AD-A096 519 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 9/2
H2250-RESERVOIR STORAGE DRAWDOWN TIME, PROGRAM NUMBER 722-F3-R0--ETC(U
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ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM	PROGRAM NO.
H225Ø - Reservoir Storage Drawdown Time	722-F3-RØ-2DØ

PREPARING AGENCY Hydraulics Analysis Division, Hydraulics Laboratory, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, MS 39180

AUTHOR(S)	DATE PROGRAM COMPLETED	STATUS OF PROGRAM	
		PHASE	STAGE
Bobby J. Brown	February 1979	Origin	Operational

A. PURPOSE OF PROGRAM

To compute the drawdown time (hrs) of a reservoir from a given upper pool elevation to a specified lower pool elevation given either a constant inflow (may be zero) or an inflow hydrograph

LEVEL

B. PROGRAM SPECIFICATIONS

SEE FOLLOWING PAGES.

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C. METHODS

The program is written in G635 time-share series, FORTRAN IV, and is part of a Conversationally Oriented Real-Time Program-Generating System (CORPS). The program consists of a main program and a subroutine. The main program handles all I/O requirements and computations. The subroutine performs all writing and file requirements to save the output for graphics and/or other use if requested.

D. EQUIPMENT DETAILS

The program was developed and is operational on the WES G635, Vicksburg, MS. It is also operational on HIS 66/8Ø, Macon, GA, and Boeing CDC, Seattle, WA.

E. INPUT-OUTPUT

Input requirements are: Either constant (may be zero) or inflow hydrograph; time in hours, flow rate in acre-ft/hr, loss coefficient of outlet conduit, initial and final gage heights of reservoir water surface in ft above outlet intake invert, and coefficients of power curve to data of gage height (ft) versus reservoir storage (acre-ft). Output includes given data and the values of inflow, outflow, storage, and gage height of water surface for each time step.

F. ADDITIONAL REMARKS

Complete documentation of this program is available from the Engineer Computer Programs Library, Technical Information Center, WES.

DDC FILE COPY

B. PROGRAM SPECIFICATIONS:

LANGUAGE: ANSI FORTRAN (FORTRAN IV)

Solution Requirements: The run command

RUN WESLIB/CORPS/H225Ø,R

and the inputs defined in (E).

Method of Analysis: Numerical solution of the level pool routing-lumped-form of the continuity equation.

Core Requirements G635: 13 K words

External Storage:

1. If input is to be entered for an inflow hydrograph and the user has no existing hydrograph file, the program will create and save the user named hydrograph file. The file limits will be from 640 to 12K G635 words.

2. If the output is to be saved for graphics and/or other use, then the program will create and save the user named output file with limits from 64Ø to 12 K G635 words.

Restrictions: None

General Equation: Continuity equation discretized over a time interval (Δt)

$$\frac{1}{2}(I_1 + I_2) - \frac{1}{2}(O_1 - O_2) = \frac{V_2 - V_1}{\Delta t}$$

where I, O, and V are inflow, outflow, and volume, respectively, and the subscripts 1 and 2 indicate the start and end of the time interval (Δt).

Range of Quantities:

Unlimited

Accuracy: Same order of magnitude as the accuracy of the gage height versus storage relation.

Accession For
NTIS GRA&I
DDC TAB
Unannounced
Justification Form 50
on file
By
Distribution/
Availability Codes
Avail and/or
Dist Special
A

REF: ER 1110-1-10 - ENGINEERING AND DESIGN - Engineering and Computer Program Library Standards and Documentation, Appendix B

PART I: ENGINEERING DESCRIPTION

1. PROGRAM NUMBER: 722-F3-RØ-2D0

2. TITLE: H2250 - Reservoir Storage Drawdown Time

3. REVISION LOG: N/A

4. PURPOSE OF PROGRAM: To compute the time required to draw down a reservoir from some upper pool elevation to a lower pool elevation given either a constant inflow (may be zero) or an inflow hydrograph.

5. STEP SOLUTION:

a. Input. The input variables that must be supplied upon request are:

(1) Type of inflow. Either constant (may be zero) or an inflow hydrograph. If constant, the value must be supplied (acre-ft/hr), however, if a hydrograph is used, a data file must either be created or a data file from a previous run may be used. If a data file does not exist, the program will furnish instruction on how the user may create the file. These instructions include: requests for data file name, number of points on hydrograph, and the values of time versus discharge. If a data file already exists, the name of the file is requested.

(2) The loss coefficient of the outlet conduit defined by:

$$Q = A\sqrt{\frac{2gh}{K}} \qquad (1)$$

where K is the loss coefficient, Q is the discharge, A is the cross-sectional area of the outlet conduit, and h is the head or gage height (ft above intake invert), and g is the acceleration of gravity. See program H2251, which may be used to compute the loss coefficient of an outlet conduit from prototype measurements of drawdown.

(3) The cross-sectional area of the outlet conduit, ft^2.

(4) The initial gage height of the water surface at which drawdown begins (feet above datum used to determine loss coefficient in (2) above).

(5) The final gage height of the water surface, ft.

(6) The coefficients of a power curve fit to the plot of gage height (ft) versus reservoir volume (acre-ft). A straight line is fitted to the log-log plot and the equation has the form:

$$Y = CX^D \tag{2}$$

where Y is the reservoir volume (acre-ft), X is the gage height of water surface (same datum as in (2) and (4) above) and C and D are the coefficients required by the program. If one straight line does not fit the data over the range of gage heights, straight line segments of best fit should be used. If the drawdown limits overlap segments, the problem must be solved in steps, where the initial and final gage heights for each step lie on one segment and the respective C and D coefficients are used for that step. Thus, the final gage height for one step would become the initial gage height for the succeeding step.

(7) Desired type of output. The user has an option on the amount of printout. Either a detailed printout of gage height, inflow, storage, and outflow for each time step or a printout of these parameters for the initial and final time steps are available. Furthermore, for the detailed printout, the user may specify the time step increments.

b. Theoretical Formulation: The level pool routing technique is used to describe the movement of water through the reservoir. The procedure follows from the lumped form of the water continuity equation,

$$I - O = \frac{dV}{dt} \tag{3}$$

where I is the inflow, O is the outflow and V is the reservoir storage or volume.

Equation 3, discretized over a time interval Δt is

$$\frac{1}{2}(I_1 + I_2) - \frac{1}{2}(O_1 + O_2) = \frac{\Psi_2 - \Psi_1}{\Delta t} \tag{4}$$

where the subscripts 1 and 2 indicate the start and end of the time interval, respectively. Equation 4 can be expressed as

$$\frac{\Psi_2}{\Delta t} + \frac{O_2}{2} = \frac{\Psi_1}{\Delta t} + \frac{O_1}{2} - O_1 + \frac{1}{2}(I_1 + I_2) \tag{5}$$

Define

$$N = \frac{\Psi}{\Delta t} + \frac{O}{2} \tag{6}$$

Equation 5 reduces to

$$N_2 = N_1 - O_1 + \frac{1}{2}(I_1 + I_2) \tag{7}$$

The data consists of the inflow hydrograph and of a relation between outflow and storage. The inflow hydrograph is discretized in time to yield a series of I values.

c. <u>Steps in Program Execution</u>.

(1) Input variables defined.

(2) Given the initial gage height (head on outlet conduit) the initial value of outflow is computed by

$$Q = 0.08264A\sqrt{\frac{2gh_1}{K}} \tag{8}$$

where Q is the outflow in acre-ft/hr, A is the cross-sectional area of the outlet conduit (ft^2), g is the acceleration of gravity (32.2 ft/sec^2), h_1 is the initial gage height (datum is taken at the outlet intake invert) and K is the outlet conduit's loss coefficient.

(3) The initial storage or volume of the reservoir is computed,

$$\forall = Ch_1^D \tag{9}$$

where $\forall$ is the storage in acre-ft, h is the initial gage height, and C and D are the coefficients of the power fit curve of gage height versus storage.

(4) The initial N value (N_1) is computed with equation 6. The time step (Δt) used in the computations is set at 1 hour for the conditions of constant inflow and it is set at the time interval of the inflow hydrograph for the hydrograph condition.

(5) Given the inflow hydrograph (I values), the updated N value (N_2) is computed with equation 7.

(6) With N_2 known, solve for h_2 by noting that

$$N_2 = \frac{Ch_2^D}{\Delta t} + 0.0826A\sqrt{\frac{2g}{K}}\left(h_2\right)^{1/2} \tag{10}$$

or

$$ah_2^D + bh_2^{1/2} - N_2 = 0 \tag{11}$$

where $a = 0.0826A\sqrt{\frac{2g}{K}}$ and $b = \frac{C}{\Delta t}$.

Equation 11 is solved by a first order Newton technique, i.e.,

$$F(h) = ah_2^D + bh_2^{1/2} - N_2 \tag{12}$$

and the derivative with respect to h ,

$$F'(h) = aDh_2^{D-1} + \frac{1}{2}\,bh_2^{-1/2} \tag{13}$$

Initially the value of h_2 is assigned the value of h_1 and by iteration, i.e.,

$$h_2^* = h_2 - \frac{F(h)}{F'(h)} \tag{14}$$

the new approximation (h_2^*) is obtained. Iteration using equations 12, 13, and 14 is continued until

$$\left| h_2^* - h_2 \right| \leq 0.01 \tag{15}$$

or for 200 iteration.

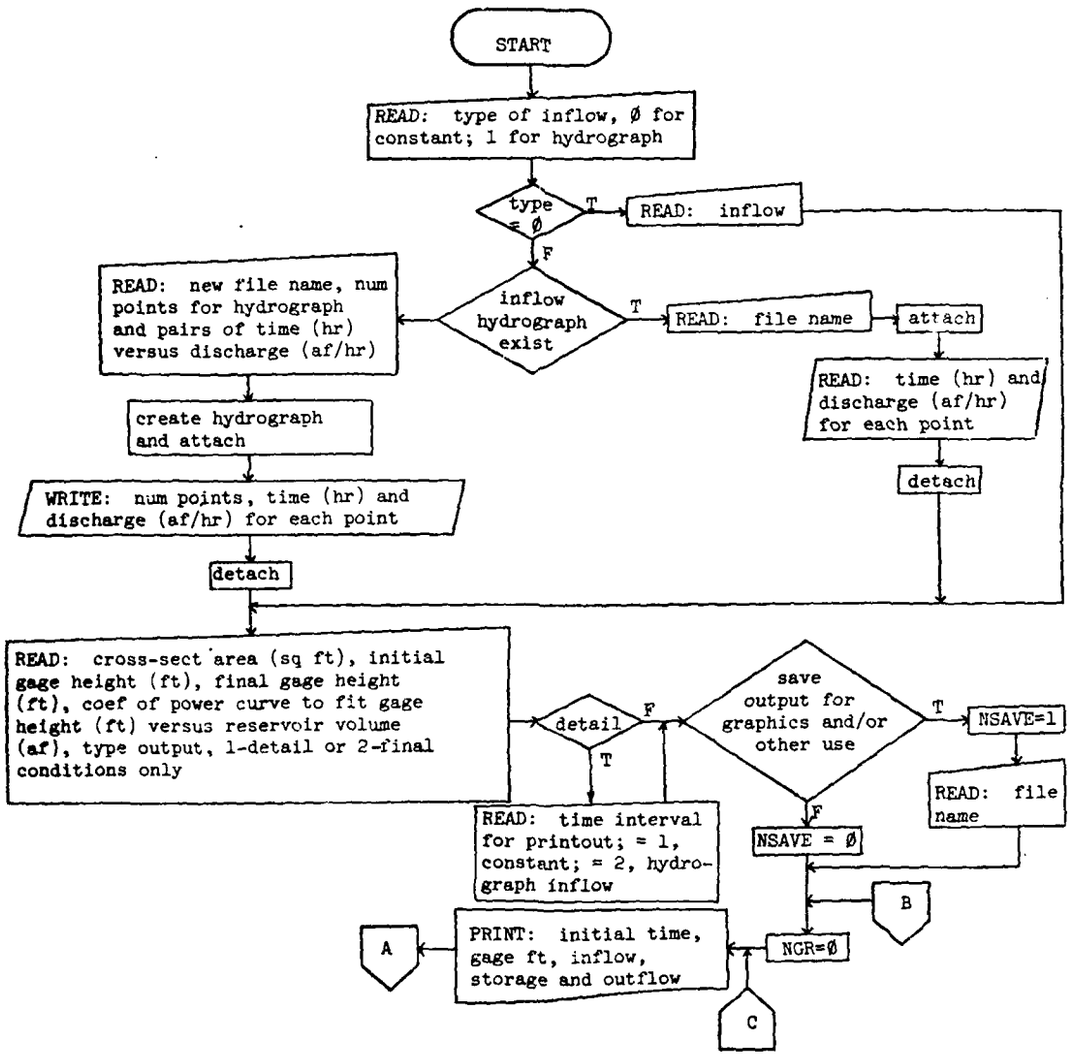
(7) With h_2 determined, the values of storage ($\forall_2$) and outflow (O_2) are computed by equations 9 and 8, respectively. Set $\forall = \forall_2$ and $O_1 = O_2$ and repeat for the next h.

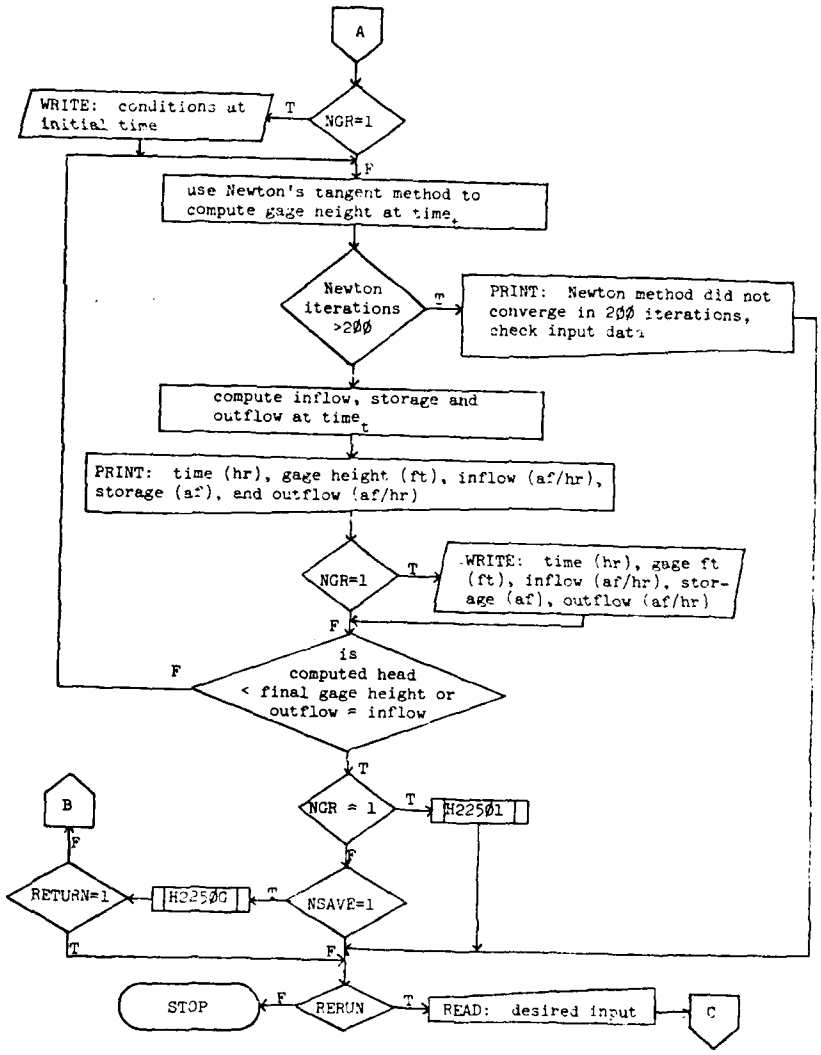
(8) Termination criteria is when the value of h_2 is less than the lower limit of gage height supplied as input or when the outflow equals the inflow.

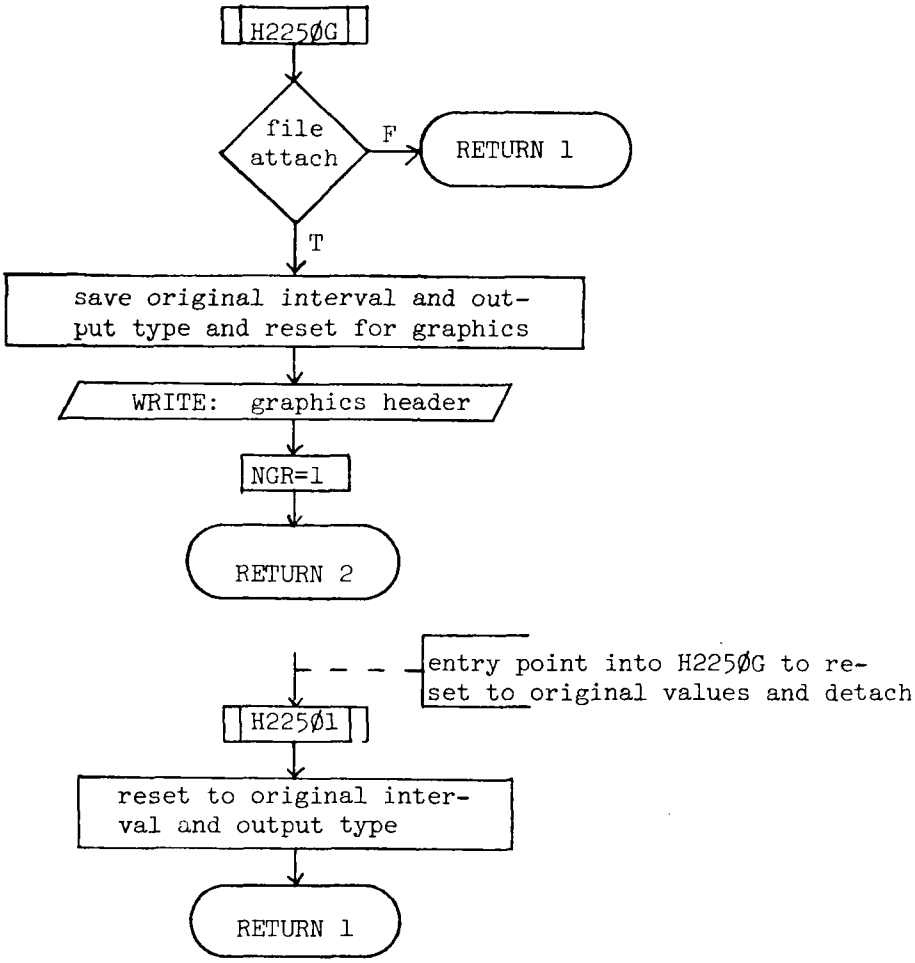
PART II: COMPUTER FUNCTIONAL DESCRIPTION

1. REVISION LOG: N/A

2. FUNCTIONAL FLOW CHART:




A
NGR=1
T
WRITE: conditions at initial time
F
use Newton's tangent method to compute gage height at time$_t$
Newton iterations >2ØØ
T
PRINT: Newton method did not converge in 2ØØ iterations, check input data
compute inflow, storage and outflow at time$_t$
PRINT: time (hr), gage height (ft), inflow (af/hr), storage (af), and outflow (af/hr)
NGR=1
T
WRITE: time (hr), gage ft (ft), inflow (af/hr), storage (af), outflow (af/hr)
F
F
is computed head < final gage height or outflow = inflow
T
NGR = 1
T
H2250Ø1
F
B
F
RETURN=1
H2250C
T
NSAVE=1
T
F
STOP
F
RERUN
T
READ: desired input
C


H225ØG
file attach
F
RETURN 1
T
save original interval and output type and reset for graphics
WRITE: graphics header
NGR=1
RETURN 2
entry point into H225ØG to reset to original values and detach
H225Ø1
reset to original interval and output type
RETURN 1

3. EQUIPMENT AND OPERATING SYSTEM: The program was developed on a G635 time-share system in which input/output equipment consisted of a Model 33 remote teletype. It is now operational on the WES/G635, Vicksburg, MS; HIS 66/8Ø, Macon, GA; and Boeing CDC, Seattle, WA.

4. INPUT REQUIREMENTS: All required inputs, except for the case where the user has an existing hydrograph input data file, are entered via the user's time-share terminal device in free-field format.

5. SECONDARY STORAGE INPUT: The following is the format setup for the user's hydrograph input data file. If the user has no existing hydrograph file, then the program will create and save the user named hydrograph file. All line numbers are three digit.

Line 1 FORMAT(4X,A5,1X,I3)

Equal to H2Ø5Ø followed by the number of points (NP) in the hydrograph. Must always have H2Ø5Ø since it is used by WESLIB routine TACHFILE to verify that the file is an input data file for program H2Ø5Ø

1ØØ H2Ø5Ø 19

Line 2 FORMAT(3X,2(1X,F1Ø.2))

This format controls the remainder of the data file. Each line will contain one value of time and one value of discharge. The number of lines will be equal to the number of points (NP) as given for the hydrograph.

1Ø2	Ø.ØØ	Ø.ØØ
1Ø4	1.ØØ	6.61
.		
.		
.		
2NP+1ØØ	18.ØØ	Ø.ØØ

6. INPUT DATA DESCRIPTION: The following names are used for the input variables in program H2Ø5Ø.

AC	- outlet conduit cross-sectional area, ft^2
CD	- loss coefficient of outlet conduit
CI	- constant inflow, af/hr
COEFFA	- coefficient of power equation for gage height (ft) versus reservoir storage, af/ft
COEFFB	- coefficient of power equation for gage height (ft) versus reservoir storage, af/hr
FILEK(1)	- 8 character, dimension max 2; name of input data file
HI	- initial gage height of reservoir water surface, ft
HF	- final gage height of reservoir water surface, ft
IPR	- time step increment for printout
NP	- number of points on inflow hydrograph, $\leq$1ØØ
NT	- type of inflow, Ø - constant; 1 - hydrograph
OUTPUT	- integer; type of output, 1 - detail; 2 - final conditions only
Q(I)	- dimension max 1ØØ; inflow values of hydrograph, af/hr
T(I)	- dimension max 1ØØ; time values of hydrograph, hr

7. OUTPUT DATA DESCRIPTION: The following names are used for the output variables in program H2Ø5Ø.

H2	- gage height of reservoir water surface at end of time step, ft
HI	- initial gage height of reservoir water surface, ft
O1	- inflow at initial time step, af/ft
O2	- inflow at end of time step, af/hr

Q2 - outflow at end of time step, af/hr

QI(1) - dimension max 1ØØ; outflow at initial time step, af/ft

TT - time at time step n for n = initial time to drawdown time

VOL1 - reservoir storage at initial time step, af

VOL2 - reservoir storage at end of time step, af

8. PROGRAM MESSAGES: Return from program message is to RERUN (another set of conditions) or STOP.

NEWTON METHOD DID NOT CONVERGE IN 2ØØ ITERATIONS - CHECK INPUT DATA

9. VARIABLE DEFINITIONS:

AA - temporary variable used in computing the gage height of the reservoir water surface at end of time step

AC - outlet conduit cross-sectional area, ft^2

AN1 - N value at beginning of time step (N_1)

AN2 - N value at end of time step (N_2)

B - temporary variable used in computing outflow

BB - temporary variable used in computing the gage height of the reservoir water surface at end of time step

CD - loss coefficient of outlet conduit

CI - constant inflow, af/ft

COEFFA - coefficient of power equation for gage height (ft) versus reservoir storage, af

COEFFB - coefficient of power equation for gage height (ft) versus reservoir storage, af

DELT - time step, hr

DH - difference between previous value of gage height at end of time step and the value of the new approximation, equation 15, ft

DQ - difference between outflow and inflow, af/hr

FH - functional relation (equation 12) in terms of gage height at end of time step

FHP - first derivative of FH, equation 13

FILEK(I) - 8 character, dimension max 2; I = 1 , name of input data file; I = 2 , name of output data file for graphics and/or other use

G - acceleration of gravity, 32.2 ft/sec^2

H1 - new approximation of gage height of reservoir water surface at end of time step, equation 14, ft

H2 - gage height of reservoir water surface at end of time step, ft

HF - final gage height of reservoir water surface, ft

HFILE - 5 character name of program (H2Ø5Ø); passed to WESLIB routine HACCT for bookkeeping; passed to WESLIB routine TACHFILE to verify that I/O files to be used are files for H2Ø5Ø

HI - initial gage height of reservoir water surface, ft

IPR - time step increment for printout, hr

JKL - directs return from WESLIB routine RERUN to desired input read

KFILE - file code; KFILE = 1 , file is an input data file; = 2, file is an output file

LQX - equal 1, print instructions from WESLIB routine RERUN; equal 3, no print

LQZ - equal 1, execute all manual input cues and reads; equal 2, call WESLIB routine RERUN and enter only desired inputs

NP - number of points on inflow hydrograph

NT - type of inflow; Ø - constant; 1 - hydrograph

O1 - inflow at beginning of time step, af/hr

O2 - inflow at end of time step, af/hr

OUTPUT - integer; type of output, 1 - detail; 2 - final conditions only

Q1 - outflow at beginning of time step, af/hr

Q2 - outflow at end of time step, af/hr

Q(I) - dimension max 1ØØ; inflow values of hydrograph, af/hr

T(I) - dimension max 1ØØ; time values of hydrograph

TT - time at time step n for n = initial time to drawdown time

VOL1 - reservoir storage at beginning of time step, af

VOL2 - reservoir storage at end of time step, af

ZZZZZ - 2 character; equal RE, rerun; equal ST, stop

10. EXAMPLE CASE: User has an existing hydrograph data file.

Input: Type of inflow (NT) = 1
File name (FILEK(1)) = HYDRO
Loss coefficient outlet (CD) = 16.2
Cross-sectional area (AC) = 16 ft^2
Initial gage height (HI) = 6Ø ft
Final gage height (HF) = 1Ø ft
Coefficients of power curve (COEFFA) = .Ø435;
(COEFFB) = 2.574
Type of output (OUTPUT) = 1
Time interval (IPR) = 12 hr
Save output for graphics and/or other use = NO

List of HYDRO

```
100 H2250  19
102        0.        0.
104        1.00      6.61
106        2.00     14.05
108        3.00     21.49
110        4.00     24.79
112        5.00     22.31
114        6.00     19.83
116        7.00     18.18
118        8.00     16.53
120        9.00     14.88
122       10.00     13.22
124       11.00     11.57
126       12.00      9.92
128       13.00      8.26
130       14.00      6.61
132       15.00      4.96
134       16.00      2.48
136       17.00      0.83
138       18.00      0.
```

Output:

```
H2250 - RESERVOIR STORAGE EVACUATION TIME

AA - TYPE OF INFLOW: ENTER 0 FOR CONSTANT INFLOW(MAY BE ZERO) OR
ENTER 1 FOR INFLOW HYDROGRAPH(MAY BE FOLLOWED WITH CONSTANT INFLOW).
=1

DO YOU HAVE AN INPUT DATA FILE FOR INFLOW HYDROGRAPH? Y OR N:
IF NO, WE WILL HELP YOU CREATE FILE.
=Y
AF - FILE NAME
=HYDRO
AG - LOSS COEFFICIENT FOR OUTLET CONDUIT DEFINED BY:
K=2.*G*H/(Q/A)**2; WHERE K=LOSS COEFF,G=ACCELERATION OF
GRAVITY,Q=DISCHARGE AND A=CROSS-SECTIONAL AREA OF OUTLET CONDUIT.
=16.2
AH - CROSS-SECTIONAL AREA(FT**2) OF OUTLET CONDUIT.
=16
AI - INITIAL GAGE HEIGHT AT WHICH DRAWDOWN BEGINS(FT. ABOVE
DATUM USED TO DETERMINE OUTLET CONDUIT LOSS COEFF).
=60
AJ - FINIAL GAGE HEIGHT TO WHICH RESERVOIR IS TO BE DRAWN DOWN
(FT. ABOVE DATUM USED TO DETERMINE OUTLET CONDUIT LOSS COEFF).
=10
AK - COEFFICIENTS OF POWER CURVE FIT TO GAGE HEIGHT(FT) VS RESERVOIR
VOLUME(ACRE-FT). FORM OF EQUATION: Y=A*X**B; WHERE Y EQUALS
VOLUME, X EQUALS GAGE HEIGHT AND A AND B ARE THE COEFFICIENTS.
ENTER A THEN B SEPERATED WITH A COMMA.
=.0435,2.574
AL - DESIRED TYPE OF OUTPUT AS FOLLOWS:
    ENTER 1 - DETAILED PRINTOUT OF GAGE HT., INFLOW, STORAGE
              AND OUTFLOW FOR EACH INCREMENTED TIME.
    ENTER 2 - LIMITS OUTPUT TO INITIAL AND FINAL CONDITIONS ONLY.
=1
AM - TIME INTERVAL FOR PRINTOUT.
NOTE: MUST BE EQUAL TO MULTIPLES OF 1 FOR CONSTANT INFLOW OR MULTIPLES
     OF TIME INTERVAL OF THE INFLOW HYDROGRAPH.
=12
AN - SAVE OUTPUT FOR GRAPHICS AND/OR OTHER USE
=NO
```

TIME (HR)	GAGE HT. (FT)	INFLOW (AF/HR)	STORAGE (AF)	OUTFLOW (AF/HR)
0.	60.00	0.	1642.29	20.42
12.00	59.20	9.92	1586.50	20.28
24.00	55.99	0.	1374.19	19.73
36.00	52.09	0.	1141.59	19.03
48.00	47.86	0.	917.39	18.24

60.00	43.18	0.	704.37	17.32
72.00	37.38	0.	502.84	16.23
84.00	31.63	0.	316.12	14.83
96.00	23.64	0.	149.34	12.82
108.00	10.07	0.	16.62	8.37
109.00	7.85	0.	8.75	7.39

```
BEGIN OR STOP
=STOP
```

REF: ER 1110-1-10 - ENGINEERING AND DESIGN - Engineer and Computer Program Library Standards and Documentation, Appendix C

PART III: FILE DOCUMENTATION

1. REVISION LOG: N/A

2. TITLE: H225Ø - Reservoir Storage Drawdown Time

3. PROGRAM SOURCE LISTINGS: See pages 17-22

4. NUMERICAL AND LOGICAL ANALYSIS:

First order (Newton) fixed point iteration technique is used to determine gage height of reservoir water surface at end of time step

5. SUBROUTINES NOT DOCUMENTED IN ABSTRACT: None

6. MISCELLANEOUS: The program is part of the CORPS computer system. CORPS is an acronym standing for Conversationally Oriented Real-Time Program-Generating System. The program is now operational on the WES G635, Vicksburg, MS; HIS 66/8Ø, Macon, GA; and Boeing CDC, Seattle, WA. The source listing on page 17 contains the first line run command and brief for H225Ø. This first line run command runs the binary H225ØB of the source listing on pages 18-22 (FORTRAN source of H225Ø) and attaches the WESLIB routines HACCT, TACHFILE, and RERUN.

H2250

```
0001*#PCL WESLIB/CORPS/H2250B,P;WESLIB/PERIN,P;WESLIB/TACHFILE,P;
0002*#WESLIB/HACCT,P
0800 62  THIS PROGRAM COMPUTES THE DRAWDOWN TIME (HR) FOR A RESERVOIR
0810 64WITH CONSTANT INFLOW (AF/HR) OR INFLOW HYDROGRAPH SPECIFIED WITH
0820 62THE GIVEN GAGE HEIGHT (FT) VERSUS STORAGE RELATION (AF). OTHER
0830 59INPUTS REQUIRED ARE THE CROSS-SECTION AREA (FT**2) AND LOSS
0840 60COEFFICIENT OF THE OUTLET CONDUIT AND THE LIMITS (FT) OF THE
0850 24WATER SURFACE ELEVATION.
0860 63  THE OUTPUT CONSIST OF A TABLE OF TIME (HR) VERSUS GAGE HEIGHT
0870 65(FT),INFLOW (AF/HR),STORAGE (AF) AND OUTFLOW (AF/HR) AS SPECIFIED
0880 47BY THE USER'S TIME INCREMENT (HR) FOR PRINTOUT.
0999*06FINISH
```

02/06/79

H2250<

```
00001*@RUN *=J/CORPS/H2250B(NOGO)
10000 DIMENSION T(100),QI(100)
10010 COMMON /C77301/KFILE,FILEK(2),/MAIN/LQZ,LQY
10020 CHARACTER FILEK*8,HFILE*5,ZZZZZ*2
10030 INTEGER OUTPUT
10040 LQZ=1;LQY=1;HFILE=5HH2250;NCON=1;NYC=1
10050 PRINT 10033
10060 10033 FORMAT(/"H2250 - RESERVOIR STORAGE EVACUATION TIME"//)
10070 10034 CALL HACCT(HFILE)
10080 GO TO(10040,10346),LQZ
10090 10040 PRINT 1
10100 1 FORMAT("AA - TYPE OF INFLOW; ENTER 0 FOR CONSTANT INFLOW(MAY BE
10110&FOLLOWED) OR"/"ENTER 1 FOR INFLOW HYDROGRAPH(MAY BE FOLLOWED WITH CONS
10120&TANT INFLOW).")
10130 10080 READ,NT
10140 IF(NT.NE.0) GO TO 2
10150 IF(NCON.EQ.1) GO TO 10100
10160 GO TO(10100,10346),LQZ
10170 10100 PRINT 4
10180 4 FORMAT("AB - CONSTANT INFLOW VALUE IN ACRE-FT/HR. IF NO INFLOW
10190&-ENTER 0.0.")
10200 10130 READ,CI
10210 NCON=2
10220 QI(1)=CI
10230 DELT=1.0
10240 GO TO 30
10250 2 GO TO(10175,10205),LQZ
10260 10175 PRINT 6
10270 6 FORMAT(/"DO YOU HAVE AN INPUT DATA FILE FOR INFLOW HYDROGRAPH?
10280& Y OR N?"/"IF NO, WE WILL HELP YOU CREATE FILE.")
10290 CALL ANSWER($500,$150)
10300 10205 IF(NHY.EQ.1) LQZ=1
10310 NHY=3
10320 GO TO(150,10846),LQZ
10330 150 PRINT3;LQZ=1
10340 3 FORMAT("AC - NEW INPUT DATA FILE NAME.")
10350 10230 READ 9,FILEK(1);LQZ=1
10360 9 FORMAT(A8)
10370 GO TO(10250,10346),LQZ
10380 10250 PRINT 10
10390 10 FORMAT("AD - NUMBER OF POINTS FOR HYDROGRAPH.")
10400 10270 READ,NP
10410 GO TO(10280,10846),LQZ
10420 10280 PRINT 11
10430 11 FORMAT("AE - PAIRS OF TIME(HRS) VS Q(ACRE-FT/HR) OF THE HYDROGR
10440&APH;"/"SEPERATE ALL VALUES WITH COMMAS. MAXIMUM NO.=100 AND TIME"/
10450&"INTERVAL MUST BE CONSTANT. FOLLOWING HYDROGRAPH THE PROGRAM ASSUM
10460&ES A"/"CONSTANT INFLOW EQUAL TO LAST Q VALUE OF THE HYDROGRAPH.")
10470 10330 READ,(T(I),QI(I),I=1,NP)
10480 KFILE=1
```

```
10490 CALL TACHFILE(HFILE,$11784)
10500 WRITE(KFILE,270) NP,(I*2+100,T(I),QI(I),I=1,NP)
10510 CALL DETACH(KFILE,,)
10520 270 FORMAT("100 EVACU ",I3/(I3,2(1X,F10.2)))
10530 GO TO 20
10540 500 IF(NXO.NE.1) GO TO 20
10550 PRINT,"AF - FILE NAME"
10560 10410 READ 9,FILEX(1)
10570 KFILE=1;LOZ=2
10580 CALL TACHFILE(HFILE,$11784)
10590 REWIND KFILE
10600 IF(LOX.EQ.1) LOZ=1
10610 READ(KFILE,540,END=545) NP,(T(I),QI(I),I=1,NP)
10620 540 FORMAT(10X,I3/(3X,2(1X,F10.2)))
10630 545 CONTINUE
10640 CALL DETACH(KFILE,,)
10650 20 DELT=T(2)-T(1)
10660 30 IF(LOX.EQ.1) GO TO 35
10670 LOZ=2
10680 35 GO TO(10515,10846),LOZ
10690 10515 PRINT 13
10700 13 FORMAT("AG - LOSS COEFFICIENT FOR OUTLET CONDUIT DEFINED BY:"/
10710&"K=2.*G*H/(Q/A)**2; WHERE K=LOSS COEFF,G=ACCELERATION OF"/"GRAVITY
10720&,Q=DISCHARGE AND A=CROSS-SECTIONAL AREA OF OUTLET CONDUIT.")
10730 10550 READ,CD
10740 GO TO(10560,10846),LOZ
10750 10560 PRINT 14
10760 14 FORMAT("AH - CROSS-SECTIONAL AREA(FT**2) OF OUTLET CONDUIT.")
10770 10580 READ,AC
10780 GO TO(10590,10846),LOZ
10790 10590 PRINT 16
10800 16 FORMAT("AI - INITIAL GAGE HEIGHT AT WHICH DRAWDOWN BEGINS(FT.
10810& ABOVE"/"DATUM USED TO DETERMINE OUTLET CONDUIT LOSS COEFF..")
10820 10620 READ,HI
10830 GO TO(10630,10846),LOZ
10840 10630 PRINT 17
10850 17 FORMAT("AJ - FINIAL GAGE HEIGHT TO WHICH RESERVOIR IS TO BE DRA
10860&WN DOWN"/"(FT. ABOVE DATUM USED TO DETERMINE OUTLET CONDUIT LOSS C
10870&OEFF.")
10880 10660 READ,HF
10890 GO TO(10670,10846),LOZ
10900 10670 PRINT 18
10910 18 FORMAT("AK - COEFFICIENTS OF POWER CURVE FIT TO GAGE HEIGHT(FT)
10920& VS RESERVOIR"/"VOLUME(ACRE-FT). FORM OF EQUATION: Y=A*X**B; WHERE
10930& X EQUALS"/"VOLUME, X EQUALS GAGE HEIGHT AND A AND B ARE THE COEFF
10940&ICIENTS."/"ENTER A THEN B SEPERATED WITH A COMMA.")
10950 10720 READ,COEFFA,COEFFB
10960 GO TO(10730,10846),LOZ
10970 10730 PRINT 19
10980 19 FORMAT("AL - DESIRED TYPE OF OUTPUT AS FOLLOWS:"/5X,"ENTER
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H2250S CONT.

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10990& 1 - DETAILED PRINTOUT OF GAGE HT., INFLOW, STORAGE"/16X,"AND OUTF
11000&LOW FOR EACH INCREMENTED TIME."/5X,"ENTER 2 - LIMITS OUTPUT TO INI
11010&TIAL AND FINAL CONDITIONS ONLY.")
11020 KOUT=1
11030 10780 READ,OUTPUT
11040 GO TO(10787,10846),LOZ
11050 10787 IF(OUTPUT.NE.1) GO TO 29
11060 IF(KOUT.EQ.1) GO TO 10800
11070 GO TO(10800,10846),LOZ
11080 10800 PRINT 12,KOUT=2
11090 12 FORMAT("AM - TIME INTERVAL FOR PRINTOUT."/"NOTE: MUST BE EQUAL
11100& TO MULTIPLES OF 1 FOR CONSTANT INFLOW OR MULTIPLES"/,6X,"OF
11110& TIME INTERVAL OF THE INFLOW HYDROGRAPH.")
11120 10840 READ,IDR
11130 29 GO TO(10850,10846),LOZ
11140 10850 PRINT,"AN - SAVE OUTPUT FOR GRAPHICS AND/OR OTHER USE"
11150 CALL ANSWER(S11153,S11158)
11160 11153 NSAVE=1
11170 PRINT,"FILE NAME"
11180 KFILE=2
11190 11156 READ 9,FILEK(2)
11200 GO TO 11160
11210 11158 NSAVE=0
11220 11160 GO TO(11200,10846),LOZ
11230 10846 KKK=14
11240 CALL REWIN(KKK,LOX,JKL)
11250 GO TO(10080,10130,10230,10270,10330,10410,10550,10580,10620,10660,
11260&10720,10780,10840,11156,11200),JKL
11270 11200 PRINT 31
11280 31 FORMAT(//,2X,"TIME     GAGE HT.   INFLOW   STORAGE   OUTFLOW"/"
11290&  (HR)",7X,"(FT)",5X,"(AF/HR)",3X,"(AF)",5X,"(AF/HR)",/)
11300 NGF=0
11310 11225 H2=HI
11320 K=0
11330 G=32.2
11340 I=1
11350 B=0.08264*AC*SQRT(2.*G/CD)
11360 TT=0.0
11370 Q1=B*SQRT(HI)
11380 VOL1=COEFFA*HI**COEFFB
11390 IF(NGF.EQ.1) GO TO 11322
11400 PRINT 34,TT,HI,QI(1),VOL1,Q1
11410 GO TO 40
11420 34 FORMAT(F7.2,5X,F6.2,4X,F6.2,3X,F7.2,4X,F6.2)
11430 11322 WRITE(2,11323) TT,HI,QI(1),VOL1,Q1
11440 11323 FORMAT(3F3.2,F10.2,F8.2)
11450 40 AN1=VOL1/DELT+Q1/2.
11460 K=K+1
11470 IF(NT.NE.0) GO TO 45
11480 Q1=QI
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11490 Q2=QI
11500 45 IF(NT.NE.1) GO TO 50
11510 IF(I.GE.NP) GO TO 51
11520 Q1=QI(I)
11530 Q2=QI(I+1)
11540 GO TO 50
11550 51 Q1=QI(NP)
11560 Q2=QI(NP)
11570 50 AN2=AN1-Q1+(Q1+Q2)/2.
11580 AA=COEFFA/DELT
11590 BB=B/2.
11600 KK=0
11610 55 FH=H2**COEFFB+(BB/AA)*SQRT(H2)-AN2/AA
11620 FPH=COEFFB*H2**(COEFFB-1.0)+(BB*0.5/AA)/SQRT(H2)
11630 H1=H2-FH/FPH
11640 DH=ABS(H1-H2)
11650 KK=KK+1
11660 H2=H1
11670 IF(KK.GT.200) GO TO 60
11680 IF(DH.GT.0.01) GO TO 55
11690 GO TO 65
11700 60 PRINT 61
11710 61 FORMAT(/"NEWTON METHOD DID NOT CONVERGE IN 200 ITERATIONS -
11720&CHECK INPUT DATA.")
11730 GO TO 999
11740 65 TT=TT+DELT
11750 Q2=B*SQRT(H2)
11760 VOL2=COEFFA*H2**COEFFB
11770 DQ=ABS(Q2-Q2)
11780 IF(OUTPUT.NE.1) GO TO 66
11790 KK1=K/IPR*IPR-K
11800 IF(KK1.LT.0.OR.KK1.GT.0) GO TO 68
11810 67 IF(NGR.EQ.1) GO TO 11696
11820 PRINT 34,TT,H2,Q2,VOL2,Q2
11830 GO TO 66
11840 11696 WRITE(2,11323) TT,H2,Q2,VOL2,Q2
11850 66 IF(NGR.EQ.1) GO TO 11703
11860 IF(OUTPUT.GE.2.AND.H2.LT.HF) PRINT 34,TT,H2,Q2,VOL2,Q2
11870 GO TO 11710
11880 11703 CONTINUE
11890 11710 IF(H2.LT.HF.OR.DQ.LT..01) GO TO 999
11900 68 IF(H2.LT.HF.OR.DQ.LT..01) GO TO 67
11910 I=I+1
11920 Q1=Q2
11930 VOL1=VOL2
11940 GO TO 40
11950 999 LOZ=2
11960 IF(NGR.EQ.1) CALL H22501(OUTPUT,IPR,$11784)
11970 IF(NSAVE.EQ.1) CALL H2250G(HFILE,TT,OUTPUT,IPR,NGR,$11784,$11225)
11980 11784 PRINT 11785
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11990 11785 FORMAT(//"REPIN OR STOP")
12000 11430 READ,ZZZZZ
12010 IF(ZZZZZ.EQ.2HRE) GO TO 10034
12020 IF(ZZZZZ.EQ.2HST) GO TO 11480
12030 PRINT,"AND MUST BE REPIN OR STOP"
12040 GO TO 11430
12050 11480 STOP
12060 END
13000 SUBROUTINE H2250G(HFILE,TT,OUTPUT,IPP,NGP,*,*)
13010 COMMON /C77801/KFILE,FILEK(2)/MAIN/LOZ,LOX
13020 CHARACTER FILEK*8,HFILE*5
13030 INTEGER OUTPUT
13040 KFILE=2
13050 CALL TACHFILE(HFILE,$13220)
13060 ND=TT;NW=TT;N2=1
13070 13060 IF(ND.LE.200) GO TO 13080
13080 N2=N2*2;ND=ND/N2;GO TO 13060
13090 13080 NS1=OUTPUT;NS2=IPP
13100 IPP=N2;OUTPUT=1
13110 NW=NW-(NW/N2)*N2
13120 IF(NW.GT.0) NW=1
13130 ND=ND+1+NW
13140 REWIND 2
13150 WRITE(2,13120) (ND,I=1,5)
13160 13120 FORMAT("10 H2250 05 05 EDGE"/"11 (05(/),(3F8.2,F10.2,F8.2))"
13170&/"12 ",I3,4(1X,I3)/"13",5("  1"))
13180 WRITE(2,13150)
13190 13150 FORMAT("14 CURVE DESIGNATIONS FOR H2250 ARE:"/"15  1=TIME
13200&2=GAGE HT   3=INFLOW"/"16  4=STORAGE   5=OUTFLOW"/"17 UNITS FOR AB
13210&OVE VARIABLES ARE:"/"18  HR=1   FT=2   AF/HR=3,5   AF=4")
13220 NGP=1
13230 RETURN 2
13240 ENTRY H22501(OUTPUT,IPP,*)
13250 IPP=NS2;OUTPUT=NS1;CALL DETACH(2,,)
13260 13220 RETURN 1
13270 END
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8