) ARE ACCEPTABLE.**

  Remarks: The hydrograph type code in column 17 of the first record in the 7READHD table is not one of the standard input hydrograph codes. Thus, the program ignores the hydrograph in the computations unless you enter a SAVMOV.

  Action: Inspect the output to see if the program uses the hydrograph as intended or change to an appropriate code and rerun.

- **TR–60 REQUIRES AN INCREASE IN RAINFALL AMOUNT COMPATIBLE WITH INCREASE IN SDH OR FBH STORM DURATION WHEN TC EXCEEDS 6–HRS.**

  Remarks: The T_c is greater than the storm duration. TR–60 criteria requires the duration to be equal or greater than the Tc. Rainfall amounts increase with duration.

  Action: Inspect the PDIRECT, RAINTABLE, and GO,DESIGN and revise the rainfall volume and duration as necessary.

- **UPSTREAM END OF CREST xxxxx. IS UPSTREAM OF THE FIRST GROUND POINT xxxxx. STATION.**

  Remarks: The position of the upstream end of the auxiliary spillway crest is upstream of the first point associated with the spillway geology profile. Fill material is assumed when no other material is given. The potential exists for this fill material to become involved in spillway integrity erosion computations.

  Action: Adjust position of spillway or provide additional geologic information.

Warnings (U, V)

- **USER SUPPLIED RATING CURVE DID NOT MEET CRITERIA FOR MINIMUM FLOW THROUGH AUXILIARY SPILLWAY (xxxxx.xx CFS).**

  Remarks: The given auxiliary spillway discharge elevation or stage data did not meet criteria in TR–60 for minimum flow.

  Action: Revise input to meet criteria.

- **USING STANDARD DESIGN RAINFALL DISTRIBUTION WITH RUNOFF GIVEN.**

  Remarks: The program is using a standard program rainfall distribution as a runoff distribution for AS design with runoff volumes entered by QDIRECT. This means runoff starts at the same time as rainfall and less flood storage is required as the runoff is distributed over a longer time.

  Action: Enter a special runoff distribution table or enter rainfall values on the PDIRECT record.

- **VEGETAL COVER FACTOR EXCEEDED 0.9 ON control word REACH xx.**

  Remarks: It is unusual for the vegetal cover factor to exceed 0.9. The highest value observed for laboratory conditions was approximately 0.92.

  Action: Check vegetal cover factor entries.

- **VEGETAL RETARDANCE CURVE INDEX EXCEEDED 10.0 ON control word REACH xx.**

  Remarks: It is unusual for the vegetal retardance curve index to exceed 10. A retardance curve index of 10 implies a dense cover with a stem length on the order of 3 ft and corresponds approximately to a class A retardance.

  Action: Check vegetal retardance curve index entries.

- **VEGETAL RETARDANCE CURVE INDEX OR MANNING’S "n" xxx.xx IS HIGH IN STABILITY CONTROL REACH WHICH STARTS AT STATION xxxxx.xx.**

  Remarks: A relatively high value of flow resistance was noted during stability calculations for the auxiliary spillway exit channel. Either a value of Manning’s "n" greater than 0.1 or a retardance curve index greater than 10 was encountered.

  Action: Check exit channel flow resistance data.

Warnings (W)

- **WITH SPECIFIED WIDTH, SHOULD ALSO SPECIFY EXIT SLOPE. VELOCITIES IN EXIT CHANNEL SHOULD BE FOR THE CRITICAL SLOPE BASED ON 25% OF THE FBH PEAK DISCHARGE.**

  Remarks: TR–60 criteria specify that the exit slope, if not given, be determined by one-fourth of the maximum discharge from passage of the freeboard hydrograph. The stability design hydrograph exit channel velocities may be for the wrong slope.

  Action: Reroute using the exit channel slope determined by the freeboard hydrograph routing or estimate actual exit channel slope for input on the ASDATA record. Use the switch on the OLDTR60 control word if desiring to use the stability design hydrograph to determine the exit channel slope.

Warnings (W)

- **WARNINGS FROM INTEGRITY ANALYSIS FOLLOW:**
  (One or more of the following eight warnings will be displayed.)

  Questionable line intersect during development of final geologic description. Possible logic error.

  No exit reach entered: vertical assumed from crest to valley floor.

  Unresolved question in eroded surface following specified material: probable logic or coding error.

  Problem in identifying material at headcut: logic or coding error implied.

  Phase 2 computations initiated with negligible flow concentration depth: unusual condition.

  Problem in identifying downstream end of materials: coding or logic error implied.

  Vegetal cover over a surface material with a diameter greater than 12" indicated in xx reaches, including reach xx. Base (minimum) value of Manning's "n" computed assuming 12" material.

  Vegetal cover over a surface material with a diameter greater than 12" indicated in reach xx. Base (minimum) value of Manning's "n" computed assuming 12" material.

  Remarks: Generation of any of these warnings indicates a problem or unusual condition encountered during integrity analysis of the auxiliary spillway. Generation of possible logic or coding error warnings will be unusual. Phase 2 computations may be initiated with negligible flow concentration depth by entering a small, but finite value, for potential rooting depth (unusual). Vegetal cover rooted in a surface material with a diameter greater than 12 inches is considered questionable.

  Action: Those warnings with a logic or coding error implied should be referred to an appropriate code maintenance person. Check input data as appropriate for the other warnings.

Messages (A)

Messages are listed alphabetically. To help you quickly locate the message you need, the first letter of the messages on each page are shown with the heading.

- **ACTUAL MAINTENANCE CODES ALLOWED FOR STORM SIMULATION**

  Remarks: The auxiliary spillway maintenance code is adjusted to be not less than 2 for spillway integrity analysis except when actual value is requested for storm simulation (see remarks, GO STORM). This message indicates that use of actual values has been requested.

  Action: None, if use of actual values is appropriate.

- **ADVERSE NATURAL GROUND SLOPE DOWNSTREAM OF CONSTRUCTED EXIT CHANNEL. PROGRAM ASSUMES A LEVEL CUT TO THE HIGH POINT OF THE HUMP, THEN ANOTHER CUT THAT EXTENDS TO THE NEXT POINT.**

  Remarks: Auxiliary spillway integrity analysis is not capable of handling adverse slopes (elevation increasing with distance) in the spillway profile downstream of the crest. Therefore, the indicated adjustment is made to eliminate the adverse slope from the profile for purposes of spillway integrity analysis.

  Action: Examine natural ground along spillway flow path below exit channel. Adjust surface coordinates if appropriate.

- **ALTERNATE LOCATION ID (id) BEING USED SINCE USER DID NOT INPUT AN ID.**

  Remarks: The Location Point field on the GO,ADDHYD and/or GO,REACH record(s) was left blank. For identification in the output, the program assigns the alternate (default) ID shown above.

  Action: None, if the default Location Point ID's are satisfactory.

- **ALTERNATE STRUCTURE ID (id) BEING USED SINCE USER DID NOT INPUT AN ID.**

  Remarks: The Structure ID field on the header record of the STRUCTURE table was left blank. For identification in the output, the alternate (default) ID shown above is used.

  Action: None, if the default Structure ID is satisfactory.

Messages (A)

- **ALTERNATE SUBWATERSHED ID (id) BEING USED SINCE USER DID NOT INPUT AN ID.**

  Remarks: The Subwatershed ID field on the WSDATA record was left blank. For identification in the output, the alternate (default) ID shown above is used.

  Action: None, if the default Subwatershed ID is satisfactory.

- **ANALYSIS USES THE MINIMUM MANNING'S "n" (x.xxx) AS A DEFAULT. SUGGEST ASINSURF OR ASDATA BE USED TO ENTER CI OR "n" VALUES.**

  Remarks: Manning's "n" for the auxiliary spillway inlet channel has been defaulted as indicated.

  Action: Enter the actual retardance curve index or Manning's "n" value(s) using the control word appropriate for the input form selected.

- **AREAL CORRECTIONS GIVEN BY USER:**

  Remarks: The program gives this message if using an AREACRCT record in the computation of design rainfall volumes of sites less than or equal to 100 mi^2 drainage area. The program shows the areal correction values below the message.

  Action: Do nothing, if coefficients are satisfactory.

- **AREAL CORRECTION ZONE ON THE "AREACRCT" COMMAND SHOULD BE 4. DEFAULTED TO USE ZONE 4. SAME ZONE 4 SHOULD BE USED ON THE "WSDATA" COMMAND, RUN CONTINUING.**

  Remarks: You input an AREACRCT record with an areal correction climate zone number of less than 4. The program sets the zone number to 4 to store the entered areal correction factors as special case factors. If the zone number is not 4, the program makes standard areal corrections if a TR–60 site or makes no corrections if a NHCP–378 site.

  Action: Do nothing if program actions are acceptable.

Messages (A)

- **AREAL CORRECTIONS BASED ON DRAINAGE AREA OF xxxx.x SQ MILES**

Remarks: The rainfall has been corrected by a factor computed from the indicated watershed area. If the actual area is different from that used to correct the rainfall, the actual area will be indicated as well.

Action: Do nothing if the indicated area is correct. Otherwise, enter the correct system area in square miles on the SITES record, or enter areally corrected rainfall and so indicate on the WSDATA record.

- **ASEXSURF ENTRY xx: ZERO ROOTING DEPTH IS DEFAULTED TO O.5 FT.**

Remarks: Vegetation is indicated in the specified reach ($C_I > 1.0$ or $C_F > 0.0$) with no entry or an entry of 0.0 for the available rooting depth. Because a zero rooting depth is not consistent with vegetation, a default rooting depth of 0.5 ft is assumed. This default potential rooting depth will imply stripping of the vegetal cover at comparatively low total stresses.

Action: Enter appropriate rooting depth if different from 0.5 ft.

- **ASSURFACE REACH xx: ZERO ROOTING DEPTH IS DEFAULTED TO O.5 FT.**

Remarks: Vegetation is indicated in the specified reach ($C_I > 1.0$ or $C_F > 0.0$) with no entry or an entry of 0.0 for the available rooting depth. Because a zero rooting depth is not consistent with vegetation, a default rooting depth of 0.5 ft is assumed. This default potential rooting depth will imply stripping of the vegetal cover at comparatively low total stresses.

Action: Enter appropriate rooting depth if different from 0.5 ft.

- **ASTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW. DOLLAR SIGN MEANS VELOCITY EXCEEDS THEORETICAL LIMIT.**

Remarks: These messages appear as needed at the bottom of line plots that contain auxiliary spillway flow with these special flow conditions. The "*" and "$" identify these flow conditions on the line plot at the time and discharge that they occur.

Action: Review the plot to see if input data changes are needed.

- **AUXILIARY SPILLWAY AREAL CORRECTIONS NOT USED; ILLEGAL VALUE ON WSDATA CONTROL.**

Remarks: The program ignored the AREACRCT record, and used areal correction factors of 1.0, because you did not enter a climate zone of "4" in column 11 of the WSDATA record.

Action: Check WSDATA and correct or remove AREACRCT record.

- **AUXILIARY SPILLWAY CREST ELEVATION IS SET TO xxxxx.xx FROM THE ____name____ RECORDS.**

Remarks: The auxiliary spillway surface profile was entered in the format of actual coordinates on the record indicated. The value indicated is the maximum elevation of that profile.

Action: None, if input is correct.

- **AUXILIARY SPILLWAY CREST ELEVATION IS SET TO xxxxx.xx, VALUE x ON THE ASCREST CONTROL, TO AGREE WITH THE CREST FROM THE __name__ RECORDS. ALL OTHER ASCREST VALUES ARE IGNORED.**

Remarks: The auxiliary spillway surface profile was entered in the format of actual coordinates on the record indicated. The value indicated is the maximum elevation of that profile. That value was also entered using the ASCREST control word as indicated. The fourth line of the message only appears if there is more than one AS crest given on the ASCREST control word.

Action: None if crest elevation assumptions are correct.

Messages (A, C)

- **AUXILIARY SPILLWAY RATING EXTENDED ABOVE ELEVATION xxxx.xx.**

  Remarks: The program linearly extrapolated the auxiliary rating above the elevation shown to complete the rating table. The program based the rating, up to this elevation, on the type of input and computational method. The program used one of the following methods (altered by ASINC if used) to develop the maximum range of the computed data:

WSPVRT Method	–	maximum elevation in STRUCTURE table
Frictionless Side Slope Method	–	12-foot stage in reservoir above the crest.
TRAPW Method	–	12-foot critical depth plus head loss in AS.
ASRATING	–	Given stage increment times 12
ASFILE	–	Given stage increment times 12

  Action: Do nothing if accuracy is acceptable. If not, lower the maximum elevation of the STRUCTURE table if excessively high to within the range of the maximum computed data and the expected top of dam; use ASINC to alter the 12 feet; enter the auxiliary spillway rating in the STRUCTURE table; or use ASRATING with a larger increment of stage.

- **AUXILIARY SPILLWAY DISCHARGE OF xx. CFS IS TOO SMALL FOR STABILITY COMPUTATIONS. NO STRESS COMPUTED.**

  Remarks: The auxiliary spillway discharge computed for stability computations (given) is less than approximately 0.01 cfs/ft for the spillway. Therefore, a meaningful value of erosionally effective stress may not be computed for the exit channel. Stress is not likely to be the governing consideration for auxiliary spillway channel width.

  Action: None, if input data is correct.

- **CREST LENGTH ON ASINLET xxx. LESS THAN 30 FT, TR–60 MINIMUM.**

  Remarks: An auxiliary spillway crest length has been entered which is less than the minimum required by TR–60 criteria. Analysis uses the crest length entered.

  Action: If the crest length is correct, no action is required.

Messages (C, D)

- **CREST OF AUXILIARY SPILLWAY RAISED 0.5 FT ABOVE THE FULL FLOW PIPE FLOW ELEVATION IN THE NEXT RATING TO AVOID HAVING INTERPOLATION PROBLEMS. NEW CREST ELEVATION = xxxx.xx**.

Remarks: The crest of the auxiliary spillway and the full pipe flow elevation are designated points on the principal spillway rating. Rating points in between need elevation differences for interpolation. The designated points were less than 0.05 feet apart, therefore the crest was raised.

Action: None, if crest is reasonable, or else check rating input.

- **CREST OF AUXILIARY SPILLWAY RAISED TO MAKE CONDUIT FLOW FULL. NEW CREST ELEVATION = xxxx.xx**.

Remarks: Your input of principal spillway data did not result in full pipe flow in the principal spillway at the elevation of the auxiliary spillway crest. The entered PSFULL control word instructed the program to ensure that the principal spillway was in full pipe flow when the water surface was at the auxiliary spillway crest elevation. The program set the crest at 0.0001 ft. above the full pipe flow elevation.

Action: Do nothing if input data are correct.

- **CROSS SECTION END AREA DIFFERENCE ZERO FOR POINTS xxxx TO xxxx.**

Remarks: In developing the Att-Kin weighted "m" value the current cross section has the same end area for the two consecutive points listed. To avoid dividing by zero, the slope between these points is omitted from the computation of the weighted "m" for the reach routing.

Action: Check cross section input. It the values are correct and the flat segment of slope is significant, increase higher elevation end area slightly.

- **DEFAULT FILL MATERIAL NO. 1 USED IF GENERAL FILL IS REQUIRED.**

Remarks: Properties of general fill within the auxiliary spillway have not been identified. If fill is used, it will be assumed to have the same properties as the first material on the ASMATERIAL record.

Action: None, if there is no fill in the auxiliary spillway or if the fill has the properties of material 1.

Messages (D)

- **DEFAULT MANNING'S "n" OF x.xx USED IN PLACE OF GIVEN VEGETAL RETARDANCE CURVE INDEX OF x.xxxx ON _____name_____ REACH xx.**

Remarks: Manning's "n" for the auxiliary spillway reach indicated was not entered or was entered as a negative value using the indicated control word. The program set "n" to the default value shown.

Action: If default is not the correct value, enter the correct value using control word(s) appropriate for the form of data entry used.

- **DEFAULT ROUGHNESS OF 0.04 USED IN xx OF THE xx INPUT REACHES.**

Remarks: A default roughness (Manning's "n") of 0.04 is used for the indicated number of reaches of the auxiliary spillway channel. Values were not entered by you for these reaches.

Action: If the default of 0.04 is not the correct value, enter the correct value for the reach(es) (see ASSURFACE).

- **DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.**

Remarks: The material properties for topsoil fill in the auxiliary spillway are not indicated. Anywhere topsoil fill is requested, default properties will be assumed. The default properties are those consistent with a comparatively erodible material.

Action: None, if topsoil fill is not used (topsoil depth of 0.0 ft) or if topsoil default properties reasonably represent the material to be used.

- **DETACHMENT RATE COEFFICIENT xx.xx GIVEN FOR MATERIAL xx.**

Remarks: The detachment rate coefficient was entered directly through use of a negative entry on the ASMATERIAL record. The value is that indicated. Message is output for data entry check.

Action: None required.

Messages (D, E)

- **DISCHARGE ZERO FOR POINT xxxxx.**

Remarks: In developing the Att-Kin weighted "m" value the current cross section has zero discharge for the point listed. To avoid dividing by zero, this point is omitted from the computation of the weighted "m" for the reach routing.

Action: Check cross section input. If zero value is incorrect, correct data and rerun.

- **DOLLAR SIGN MEANS VELOCITY EXCEEDS THEORETICAL LIMIT. (See message "ASTERISK NEXT...." for Remarks and Actions.)**

- **DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.**

Remarks: The program found an "AC" in columns 18–19 of the WSDATA record. This indicates the input drainage area in columns 31–40 of the WSDATA record was in acres rather than square miles.

Action: Do nothing if the drainage area is in acres. There is no warning for an input error in columns 18–19.

- **DRAWDOWN TEST ELEVATION CANNOT BE LESS THAN SEDIMENT, BASEFLOW ELEVATION, OR INPUT DRAWDOWN ELEVATION; DDT TEST USED = xxxxxx.xx FT, xxxxxxxx.x ACFT, xxxxx.x CFS.**

Remarks: The program computes a minimum drawdown test elevation used in principal spillway hydrograph drawdown calculations. If the computed elevation is below the sediment storage, baseflow, or your input drawdown elevation, the program utilizes the highest of the three elevations for the drawdown target elevation.

Action: Normally, do nothing.

- **EFFECTIVE TRACTIVE STRESS (xx.xxx) ENTERED FOR BW COMPUTATION IS NOT CHECKED FOR APPLICABILITY WITHOUT A SURFACE D75 VALUE.**

Remarks: The effective tractive stress used to establish the bottom width of the auxiliary spillway is not checked against material size, because the size of the surface material in the spillway exit channel was not entered. When both effective stress and surface material size are entered, a relative magnitude check is made to assist in identifying data entry errors.

Action: None required if data is entered correctly.

Messages (E)

- **ENGINEERING MUST APPROVE THESE AREAL CORRECTIONS:**
  DESIGN xx.xxxxx PS–1 DAY xx.xxxxx PS–10 DAY xx.xxxxx.

  Remarks: The program gives this message if the structure drainage area exceeds 100 square miles. The program lists the areal correction coefficients used. The NRCS Engineering Division must approve these coefficients.

  Action: Do nothing except to note message.

- **EXISTING SURFACE PASSED CONTINUITY CHECK.**

  Remarks: The existing surface (natural ground surface) profile along the auxiliary spillway flow path is obtained from the geologic surfaces data entered in the ASCOORD tables. The continuity check of this composite surface is a check of the completeness of the geologic data. If the continuity check fails, a warning will be generated.

  Action: None, as this is an informational message acknowledging that the ASCOORD tables were successfully processed.

Message has been removed from versions of the program after 3–2000

- **EXIT CHANNEL ROUGHNESS BASED ON VEGETAL RETARDANCE (CI) VALUE.**

  Remarks: Although the auxiliary spillway rating is obtained by a procedure requiring the use of Manning's "n" (TRAPW or frictionless side slope), the input indicates the exit channel roughness to be based on vegetal retardance. When vegetation is present, use of the WSPVRT procedure for auxiliary spillway rating is encouraged.

  Action: Review input data for consistency.

- **EXIT CHANNEL SLOPE SET TO 4%; INSUFFICIENT DESIGN INPUT DATA.**

  Remarks: No basis for computing the auxiliary spillway exit channel bed slope has been entered. A default value of 4% is assumed when needed in computations.

  Action: Enter correct auxiliary spillway exit channel slope if using related design output from the routine.

- **EXIT CHANNEL VELOCITY OF xxxxx.xx FT/SEC EXCEEDS THEORETICAL LIMIT OF xxxxx.xx FT/SEC.**

Remarks: The velocity computed for normal depth in the auxiliary spillway exit channel exceeds the theoretical limit as indicated. The theoretical limit is computed as the velocity corresponding to the available potential energy from the reservoir surface to the tailwater surface.

Action: Verify exit channel slope and flow resistance entries and tailwater elevation relative to auxiliary spillway crest. Do not accept computed velocities.

- **EXIT FLOW RESISTANCE VALUE OF xxx.xxx FROM ASDATA OVERRIDDEN BY ENTRY OF xxx.xxx FROM ASEXSURF RECORDS.**

Remarks: The flow resistance of the auxiliary spillway exit channel was entered more than once as indicated. The value from the ASEXSURF record is assumed to be correct.

Action: Remove conflicting or redundant entries from data entry file.

- **EXIT FLOW RESISTANCE VALUE OF xxx.xxx FROM ASDATA OVERRIDDEN BY ENTRY OF xxx.xxx FROM ASSURFACE RECORDS.**

Remarks: The flow resistance of the auxiliary spillway exit channel was entered more than once as indicated. The value(s) from the ASSURFACE record is assumed to be correct.

Action: Remove conflicting or redundant entries from data entry file.

- **EXIT ROUGHNESS VALUES MISSING; DEFAULT VALUES OF n = 0.04 USED.**

Remarks: No exit channel roughness values were entered with spillway template auxiliary spillway data. Roughness defaulted as indicated.

Action: Enter exit channel flow resistance if different from default.

Messages (F, I)

- **FLOW RETARDANCE ENTRY ON ASDATA OVERRIDDEN BY LATER FLOW RESISTANCE ENTRY OF <u>xxx.xxx</u> FOR PART OR ALL OF EXIT.**

  Remarks: The flow resistance of the auxiliary spillway exit channel was entered more than once as indicated. The value(s) from the more detailed record is assumed to be correct.

  Action: Remove conflicting or redundant entries from data entry file.

- **FLOW RETARDANCE ENTRY ON ASDATA OVERRIDDEN BY LATER FLOW RESISTANCE ENTRY OF <u>xxx.xxx</u> FOR PART OR ALL OF INLET.**

  Remarks: The flow resistance of the auxiliary spillway inlet channel was entered more than once as indicated. The value(s) from the more detailed record is assumed to be correct.

  Action: Remove conflicting or redundant entries from data entry file.

- **FULL FLOW ACCURACY MUST BE GREATER THAN ZERO. DEFAULT VALUE USED = <u>xxx.xx</u>.**

  Remarks: An ACCURACY control word contains a blank or non-numeric elevation difference value for the trial and error solution for the pipe and orifice full flow computations. The program inserted the default value shown.

  Action: Do nothing if satisfied with the default value.

- **INLET CHANNEL LENGTH SHOULD BE USED WITH PROFILE REFERENCE NUMBER <u>xx</u> TO SET UPSTREAM LIMIT OF WSP COMPUTATIONS.**

  Remarks: When a computed auxiliary spillway rating is requested, but no ASCOORD tables are required, an alternative means of specifying the inlet channel length is needed. If no inlet length is specified, water surface profile computations will be carried to the upstream end of the specified template.

  Action: Specify inlet channel length (see ASDATA).

Messages (I)

- **INLET FLOW RESISTANCE VALUE OF xxx.xxx FROM ASDATA OVERRIDDEN BY ENTRY OF xxx.xxx FROM ASINSURF RECORD.**

  Remarks: The flow resistance of the auxiliary spillway inlet channel was entered more than once as indicated. The value from the ASINSURF record is assumed to be correct.

  Action: Remove conflicting or redundant entries from data entry file.

- **INLET FLOW RESISTANCE VALUE OF xxx.xxx FROM ASDATA OVERRIDDEN BY ENTRY OF xxx.xxx FROM ASSURFACE RECORDS.**

  Remarks: Flow resistance of the auxiliary spillway inlet channel was entered more than once as indicated. The value(s) from the ASSURFACE record is assumed to be correct.

  Action: Remove conflicting or redundant entries from data entry file.

- **INLET ROUGHNESS VALUES MISSING; DEFAULT VALUES OF n = 0.04 USED.**

  Remarks: No inlet channel roughness values were entered with spillway template auxiliary spillway data. Roughness defaulted as indicated.

  Action: Enter inlet channel flow resistance if different from default.

- **INPUT (given value) TO INTERPOLATION ROUTINE IS BELOW ARRAY LIMIT (1st value).**

  Remarks: Indicates that a value used in a two-way interpolation was below the lower limit of the independent variable array. Therefore, the program selected the first value in the array for the dependent (given) value.

  Action: Check source of the given value. If correct, alter input data to extend array low enough.

- **INTEGRITY COMPUTATIONS SKIPPED, NO AUXILIARY SPILLWAY INLET PROFILE GIVEN.**

  Remarks: Integrity analysis of the auxiliary spillway cannot be carried out because of lack of data. No spillway surface is specified.

  Action: Enter data describing spillway surface profile and surface conditions if spillway integrity analysis is desired.

Messages (L, M)

- **LENGTH FACTOR (K*) ABOVE 1, CONSIDER DIVIDING REACH LENGTH FOR REACH id.**

  Remarks: The given reach length will give less desirable Att-Kin routing results than would result from a shorter reach length.

  Action: To obtain best results with Att-Kin routing procedure, split the reach length. Use another GO,REACH using the same cross section data if feasible.

- **MATERIAL TABLES REQUIRED RE–ORDERING. STARTING FROM TOP, THE NEW MATERIAL ORDER USED IS, xx xx xx xx xx xx xx xx xx xx.**

  Remarks: For computational purposes, the program orders the material tables from the top downward such that no lower numbered material is ever above a higher numbered material. The materials entered were successfully reordered as indicated to achieve this condition.

  Action: None, if the coordinates of the material surfaces in the ASCOORD tables are correct.

This message has been removed from versions after 3–2000.

- **MATERIAL xx, X–DISTANCES ARE NOT WITHIN THE RANGE OF THE MATERIAL ABOVE IT.**

  Remarks: A check is made to see if the x-coordinates of sequential entries in the ASCOORD tables are within the same range. The material "above" assumes the recommended top-down numbering of materials is used.

  Action: Check coordinates of material surfaces in ASCOORD tables. No action required if coordinates are correct.

- **MAX. DISCHARGE OF xxxxxxx. CFS IS BELOW CREST AUXILIARY SPILLWAY. NO STABILITY STRESS COMPUTED.**

  Remarks: The head for stability analysis of the auxiliary spillway is less than or equal to zero, resulting in a discharge of zero cfs through the spillway. Hydraulic stress on the spillway is zero (no computed stress). Stress is not the controlling factor for determining spillway width for this crest elevation.

  Action: None if input data are correct.

- **MAXIMUM RATING CURVE ELEVATION EXCEEDED THE MAXIMUM INPUT ELEVATION (xxxxx.xx) BY xxxx.x FT. ASINC RATIO WAS x.xx.**

Remarks: The WSPVRT water surface profile procedure was used with the ASINC ratio shown. If difference between the maximum rating curve elevation and the maximum input elevation in the STRUCTURE table is significant, the extrapolation of the rating curve should be examined to see if the peak flow approaches the maximum STRUCTURE table elevation.

Action: If significant, rerun without the ASINC.

- **MAXIMUM VERTICAL HEIGHT INCREMENT xx.xx FT IGNORED. USED SINGLE STABILITY BERM HEIGHTS.**

Remarks: Conflicting stability berm heights were given on TEMPLATE and/or STABERM. Only the single vertical height(s) on STABERM were used. The maximum vertical height for multiple berms was ignored.

Action: None, if single upstream and downstream stability berms are desired. Otherwise, correct input and rerun.

- **MINIMUM CREST LENGTH OF xx. FT USED WITH FIXED U/S POINT.**

Remarks: A fixed point on the auxiliary spillway inlet surface is specified, but no crest length is given. A default value of 30 ft is assumed based on minimum TR–60 criteria.

Action: Enter crest length if different from 30 ft.

- **NCHP–378 CRITERIA USED BUT AUXILIARY SPILLWAY RATING NOT BASED ON ASFILE RATINGS.**

Remarks: For pre-1995 versions of this program (DAMS2), the preferred form of specifying the auxiliary spillway rating for NHCP–378 sites with vegetal retardance and/or subcritical flow in the exit channel was through the ASFILE. The WSPVRT procedure is now able to account for these conditions in the rating developed by the program.

Action: Do nothing if approved for supercritical flow in the auxiliary spillway or if WSPVRT is used to compute subcritical rating.

Messages (N)

- **NO CREST LENGTH GIVEN WITH FIXED U/S POINT, USE xx FT MINIMUM.**

  Remarks: A fixed point on the auxiliary spillway inlet surface is specified, but no crest length is given. A default value of 30 ft is assumed based on minimum TR–60 criteria.

  Action: Enter crest length if different from 30 ft.

- **NO "END RUN" CONTROL COMMAND FOUND.**

  Remarks: ENDRUN is missing at the end of the input file. The program assumed the run to be complete and summary tables are output.

  Action: Remember to include an ENDRUN next time.

- **NO ASDATA RECORD, AUXILIARY SPILLWAY SIDE SLOPE RATIO IS 0.0.**

  Remarks: Auxiliary spillway bank slope was not specified. A default value of 0.0 (rectangular channel) is used in computations.

  Action: Enter spillway bank slope on ASDATA and rerun if the slope is significant.

- **NO EXIT CHANNEL REACH IDENTIFIED ON WHICH TO COMPUTE EFFECTIVE STRESS FOR STABILITY.**

  Remarks: As input, the auxiliary spillway contains no constructed exit channel reach appropriate for stability analysis. The indicated end of constructed exit channel is at or upstream of the downstream end of the crest.

  Action: Check location of end of constructed exit channel.

- **NO EXIT SLOPE GIVEN, A DEFAULT SLOPE OF x.xx FT/FT IS USED.**

  Remarks: The default auxiliary exit channel slope shown was used because no slope was given in the input data.

  Action: None if exit slope is reasonable; otherwise, enter input data to provide a downstream exit slope.

Messages (N)

- **NO EXIT SLOPE GIVEN, A DEFAULT SLOPE WILL BE COMPUTED, IF THE SITE IS BASED ON TR–60 CRITERIA.**

  Remarks: No auxiliary exit channel slope was entered. If the site is designed on TR–60 criteria, the slope will be computed based on 1/4 of the discharge from passage of the freeboard hydrograph. For alternative use of the stability design hydrograph, see OLDTR60.

  Action: None, if exit slope is reasonable; else, enter input data to provide a downstream exit slope.

- **NO EXIT VELOCITY OR STABILITY VALUES WILL BE COMPUTED WITH A ZERO EXIT SLOPE.**

  Remarks: No auxiliary exit channel slope was entered. Because it is not a design run, exit velocity and stability are not computed with a default slope.

  Action: If exit velocity or stability values are important, enter input data to provide a downstream exit slope.

- **NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.**

  Remarks: You must specify auxiliary spillway crest elevation(s) and/or bottom width(s) or the program will not do a stability design or freeboard routing for this next pass.

  Action: Enter BTMWIDTH and/or ASCREST if SDH and FBH routings are desired.

- **NO INTEGRITY ANALYSIS, HYDROGRAPH HAS NO SIGNIFICANT AUXILIARY SPILLWAY FLOW.**

  Remarks: The condition for which integrity analysis of the auxiliary spillway was requested generated no significant flow in the spillway. Therefore, no integrity analysis was performed.

  Action: None, if input is correct.

- **NO INTEGRITY ANALYSIS, MAX. DISCHARGE IS BELOW AUX. CREST.**

  Remarks: The condition for which integrity analysis of the auxiliary spillway was requested generated no flow in the spillway. The maximum reservoir water surface elevation was computed to be below the auxiliary spillway crest. Therefore, no integrity analysis was performed.

  Action: None, if input is correct.

Messages (N, O)

- **NO RUNOFF TO ROUTE label WITH AUX. SPILLWAY CREST ELEVATION AT xxxxxx.xx AND BOTTOM WIDTH = xxxxx.x FEET PASS NUMBER xxx STOPPED.**

  Remarks: The hydrograph has no runoff volume, so the program gives no further output for this pass.

  Action: Inspect results and input to see if changes are needed.

- **NO SUMMARY TABLE FOR PASS, VALUES TOO LARGE. FOUND ASTERISK ON SUMMARY FILE.**

  Remarks: During the computations, the program saves data to a summary file in preset sized data fields. If a number is too large for its field, the program fills that field with asterisks. At the end of the run when the program reads the file to output the summary table, asterisks will cause a system error. DAMSITE checks each pass on the file, and if an "*" is found, skips that pass in the summary table and gives the above message.

  Action: Inspect the output for unreasonably large values and determine what caused them. Revise input if necessary.

- **NRCS–SDH DOES NOT CAUSE FLOW, MIN BW ACCEPTED.**

  Remarks: You instructed the program to compute an auxiliary spillway bottom width based on velocity but the auxiliary spillway hydrograph did not cause flow in the spillway, so the program used the minimum AS bottom width specified by you or the program default (20 ft).

  Action: Do nothing if bottom width is acceptable.

- **ORDER OF MAXIMUM PEAK CHANGED WHEN REACH id ROUTED. OUTFLOW PEAK SHIFTED xxxx.x HOURS.**

  Remarks: Multiple hydrograph peaks are usually encountered with the Att-Kin reach routing when you see this message. When given, the maximum inflow peak and the maximum outflow peak are not in the same order in their respective hydrographs with the other peaks or an unusually long storage time adjustment was used. To avoid same burst multiple peak storms, the maximum outflow peak must be more then 3 hours before the inflow peak or more than 6 hours after the inflow peak to generate this message.

  Action: Check output for reason for message: multiple peaked inflow and outflow hydrographs or possible input error in reach data.

Messages (P, R)

- **PSFULL CONTROL ENTERED BUT NOT USED IN THE RATING CURVE COMPUTATION FOR AN EXISTING SITE OR A SIMULATION ONLY RUN; SITUATIONS WHERE THE AUX. SPILLWAY ELEVATIONS ARE ESTABLISHED.**

  Remarks: The PSFULL control was ignored since it is only used in design runs where the principal spillway flow is calculated and the auxiliary spillway elevation has not been set.

  Action: If PSFULL was intended, you must use GO,DESIGN and let the program compute the principal spillway rating and the auxiliary spillway crest.

- **PSFULL CONTROL ENTERED BUT NOT USED IN THE NEXT RATING: BECAUSE EITHER THE PS OR AUX. SPILLWAY RATINGS ARE GIVEN, OR THE AUX. CREST ELEVATION xxxx.xx IS HIGHER THAN THE FULL PIPE FLOW ELEVATION xxxx.xx.**

  Remarks: The PSFULL control word was ignored since a rating is given in the STRUCTURE table or the auxiliary spillway crest is set above the full pipe flow elevation.

  Action: With the given input, the PSFULL control should be removed to eliminate this message.

- **ROUTING COEFFICIENT (C) IS 1.00, NO ROUTING PERFORMED. CONSIDER LONGER REACH LENGTH FOR REACH id.**

  Remarks: The program did not route the inflow hydrograph because there is no attenuation in the reach.

  Action: Review the reach and cross section input data and revise if possible. If there is a series of short reaches, combine reach lengths.

- **ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS**

  Remarks: The data set called for a routing only without either stability or integrity analysis of the auxiliary spillway.

  Action: None required if this represents the analysis desired.

Messages (R, S)

- **RUN OPTION "S" NOT ALLOWED WITH GO,DESIGN, OPTION REMOVED.**

  Remarks: Program option "S" (principal spillway routing only) is not valid with a GO,DESIGN run and is ignored.

  Action: If PSH routing only is desired with a design run, enter only the PSH rainfall/runoff input. Use the "S" option only with GO,STORM, GO,RAINS, or GO,HYD.

- **RUN OPTION "S" USED FOR THIS PASS, ONLY THE PSH WILL BE ROUTED IF THE FIRST AUX. SPILLWAY CREST IS BLANK.**

  Remarks: To use the "S" program option the first AS crest field of the ASCREST record must be blank. If a AS crest is given the option is ignored.

  Action: None, if above input conditions are satisfied.

- **RUN/PASS xxx STOPPED BECAUSE OF ERROR NO. xxx.**

  Remarks: The program stopped the summary table output at the pass number shown because of the numbered error.

  Action: See the Error list, correct the error, and rerun.

- **RUN STOPPED BECAUSE OF ERROR NO. 31.**

  Remarks: Message given at end of output if input date on the SITES or DAMS2 record does not agree with the date associated with the SITES version being run. The input date must have 10 characters in the format mm/dd/yyyy with leading zeros (example 05/01/2000).

  Action: Correct date format or use correct input date associated with version being used. See list of input differences and current version date in the detailed output generated by Error No. 31.

- **SEARCH FOR GIVEN EFFECTIVE TRACTIVE STRESS (xx.xxx) STOPPED AT MINIMUM BOTTOM WIDTH xxxx.x FT, AFTER xx TRIES.**

  Remarks: The auxiliary spillway bed width required to generate the specified erosionally effective stress is less than the specified minimum bed width. Minimum bed width is used in subsequent calculations.

  Action: None.

Messages (S)

- **SEARCH FOR GIVEN EXIT CHANNEL VELOCITY (<u>xx.xxx</u>) STOPPED AT MINIMUM BOTTOM WIDTH <u>xxxx.x</u> FT, AFTER <u>xx</u> TRIES.**

  Remarks: The auxiliary spillway bed width required to generate the specified permissible velocity is less than the specified minimum bed width. Minimum bed width is used in subsequent calculations.

  Action: None.

- **SLUG FLOW COEFFICIENT OF <u>x.xxx</u> ENTERED.**

  Remarks: The slug flow coefficient used in developing the hood inlet rating was input directly on the PSCOEFFS record rather than using the default value based on pipe roughness. The value entered is within the range 1.0 to 1.6.

  Action: None, if coefficient is reasonable.

- **SOIL GRAIN DIAMETER <u>xxxx.</u> UNUSUALLY LARGE IN STABILITY CONTROL REACH WHICH STARTS AT STATION <u>xxxxx.xx</u>.**

  Remarks: The computed soil grain roughness in the indicated constructed exit channel reach is greater than or equal to 0.05. This implies a soil grain diameter of approximately 55 inches or greater. This diameter is considered unusually large for surface material used in stability analysis. Exit channel stability will probably not be a controlling factor for spillway design in this material.

  Action: Check diameter of surface material in exit channel.

- **STABILITY BERM FROM STABERM CONTROL USED, WIDTH = <u>xxx.xx</u> FT. TEMPLATE STABILITY BERM WIDTH IGNORED.**

  Remarks: Both STABERM and TEMPLATE stability berm widths are input. Only the width shown is used from the STABERM control. Separate checks for duplicate width entries are made for the upstream and downstream berms.

  Action: None, if correct berm widths are used; otherwise correct and rerun.

Messages (S, T)

- **STABILITY COMPUTATIONS SKIPPED, NO AUX. INLET PROFILE GIVEN.**

  Remarks: Stability analysis of the auxiliary spillway cannot be carried out because of lack of data. No spillway surface is specified.

  Action: Enter data describing spillway surface profile and surface conditions if spillway stability analysis is desired.

- **TESTLIST REQUESTED, BUT NOTHING ADDED.**

  Remarks: You requested the hydrograph listing TESTLIST after a GO,ADDHYD but did not add a hydrograph, so the program skipped the hydrograph listing.

  Action: If expecting an addition, check the setup of the run.

- **THE PS RATING CONTAINS NO OR INSIGNIFICANT FLOW VALUES.**

  Remarks: The principal spillway has no flow.

  Action: Do nothing if that was the intent of the input.

- **THE SITE TYPE HAS BEEN CHANGED TO <u>x</u> FOR THIS PASS.**

  Remarks: The program changed the site type entered in column 16 on the WSDATA record because you entered a different site type in columns 11–20 on the second record of a HYD table or column 25 on the first record of a 7READHD table. The program does not need the WSDATA record if all the required data is on the hydrograph table.

  Action: Inspect output to see if site type is correct.

- **TOTAL DRAINAGE AREA GREATER THAN 10 SQ. MILES. NRCS CRITERIA ALLOWS CORRECTIONS TO ENTIRE WATERSHED.**

  Remarks: The program gives this message if the uncontrolled drainage area of a site is less than 10 mi^2, but its total drainage area is over 10 mi^2 with no given areal corrections. NRCS TR–60 criteria allows areal corrections in this case to the design rainfall volumes for the entire watershed.

  Action: Give areal corrections if desired; see AREACRCT.

Messages (T, U)

- **TRIALS TO OBTAIN AUX. BOTTOM WIDTH STOPPED AT BW = xxxx. FT; NO AUXILIARY SPILLWAY FLOW.**

  Remarks: Flow elevation was below auxiliary spillway crest, so trials were not run or were stopped at the bottom width shown above.

  Action: Check reason for no auxiliary spillway flow in this pass.

- **TR–60 CRITERIA FOR CLASS A1 APPLIES ONLY WHEN PRODUCT IS LESS THAN 3000.**

  Remarks: The product of effective height and storage exceeds the limits of the given design class code. You may be using less than minimum national criteria.

  Action: Revise input if necessary and use the proper design class code.

- **TR–60 CRITERIA FOR CLASS A2 APPLIES ONLY WHEN PRODUCT IS LESS THAN 30,000.**

  Remarks: The product of effective height and storage exceeds the limits of the given design class code. You may be using less than minimum national criteria.

  Action: Revise input if necessary and use the proper design class code.

- **USING NEW (AFTER 1986) CRITICAL DEPTH COMPUTATION PROCEDURE IN AUXILIARY SPILLWAY RATING.**

  Remarks: Notification that user entered a NEWCDEPTH control word. This changes the critical depth computational procedure to the new default procedure.

  Action: Do nothing if wanting the new procedure.

- **USING OLD (PRIOR TO 1986) CRITICAL DEPTH COMPUTATION IN AUXILIARY SPILLWAY RATING.**

  Remarks: Notification that user entered a OLDCDEPTH control word. This will change the critical depth computational procedure to the old procedure.

  Action: Do nothing if wanting the old procedure.

Messages (V, W)

- **VALUES FROM ASEXSURF ENTRY xx IMPLY NO VEGETAL COVER WITH "n" OF x.xxx.**

  Remarks: Manning's "n" has been entered directly for the indicated reach along with a vegetal cover factor of zero. These values are interpreted by the program as implying no vegetal cover. This interpretation may be reflected in other messages and/or warnings generated by the program.

  Action: None, if input is correct.

- **VALUES FROM ASSURFACE, REACH xx IMPLY NO VEGETAL COVER WITH "n" OF x.xxx.**

  Remarks: Manning's "n" has been entered directly for the indicated reach along with a vegetal cover factor of zero. These values are interpreted by the program as implying no vegetal cover. This interpretation may be reflected in other messages and/or warnings generated by the program.

  Action: None, if input is correct.

- **VEGETAL RETARDANCE INDEX (CI) OF xx.xx USED FOR RETARDANCE CLASS x (TABLE 3.2, AH–667).**

  Remarks: Flow resistance for all or part of the auxiliary spillway is entered in the form of a retardance class (SCS, TP–61). This retardance class has been converted to a retardance curve index using the values from table 3.2 of Agriculture Handbook 667.

  Action: No action required, if input is correct.

- **WATER SURFACE PROFILES REQUESTED, NOT USED WITH GIVEN RATING.**

  Remarks: Information to compute the auxiliary spillway rating is input along with a given rating. The given auxiliary spillway rating is used, according to the hierarchy of input (see ASDATA). The information to compute the rating is ignored.

  Action: Do nothing, if this is what was intended; otherwise correct and rerun.

Messages (W)

- **WITH AUX. RATING GIVEN ON STRUCTURE CONTROL, COMPUTED CRITICAL FLOW VALUES MAY NEED REVISION.**

  Remarks: The program uses ASDATA values for a trapezoidal x-section in computing critical flow values. The given auxiliary spillway rating may not be compatible.

  Action: Do nothing if compatible, otherwise compute new critical flow values as needed.

- **WSPVRT PROCEDURE INPUT SHOULD INCLUDE AN EXIT CHANNEL SLOPE.**

  Remarks: The WSPVRT water surface profile procedure used for rating the auxiliary spillway seeks the point of hydraulic control for each discharge. Therefore, the entire spillway profile, including the exit channel, should be entered when using this procedure.

  Action: Enter data for entire spillway profile.

Notes and Other Output Information (A, B, C)

The following list contains notes and other information useful in understanding the program output. The three types of information are identified by the prefixes in the parentheses beginning each remark:

(NOTES)—Informational
(>>>>>)—Emphasized notes
(blank)—Standard output or not classified

- **ACCUMULATED SYSTEM DRAINAGE AREA = xxxx.xx SQUARE MILES.**

  Remarks: (   ) This is the total accumulated drainage area of the system to this point, including the area just entered. It includes all subwatersheds and sites in the run above this point in the system.

  Action: Use to check if the series routing is in proper sequence.

- **BASEFLOW FROM "7READHD" INPUT IS BEING IGNORED. USE OTHER FEATURES IN SITES TO HANDLE BASEFLOW.**

  Remarks: (Note) DAMSITE assumes the baseflow in columns 49–60 of the second record on the 7READHD record is zero. You may enter baseflow in the BASEFLOW or STORM control words and set the start routing elevation at the baseflow elevation with the GO,DESIGN or GO,HYD control words.

  Action: Identify the baseflow in the hydrograph by the design or simulation procedures. Make input changes, rerun, and inspect results for correct baseflow handling.

- **COMPUTED DIMHYD FACTOR = xxxx.xx GIVEN VALUE = xxxx.xx.**

  Remarks: (Note) The program computes the factor from your entered DIMHYD table and compares it against your entered factor.

  Action: If the computed DIMHYD factor is not what was wanted, correct the DIMHYD table and rerun.

Notes and Other Output Information (C, D, E)

- **CREST OF AUX. RAISED TO HOLD xxxxx.xx ACFT. NOT EVACUATED IN DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = xxxxx.xx ACFT, NEW ELEVATION OF AUXILIARY CREST = xxxxx.xx FT.**

  Remarks: (Note) Technical Release 60, revision of August 1981, requires flood water storage not drawn down in 10 days to within 15% of the required routed storage, to be added to the routed storage which sets a new auxiliary spillway crest elevation. The 10 days and 15% are program defaults that you may change with the DDTEST control word.

  Action: If addition is excessive, increase size of principal spillway to reduce drawdown time. If using old TR–60 criteria prior to that of the 1981 TR–60, adjust values on DDTEST or use OLDTR60.

- **DRAWDOWN USING FREEBOARD STORM FOLLOWS, STARTING AT ELEVATION xxxxxxx.xx FT.**

  Remarks: (   ) NHCP–378 requires the freeboard (design) storm to be drawn down within ten days. The drawdown starts at the maximum routed stage or the auxiliary spillway crest, whichever is lower. The program adds inflow to the drawdown. Ten days is the default value on the DDTEST record.

  Action: If drawdown approaches 10 days, consider greater principal spillway capacity.

- **ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR STRUCTURE CLASSIFICATION.**

  Remarks: (   ) You did not enter a CLPROFILE table and left blank columns 51–60 of POOLDATA.

  Action: Note message and enter either one of the missing data to obtain the check on structure classification.

- **EXTENSIVE TIME REQUIRED TO DRAWDOWN SITE; COMPUTATIONS STOPPED AT 30 DAYS (xxxx.xx CFS).**

  Remarks: (Note) The drawdown computations used excessive time, and the program stopped the routing at 30 days. The probability of recurrent storms necessitates that the drawdown normally be completed within 10 days or less.

  Action: Check for input errors that would limit principal spillway flow or else enlarge principal spillway capacity.

Notes and Other Output Information (F, G)

- **FREEBOARD ROUTING STARTED AT PS CREST, ELEVATION = xxxxxx.xx.**

  Remarks: (Note) The program used old TR–60 criteria (prior to that published in the 1981 TR–60) for high hazard or class code "C" structures, to set the starting elevation for freeboard routing.

  Action: Ensure that OLDTR60 criteria switch col. 21–30, was intentionally set to 1.

- **FULL CONDUIT FLOW, ELEVATION = xxxxx.xx FEET IS BELOW HIGH STAGE WEIR ELEVATION. FULL ORIFICE FLOW IS AT ELEVATION xxxxx.xx FEET.**

  Remarks: (Note) This is not a standard two-stage principal spillway.

  Action: Check input for possible errors. If input is for an actual spillway, do nothing, otherwise revise input so orifice flow controls before full conduit flow.

- **GO,DRAW CONTROL NOT PERMITTED WITH HYDROGRAPH NUMBER xx, USE ONLY WITH GO,STORM OR GO,HYD OR GO,RAINS.**

  Remarks: (Note) The GO,DRAW control word is only valid with hydrograph type codes "7" and "9." Draw down computations are automatic with GO,DESIGN.

  Action: Delete GO,DRAW record if not needed.

- **GO,DRAW CONTROL WILL NOT OPERATE WITHOUT A ROUTED STORAGE VOLUME TO BE DRAWN DOWN.**

  Remarks: (Note) A storm or given inflow hydrograph must have been routed to create a volume of storage greater than 0.0 ac-ft remaining to draw down to use GO,DRAW.

  Action: Check input if storage volume to draw down was expected.

Notes and Other Output Information (I)

- **INITIAL VOLUME OF xxxxx.xx ACFT TAKEN FROM INFLOW HYDROGRAPH FOR STORAGE BELOW PRINCIPAL SPILLWAY CREST.**

  Remarks: (   ) The program subtracted this volume from the inflow hydrograph to satisfy the initial or extra volume, col. 31–40 on the BASEFLOW control word. The program determines this amount based on the time increment prior to exceeding the PS crest elevation.

  Action: Do nothing if amount is reasonably close to the initial volume requested, otherwise decrease size of time increment by increasing the number of hydrograph points, for example.

- **IMPORTANT**
  Allow sufficient disk space for temporary and output files. The program disk may be replaced, if necessary, with the input data disk or scratch disk. Any output option GO, or GRAPHICS files are generated with the output file prefix. All output files are written on the output file drive. The temporary SITES file is written on the default drive.

  Remarks: (   ) The system will truncate the job if it runs out of disk space to handle the output, temporary files, and generated files. This is very important if using floppy disks.

  Action: Estimate if the amount of disk space available is sufficient for the size of the job before starting the run. Refer to Chapter 1 for more information.

- **INTEGRITY DIST. AND EXIT VEL. ARE BASED ON THE ROUTED HYDROGRAPH AND WILL NOT RELATE TO THE MAX. ELEV. (TOP OF DAM), WHICH IS SET BY MINIMUM DESIGN CRITERIA.**

  Remarks: ( ) The program prints this footnote to the summary table advising you that the maximum routed elevation is the basis for those computed values marked with an asterisk. They are not related to the minimum criteria elevations and discharges. See detailed output for complete results at the various elevations.

  Action: Review summary table values for consistency and reasonableness before analyses of detailed output.

Notes and Other Output Information (I, M)

- **INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.**

Remarks: (   ) The program prints this footnote to the summary table advising you that those values marked with an asterisk are the computed values at the maximum routed elevation based on the hydrograph shown under Type HYD. See the detailed output for values at other elevations.

Action: Review summary table values for consistency and reasonableness before analyses of detailed output.

- **MAIN TIME INCREMENT = <u>xxxxx.xx</u>. CHANGED TO 1.0 FOR 10–DAY PS HYDROGRAPH.**

Remarks: (Note) The program converts the main time increment to an even 1.0 hour time increment by interpolation for use by the 10-day principal spillway inflow hydrograph developed by the post–1989 procedure. This was done to improve the peak correlation with the old procedure.

Action: Do nothing unless review of results shows unreasonableness.

- **MINIMUM DEPTH IN AUX. SPILLWAY SET AT <u>xx.xx</u> SINCE NO EFFECTIVE HEIGHT GIVEN.**

Remarks: (   ) Small NHCP–378 ponds with 20 acres or less and effective heights of dams 20 feet or less can use a minimum depth of 0.5 feet between the crests of the principal and auxiliary spillways. The program used the larger pond depth of 1.0 feet because no height could be checked.

Action: Enter a low point on the POOLDATA record or a minimum depth on the MINDEPTH record and rerun.

- **MINIMUM DEPTH IN AUX. TO TOP OF DAM IN TR–60 IS <u>x.xxx</u> FEET.**

Remarks: (>>>>>) The routed freeboard hydrograph resulted in an auxiliary spillway with less than the required depth in feet between the crest of the PS and the top of the dam. TR–60 criteria requires a minimum depth of 3.0 feet unless changed by the MINDEPTH control word.

Action: Do nothing if acceptable, or consider alternate designs.

Notes and Other Output Information (M, N)

- **MINIMUM DEPTH (x.xx FT) USED FOR NHCP378 RUN – CREST PS TO CREST AUX.**

  Remarks: (>>>>>) NHCP–378 requires a minimum of one foot between principal spillway and auxiliary spillway crest elevations. Input data required something less than one foot difference and program defaults to one foot. See MINDEPTH if it is necessary to change this minimum difference.

  Action: Note change made by program.

- **MINIMUM FLOW IN AUXILIARY SPILLWAY FROM TR–60 (xxxx. CFS).**

  Remarks: (>>>>>) Total flow through auxiliary spillway from routing freeboard is less than required by TR–60 criteria. The program lists results at the minimum discharge. See MINDISCH if it is necessary to change the minimum capacity equation.

  Action: Do nothing if acceptable, or consider alternate designs.

- **NHCP378 RUN—MINIMUM DEPTH, CREST AUX. TO TOP OF DAM IS xx.xx FT. NEW TOP OF DAM ELEVATION = xxxxx.xx**

  Remarks: (>>>>>) NHCP–378 criteria requires a minimum depth of 2.0 feet from the auxiliary spillway crest to the top of the dam when the drainage area is over 20 acres or if the effective height of the dam is over 20 feet. For smaller dams this minimum depth is 1.0 feet. The adjustment for minimum capacity has already been made, if required.

  Action: If no other elevation adjustment, use as new top of dam. If state or local criteria requires different depths, use the MINDEPTH control word.

- **NHCP378 RUN—MINIMUM DEPTH, DESIGN FLOW TO TOP OF DAM: x.xx FT REQUIRED FOR THIS PASS. NEW TOP OF DAM ELEVATION = xxxxx.xx**

  Remarks: (>>>>>) The NHCP–378 criteria calls for an added 1.0 foot minimum depth above the design storm routed elevation. Use MINDEPTH to revise this depth if necessary.

  Action: Review input and output for reasonableness.

Notes and Other Output Information (N, P)

- **NHCP378 RUN—MINIMUM FLOW IN AUX. SPILLWAY FROM TR60 USING FORMULA WITHOUT 200 CFS MINIMUM LIMIT (xxxx.cfs).**

  Remarks: (>>>>>) The program checks the minimum discharge capacity for an NCPS–378 auxiliary spillway using the TR–60 criteria equation without the 200 cfs minimum. The minimum capacity equation can be revised if necessary using the MINDISCH control word.

  Action: Ensure the input requires minimum capacity.

- **NUMBER OF INPUT DATA ERRORS DETECTED = xxx.**

  Remarks: ( ) This message appears at the end of a job to alert you to the number of input errors detected.

  Action: Correct the errors indicated by messages in the data file before rerunning.

- **PASS xxx EXECUTION TERMINATED DUE TO INPUT RELATED DATA ERRORS. NO GRAPHIC FILES WRITTEN.**

  Remarks: (>>>>>) The program gives the first sentence of this message just before aborting the pass. The second sentence only occurs when it aborts prior to processing the spillway template for water surface profile computations.

  Action: Find and correct errors identified in the pass output and rerun.

- **PEAK OF xxxxxxxxxxx LESS THAN SHUTOFF TEST...PLOT SKIPPED.**

  Remarks: (>>>>>) The program generally skips the plot if the peak outflow is less than the crest of the auxiliary spillway. See SHUTOFF for simulation runs.

  Action: Check storage requirements of hydrograph to ensure that program should skip the plot.

Notes and Other Output Information (P)

- **PRINCIPAL SPILLWAY CONDUIT AREA (<u>xx.xxxx</u> SQ.FT.) IS LESS THAN NHCP–378 CRITERIA FOR USE IN ROUTING THE DESIGN STORM. PRINCIPAL SPILLWAY HYDROGRAPH ROUTINGS WILL BE IGNORED AND AUXILIARY SPILLWAY ROUTING WILL START AT THE CREST OF THE <u>AUXILIARY</u> SPILLWAY.**

  Remarks: (Note) Minimum NHCP–378 pipe area is 0.545 sq. ft. (10" dia.), unless you give a new pipe size in columns 31–40 on the MINDISCH record. The program assumes a smaller then minimum pipe size will plug with trash during a storm and flood storage will not be available below the auxiliary spillway crest.

  Action: Do nothing unless it is desirable to increase the size of the principal spillway, change the minimum pipe size criteria, or change the start routing criteria using OLD378.

- **PRINCIPAL SPILLWAY CONDUIT AREA (<u>xx.xxxx</u> SQ.FT.) IS LESS THAN NHCP–378 CRITERIA FOR USE IN ROUTING THE DESIGN STORM. PRINCIPAL SPILLWAY HYDROGRAPH ROUTINGS WILL BE IGNORED AND AUXILIARY SPILLWAY ROUTING WILL START AT THE CREST OF THE <u>PRINCIPAL</u> SPILLWAY.**

  Remarks: (Note) Same as in above Note except OLD378 is used to allow routings to start at the crest of the principal spillway with below minimum pipe size.

  Action: Do nothing if change in criteria is approved.

- **PRINCIPAL SPILLWAY DRAWDOWN SKIPPED DUE TO SMALL CONDUIT SIZE. AUX. SPILLWAY CREST SET TO STORE TOTAL PSH VOLUME = <u>xxxx.x</u> ACFT. TOTAL VOLUME = <u>xxxxx.x</u> ACFT.
NEW AUX. CREST DOES NOT INCLUDE BASEFLOW OR INITIAL VOLUME.**

  Remarks: (Note) The program assumes a smaller than minimum allowable pipe size will plug with trash during a storm. With no outflow, the entire principal spillway hydrograph is stored which sets the auxiliary spillway crest. The last sentence indicates that the program ignores the baseflow or initial volume entered in setting the crest of the auxiliary spillway.

  Action: Do nothing unless increasing pipe size or changing minimum pipe size criteria.

Notes and Other Output Information (P, R, S)

- **PROGRAM TERMINATED – ASFILE NOT FOUND.**

Remarks: (   ) The program did not find the "ASFILE" in the default directory or within the path in which the SITES program was run on the system.

Action: Find and load the "ASFILE" that was furnished with the program into the directory with the "DAMSITE.EXE" file or develop a new file — see ASFILE control word.

- **PROGRAM TERMINATED – INPUT FILE SPECIFIED NOT FOUND.**

Remarks: (   ) Your specified input file was not in the specified directory or it was misspelled.

Action: Locate the file and rerun with the correct file name.

- **RATING TABLE DEVELOPED, SITE = xxxxx:**

Remarks: (   ) The program follows this message with the type of input and/or computations it uses to develop the rating table for this pass.

Action: Ensure the development method for the rating is acceptable.

- **RETARDANCE EQUATION LIMITS WERE EXCEEDED. VR LIMITS ARE 0.3 AND 20.0, COMPUTED VR = xxx.xxxx. COMPUTATION CONTINUED.**

Remarks: (Note) The product of velocity times hydraulic radius is outside the range of the equations used to compute the "n" value with retardance class and precomputed spillway ratings (profile no. 30).

Action: Do nothing if computed "n" value is reasonable.

- **SECOND STAGE WEIR LOWERED TO 0.01 FEET BELOW AUX. SPILLWAY CREST.**

Remarks: (   ) The program requires that the principal spillway high stage inlet elevation be below the auxiliary spillway crest elevation. The program lowers the second stage weir elevation if necessary.

Action: Input a total rating in the STRUCTURE table if desiring the principal spillway second stage inlet above the AS crest.

Notes and Other Output Information (S, T)

- **SELECTED DESIGN CLASS Ax EXCEEDS THE MINIMUM TR–60 CRITERIA.**

Remarks: (Note) The product of effective height and storage is less than the required minimum for the given design class code.

Action: None, if using higher than the minimum criteria is warranted.

- **STARTING TIME IN SITES IS ZERO. STARTING TIME FROM "7READHD" INPUT IS BEING IGNORED.**

Remarks: (Note) The starting time in columns 13–24 of the second record on the 7READHD record must be 0.0. If not, the program ignores the time and if adding hydrographs they will be out of sync with each other and peaks will not be correct.

Action: Probably do nothing if a single site. If in series, add the correct number of 0.0 points at the start of the inflow hydrograph to make the starting time zero.

- **STORED ENTIRE HYDROGRAPH IN STORAGE POOL BELOW PS CREST.**

Remarks: ( ) Initial or extra volume available for floodwater storage below the principal spillway crest, col. 31-40 on the BASEFLOW record, contained the entire volume of the inflow hydrograph with no outflow.

Action: Check results for reasonableness.

- **TAILWATER ELEVATION GREATER THAN CREST OF ORIFICE. SUBMERGENCE IS NOT HANDLED BY THE PROGRAM.**

Remarks: (Note) Given tailwater elevation will submerge the orifice reducing its flow. SITES assumes a free flowing orifice.

Action: If significant backwater effect, revise input or enter computed rating in STRUCTURE table.

Notes and Other Output Information (T, U, W)

- **THIS IS ONLY A PRELIMINARY AUX. RATING CURVE OF DISCHARGE/FT OF WIDTH AND DOES NOT INCLUDE SIDESLOPE CORRECTION OR A REVISED RATING USING THE ACTUAL AUX. SPILLWAY CONFIGURATION.**

  Remarks: (Note) The auxiliary spillway rating per foot of width provided with the Basic Data output is not the final rating used in the rating table. The program is given or computes the preliminary rating in the form shown on the ASRATING record except when using profile reference number 30 and the ASFILE control word. The total rating used in the rating tables is then based on the formula in the ASRATING or the ASFILE description. The TRAPW and WSPVRT procedures provide the total rating based on the actual auxiliary spillway configuration and do not output a preliminary rating.

  Action: Note the reasonableness of the preliminary rating. Check input if not reasonable.

- **UNCONTROLLED AREA HYDROGRAPH PEAK HIGHER THAN TOTAL SUMMATION PEAK DUE TO THE SELECTION OF DISCHARGES ON A COMMON TIME INCREMENT.**

  Remarks: (Note) Discrepancy results from difference in time increments between subarea hydrographs being added and by the need to add hydrographs on a common time increment.

  Action: If needing greater accuracy, try to divide watershed into subareas with more similar times of concentration.

- **WITH SPECIFIED EXIT CHANNEL SIZE AND SLOPE, THE DEPTH OF FLOW IS BELOW CRITICAL DEPTH:**
  FLOW DEPTH = <u>xxxx.xxx</u> FT   CRITICAL DEPTH = <u>xxxxx.xx</u> FT
  EXIT CHAN. SLOPE = <u>xxxx.xxx</u> FT/FT   CRITICAL SLOPE = <u>xxxx.xxx</u> FT/FT
  EXIT CHAN. VELOCITY= <u>xxxx.xxx</u> FT/SEC   CRITICAL VELOCITY = <u>xxxx.xxx</u> FT/SEC.

  Remarks: (Note) The depth of flow in the exit channel is less than critical depth, resulting in supercritical flow. This is not acceptable for the NHCP–378 design storm since the program based the AS rating on subcritical flow.

  Action: Decrease the exit channel slope or redesign to provide less AS discharge from the design storm. If related to minimum criteria, determine if acceptable.

Appendix E DAMSITE Control Words

No.	Control word	Function	Page
1.	**ACCURACY**	Sets tolerance for full pipe flow computation	4–164
2.	**ADDMOV**	Adds hydrographs in conjuction with stack storage in the IDE.	4–120
3.	**AREACRCT**	Loads areal rainfall corrections for sites with DA's greater than 10 mi^2 and other special cases	4–156
4.	**ASCOORD**	Loads coordinates of materials for auxiliary spillway integrity analyses	4–12
5.	**ASCREST**	Loads auxiliary spillway crest elevation information	4–16
6.	**ASDATA**	Loads auxiliary spillway channel data	4–18
7.	**ASEXIT**	Describes auxiliary spillway exit channel template	4–26
8.	**ASEXSURF**	Describes surface parameters of auxiliary spillway exit channel template	4–28
9.	**ASFILE**	Loads a series of auxiliary spillway stage-discharge records into a temporary reference file	4–136
10.	**ASINC**	Changes auxiliary spillway water surface profile stage range	4–170
11.	**ASINLET**	Describes auxiliary spillway inlet channel template	4–32
12.	**ASINSURF**	Describes surface parameters of auxiliary spillway inlet channel template	4–37
13.	**ASMATERIAL**	Provides geologic description of auxiliary spillway materials	4–39
14.	**ASRATING**	Loads rating curve for a nonstandard auxiliary spillway	4–139
15.	**ASSPRFL**	Describes total design auxiliary spillway profile in coordinates (alternate to template form of input)	4–42
16.	**ASSURFACE**	Describes surface conditions of auxiliary spillway specified in coordinates	4–44
17.	**BASEFLOW**	Loads baseflow and initial elevations used in routing design storms	4–48
18.	**BTMWIDTH**	Loads auxiliary spillway control section bottom widths (BW), maximum exit channel velocities, or effective tractive stress values	4–51
19.	**BWDATA**	Controls for determining BW of auxiliary spillway when maximum velocity or effective tractive stress in the exit channel is given	4–169
20.	**CLASS**	Loads coefficients for generalized design rainfall equation	4–157
21.	**CLPROFILE**	Loads centerline profile of a dam for computating embankment quantities	4–53

No.	Control word	Function	Page
48.	**NEWCDEPTH**	Reactivates the default auxiliary spillway flow critical depth computation procedure	4–171
49.	**NEWHYD**	Activates the default hydrograph development procedure similar to TR–20 used 1989 to 2005	4–161
50.	**NOGRAPHICS**	Turns off GRAPHICS file options	4–180
51.	**NOHOODETL**	Turns off the HOODETL list option	4–182
52.	**NPOINTS**	Sets number of points on stability design and freeboard design hydrographs	4–183
53.	**OEOVB**	Lists details of attack computations, OE/B	4–184
54.	**OFFTRAPW**	Turns off the TRAPW procedure	4–152
55.	**OFFWSPVRT**	Switches off the default WSPVRT procedure	4–175
56.	**OLD378**	Changes default NHCP–378 criteria	4–199
57.	**OLDCDEPTH**	Changes to previous auxiliary spillway flow critical depth computation procedure	4–172
58.	**OLDHYD**	Changes to DAMS2 hydrograph development procedure used prior to 1989	4–162
59.	**OLDTR60**	Changes default NRCS TR–60 criteria	4–200
60.	**P100,PMP**	Loads data to calculate design rainfall amounts	4–142
61.	**PDIRECT**	Loads design rainfall amounts	4–62
62.	**POOLDATA**	Loads storage pool information and key valley floor elevations	4–65
63.	**PROFILELST**	Lists details of frictionless side slope computations – debug tool only	4–185
64.	**PSCOEFFS**	Changes principal spillway inlet coefficients and fillet size used in hydraulic computations	4–167
65.	**PSDATA**	Loads principal spillway conduit information	4–67
66.	**PSFULL**	Requires that principal spillway conduit must flow full at auxiliary spillway crest	4–168
67.	**PSHOOD**	Loads hood inlet principal spillway information	4–144
68.	**PSINLET**	Loads principal spillway inlet information	4–69
69.	**QDIRECT**	Loads design runoff amounts	4–72
70.	**Q,IA+I**	Computes excess rainfall computed by initial abstraction – infiltration method	4–147
71.	**Q,SCS**	Reactivates excess rainfall amounts computed by default CN method (chapter 10, NEH–4)	4–148

No.	Control word	Function	Page
72.	**RAINTABLE**	Loads a rainfall distribution	4–74
73.	**7READHD**	Inputs a hydrograph in TR–20 format	4–103
74.	**SAVMOV**	Moves hydrographs to different storage locations for flexibility in modeling	4–126
75.	**SHUTOFF**	Provides value to cut off long hydrograph plots (simulation runs only)	4–186
76.	**SITES**	Starts a new job, restores all optional conditions to the program assumed values	4–77
77.	**STABERM**	Adds separate upstream and downstream stability berms to template	4–189
78.	**STEPSTP**	Provides number of time increments to peak of unit hydrograph in old hydrograph development procedure	4–163
79.	**STORM**	Loads watershed data for a specific storm	4–106
80.	**STRUCTURE**	Loads structure site data	4–79
81.	**TC–15.3**	Computes T_c by figure 15.3, NEH–4 (CN method)	4–149
82.	**TDD/NOINFL**	Removes inflow hydrograph from default drawdown computations	4–202
83.	**TEMPLATE**	Loads shape and size parameters for embankment cross section template	4–191
84.	**TESTLIST**	Lists complete hydrographs in tabular form for inspection	4–187
85.	**TITLE**	Enters title for hydrographs input by HYD	4–107
86.	**TRAPW**	Uses TRAPW procedure for auxiliary spillway rating computations	4–150
87.	**WSDATA**	Loads data pertaining to watershed area above structure or subarea	4–82
88.	**WSPACCUR**	Sets precision of water surface profile solutions for the frictionless side slope procedure	4–173
89.	**WSPVRT**	Reactivates the default WSPVRT procedure for auxiliary spillway rating computations	4–176
90.	**XSECTN**	Enters cross section data for reach routing (10 column fields)	4–128
91.	**2XSECTN**	Enters cross section data in TR–20 format for reach routing	4–130

Appendix F   Blank Worksheets

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR TR–60 STRUCTURE

12-05

Case A-Determine PS rating and Aux. crest elevation only

JOB ______________ PREPARED BY ______________ DATE ________ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – – – – – – title	– – – – – – – –	– – – – – – – –	System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	zone ID class	RCN	DA sq. mi.	Tc hours		QRF csm	
WSDATA*							
select one	climatic index	P 1-day	P 10-day			P100-10-day	
PDIRECT*							
		Q 1-day	Q 10-day				
QDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	Height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	program options			PS RF-ID	PS RF duration		
GO, DESIGN*	N						
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case A-Determine PS rating and Aux. crest elevation only

JOB ______ PREPARED BY ______ DATE ______ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	title			System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	class ID AC	RCN	DA acres	Tc hours	or (L' & WS slope %)	QRF csm	
WSDATA*	A C						
		P 1-day					
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia. or width	height	"n" conduit	tailwater elev.	
PSDATA							
select one	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	H. length 1	H. length 2	elev. bend	elev. outlet	Ce (weir)	Ke (entr.)	
PSHOOD							
	program options			PS RF-ID Switch	PS RF duration		
GO, DESIGN*	N			378			
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR TR–60 STRUCTURE

12-05

Case B-Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with Aux. crest elevation known.

JOB ______________ PREPARED BY ______________ DATE ________ PAGE ____ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	title			System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
WSDATA*	zone class ID type	RCN	DA sq. mi.	Tc hours		QRF csm	
PDIRECT				P-SDH	P-FBH		
POOLDATA	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
PSDATA	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSINLET	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
ASDATA*	PN** tie sta.			side slope ratio		exit slope	
ASCREST	unit	alternate auxiliary spillway crests					
BTMWIDTH	unit	alternate auxiliary spillway bottom widths, exit velocities, or eff. tractive stresses					
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
Select one or both							
ASINLET	Points for user inlet channel profile (PN = #41 to #50)						See option 1, ASINLET
ASINLET	PN**	fixed X	fixed Y	length Aux. Crest***			option 2
ASEXIT	PN**	gen. fill ?	top soil depth	fixed X	fixed Y	cons. exit length	
ASINSURF	PN**	label: "n" or CI	cons. "n" or CI	natural "n" or CI	generate tables		
ASEXSURF	Table of exit channel surface parameters						
GO, DESIGN*	program options	Aux. RF-ID	Aux. RF duration			Start routing elev. (no PSH routing)	
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.
** Use profile number 01 to 29 or 41 to 50.
*** Use only if option 2 is selected alone.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case B-Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with Aux. crest elevation known.

JOB ____ PREPARED BY ____ DATE ____ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – title	– – –		System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	ID class AC type	RCN	DA acres	Tc hours	or (L' & WS slope %)		
WSDATA*	A C						
				P-SDH	P-FBH (Design)		
PDIRECT							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia. or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET***							
Select one	PN** R tie sta.	inlet length	inlet "n" or CI	side slope ratio	exit "n" or CI	exit slope	
ASDATA							
	PN R crest L.			side slope ratio	exit "n" or CI	exit slope	
ASDATA (subcritical flow)	30						
	Notes: R = retardance. Crest L = level crest length. BW must be given.						
	unit	– – – alternate auxiliary spillway crests – – –					
ASCREST							
	unit	– – – alternate auxiliary spillway bottom widths – – –					
BTMWIDTH	FEET						
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
Select one							
ASINLET	Points for user inlet channel profile (PN = #41 to #50)						See option 1, ASINLET
	PN**	fixed X	fixed Y	length Aux. Crest****			
ASINLET							option 2
	PN**	gen. fill ?	top soil depth	fixed X	fixed Y	cons. exit length	
ASEXIT							
	PN**	label: "n" or CI	cons. "n" or CI	natural "n" or CI	generate tables		
ASINSURF							
ASEXSURF	Table of exit channel surface parameters						
	program options	Aux. RF-ID	Aux. RF duration	Switch		Start routing elev. (no PSH routing)	
GO,DESIGN*				378			
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

** Use profile number 01 to 29 or 41 to 50.

*** If using Hood Inlet see PSHOOD in Case A.

**** Use only if this option is selected alone.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR TR–60 STRUCTURE

12-05

Case C-Design auxiliary spillway using a known spillway profile (ASSPRFL).

JOB ______________ PREPARED BY ______________ DATE __________ PAGE _____ OF _______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – – – – – – – –	title	– – – – – – – – – –	System Drainage Area	Case, Run Type, record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	zone class, ID type	RCN	DA sq. mi.	Tc hours		QRF csm	
WSDATA*							
				P-SDH	P-FBH		
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	PN			side slope ratio			
ASDATA*							
	Note: PN = #1 to #29 or #41 to #50						
	unit	– – – – – – – – – – – – –	alternate auxiliary spillway crests	– – – – – – – – – – – – –			
ASCREST							
	unit	– – – – –	alternate aux. splwy bottom widths, exit velocities, or effective tractive stresses	– – – – –			
BTMWIDTH							
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
ASSPRFL	Table with total design auxiliary spillway profile coordinates						
	program options	Aux. RF-ID	Aux. RF duration			Start routing elev. (no PSH routing)	
GO,DESIGN*							
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case C-Design auxiliary spillway using a known spillway profile (ASSPRFL).

JOB ______ PREPARED BY ______ DATE ______ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	title			System Drainage Area	Case / Run Type / record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	ID class / AC type	RCN	DA acres	Tc hours	or (L' & WS slope %)		
WSDATA*	AC						
				P-SDH	P-FBH (Design)		
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia. or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET**							
Select one	PN R tie sta.	inlet length	inlet "n" or CI	side slope ratio	exit "n" or CI	exit slope	
ASDATA							
	Notes: PN = #1 to #29 or #41 to #50, R = retardance.						
	PN R crest L.			side slope ratio	exit "n" or CI	exit slope	
ASDATA (subcritical flow)	30						
	Notes: R = retardance. Crest L = level crest length. BW must be given.						
	unit	alternate auxiliary spillway crests					
ASCREST							
	unit	alternate auxiliary spillway bottom widths					
BTMWIDTH	FEET						
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
ASSPRFL	Table with total design auxiliary spillway profile coordinates						
	program options	Aux. RF-ID	Aux. RF duration	switch		start routing elev. (no PSH routing)	
GO,DESIGN*				378			
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

** If using Hood Inlet see PSHOOD in Case A

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

12-05

TYPICAL DESIGN INPUT TR–60 STRUCTURE

Case D-Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with Aux. crest elevation unknown.

JOB ____ PREPARED BY ____ DATE ____ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – – – – title	– – – – – –		System Drainage Area	Case / Run Type / record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	zone class / ID type	RCN	DA sq. mi.	Tc hours		QRF csm	
WSDATA*							
Select one	climatic index	P 1-day	P 10-day	P-SDH	P-FBH	P100–10–day	
PDIRECT*							
		Q 1-day	Q 10-day				
QDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	PN** tie sta.			side slope ratio		exit slope	
ASDATA*							
	unit	– – – – – – alternate aux. splwy bottom widths, exit velocities, or eff. tractive stresses – – – – – –					
BTMWIDTH							
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
Select one or both							
ASINLET	Points for user inlet channel profile (PN = #41 to #50)						See option 1, ASINLET
	PN**	fixed X	fixed Y	length Aux. Crest***			
ASINLET							option 2
	PN**	gen. fill ?	top soil depth	fixed X	fixed Y	cons. exit length	
ASEXIT							
	PN**	label: "n" or CI	cons. "n" or CI	natural "n" or CI	generate tables		
ASINSURF							
ASEXSURF	Table of exit channel surface parameters						
	program options	Aux. RF-ID	Aux. RF duration	PS RF-ID	PS RF duration	start routing elev. (no PSH routing)	
GO,DESIGN*							
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

** Use profile number 01 to 29 or 41 to 50.

*** Use only if this option is selected alone.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case D-Design auxiliary spillway using spillway templates (ASINLET & ASEXIT) with Aux. crest elevation unknown.

JOB________________ PREPARED BY ______________ DATE________ PAGE____ OF_____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – title	– – –	– – –	System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	class ID type AC	RCN	DA acres	Tc hours or (L' & WS slope %)			
WSDATA*	A C						
		P 1-day		P-SDH	P-FBH (Design)		
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width - height		"n" conduit	tailwater elev.	
PSDATA							
Select one	H. length 1	H. length 2	elev. bend	elev. outlet	Ce (weir)	Ke (weir)	
PSHOOD							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
Select one	PN** R Tie sta.	inlet length	inlet "n" or C1	side slope ratio	exit "n" or CI	exit slope	
ASDATA							
	R crest L.			side slope ratio	exit "n" or CI	exit slope	
ASDATA (subcritical flow)	30						
	Notes: R = retardance. Crest L = level crest length. BW must be given.						
	unit	– – – alternate auxiliary spillway bottom widths	– – –	– – –	– – –	– – –	
BTMWIDTH	FEET						
ASCOORD	Tables of X,Y coordinates for natural or existing spillway material surfaces						
ASMATERIAL	Table with geological description of materials						
Select one or both							
ASINLET	Points for user inlet channel profile (PN = #41 to #50)						See option 1, ASINLET
	PN**	fixed X	fixed Y	length Aux. Crest***			
ASINLET							option 2
	PN**	gen. fill ?	top soil depth	fixed X	fixed Y	cons. exit length	
ASEXIT							
	PN**	label: "n" or CI	cons. "n" or CI	natural "n" or CI	generate tables		
ASINSURF							
ASEXSURF	Table of exit channel surface parameters						
	program options	Aux. RF-ID	Aux. RF duration PS	RF-ID	PS RF duration	start routing elev. (no PSH routing)	
GO,DESIGN*				378			
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

** Use profile number 01 to 29 or 41 to 50.

*** Use only if this option is selected alone.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT TR–60 STRUCTURE

12-05

Case E-Analyze existing auxiliary spillway for design conditions.

JOB ____________ PREPARED BY ____________ DATE ________ PAGE ____ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – – title	– – – –		System Drainage Area	Case / Run Type / record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	zone class / ID type	RCN	DA sq. mi.	Tc hours		QRF csm	
WSDATA*							
				P-SDH	P-FBH		
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	PN			side slope ratio			
ASDATA*							
	Note: PN = #01 to #29 or #41 to #50.						
	unit	– – – – – – alternate auxiliary spillway crests	– – – – – –				
ASCREST							
	unit	– – – alternate aux. splwy bottom widths, exit velocities, or eff. tractive stresses – – –					
BTMWIDTH							
ASCOORD	Tables of X,Y coordinates for existing spillway and natural material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
	program options	Aux. RF-ID	Aux. RF duration			start routing elev. (no PSH routing)	
GO,DESIGN*							
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case E-Analyze existing auxiliary spillway for design conditions.

JOB ______ PREPARED BY ______ DATE ______ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	title	title	title	System Drainage Area	Case Run Type record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	class ID type AC	RCN	DA acres	Tc hours	or (L' & WS slope %)		
WSDATA*	A C						
				P-SDH	P-FBH (Design)		
PDIRECT*							
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET**							
Select one	PN R tie sta.	inlet length	inlet "n" or CI	side slope ratio	exit "n" or CI		
ASDATA							
	Notes: PN = #01 to #29 or #41 to #50, R = Retardance.						
	R crest L.			side slope ratio	exit "n" or CI		
ASDATA (subcritical flow)	3 0						
	Notes: R = retardance. Crest L = level crest length. BW must be given.						
	unit	alternate auxiliary spillway crests					
ASCREST							
	unit	alternate auxiliary spillway bottom widths					
BTMWIDTH	FEET						
ASCOORD	Tables of X,Y coordinates for existing spillway and natural material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
	program options	Aux. RF-ID	Aux. RF duration	switch		start routing elev. (no PSH routing)	
GO,DESIGN*				378			
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

** If using Hood Inlet see PSHOOD in Case A.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR TR–60 STRUCTURE

12-05

Case F-Analyze existing auxiliary spillway for a given storm.

JOB ____________ PREPARED BY ____________ DATE ________ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – – title – – – –			System Drainage Area	Case / Run Type / record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	class / ID type / AC	RCN	DA sq. mi.	Tc hours		QRF csm	
WSDATA*	AC						
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
	PN			side slope ratio			
ASDATA							
Notes: BW must be given.	unit	– – – – alternate auxiliary spillway crests – – – –					
ASCREST							
	unit	– – – alternate Aux. bottom widths, exit velocities, or eff. tractive stresses – – –					
BTMWIDTH							
ASCOORD	Tables of X,Y coordinates for existing spillway and natural material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
		In. hyd. time inc.	duration hrs.	RCN	Tc hours	baseflow csm	
STORM*							
RAINTABLE	Table for storm rainfall distribution						
	program options	storm ID	storm rainfall-in.	MC Switch		start routing elev. (no PSH routing)	
GO, STORM*							
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

TYPICAL DESIGN INPUT FOR 378 STRUCTURE

12-05

Case F-Analyze existing auxiliary spillway for a given storm.

JOB ______ PREPARED BY ______ DATE ______ PAGE ____ OF ____

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	program date	watershed ID	– – – title	– – –	– – –	System Drainage Area	Case / Run Type / record ID
SITES							
STRUCTURE	Table for elevation-surface area and/or volume data						
	class / ID type / AC	RCN	DA acres	Tc hours	or (L' & WS slope %)		
WSDATA*	AC						
	unit	perm. pool	PS crest	flood pool sed.	low pt. dam	valley floor elev.	
POOLDATA							
	no conduits	conduit length	dia or width	height	"n" conduit	tailwater elev.	
PSDATA							
	unit HS crest	K_e	weir length	HS crest	LS orif. height	LS orif. width	
PSINLET							
Select one	PN R Tie sta.	inlet length	inlet "n" or CI	side slope ratio	exit "n" or CI	exit slope	
ASDATA							
	Notes: PN = #01 to #29 or #41 to #50, R = Retardance.						
	R crest L.			side slope ratio	exit "n" or CI	exit slope	
ASDATA (subcritical flow)	30						
	Notes: R = retardance. Crest L = level crest length. BW must be given.						
	unit	– – –	– – – alternate auxiliary spillway crests	– – –	– – –	– – –	
ASCREST							
	unit	– – –	– – – alternate auxiliary spillway bottom widths	– – –	– – –	– – –	
BTMWIDTH	FEET						
ASCOORD	Tables of X,Y coordinates for existing spillway and natural material surfaces						
ASMATERIAL	Table with geological description of materials						
ASSURFACE	Table with surface parameters for spillway by reach						
		In. hyd. time inc.	duration hrs.	RCN	Tc hours	baseflow csm	
STORM*							
RAINTABLE	Table for storm rainfall distribution						
	program options	Storm ID	storm rainfall-in.	MC Switch		start routing elev. (no PSH routing)	
GO, STORM*							
ENDJOB							
ENDRUN							

* Control word descriptions may contain additional parameters that may be used.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STRUCTURE DATA

2-95

STRUCTURE ID ____________________ PREPARED BY ____________ DATE ________ PAGE ______
JOB ____________________ CHECKED BY ____________ DATE ________ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Struc. ID	Label					Record Identification
STRUCTURE							
		Elevation feet	Surface Area acres	Principal Spillway Rating cfs	Auxiliary Spillway Rating cfs	Storage acre – feet	Record Identification
(maximum of 20 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

EMBANKMENT CENTERLINE

1-95

STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Elevation Adjustment Factor–feet	Label				Record Identification
CLPROFILE							
Control Word	Enter successive coordinates left to right						Record Identification
	Distance–feet	Elevation–feet	Distance–feet	Elevation–feet	Distance–feet	Elevation–feet	
(maximum of 33 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CUMULATIVE RAINFALL TABLE

12-05

LOCATION ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20		21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	12345	67890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Table ID		Duration hours	Label				Record Identification
RAINTABLE								
			Enter successive entries left to right with initial entry for time = 0					Record Identification
(maximum of 60 data records)								
ENDTABLE								

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

INPUT HYDROGRAPH

12-05

HYDROGRAPH LOCATION ______ PREPARED BY ______ DATE ______ PAGE ______

JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Hydrograph Type Code	Drainage Area sq. mi. *	Label				Record Identification
HYD							
	Site Type Code *	Time Increment hours	Start time hours				Record Identification
		Enter successive entries left to right with first entry for starting time					
1. maximum of 100 data records 2. * Only use if not given on WSDATA Control							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

DIMENSIONLESS HYDROGRAPH

12-05

LOCATION ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word		Peak Factor	Label				Record Identification
DIMHYD							
		Enter successive entries left to right with initial entry for time = 0					Record Identification
(maximum of 20 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STREAM CROSS SECTION DATA

(TR–20 Format – 12 Column Data Fields)

2-95

CROSS SECTION NAME ______________ PREPARED BY ______________ DATE ________ PAGE ________
JOB ______________ CHECKED BY ______________ DATE ________ OF ________

1 – 12			13 – 24	25 – 36	37 – 48	49 – 60	61 – 72	73 – 80
1234567890 12			345678901234	567890123456	789012345678	901234567890	123456789012	34567890
Data Code		Table Name	Cross Section No.	Drainage Area sq. mi. * (use 1.0 if cfs)	Bankfull * Elevation–feet	Zero Damage * Elevation–feet	Low Ground * Elevation–feet	Record Identification
2		XSECTN						
			(001 to 200)	Elevation feet	Discharge cfs or csm	End Area square feet		Record Identification
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
8								
9		ENDTBL		This record must be the last record of this table.				

1. Maximum of 20 data records.
2. Data Fields in Col. 25 to 72 require decimal points.
3. * TR–20 Data Fields in Col. 25 to 72 on the 2 XSECTN record and Data Code 8 on the data records are not used in SITES. Discharge must be in cfs for SITES.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STREAM CROSS-SECTION DATA

12-05

LOCATION ID ______________ PREPARED BY ______________ DATE ________ PAGE ______

JOB ______________ CHECKED BY ______________ DATE ________ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Cross Section Number (001 to 200)	Bank Full Elevation feet	Low ground Elevation feet				Record Identification
XSECTN							
Control Word		Elevation feet	Discharge cfs	End Area square feet	Top width feet	Slope ft/ft	Record Identification
(maximum of 20 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

READ DISCHARGE HYDROGRAPH

(TR–20 Format – 12 Column Data Fields)

12-05

HYDROGRAPH LOCATION ______________ PREPARED BY ______________ DATE __________ PAGE ________
JOB ______________ CHECKED BY ______________ DATE __________ OF ________

1 – 12	13 – 24	25 – 36	37 – 48	49 – 60	61 – 72	73 – 80
123456789012	345678901234	567890123456	789012345678	901234567890	123456789012	34567890
Data Code / Table Name / Opp. Code	Storage Location No. 1 to 7	SITES only site Type Code 1 = Null Site				Record Identification
7 READHD 8						
	Starting Time hours *	Time increment hours	Drainage Area square miles	Baseflow included cfs *		Record Identification
7 READHD 9						
	Enter successive discharge left to right with first entry for starting time. Fill last row of data with last entry of table. Include Baseflow if applicable.					
8						
8						
8						
8						
8						
8						
8						
8						
8						
8						
8						
8						
8						
8						
9 ENDTBL	This record must be the last record of this table.					

1. Maximum of 80 records (400 pts.)
2. Data Fields in Col. 13 to 72 require decimal points.
3. * TR–20 Data Fields in Col 13 to 24 and 49 to 60 on the 7 READHD 9 record are not used in SITES.

Note: For SITES, the table may contain up to 100 records or 500 points

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY COORDINATES

12-05

STRUCTURE ID ______________ PREPARED BY ______________ DATE __________ PAGE ________
JOB ______________ CHECKED BY ______________ DATE __________ OF ________

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Material No.	Material Description	Aux. Surface ? (Y or N)	Barrier Station	User Label		Record Identification
ASCOORD							
Control Word	Enter successive coordinates left to right						Record Identification
	Station–feet	Elevation–feet	Station–feet	Elevation–feet	Station–feet	Elevation–feet	
(maximum of 7 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY MATERIAL

2-95

STRUCTURE ID ______________________ PREPARED BY ______________ DATE __________ PAGE ________
JOB ______________________ CHECKED BY ______________ DATE __________ OF ________

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Topsoil Fill Material No.	General Fill Material No.		- - - - - - - - User Label	- - - - - - - -	- - - - - - - -	Record Identification
ASMATERIAL							
Control Word	Material No.	Plasticity Index	Rep. Diameter in *	Percent Clay or -Det. Rate Coef.	Dry Buld Density #/cf **	Head Cut Index	Record Identification
(maximum of 12 data records)							
ENDTABLE							

* Conversion millimeters to inches: mm/25.4 = inches
** Conversion gm/cc to #/cf: 62.428 x gm/cc = #/ft³

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY SURFACE

2-95

STRUCTURE ID ______________________ PREPARED BY ______________ DATE __________ PAGE ________
JOB ______________________ CHECKED BY ______________ DATE __________ OF ________

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Profile Reference No. 41–50	D/S End Exit Channel Station – ft	D_{75} Surface Material in	Reserved	- - - - - - Label	- - - - - -	Record Identification
ASSURFACE							
Control Word	Reach Begin Station ft	Reach End Station ft	C_I	C_F	MC	Rooting Depth ft	Record Identification
(maximum of 20 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

AUXILIARY SPILLWAY SURFACE PROFILE

2-95

STRUCTURE ID ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word	Profile Reference No. 41–50	Topsoil Fill Depth, ft		User Label			Record Identification
ASSPRFL							
Control Word	Enter successive coordinates left to right						Record Identification
	Station–feet	Elevation–feet	Station–feet	Elevation–feet	Station–feet	Elevation–feet	
(maximum of 7 data records)							
ENDTABLE							

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

EXIT CHANNEL SURFACE

3-95

LOCATION ______ PREPARED BY ______ DATE ______ PAGE ______
JOB ______ CHECKED BY ______ DATE ______ OF ______

1 – 10	11 – 20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
Control Word (record 1)	Profile Reference No.	Label "n" or C_I	Const. Exit Channel "n" or C_I	Natural Ground "n" or C_I			Record Identification
ASEXSURF		N or CI					
(record 2)		Label C_F	Const. Exit Channel C_F	Natural Ground C_F			
		CF					
(record 3)		Label MC	Const. Exit Channel MC	Natural Ground MC			
		MC					
(record 4)		Label RD	Const. Exit Channel RD	Natural Ground RD			
		RD					
(record 5)		Label D75	Const. Exit Channel D75*				
		D75					
ENDTABLE	(use if record 5 is omitted)						

select one