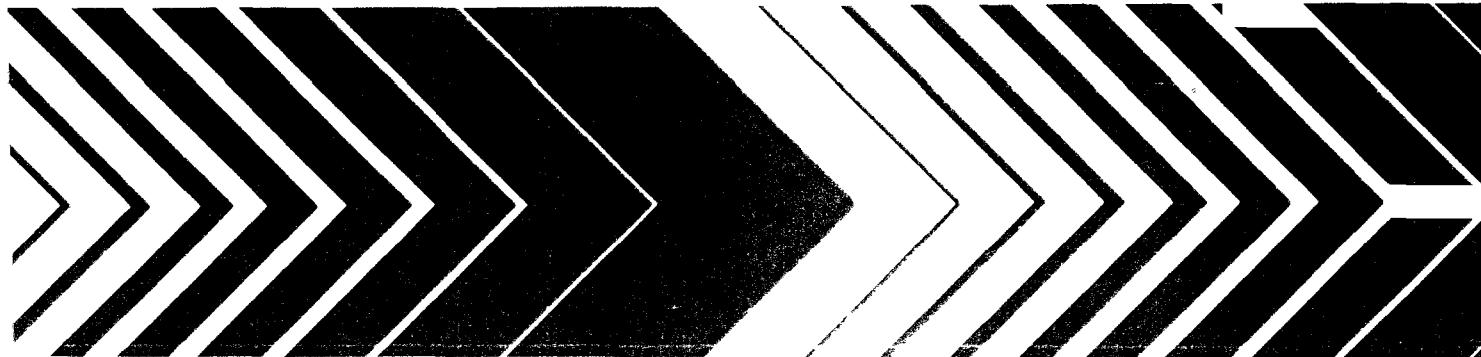


Research and Development



User's Manual for **EXPLORE-I:**

A River Basin Water Quality Model (Hydraulic Module Only)



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USER'S MANUAL FOR EXPLORE-I:
A RIVER BASIN WATER QUALITY
MODEL (HYDRAULIC MODULE ONLY)

by

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FOREWORD

As environmental controls become more costly to implement and the penalties of judgment errors become more severe, environmental quality management requires more efficient management tools based on greater knowledge of the environmental phenomena to be managed. As part of this Laboratory's research on the occurrence, movement, transformation, impact and control of environmental contaminants, the Technology Development and Applications Branch develops management and engineering tools to help pollution control officials achieve water quality goals through watershed management.

Many toxic contaminants are persistent and undergo complex interactions in the environment. As an aid to environmental decision-makers, the Chemical Migration and Risk Assessment methodology was developed to predict the occurrence and duration of pesticide concentrations in surface waters receiving runoff from agricultural lands and to assess potential acute and chronic damages to aquatic biota.

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Athens, Georgia

ABSTRACT

EXPLORE-I is a computer program that simulates the dynamic hydraulic and water quality characteristics of a river basin. It can be used to study the effects of various flow conditions, waste discharge and treatment schemes on the water quality conditions of lakes, reservoirs, rivers, and estuaries. This user's manual provides input instructions for the hydraulic module of the EXPLORE-I code. Basic programming requirements of the code are also included.

Companion reports to this document are Methodology for Overland and Instream Migration and Risk Assessment of Pesticides, Mathematical Model SERATRA for Sediment-Contaminant Transport in Rivers and Its Application to Pesticide Transport in Four Mile and Wolf Creeks in Iowa, User's Manual for the Instream Sediment-Contaminant Transport Model SERATRA, and Frequency Analysis of Pesticide Concentrations for Risk Assessment (FRANCO Model).

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USER'S MANUAL

INTRODUCTION

The Battelle-Northwest (BNW) water quality model, EXPLORE-I (Baca et al., 1973a,b), is a computer program which simulates the dynamic hydraulic and water quality characteristics in a river basin. It can be used to study the effects of various flow conditions, waste discharge and/or treatment schemes on the water quality levels in the river basin.

EXPLORE-I is capable of simulating a number of hydraulic regimes in either a dynamic or steady state mode. These are:

- streams and rivers,
- shallow lakes,
- estuaries or tidally influenced rivers, and
- thermally stratified reservoirs.

In addition, the behavior of the following water quality parameters can be studied:

- Carbonaceous Biochemical Oxygen Demand (BOD)
- Nitrogenous BOD
- Benthic BOD
- Total Organic Carbon (TOC)
- Refractory Organic Carbon
- Sedimentary Phosphorus
- Soluble Phosphorus
- Organic Phosphorus
- Ammonia Nitrogen
- Nitrite Nitrogen

- Nitrate Nitrogen
- Organic Nitrogen
- Toxic Compounds
- Phytoplankton
- Zooplankton
- Dissolved Oxygen

This user's manual is intended to provide the information necessary for application of the hydraulic module of EXPLORE-I to a river basin. A summary description of the hydraulic model used is provided to assist in understanding the code and selecting the necessary input values. Programming details of the code are also included.

GENERAL DESCRIPTION OF EXPLORE-I

The EXPLORE-I computer model consists of four computer program modules:

- hydraulic code for river and estuarine flow,
- quality code for river and estuary systems,
- hydrothermal code for thermally stratified reservoirs, and
- quality code for thermally stratified reservoirs.

The hydraulic and hydrothermal codes must be run first to provide flow and/or temperature patterns which are input information for the quality codes. The river basin codes are not coupled to the deep reservoir models, so quality profiles in impoundments must be analyzed separately.

EXPLORE-I River Basin Codes

As explained above, the EXPLORE-I river basin model consists of a hydraulic code and a quality code. The hydraulic code, which is executed first, produces a magnetic tape which contains all the necessary geometric and hydraulic data used by the quality code. This separation of hydraulic and quality calculations allows the user to set up and calibrate the hydraulic model while gathering data for the quality model.

Each of these codes has two parts, an input program and a calculational program. The results of the input programs are stored on magnetic tape for use by the calculational code. The input codes

check the input data deck for consistency and calculate all time varying functions needed by the calculational codes. This allows the user to check his input before executing the calculational portion of the code. A diagram of the river basin code is shown in Figure 1.

The hydraulic and quality codes are set up to operate for a specified number of cycles; each calculation begins with a specific cycle and ends with a specific cycle. These are normally referred to as tidal cycles. However, the user can specify a cycle different from the tidal cycle (for example, a daily cycle) if no tidal influence occurs in the river basin being modeled. The quality code will accept two types of hydraulic input:

- (1) time varying hydraulic data which in general is not cyclic in nature; and
- (2) steady or cyclic varying flows.

If the user wanted to observe the effects of increased flow from an upstream source or from time varying additions and withdrawals of water from the system, option (1) would be used since these actions are not cyclic in nature. If only constant or cyclic flows (such as tidally influenced flows) were of interest, option (2) would be used. With option (2) the quality code will use the hydraulic data for one cycle again and again as it calculates the quality parameter concentrations for a number of cycles.

Since it is difficult to input all the initial velocities, depths, and flows exactly, both options allow the hydraulic code to calculate for a specified number of cycles before writing out the results of the calculations or starting to add time varying inputs. The time variables used in the hydraulic and quality codes are discussed below.

The relationship between the time bases used in the hydraulic and quality codes is most simply illustrated by time lines, as shown in Figure 2. The variables in this figure are defined as:

- Hydraulic code time variables

NQSWRT = the number of the tidal cycle where printout and writing of time varying hydraulic data begin.
NQSWRT refers to a segment of time rather than to a specific point in time; it is the number of the tidal cycle at which the system establishes the proper initial conditions.

NTCYC = the number of the last tidal cycle for which the hydraulic calculations will be performed. NTCYC also refers to a time segment rather than to a specific point in time.

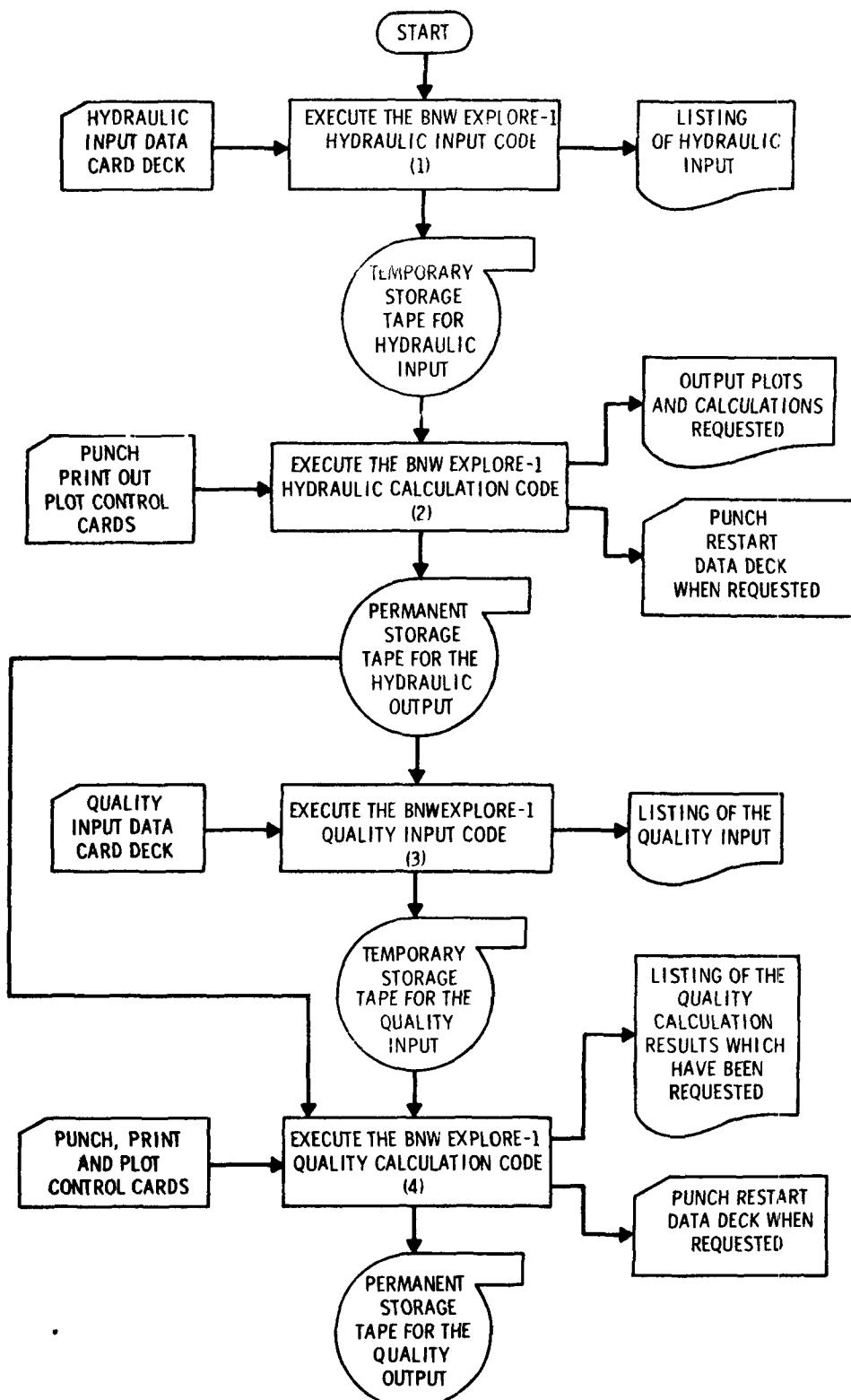
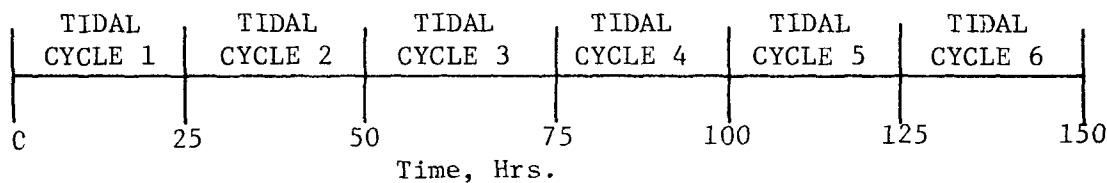


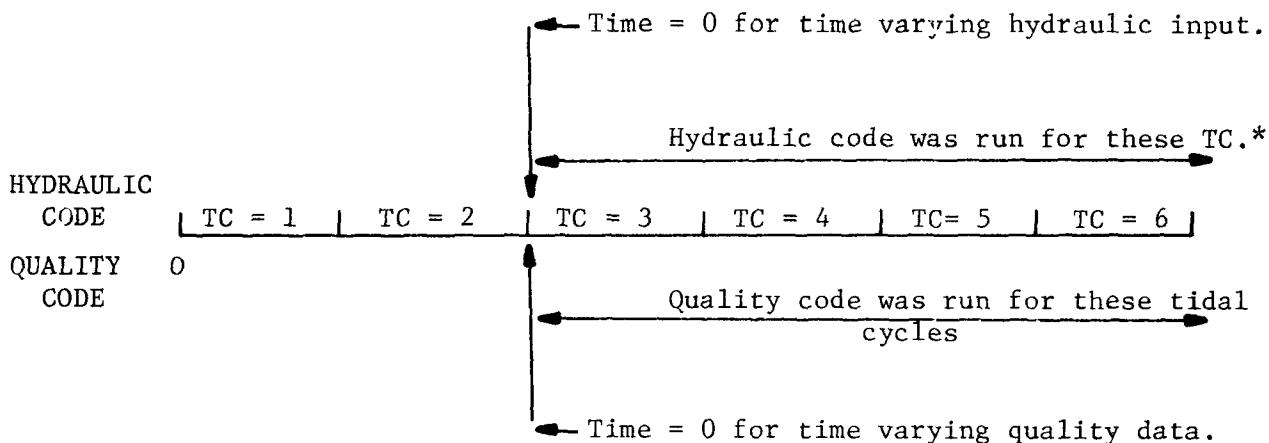
Figure 1. Overview of the BNW EXPLORE-I river basin codes.

A. Time line

Tidal Cycles with PERIOD = 25 hrs.

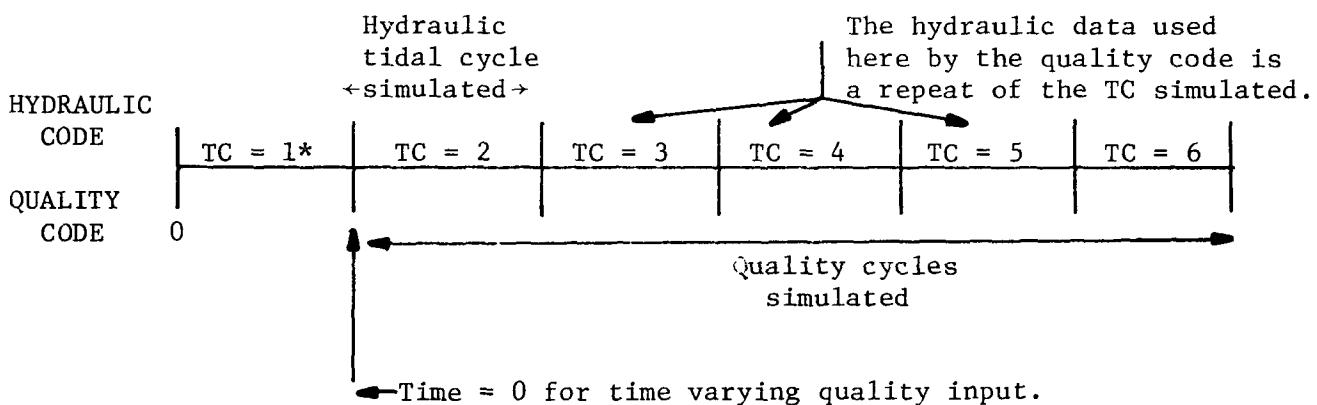


B. Time line showing NQSWRT, NTCYC, NTQCYC and zero time for the hydraulic time varying data and for the quality time varying data
(For example let NQSWRT = 3, NTCYC = 6, NTQCYC = 6, PERIOD = 25)



C. Time line showing NQSWRT, NTCYC, NTQCYC and zero time point for steady state or cyclic hydraulic data

(For example let NQSWRT = 2, NTCYC = 2, NTQCYC = 6, PERIOD = 25)



*TC = Tidal cycle

Figure 2. Relationship of time base in hydraulic and quality codes.

PERIOD = period of one tidal cycle in hours.

- Quality code time variable

NTQCYC = the number of the last tidal cycle for which the quality model will be run. The quality model will be run for the tidal cycle number starting with NQSWRT and ending with NTQCYC.

For the purposes of diurnal calculations the quality code assumes that the start of the time varying data is midnight.

HYDRAULIC CODE

The hydraulic submodel used by EXPLORE-I (Baca et al., 1973a) was originally developed for the receiving water block of the Storm Water Management Model (SWMM) by Water Resource Engineers (WRE). Because the SWMM hydraulic model has been previously applied successfully to various problems, Water Resources Engineer (1966), Callaway et al. (1969), Metcalf and Eddy (1971), it was chosen for this study. An extensive discussion of the theory appears in Callaway et al. (1969) and Baca et al. (1973a) and will not be given here.

The hydraulic code used by EXPLORE-I solves two-dimensional problems with one-dimensional equations by requiring the two-dimensional system to be described by a set of interconnected "channels" and "junctions" which represent the actual physical system. The equations of motion and continuity for a one-dimensional hydraulic system consist of two simultaneous equations referred to as the Saint Venant equations. These equations can be written in terms of the discharge, rather than velocity, as the primary kinetic variable. For flow through a channel of rectangular cross section, these equations are:

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + g \frac{\partial h}{\partial x} - gS_o + gS_f - gS_w = 0 \quad (1)$$

and

$$b \frac{\partial h}{\partial t} + \frac{\partial q}{\partial x} = 0 \quad (2)$$

where

g = gravitational acceleration

h = water depth

u = vertically averaged velocity

b = channel width

q = discharge

S_o = bottom slope

S_f = friction slope due to bed shear stress

S_w = friction slope due to wind stress

t, x = time and space coordinates, respectively.

The code uses a modified set of one-dimensional Saint Venant equations to model the two-dimensional flow in an estuary or river basin by superimposing on the estuary or river basin a grid of junctions and channels. Only one-dimensional flow is then allowed in the channels connecting the junctions. Each junction in the system is a water and potential energy storage element which is characterized by its (1) surface area, (2) water surface elevation, (3) bottom elevation, and (4) the actual (X, Y) coordinates of the junction points. The water storage of the basin or estuary is represented by this series of junctions. Flow between these junctions is through rectangular channels which connect the junctions. A channel is described by its (1) length, (2) width, (3) Manning coefficient, (4) average bottom elevation at the midpoint, and (5) the junction numbers which lie at its end points.

The two Saint Venant equations are not solved simultaneously for this system. Instead, the one-dimensional equation of motion, Equation 1, is solved for each of the channels in the system on the basis of the present values of the junction heads. Velocity and flow in each of the channels are thus determined. Next, the modified equation of continuity, Equation 3:

$$A_{sj} \frac{\partial h_j}{\partial t} = \sum_{i=1}^k Q_i + \left(Q_j^{im} - Q_j^{ex} - Q_u^{ev} \right) \quad (3)$$

where

A_{sj} = surface area associated with the junction j

Q_i = flow of a channel i connectivity to the junction j

Q_j^{im} = water importation rate to the junction j
(source term)

Q_j^{ex} = water exportation rate from the junction j
(sink term)

Q_u^{ev} = evaporation rate

is solved for each of the junctions on the basis of the predicted flows in each of the channels. This process is repeated for the duration of the simulated time period.

Hydraulic Data Input Information

An example of the nodalization of a river basin is shown in Figure 3. The selection of junctions and channel locations and the necessary data for each is discussed below.

Junction Data. The selection of junction points and the distances between them are determined by a size of a time step desired for running the hydraulic model. For a large problem a time step greater than 100 seconds would generally be used. For most estuaries and large rivers (say, flows greater than a few thousand cfs), the maximum time step, Δt , which can be used for a given channel length, L, is determined approximately from

$$\Delta t \leq \frac{L}{\sqrt{gR}} \quad (4)$$

where

R = the hydraulic radius ($R \doteq$ average water depth)
of the channel

L = length

g = gravitational constant

Figure 3 shows the initial nodalization of a sample river basin. After running the model, the user might wish to add new junctions, change the locations of junctions, or remove junctions to improve the simulation results.

Figure 4 is a worksheet which can be used to gather the data necessary to describe the junctions. As indicated on the worksheet, and described in succeeding paragraphs, hydraulic data are required for:

- 1) the average water surface elevation for the junction point,
- 2) the water surface area associated with the junction point,
- 3) any significant inflows to the junction point from small streams, tributaries or other sources,
- 4) any significant outflows from the junction point,
- 5) the average elevation of the bottom of the river or estuary for the junction point, and
- 6) the cartesian coordinates of the junction point (necessary only if the effect of wind stress on channel flow is being

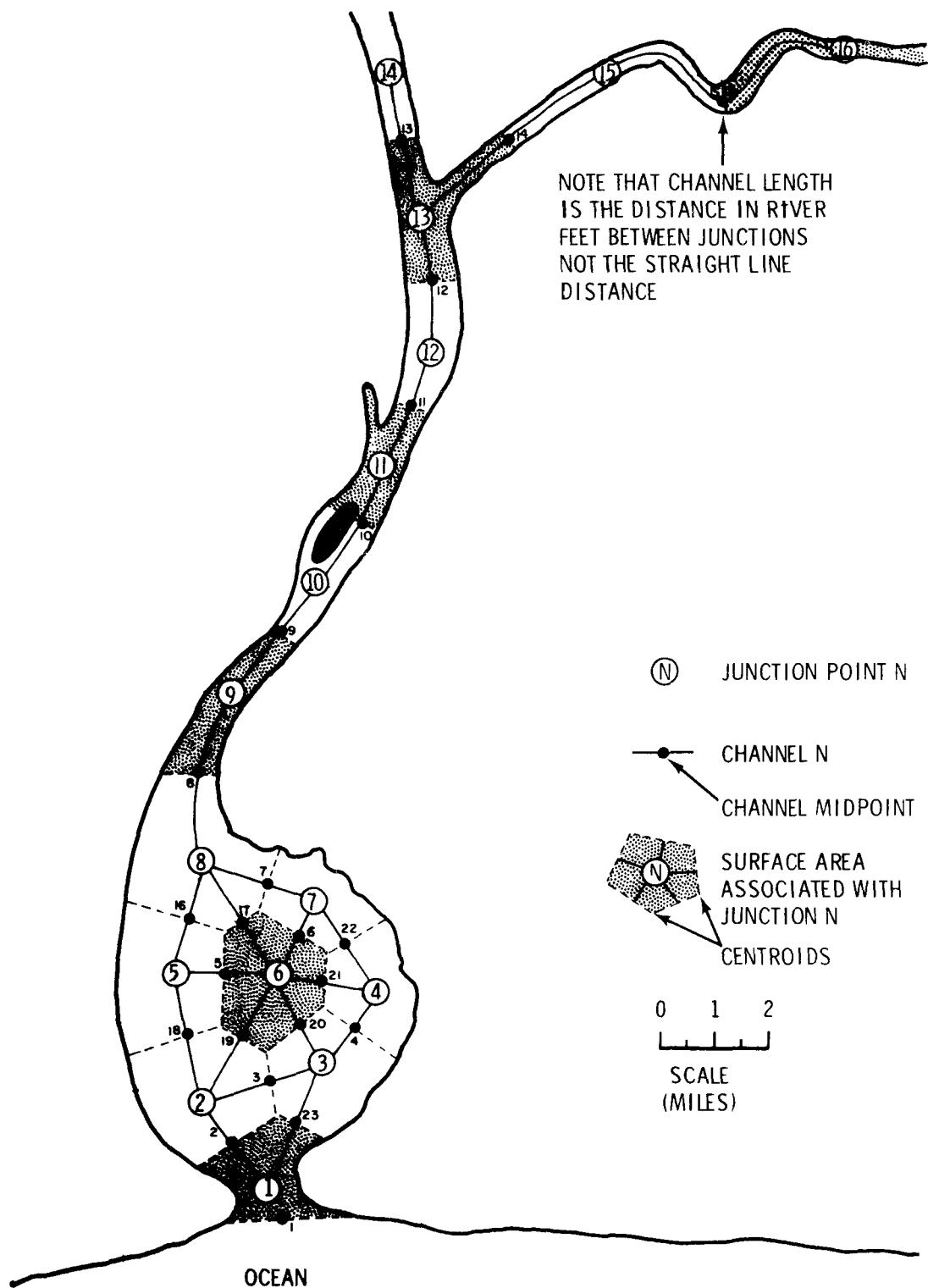


Figure 3. A sample river basin.

JUNCTION DATA
RIVER (OR STREAM)

Figure 4. Worksheet for gathering input data to describe the problem's junction points.

calculated).

The water surface elevations need only be a reasonable guess, as the code will predict the correct head after the simulation has run a day or two. The initial head can be determined from the elevation (taken from topographic maps), by adding the known water depth at the junction point to the known elevation of the river or estuary bottom, or from other sources (e.g., Corps of Engineers records, if available).

The surface area of a junction is bounded by the lines which connect the centroids of adjacent areas. Figure 3 illustrates the method of determining the surface area of a junction for almost any kind of junction point. The surface area can be obtained by planimetering topographic or navigation maps. Junctions with tributary inflows which are not modeled should be accounted for by a representative surface area.

Inflow rates for tributaries or streams which are not modeled but contribute a significant amount of water into the junction should be specified. Outflow rates for unmodeled outflows should also be specified.

The average elevation of the river or estuary bottom for the junction point can be determined from

- physical measurements;
- navigation charts or topographic maps which give sounding contours for the river or estuary (any good method of averaging this data can be used to determine the average junction point's bottom elevation; see Callaway et al. (1969) for one method; and
- data (such as from the U. S. Corps of Engineers) available on average water depth versus river mile (the area under this curve can be integrated and divided by the channel length to determine the average water depth for the junction).

The cartesian coordinate system used to define the (X,Y) values must be a right-hand coordinate system, i.e., the positive Y axis must point north.

Channel Data. Figure 5 is a worksheet which can be used to gather the data necessary to describe the channels. As indicated by the channel worksheet and described below, hydraulic data must be gathered for:

- 1) channel length,

Figure 5. Worksheet for gathering input data to describe the problem's channels.

- 2) channel width,
- 3) average elevation of the channel bottom,
- 4) Manning coefficient for the channel, and
- 5) initial velocity in the channel.

The length of a channel is simply the distance in river meters between the two junction points which lie at either end of the channel (see Figure 3).

The channel width is the average surface width of a river or tributary channel or the distance between centroids of adjacent areas for an estuary channel (see Figure 3).

The average elevation of the channel bottom can be estimated as the average of the bottom elevations of the junctions at the ends of the channel.

If actual measurements are not available, the Manning friction coefficient for the channel can be estimated from Table 1 below.

Table 1. A Tabulation of Representative Values of the Manning Friction Coefficient for Various Types of River Channels (Henderson 1966)

Natural River Channels

Clean and straight	0.025-0.030
Winding, with pools and shoals	0.033-0.040
Very weedy, winding, and overgrown	0.075-0.150

The initial velocity must be supplied only for channels where a stability problem might exist. Flow and velocity in the channels are positive when the flow in the channel is from a low junction number to a high junction number. In an estuary or large river where the channels are more likely to be stable, 0 can be input for the initial velocity.

Controlled Nodes and Upstream Boundary Conditions

The solution of the hydraulic problem requires two driving functions:

- a time varying function to control the head or outflow for the downstream end point junctions (controlled nodes), and

- an upstream constant or time varying flow input for the upstream end point functions.

For the sample river system in Figure 3, constant or time varying inflows would be specified for upstream junctions 14 and 16 and a stage versus time history would be supplied for the downstream controlled node 1.

Constant inflows to upstream end point junctions are simply specified as inflows on the junction data sheets (see Figure 4). Time varying upstream inputs are handled as indicated below.

Controlled Nodes. Controlled nodes, which are required at every downstream boundary in the river system, specify the boundary conditions. When simulating an entire river basin it is likely that points of discontinuity such as dams, waterfalls and locks will occur in the hydraulic system. These are not downstream end points but they must be controlled as if they were. The original structure of the SWMM code would have required simulation of each portion of the river basin lying between two discontinuities as a separate problem. The modified code used here nodalizes the entire river basin to include these discontinuities and locates a controlled junction at each point where flow or head is to be specified. An associated controlled channel must connect this controlled junction with the next downstream junction.

Use of the controlled nodes and channels must conform to the following rules:

- Controlled junctions must be numbered first; for instance, if there are N controlled junctions in the system they must be numbered as junctions 1 through N.
- Each controlled junction (except a tidally influenced one) must have only downstream flow.
- Each controlled junction must have only one controlled channel connecting it downstream to another junction (or seaward, with no junction, in the case of a tidally influenced junction). The controlled channel must be assigned the same number as the controlled junction with which it is associated.
- No two controlled nodes can be directly connected by a channel.

Except for these restrictions, numbering of nodes and channels can be carried out in any order.

Six types of controlled nodes are allowed. They are:

- 1) a weir type, in which the flow over the weir and out of the controlled node is determined by the formula

$$Q = A_1 (H - A_2)^{A_3} \quad (5)$$

where

Q = flow, m^3/sec

H = water surface elevation upstream of weir, m

A_1 = weir coefficient

A_2 = elevation of weir, m

A_3 = weir exponent

- 2) a tidally controlled node at which the stage versus time history is specified;
- 3) a Q versus H dam, where outflow is controlled as a function of the dam upstream water surface elevations [the user inputs an array of (H, Q) points which are fit by polynomial regression to form a function to predict Q for any value of H];
- 4) a dam at which head and outflow are both known functions of time [the user supplies an array of (t, Q) points and an array of (t, H) points; these arrays are fit by polynomial regression and two time functions are formed, one to predict Q as a function of time and one to predict H as a function of time];
- 5) a dam at which head is a known function of time [the outflow from the dam is determined via a mass balance; an array of (t, H) points is supplied by the user and a polynomial function is fit to these data points]; and
- 6) a dam at which outflow is a known function of time and head must be determined from a mass balance [an array of (t, Q) points is supplied and a polynomial fit of the data is performed].

Time Varying Inflows or Upstream Hydraulic Inputs from Discharge Hydrographs. The user can specify time varying inflows to any junction in the system by indicating the number of time varying inputs and an array of junction numbers where these inputs are to be added. In addition, the user must supply an array of (Q, t) points for each input where Q is the discharge and t is time. These arrays are then fit via polynomial regression and functions are formed so that the inflow or outflow can be

predicted for any time.

Evaporation and Wind Stress. If in the river basin being simulated evaporation or wind can significantly affect flow patterns or water quality, the gross effects of these factors can be accounted for. The user can supply an evaporation rate in (inches/month) and the average wind speed and direction for the entire basin.

Tributary Channels. The original SWMM hydraulic code was modified to allow the marking of "small tributary channels" which became necessary at every junction between a large river and a small tributary (Baca et al., 1973a,b). The original code calculates the hydraulic radius of a channel by averaging the characteristics of the nodes at the ends of the channel. In a single river or an embayment all of the channels have similar characteristics and this is a valid estimation. However, at the junction between a large river and a small side tributary the characteristics of the small tributary channel are grossly overestimated by averaging the properties of the nodes at the channel ends. The properties of the channel are most like those of the first upstream node in the tributary (except when backflow to the tributary is allowed). The changes in the hydraulic code allow the user to mark the small tributary channels and associate with each of these channels the characteristics of the first upstream node in the small tributary. The revised code then simply calculates the channel properties for the small tributary channel on the basis of the properties of the marked upstream node. If there is backflow to the tributary, channel properties are calculated in the normal manner.

Hydraulic Input Data Deck Preparation

After the river-estuary system has been nodalized as described above and the data sheets for the junctions and channels have been prepared, the input data deck is prepared. As mentioned above and in the following section, the hydraulic code consists of two separate executable programs, an input code (IMAIN and associated subroutines) and a calculation code (HMAIN and associated subroutines). Table 2 and Figure 6 indicate the input data format and the relative order of the input card deck required for running IMAINT, the input code. Modifications in Table 2 from the 1973 version of EXPLORE-I include a change from English to metric units for all variables, a maximum value for the number of data points used in defining the time varying function (see data group H9), and an additional variable, HYDEND, in the hydrograph input requirements (see data group H10). Input variables in metric units are converted to English units within the program. An additional input modification noted in the text includes the requirement of assigning the same number to a controlled node and to its associated controlled channel.

Table 2. Data Card Format for EXPLORE-I Hydraulic Input Code

Card Group	Format	Columns	Description	Variable Name	Default Value
H0	15A4	1-60	Title for run (card 1)	ALPHA (1-15)	none
	15A4	1-60	Title for run (card 2)	ALPHA (16-30)	none
Hydraulic control card					
H1	I5	1-5	Number of the last tidal day cycle to be simulated	NTCYC	none
	3F5.0	6-10	Number of hr/tidal day cycles	PERIOD	none
		11-15	Length of quality time step, hour (must be evenly divisible into PERIOD)	QINT	none
		16-20	Length of hydraulic time-step, second (must be evenly divisible into QINT)	DHT	none
	5X				
	3F5.0	26-30	Evaporation rate (mm/month)	EVAP	none
		31-35	Wind velocity, m/sec	WIND	none
		36-40	Wind direction, clockwise, degrees from North	WDIR	none
	4I5	41-45	Tidal day number where printed output will start and the quality tape will be prepared	NOSWRTP	none
		46-50	Number of junctions with time varying inflow	NJSW	none
		51-55	Number of controlled junctions	NJGW	none
		56-60	Number of tributary channels	NTRIB	none

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
[Junction numbers where hydrograph inflows are present]					
H2	I5	1-5	Junction number where first hydrograph inflow is present	JSW(1)	none
	I5	6-10	Junction number where second hydrograph input is present	JSW(2)	none
	:	:		:	:
	:	:		:	:
	:	:		:	:
			Junction number where last hydrograph input is present	JSW(NJSW)	none
[Codes which indicate the type of controlled node (a number from 1-6)]					
<p>1 means weir relationship (A1, A2, A3 needed) 2 means tidally influenced 3 means dam operated from Q vs H curve 4 means dam head and outflow determined from H vs t and Q vs t curves 5 means only dam head determined from H vs t curve 6 means only dam outflow determined from Q vs t curve</p>					
H3	I5	1-5	Code for the first controlled node	JGW(1)	none
	I5	6-10	Code for the second controlled node	JGW(2)	none
	:	:		:	:
	:	:		:	:
			Code for the last controlled node	JGW(NJGW)	none

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
[There will be NTRIB H4 data cards]					
H4	I5	1-5	Channel number of the Ith tributary channel	ITRIB(I,1)	none
Junction number of the first upstream node in the small tributary					
[Repeat this card for each junction]					
[Junction cards (maximum = 500)]					
19	H5	I5	Junction number	J	none
	F10.0	6-15	Water surface-elevation (m)	HEAD(J)	none
	F10.0	16-25	Surface area of junction (km^2)	AS(J)=SURF	none
	F10.0	26-35	Constant flow input to the junction (m^3/sec)	QIN(J)=QF1	none
	F10.0	36-45	Constant flow out of the junction (m^3/sec)	QOU(J)=QF2	none
	F10.0	46-55	Junction bottom elevation in m	DEP(J)=DT	none
	5X	56-60	Leave columns blank		
	H6	I5	1-5	To terminate junction cards, write 99999.	none

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
H7			<p style="text-align: center;">[Repeat this card group for each channel being simulated. (maximum = 600)]</p>		
	5I5	1-5	Channel number	N	none
		6-10	Junction at one end of channel	NTEMP(1)	none
		11-15	Junction at other end of channel	NTEMP(2)	none
	5F10.0	26-35	Length of channel (m)	ALEN	none
		36-45	Width of channel (m)	WIDTH	none
20		46-55	Average elevation of channel bottom (m)	RAD	none
		56-65	Manning's coefficient for the channel	COEF	0.018
		66-75	Initial velocity (m/sec)	VEL	0.0
H8	I5	1-5	To terminate channel cards, write 99999.		none

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
			<p>[Card group H9 is used to specify the time varying and/or constant data for the controlled nodes. The type of controlled node was specified on card group H3 above. There must be one set of H9 cards for each controlled node. The first set inputs the information for the first controlled node, the second set for the second controlled node, etc. The format of the H9 cards depends upon which type of controlled node has been specified. The formats are as follows:</p>		
			[WEIR TYPE (code = 1)]		
H9a	20A4	1-80	title card		
H9b	3F10.0	1-10 11-20 21-30	Weir coefficient Weir crest elevation, m Weir exponent	A0(1,J,1) A0(1,J,2) A0(1,J,3)	none none none
			[TIDALLY INFLUENCED NODE (code = 2)]		
H9a	20A4	1-80	title card		
H9b		2-6	Place \$CARD1 in columns 2-6.		
		7-72	K0 = (0 or 1, If 0 is used input is ignored. If 1 is used a full tidal cycle will be generated from only four points entered below), NI = (number of tidal stage data points), MAXIT = (Maximum number of iterations for curve fit, usually 50), TI = (list time points in hours separated by commas at which tidal heights will be specified), XY = (values of the tidal		

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
			<p>stage in meters separated by commas, which correspond to the time values, T₁T₂, listed above.)</p> <p>The \$CARD1 can consist of more than one card but all data and separating commas must be listed in any column between 2-72 on each card.</p>		
H9C		2-6	Place \$END in columns 2-5 to indicate the end of the data.	<p>[The formats for the remaining four types of controlled nodes are the same.]</p> <p>The rest of the controlled node types and the flow hydrograph inputs specify inputs which can be time varying functions. The following NAMELIST option is used for these inputs. For each variable the input format is one set of cards as follows:</p> <pre>Title card \$CARD1 \$END</pre>	<p>Columns 20-80 of the title card is used as a free field to identify the data. If the word CONST is placed in columns 2-6 of the title card then the \$CARD1 and \$END cards will not be used. Instead the number listed in columns 7-18 of the title card will be used as a constant value for the variable. If the input is to specify a time varying function (i.e. CONST does not appear in columns 2-6 of the title card) the \$CARD1 must be present and have the following form:</p>

Table 2. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
		Column 2-6	\$CARD1		
		Column 7-72	M = (number [integer] of data points used; maximum value = 20), MIN = (number [integer] giving minimum order of polynomial to be used to fit data), MAX = (number [integer] giving maximum order of polynomial to be used to fit data), X = (a list of time values separated by commas), Y = (a list of the values, separated by commas, of the function corresponding to the time values specified by X above)		
			The \$CARD1 can consist of more than one card but all data (including the separating commas) must be listed between columns 2-72 on each card.		
			[Q vs H Dam (code = 3)]		
H9a-c			NAMELIST Option	Values of flows and heads (the head corresponds to X = in the discussion above and the flow to Y =)	
H9b-c			NAMELIST Option	[H vs t and Q vs t Dam (code = 4)]	
H9a-c			NAMELIST Option	Values of head and times	
H9b-c			NAMELIST Option	[H vs t Dam (code = 5)]	
H9a-c			NAMELIST Option	Values of flow and times	
H9a-c			[Q vs t Dam (code = 6)]	Values of head and times	
H9a-c				Values of flow and times	

Table 2. (continued)

Data Group	Format	Columns	Description	Variable Name	Default Value
			[Hydrograph input cards. One set of H10 cards must be present for each input node, specified on card H2 above. The first set of hydrograph input cards is for the first input node above, the second for the second node, etc. The NAMELIST option is used on these cards and is discussed above.]		
H10			The values of flow (Y =) must be followed by the following variable: HYDEND = (time in seconds that designates end of hydrograph input)		
H10a	20AX	1-80	TITLE CARD		
H10b	NAMELIST Option 2-6 7-72		Place \$CARD1 in column 2-6 M = (number Integer of data point used), MIN = (number Integer giving minimum order of polynomial to be used to fit data. This number is disregarded by the program), MAX = (number Integer giving maximum order of polynomial to be used to fit data. This number is disregarded by the program) X = (a list of time values in hours, separated by commas), Y = (a list of flow rates in m ³ /sec, separated by commas)		
H11			Must contain all asterisks and is the terminator card for the hydrodynamic input deck.		

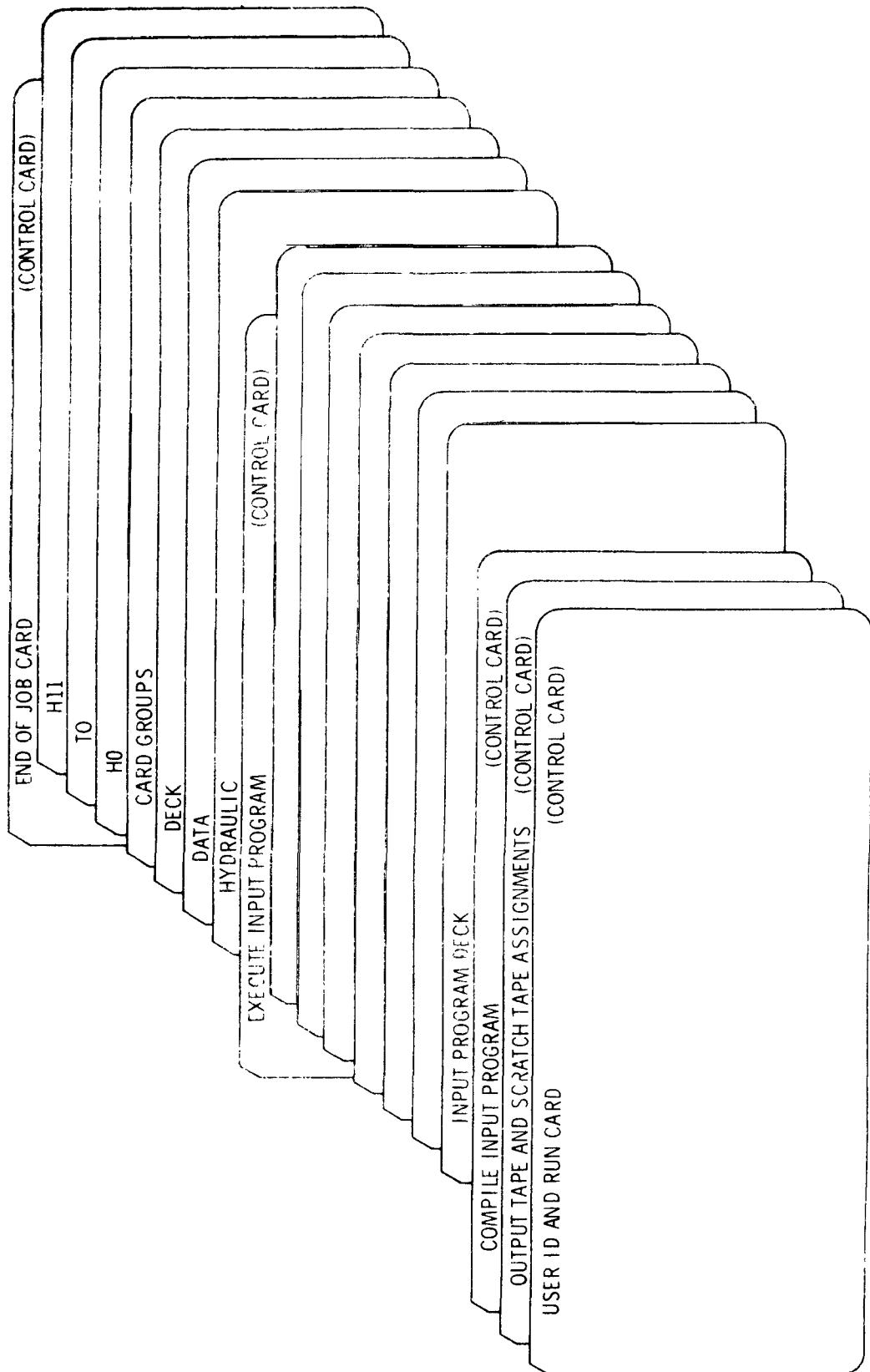


Figure 6. Sample data deck construction for executing the BNW EXPLORE-I hydraulic input code.

Table 3 and Figure 7 provide input specifications for the additional cards required for running and receiving output from the calculation code. No output is printed or plotted while the hydraulic code is running. As the program is run, a scratch file of the time history of the flows, velocities, heads, inflow, outflow, and volumes for all the junctions and channels is written to tape. These values are output once, as average values, for each quality time step. This scratch file begins with tidal day NQSWRT and is written through tidal day NTCYC. Since a hydraulic model of a river basin can produce voluminous output, the code has been set up to allow selection of junctions and channels in user-grouped and labeled sets of 20 or less for print and/or lineprinter plot output. Any particular or continuous set of 7 or less simulated tidal days starting with tidal day NQSWRT can be specified. Limiting the output to groups of 20 or fewer junctions and channels will prevent production of unwanted volumes of printout. However, since at times the user may want printout for more than 20 junctions and channels, as many groups of 20 or less as are needed may be requested. An advantage of this method is that the output can be ordered into reaches or tributaries.

Data card group P1 allows the user to request the punching of a restart hydraulic deck. The restart deck includes the H group of data cards, with revised values for the initial water surface elevations of the junctions and for the initial channel velocities.

Figures 8 and 9 provide an example application of the hydraulic component of EXPLORE-I to Four Mile and Wolf Creeks in Iowa. For this case, EXPLORE-I was run by a UNIVAC 1100 computer. Figure 8 is a stick diagram of the physical layout of the system. Figure 9 is an annotated listing of the input data used in this application and described in Tables 2 and 3. As can be seen from Figures 8 and 9, junction 1 and associated channel 1 are the downstream controls, with the control being a dam with a constant head of 1.0 m (option 5). Junctions 2 and 26 have constant inflows; a hydrograph input exists at junction 14. The simulation runs for 2 days (NTCYC = 2). Printed output will be obtainable for each hour of the two days output values and plots for all 57 junctions and channels. The accuracy of the input data for the initial channel velocities indicates that the listed input is the result of a restart deck.

PROGRAMMING INFORMATION

This section describes the two separate executable programs - the input code and the calculation code - which constitute the hydraulic module of EXPLORE-I. Figure 10 shows the relationship of these programs, which must be executed in sequence. A

Table 3. Control Cards for Requesting Punch, Print and Plot Output
From Hydraulic Calculation Code

Card Group	Format	Columns	Description	Variable Name	Default Value
P1	I5	1-5	Switch to request the punching of a restart deck. IDECK Any number other than 0 causes a restart deck to be punched.		none
P2	20A4	1-80	Descriptive title for the group of junction and channel data to be printed and/or plotted	RUNTR(I) I=1, 20	
P3	2I10	1-10	The number of tidal day where printing and/or plotting will commence (NQSWRT \leq IDAYL \leq IDAY1)	IDAY1	none
27		11-20	The number of the last tidal day to be printed and/or plotted (note IDAY1 - IDAYL is limited to be \leq 7) (NQSWRT \leq IDAYL \leq NTCYC)	IDAYL	none
P4	I10	1-10	The number of junctions for which print and/or plot information is requested (\leq 20)	NJP	none
P5	20I5	1-4 5-8 9-12 . . . 76-80	Array of NJP junction numbers for which printout is desired (the junction printout will be in the order dictated by this array)	NJW(1) NJW(2) NJW(3) . . . NJW(20)	none

Table 3. (continued)

Card Group	Format	Columns	Description	Variable Name	Default Value
P6	I10	1-10	The number of channels for which print and/or plot information is requested (≤ 20)	NCP	none
P7	20I4	1-4 5-8 9-12 • • • 77-80	Array of NCP channel numbers for which print and/or plot information is desired (The channel printout will be in the order dictated by this array.)	NCW(1) NCW(2) NCW(3) • • • NCW(20)	none
P8	I5	1-5	Switch to request plots for the channel flows and junction heads (NPLOTS = 0, then suppress the plots)	NPLOTS	none

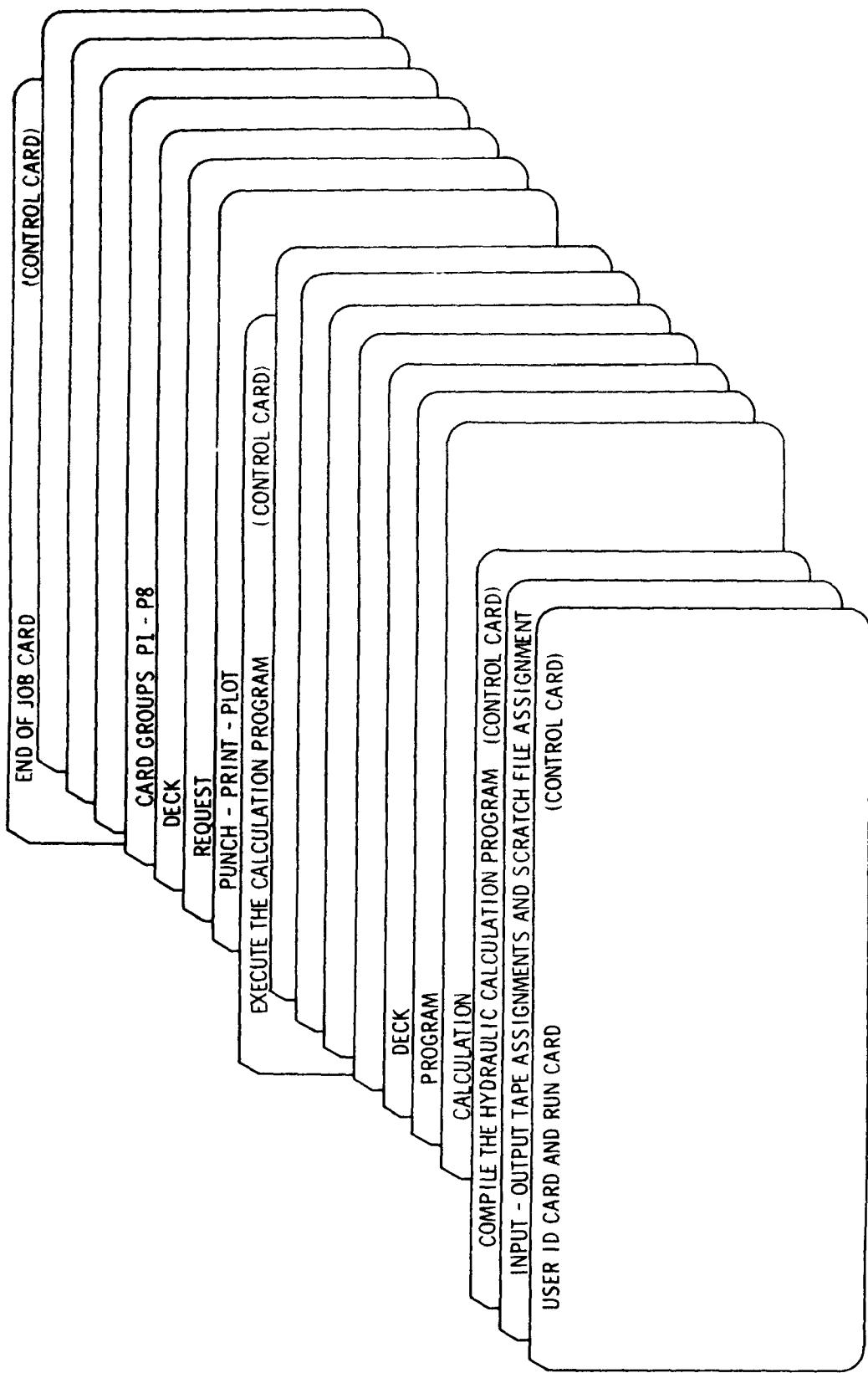


Figure 7. Sample data deck construction for executing the BNW EXPLORE-I hydraulic calculation code.

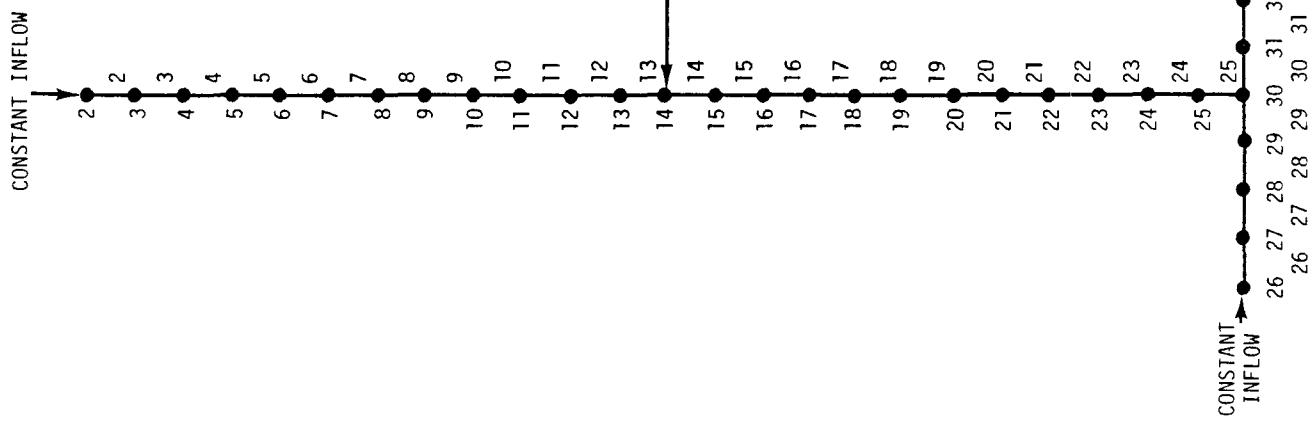


Figure 8. Layout of example system.

Computer
dependent
control
cards

USER RUN AND ID CARD
ASSIGN UNIT 1 TO A SCRATCH FILE OR SCRATCH TAPE

The hydraulic input
code and hydraulic
calculation code require
these unit assignments

ASSIGN UNIT 2 TO A PERMANENT FILE OR USER OWNED OR RENTED TAPE
(THE HYDRAULIC OUTPUT FOR THE QUALITY CODE WILL BE STORED ON UNIT 2)
cards
UNIT 5 IS THE CARD READER
UNIT 6 IS THE LINE PRINTER

COMPILE THE INPUT PROGRAM

FORTRAN CARD DECK OF THE HYDRAULIC INPUT CODE

Computer
Control Card
EXECUTE THE INPUT PROGRAM

Card Group	Four Mile and Wolf Creek System 1973, Sept 21 and 22	•00	•00	•00	•00	•00	•00	•00	•00	•00	•00	JUNCTION CARDS
H1	2 24. 1. 100.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
H2	14											
H3	5											
H4	25	•08829	•00	•00	•00	•00	•00	•00	•00	•00	•00	
H5	1 1. 000	•00564	2.00	•00	•00	•00	•00	•00	•00	•00	•00	64.00
	2 64.698	•00575	•00	•00	•00	•00	•00	•00	•00	•00	•00	62.93
	3 63.622	•00587	•00	•00	•00	•00	•00	•00	•00	•00	•00	61.87
	4 62.548	•00598	•00	•00	•00	•00	•00	•00	•00	•00	•00	60.80
	5 61.473	•00609	•00	•00	•00	•00	•00	•00	•00	•00	•00	59.73
	6 60.398	•00620	•00	•00	•00	•00	•00	•00	•00	•00	•00	58.67
	7 59.324	•00632	•00	•00	•00	•00	•00	•00	•00	•00	•00	57.60
	8 58.250	•00643	•00	•00	•00	•00	•00	•00	•00	•00	•00	56.53
	9 57.176	•00654	•00	•00	•00	•00	•00	•00	•00	•00	•00	55.46
	10 56.103	•00665	•00	•00	•00	•00	•00	•00	•00	•00	•00	54.40
	11 55.029	•00677	•00	•00	•00	•00	•00	•00	•00	•00	•00	53.33
	12 53.950											

Figure 9. Listing of sample input data deck for hydraulic code.

13	52.882	.00	52.26
14	51.811	.00	51.20
15	50.736	.00	50.13
16	49.668	.00	49.06
17	48.586	.00	48.00
18	47.532	.00	46.93
19	46.424	.00	45.86
20	45.421	.00	44.79
21	44.219	.00	43.73
22	43.417	.00	42.66
23	43.343	.00	41.59
24	43.333	.00	40.53
25	39.752	.00	39.46
26	44.519	.00	43.88
27	43.108	.00	42.51
28	41.807	.00	41.13
29	40.317	.00	39.76
30	39.156	.00	38.39
31	37.764	.00	37.02
32	36.373	.00	35.65
33	34.983	.00	34.28
34	33.595	.00	32.91
35	32.206	.00	31.54
36	30.820	.00	30.17
37	29.435	.00	28.80
38	28.051	.00	27.42
39	26.666	.00	26.05
40	25.282	.00	24.68
41	23.898	.00	23.31
42	22.519	.00	21.94
43	21.137	.00	20.57
44	19.757	.00	19.20
45	18.376	.00	17.82
46	16.999	.00	16.45
47	15.618	.00	15.08
48	14.245	.00	13.71
49	12.860	.00	12.34
50	11.497	.00	10.97
51	10.114	.00	9.60
52	8.778	.00	8.23
53	7.367	.00	6.86
54	6.081	.00	5.48
55	4.591	.00	4.11
56	3.435	.00	2.74
57	1.733	.00	1.37
H6	99999	2414.0000	.0000
H7	1 0 1	36.5760	.0400
	2 2 3	8.04.7000	.0700
	3 3 4	7.0800	.4085
		8.04.7000	.0700
		7.2200	.4053

CHANNEL CARDS

Figure 9. (continued)

Figure 9. (continued)

Constant head controlled no
Hydrograph input

```
H9a    CONSTITUTED INFLOW 1.0
H10a   M=19,MIN=6,MAX=6
      NCARD1
      X=0.1 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0
      Y=.436,3.,26.,11.,941.,17.,728.,20.,786.,16.,011.,1.,306.,1.,084.,1.,013.,,948.,,886.,
      •829.,,776.,,725.,,678.,,634.,,593.,,554.,,0.,HYDEND=68400.
C      $END
*****
```

Computer
Control Card

FORTRAN (,5,2) DEC OF THE HYDROGRAPH CALCULATION CARTE

34

Computer
Control Card

EXECUTE THE CALCULATION PROGRAM

P1	0	FOUR MILE CREEK AND WOLF CREEK	
P2	1	7	
P3	20		
P4	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		
P5	1 20		
P6	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		
P7	1		
P8	1		
		FOUR MILE CREEK AND WOLF CREEK	
	1	7	
	20		
	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40		
	20		
	21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40		
	1		
	1		
	17		
	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57		
	17		
	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57		
COMPUTER			
CONTROL CARD			
END OF RUN			

Figure 9. (continued)

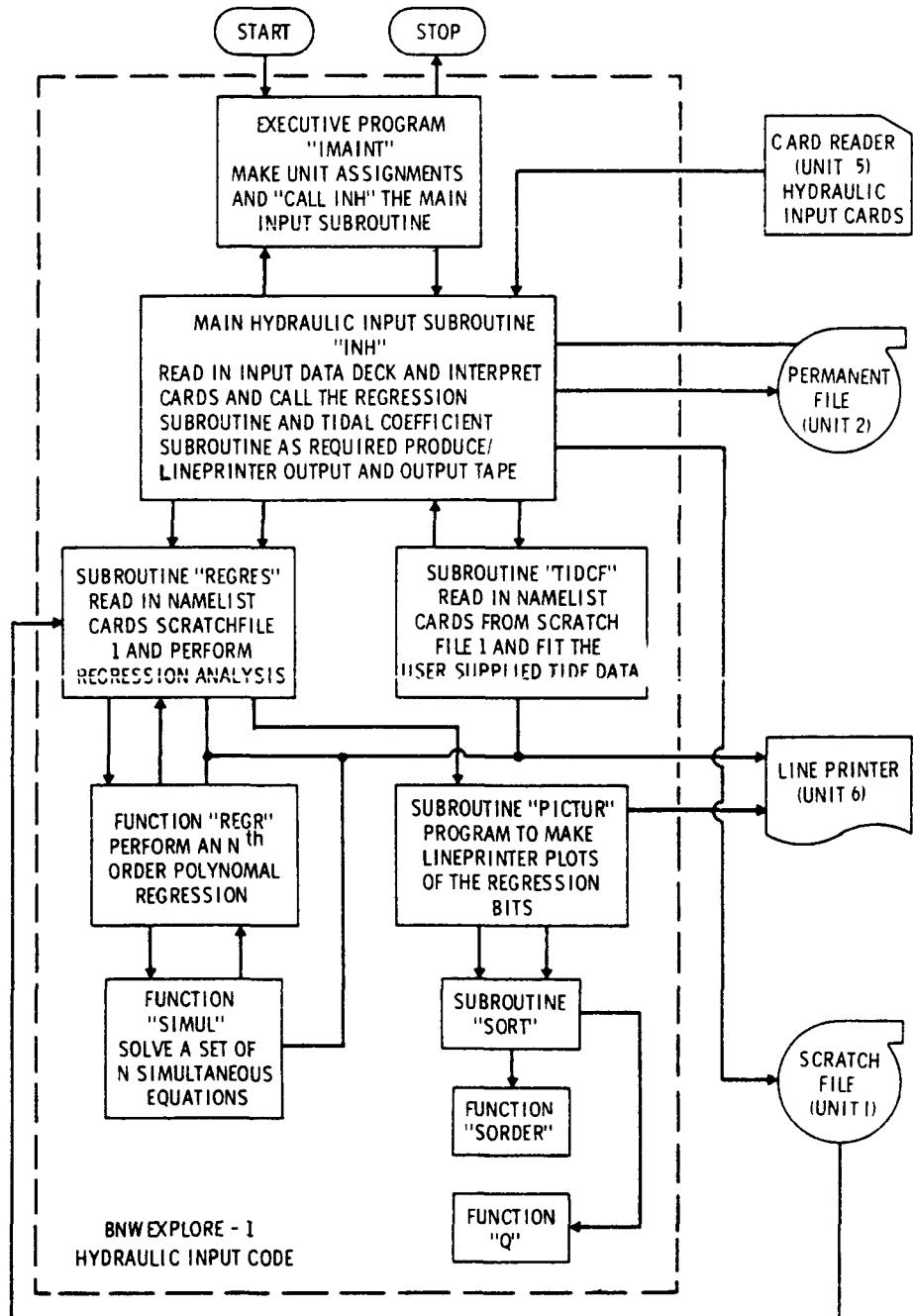


Figure 10. Relationship of the hydraulic input, calculation and output codes.

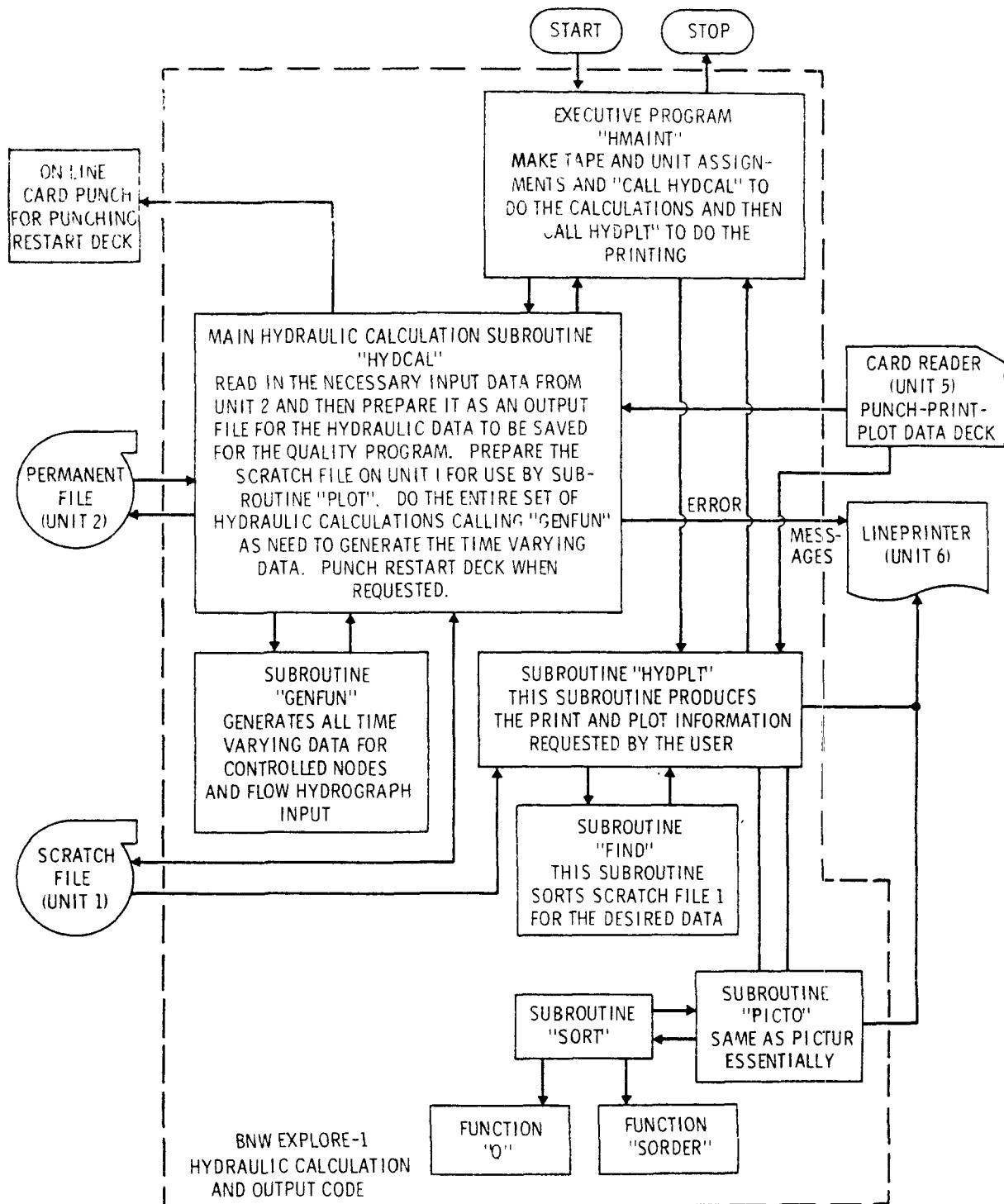


Figure 10. (continued).

listing of the two codes may be found in Appendix A. The variables used in the hydraulic program and their definitions are given in Table 4.

Hydraulic Input Program (IMAIN) Description

The executive program is MAIN (formerly IMAINT). This program serves only to make I/O device assignments and to call the main input subroutine INH. Subroutine INH reads in the input data necessary for the hydraulic calculations. INH calls subroutine TIDE (formerly TIDCF) when a fit of the stage versus time data is required and subroutine REGRES when it is necessary to fit time varying data on controlled nodes or flow hydrographs. Figure 11 shows a flow chart for subroutine INH.

Subroutine REGRES is a standard polynomial regression program taken from Reference 6. This program reads in an array of M ordered data points and does a user-specified set of Nth order polynomial regressions ($1 \leq N \leq 9$). In each case print and plot data indicating the quality of the fit are produced. REGRES calls on functions REGR and SIMUL for the regressions and on subroutine PICTUR for the line-printer plots. Details of this subroutine can be found in Reference 6.

Subroutine TIDE calculates the coefficients of the tidal function $H(t) = A_1 + A_2 \sin(t) + A_3 \sin(2t) + A_4 \sin(3t) + A_5 \cos(t) + A_6 \cos(2t) + A_7 \cos(3t)$ from input values of H and T by a least squares procedure. Figure 12 is a flow chart of TIDE.

Subroutine PICTUR prepares a lineprinter plot of a set of N data points. Figure 13 shows a flow chart of PICTUR. This subroutine uses subroutine SORT and functions SORDER and Q to sort the plot points according to descending values of Y.

Hydraulic Calculations Program (HMAINT) Description

Executive Program MAIN (formerly HMAINT) serves only to make I/O device assignments and to call the calculation subroutine HYDCAL and the print-plot program HYDPLT.

Subroutine HYDCAL, the hydraulic calculation program, receives its input data from tape unit 2 and carries out the hydraulic computations. HYDCAL calls subroutine GENFUN as required to generate all time varying input functions and to solve the weir formula. Figure 14 shows a flow diagram of HYDCAL.

Subroutine GENFUN, a flow diagram of which is shown in Figure 15, is used to solve the weir formula and to generate the functional values of all input variables which were fit via polynomial regression.

Table 4. Variable Definition for Hydraulic Code

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
A(500)	C	Channel cross-section area at start of time-step (HYDCAL,INH)
AK(600)	C	Modified friction factor (HYDCAL,INH)
ALPHA(30)	C	Title for printing (HYDCAL,INH)
ALEN		Channel length (INH)
ARRAY(33)		Dummy array used in printing (HYDCAL,INH)
AREA		Computed nodal area to find initial nodal volume (HYDCAL)
AS(500)	C	Node surface area (HYDCAL,INH)
AT(600)	C	Channel cross-section at midpoint of time-step (HYDCAL,INH)
A(3,20,10)	C	Array used to store the regression coefficients and wier constants (HYDCAL,INH)
ATEMP(10)		Variable to pass the regression constants (INH)
ASTERK		Variable containing asterisk (HYDCAL,INH)
ATOT		Total surface area of receiving water (INH)
ASTER		Variable containing asterisk
A1 A2 A3 A4 A5 A6 A7	{	Coefficients of the expression $H(WT) = A + A2*\cos(WT) + A3*\cos(2WT)$ $+ A4*\cos(3WT) + A5*\sin(WT)$ $+ A6*\sin(2WT) + A7*\sin(3WT)$ $+ A8*\sin(4WT)$ for tidal input

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
B(600)	C	Channel width (HYDCAL, INH)
BLANK		Variable containing blank (INH)
COEF		Manning's coefficient for channel (INH)
DEL		Temporary variable
{DELH } {DELHH}		Increment of head of a junction for a time-step (HYDCAL)
DELMAX		Maximum difference between the calculated and stage input
DELTA		Maximum allowable difference between the calculated and input tidal stage
DELT	C	Time-step increment (HYDCAL, INH)
DELTH		Temporary variable (HYDCAL)
DELTQ	C	Length of quality time-step (usually an hour); (HYDCAL, INH)
DELT2		1/2 time-step increment (HYDCAL)
{DELV1} {DELV2}		Component of velocity change during a time-step (HYDCAL)
DEP(500)	C	Depth of water of a junction at zero datum (HYDCAL, INH)
DEPTH		Computed depth of node at a junction for initial volume (HYDCAL)
DIFF		Difference between the calculated and input tidal stage
DT		Junction depth (INH)
DVOL		Volume change in a time-step (HYDCAL)
EVAP	C	Evaporation rate for whole system converted from ft/mo (HYDCAL, INH)
EWIND(600)	C	Drag force due to wind (HYDCAL, INH)

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
FJ1		Internal variable
FJ3		Internal variable
H(500)	C	Head at junction at beginning of time-step (HYDCAL, INH)
HAVE(500)	C	Junction average head during a daily cycle (HYDCAL)
HBAR(500)	C	Junction average head during a quality cycle (HYDCAL)
HEAD		Distance water surface is from datum plane (INH)
HN(500)	C	Junction head at end of time-step (HYDCAL)
HOUR		Time-hours
HYDRAD(600)	C	Hydraulic radius (INH)
HT(500)	C	Junction head at end of 1/2 time-step (HYDCAL)
IDELT		Length of hydraulic cycle (integration step) (INH)
IDECK		Switch variable to request restart deck be punched (HYDCAL)
I II IHJN IL IJK IJN	{	Index numbers (HYDCAL, INH)
IFLAG		Variable to indicate small tributary channel (INH)
IPERID		Length of tidal cycle (INH)
IPOINT(500,6)	C	Pointer array containing node to node connections (HYDCAL, INH)
IQINT		Length of quality cycle (INH)
IT		Iteration counter

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
ITRIB(50,2)	C	Array containing the channel numbers of the small tributary channels and also the associated junction numbers (HYDCAL,INH)
J		Index variable (HYDCAL,INH)
JGW(20)	C	Array indicating the type of controlled node I is (HYDCAL,INH)
JSW(20)	C	Array of junction numbers which have time varying flow input (HYDCAL,INH)
K		Index variable (HYDCAL,INH)
KO		Switch to cause generation of a full tide from HHW, LLW, HLW, LHW
LEN(600)	C	Channel length (HYDCAL,INH)
M		Index variable (HYDCAL,INH)
MAXIT		Maximum number of iterations in tidal curve fit, usually 50
N		Index variable (HYDCAL,INH)
NC	C	Number of channels (HYDCAL,INH)
NCHAN(500,6)	C	Channels associated with nodes (HYDCAL,INH)
NCLOS(600)	C	If equal to 1 channel dry, otherwise no effect (INH,HYDCAL)
NDRY		Number of dry junctions (HYDCAL)
NEXIT	C	Set equal to 1 when error condition exists (HYDCAL,INH)
NH		Node at channel end (HYDCAL)
NHH		Hydraulic cycle counter (HYDCAL)
NHCYC	C	Number of time-steps per quality cycle (HYDCAL,INH)
NI		Number of tidal input values
NINT		Number of hydraulic cycles per tidal cycle (INH)

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
NJGW	C	Number of controlled nodes (HYDCAL, INH)
NJ	C	Number of junctions (HYDCAL, INH)
NJ2		Temporary variables
NJGW1		NJGW+1 (HYDCAL)
NJSW	C	Number of junctions with time varying flow hydrograph input (HYDCAL, INH)
NJUNC(600,2)	C	Nodes at channel ends (HYDCAL, INH)
NL		Node at channel end (HYDCAL)
NQ		Quality cycle counter (HYDCAL)
NQCYC	C	Number of quality cycles per day (HYDCAL, INH)
NQSWRT	C	Number of daily cycles at which printing will start (HYDCAL, INH)
NT	C	Daily cycle number (HYDCAL, INH)
NTCYC	C	Number of daily cycles to be simulated (HYDCAL, INH)
NTEMP(6)	C	Temporary array of channels entering a node (HYDCAL, INH)
NTIMS		Number of times through drying up connection (HYDCAL)
NTRIB	C	Number of small tributary channels (HYDCAL, INH)
NTT		Temporary variables
NX		Temporary variable (HYDCAL)
N5	C	Card reader of equivalent (HYDCAL, INH)
N6	C	Lineprinter (HYDCAL, INH)
N7	C	(Fake printer) scratch file or permanent file (INH)
N20	C	Hydraulic input and output file (HYDCAL, INH)

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
N22	C	Scratch file (equal to N20 in HYDCAL)
N24	C	Scratch file
PERIOD	C	Period in hours of daily cycle (HYDCAL, INH, TIDCF)
Q(600)	C	Channel flow (HYDCAL, INH)
QAVE(600)	C	Daily cycle average flow (HYDCAL)
QBAR(600)	C	Quality cycle average flow (HYDCAL)
QF1		Temporary storage for junction inflow (INH)
QF2		Temporary storage for junction outflow (INH)
QIN(500)	C	Inflows to junctions (HYDCAL, INH)
QUINBAR(500)	C	Quality cycle average junction inflow (HYDCAL)
QINST(20)	C	Array for storing the constant inflow at junctions with flow hydrograph input (HYDCAL)
QUINT	C	Quality time-step interval (HYDCAL, INH)
QJ2		Temporary variable (HYDCAL)
QOU(500)	C	Outflow from junction (HYDCAL, INH)
QOUBAR(500)	C	Quality cycle average junction outflow (HYDCAL, INH)
R1(600)	C	Hydraulic radius (HYDCAL, INH)
RAD		Channel depth measured from datum (HYDCAL, INH)
RES		Accumulative difference between the calculated and input tidal stage
RNT		Temporary hydraulic radius at 1/2 time-step (HYDCAL)
SURF		Temporary storage for junction surface area (HYDCAL)

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
SUM		Computed tidal stage
SUMQ		Total flow leaving junction (HYDCAL)
{SXX(10,10)} SXY(10)}		Matrix used for least square tidal fit Vector used for least square tidal fit
TITLE(33)		Title array read from cards
T		Time counter for whole analysis (HYDCAL)
TT(50)		Time from start of storm of input for tidal condition and from hydrograph file
T2		$T + 1/2 \Delta t$ (HYDCAL)
TEMP		Simplifying variable used during solution of velocities (HYDCAL)
TF		Estimate maximum time-step for channel (INH)
TIME		Time counter for time varying input
TIM2		Time + $1/2 \Delta t$
TRBDEP(50)	C	Small tributary channels mid- point depth measured from datum (HYDCAL, INH)
VEL		Temporary storage of velocity (INH)
V(600)	C	Channel velocity at start of time-step (HYDCAL, INH)
VBAR(600)	C	Average velocity during quality cycle (HYDCAL)
VOL(500)	C	Nodal volume (HYDCAL, INH)
VOLUME		Initial nodal volume (HYDCAL)

Table 4. (continued)

<u>Variable Name</u>	<u>Location</u>	<u>Description</u>
VT(600)	C	Channel velocity at 1/2 time-step (HYDCAL)
V2		Velocity during a half hydraulic time-step (HYDCAL)
W	C	Fundamental frequency of daily tidal variation (HYDCAL, INH)
WDIR	C	Wind direction in degrees from north (HYDCAL, INH)
WIDTH		Width of channel (INH)
WIND	C	Wind force (HYDCAL, INH)
X(J)	C	X coordinate of junctions (HYDCAL, INH)
X1		Temporary storage x coordinate (INH)
XMK		Blank or asterisk depending on whether estimated maximum time-step is satisfied (INH)
XX(10)		Vector used in least square tidal fit
Y(J)	C	Y coordinate of junctions (HYDCAL, INH)
Y1		Temporary storage for y coordinate (INH)

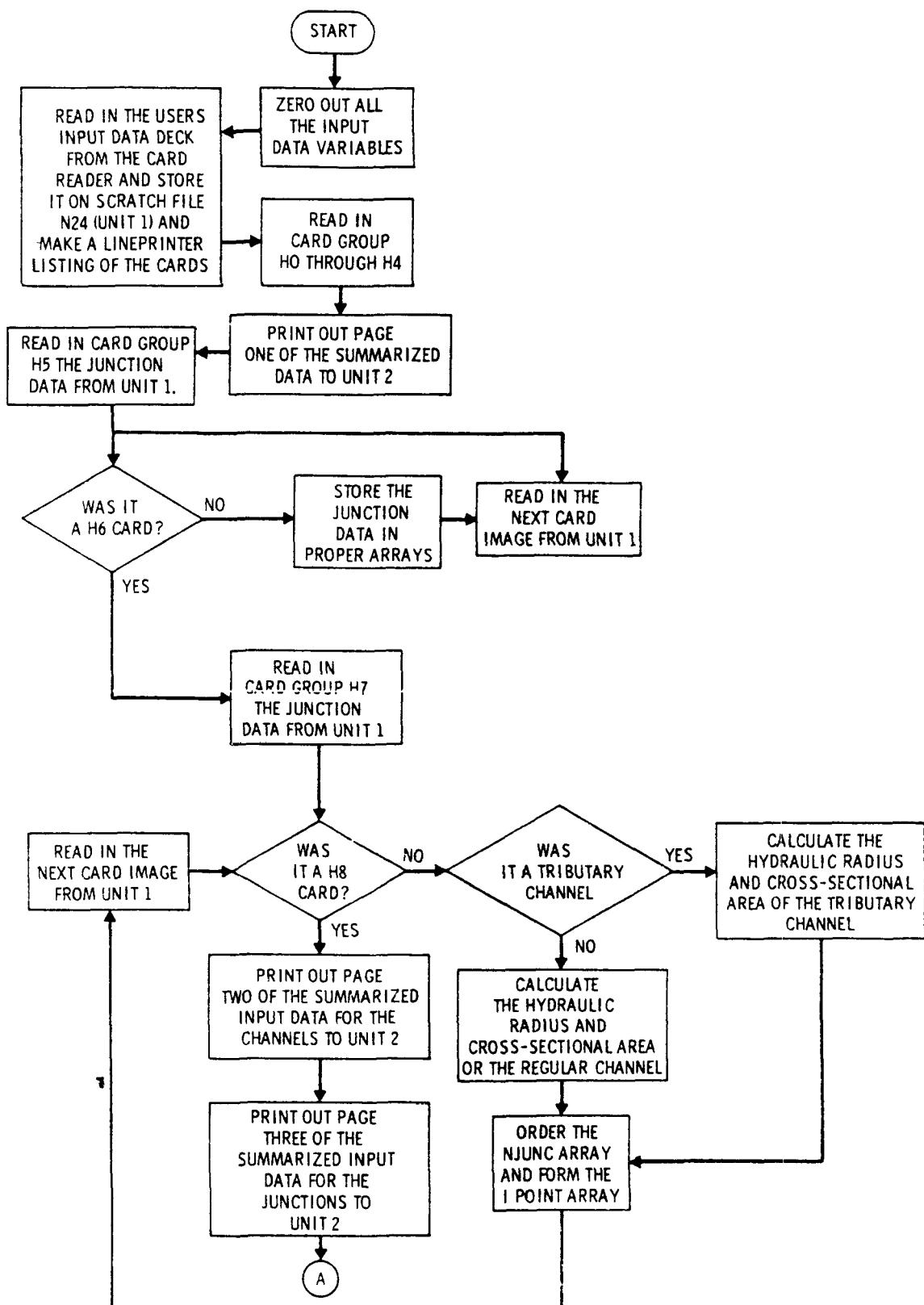


Figure 11. Flow chart of subroutine INH.

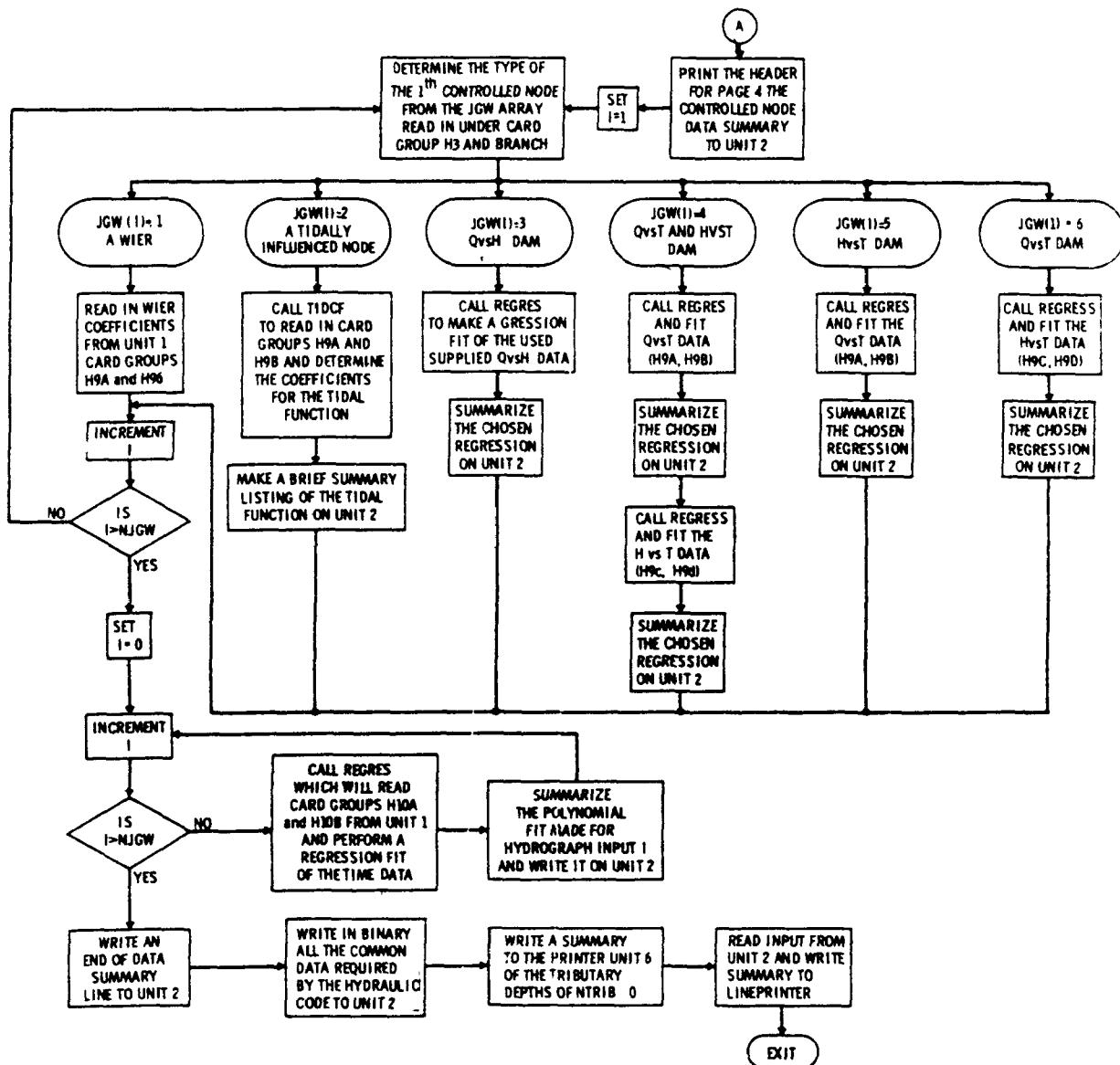


Figure 11. (continued).

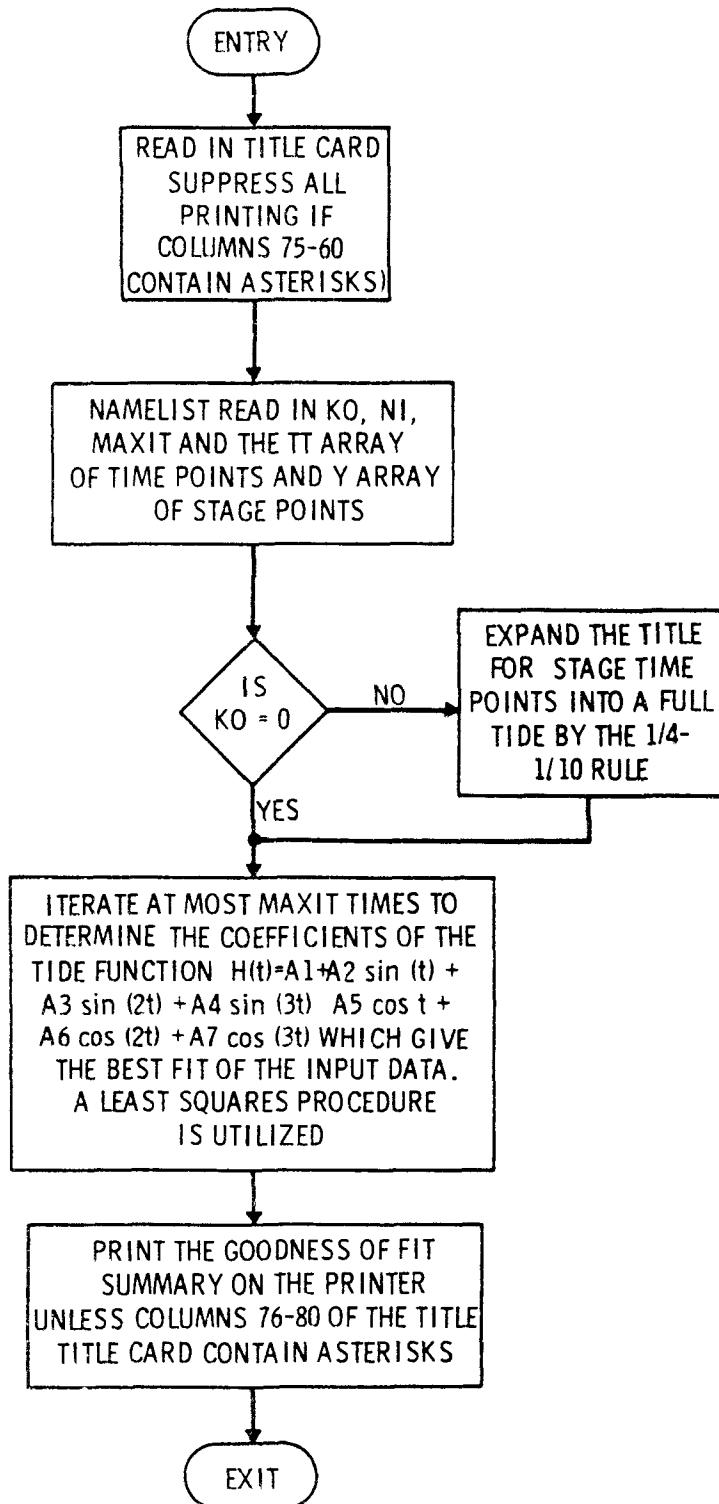


Figure 12. Flow chart of TIDE.

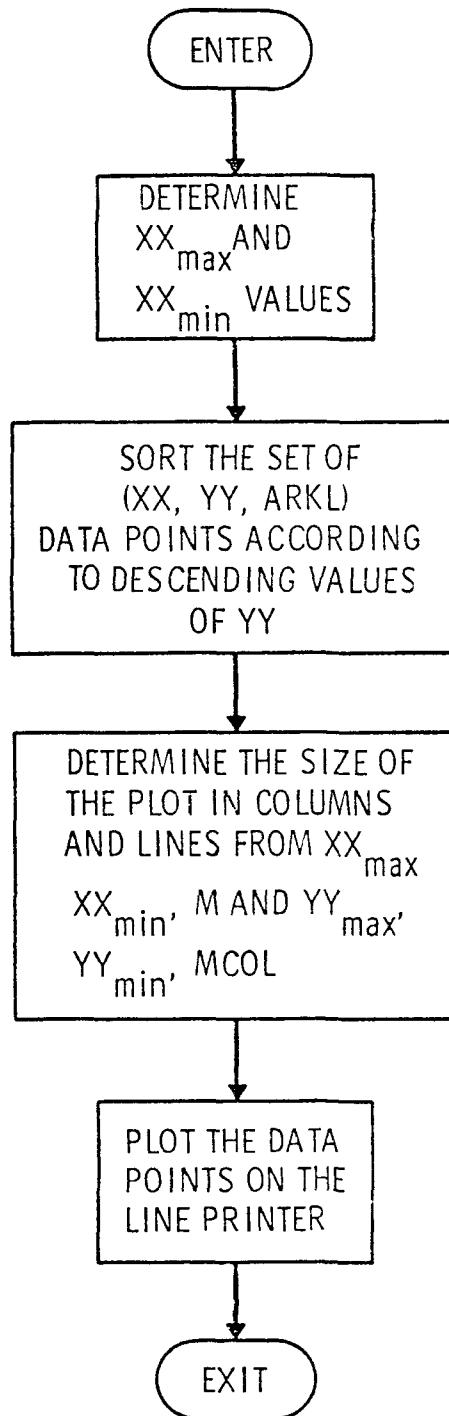


Figure 13. Flow chart of subroutine PICTUR.

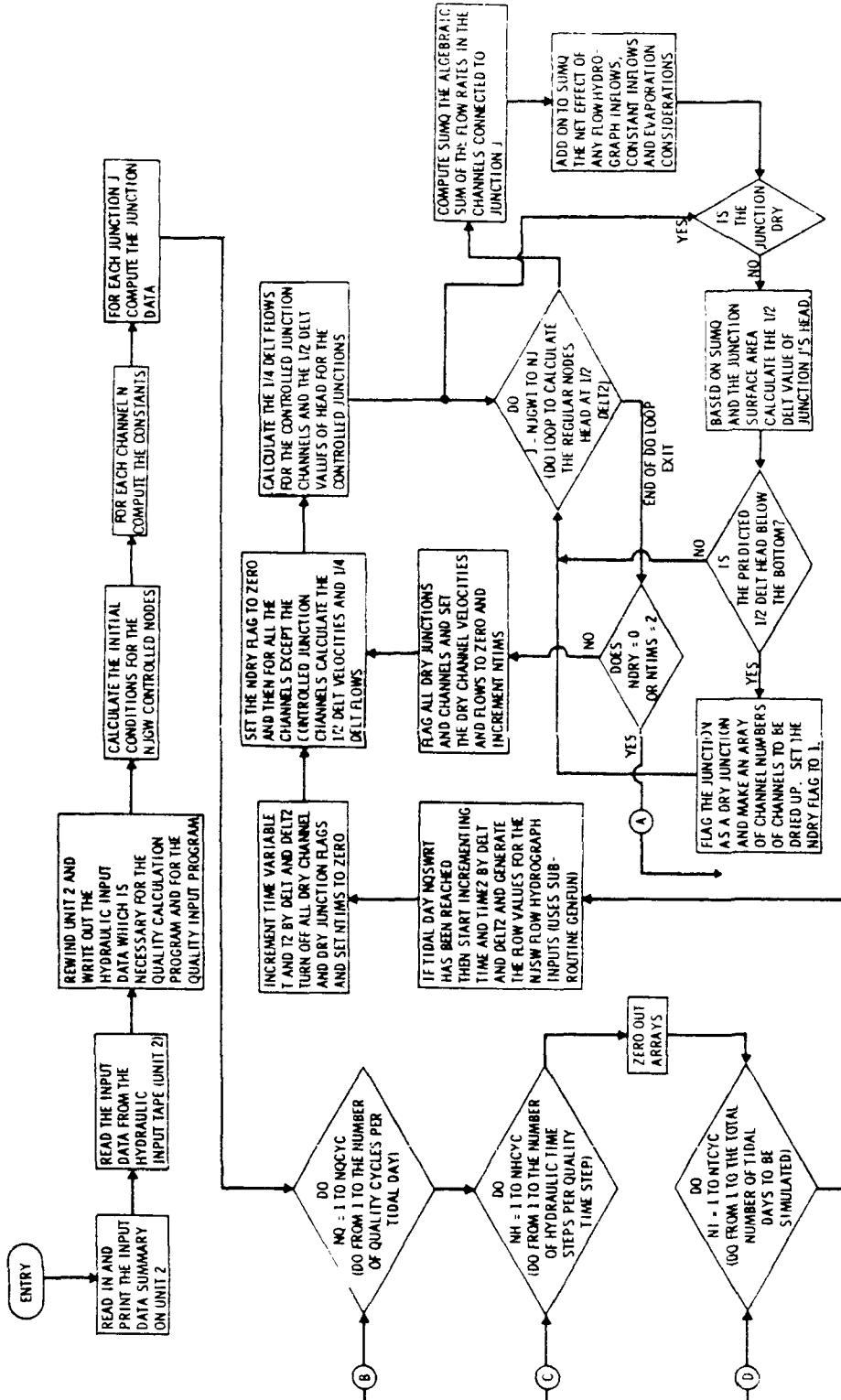


Figure 14. Flow chart of subroutine HYDCAL.

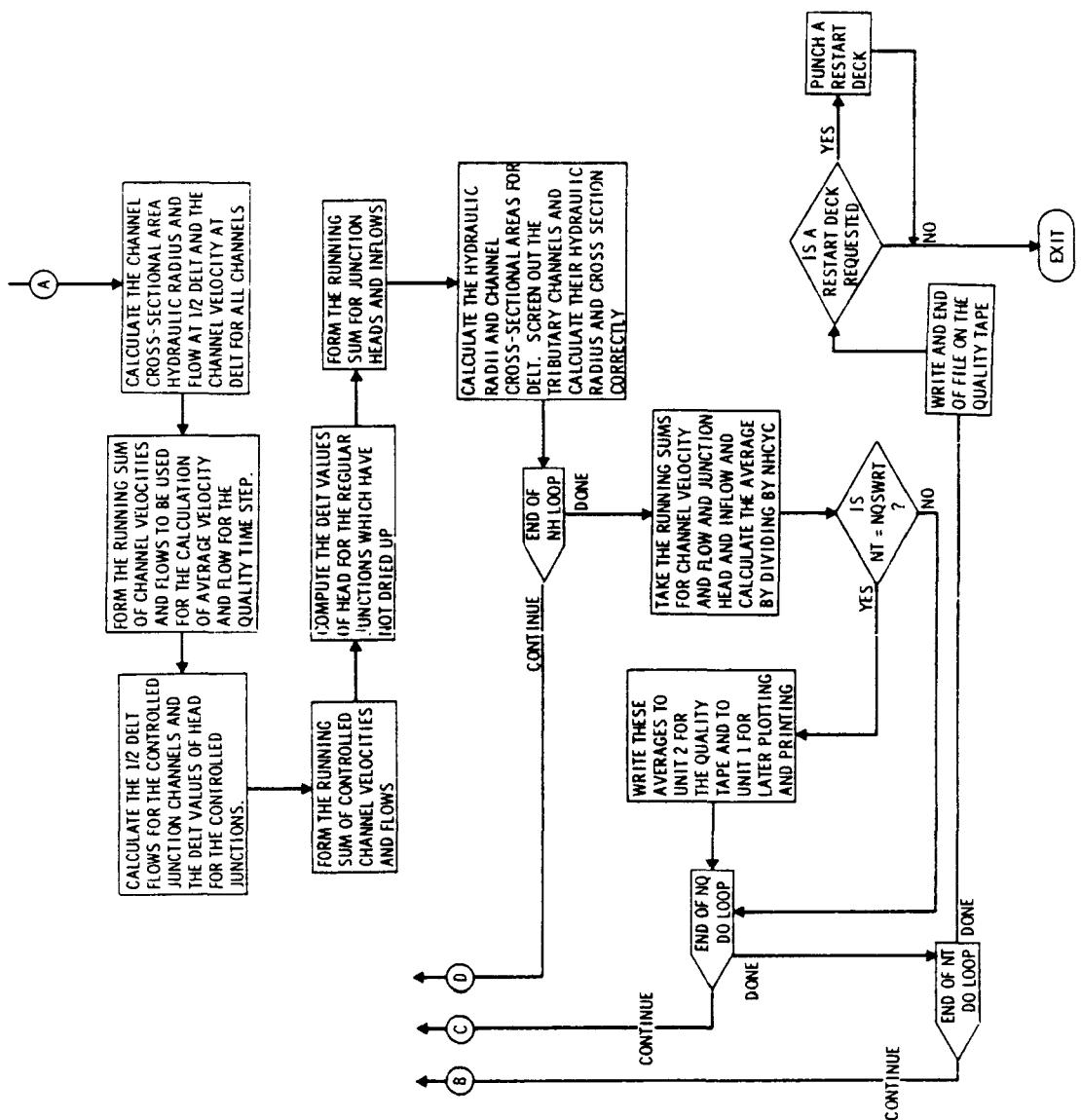


Figure 14. (continued).

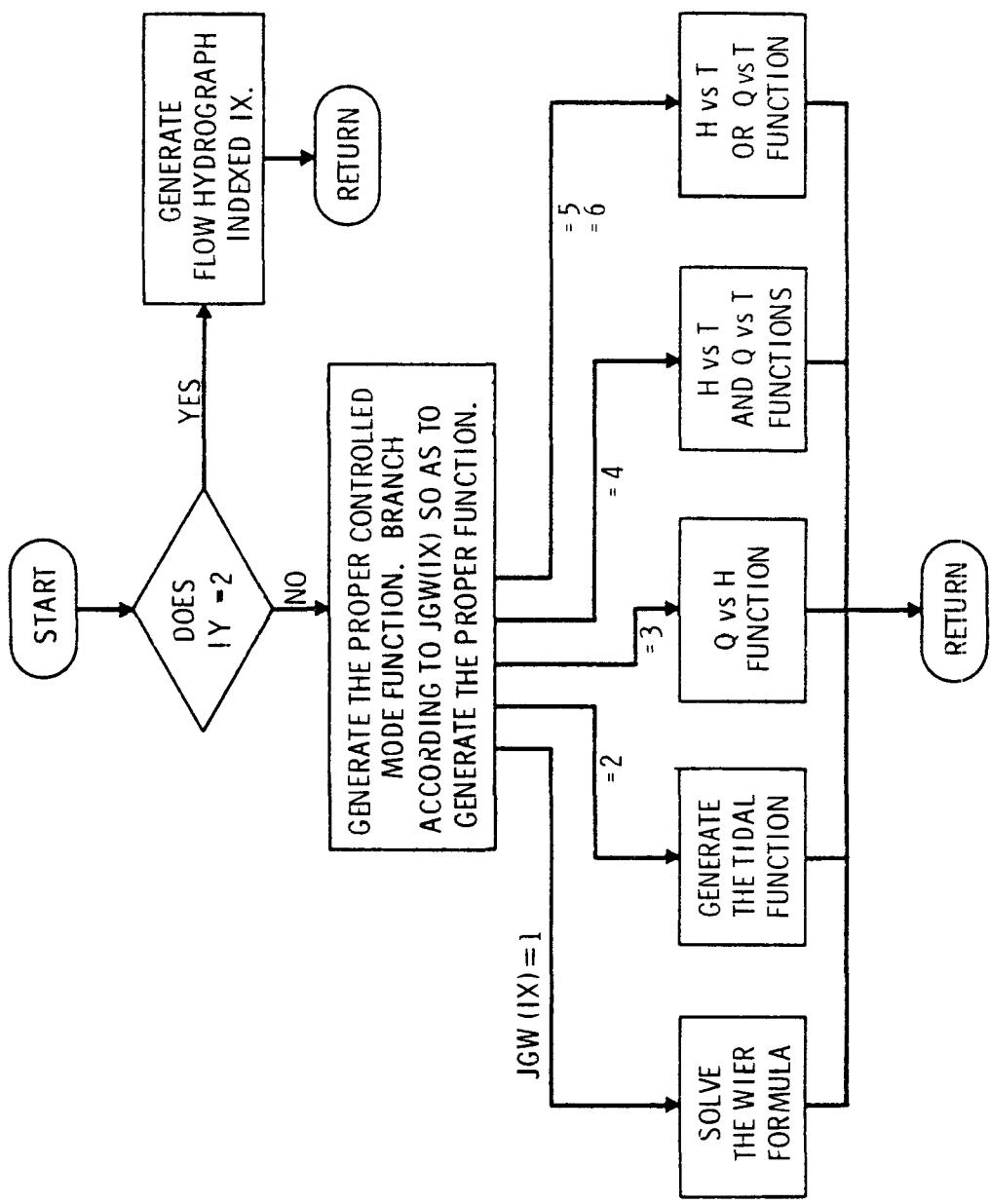


Figure 15. Flow diagram of subroutine GENFUN.

Subroutine HYDPLT is used to print out the hydraulic information calculated by HYDCAL for the user-requested sets of junctions and channels. Figure 16 is a flow diagram of subroutine HYDPLT. The plotting program PICTO used by HYDPLT is identical to PICTUR, except that titles are printed on the plots and a check insures that the data plotted covers 75% or more of the X axis.

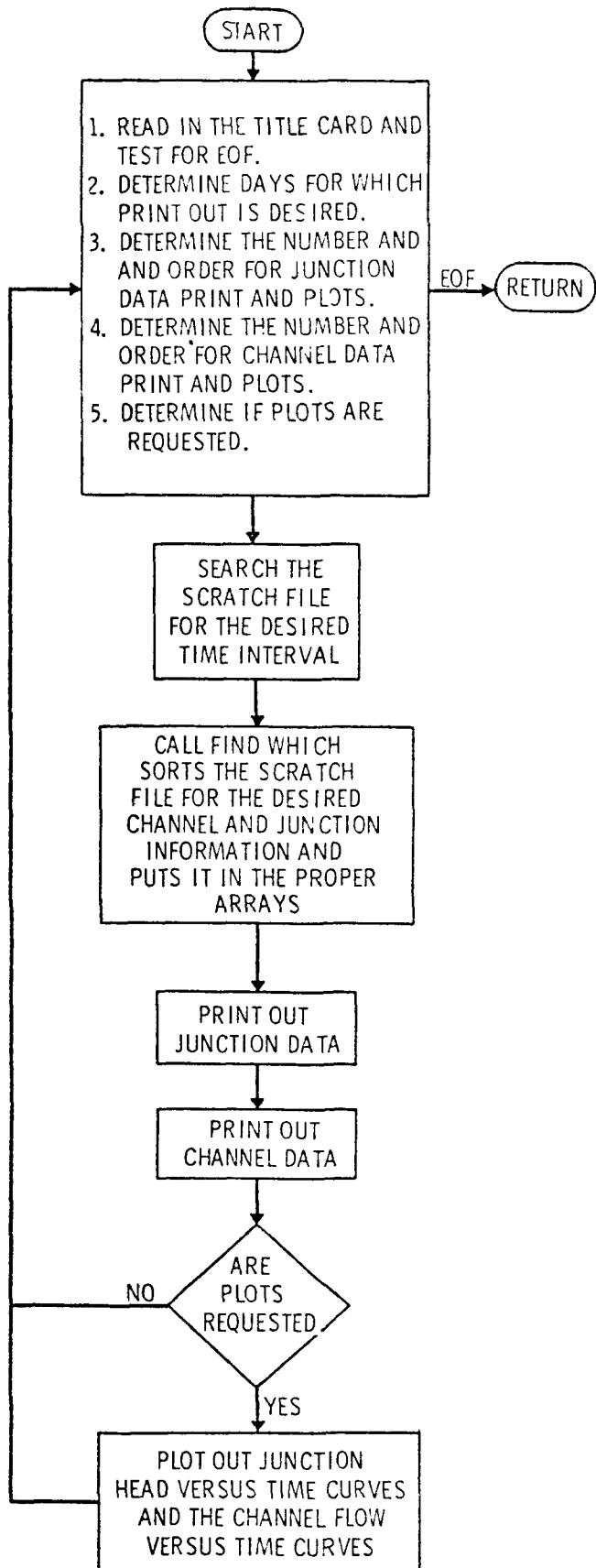


Figure 16. Flow diagram of subroutine HYDPLT

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2. Baca, R. G., W. W. Waddel, C. R. Cole, A. Brandstetter, and D. B. Gearlock. Appendix B. User's Manual for EXPLORE-I: A River Basin Water Quality Model, Prepared for the Environmental Protection Agency, Battelle, Pacific Northwest Laboratories, Richland, WA, August 1973b.
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4. Metcalf and Eddy, Inc. "Storm Water Management Model." Palo Alto, CA, Prepared as EPA Report No. 11024DOC08/71, August 1971.
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APPENDIX A
LISTING OF THE EXPLORE-I HYDRAULIC CODE

Hydraulic Input Computer Program
IMAIN

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***** GAUSS *****

ROUTINE IMANT.GAUSS

```
000001      000      SUBROUTINE GAUSS (A,X)
000002      000      C   THIS ROUTINE IS CALLED BY TIDE
000003      000      DIMENSION A(8,9),X(8)
000004      000      N=8
000005      000      M=9
000006      000      L=7
000007      000      DO 12 K=1,L
000008      000      JJ=K
000009      000      BIG=ARS(A(K,K))
000010      000      KP1=K+1
000011      000      C   SEARCH FOR LARGEST PIVOT ELEMENT
000012      000      DO 7 I=KP1,N
000013      000      AB=ARS(A(I,K))
000014      000      IF(BIG>AB) 6,7,7
000015      000      6 BIG=AB
000016      000      JJ=I
000017      000      7 CONTINUE
000018      000      C   DECIDE WHETHER ROW INTERCHANGE IS NECESSARY
000019      000      IF(JJ>K) 8,10,8
000020      000      C   INTERCHANGE ROWS
000021      000      A DO 9 J=K,M
000022      000      TEMP=A(JJ,J)
000023      000      A(JJ,J)=A(K,J)
000024      000      9 A(K,J)=TEMP
000025      000      C   CALCULATE ELEMENTS OF NEW MATRIX
000026      000      10 DO 11 I=KP1,N
000027      000      QUOT=A(I,K)/A(K,K)
000028      000      DO 11 J=KP1,M
000029      000      11 A(I,J)=A(I,J)-QUOT*A(K,J)
000030      000      DO 12 I=KP1,N
000031      000      12 A(I,K)=0.
000032      000      C   FIRST STEP IN BACK SUBSTITUTION
000033      000      X(N)=A(N,M)/A(N,N)
000034      000      DO 14 NN=1,L
000035      000      SUM=0.
000036      000      I=N-NN
000037      000      IP1=I+1
000038      000      DO 13 J=IP1,N
000039      000      13 SUM=SUM+A(I,J)*X(J)
000040      000      14 X(I)=(A(I,M)-SUM)/A(I,I)
000041      000      CONTINUE
000042      000      RETURN
000043      000      END
```

END ELT.

@HDG,P ***** END *****

***** IJH *****

DELT,I, TMAINT,INH

000001	000	SUBROUTINE INH			
000002	000	C	***** INPUT PROGRAM FOR EXPLORE-1	*****	2
000003	000	C			3
000004	000	C	***** BATTELLE NORTHWEST 11/9/71	*****	4
000005	000	C	*****	*****	5
000006	000	C	THIS ROUTINE IS CALLED BY TMAINV (OR TMAINT)		
000007	000	C	AND CALLS TIDE AND REGRES		
000008	000	C			7
000009	000	C	***** ASSIGN THE COMMON DATA	*****	8
000010	000		COMMON /TAPE/S/N5,N6,N20,N22,N24		9
000011	000		COMMON/PARAMS/IZ5,IZ6,IZ9,IZ12,IZ13		10
000012	000	C			11
000013	000	C	***** CONTROL AND TITLE INFORMATION	*****	12
000014	000		COMMON /PTINT/ NJ,NC,NJGW,NTCYC,NQSWRT,NQCYC,DELTQ,PERIOD,		1
000015	000		IALPHA(30),IEXP(70),IPPOINT(70,6),AS(70),EVAP		
000016	000		COMMON/WJAL/NCHAN(70,6),LEN(100),NJUNC(100,2),JGW(20)		
000017	000		COMMON/WIN/WTNT,DELT,WIND,WDIR,NJSW, NHCYC,NT,ICYC,NCYC,W,		
000018	000		INEXIT,JSW(20), A0(3,20,10)		
000019	000	C			18
000020	000	C	***** JUNCTION INFORMATION	*****	19
000021	000	C			20
000022	000		COMMON/H50/H(70),VOL(70),X(70),Y(70),		
000023	000		IQIN(70),Q01(70),QINST(20)		
000024	000	C			21
000025	000	C	***** CHANNEL INFORMATION	*****	21
000026	000	C			22
000027	000		COMMON/B72/B(100),R(100),A(100),AK(100),Q(100),V(100),		
000028	000		IFWIND(100),NTEMP(6),NCLOS(100)		
000029	000		DIMENSION HYDRAD(100),ITRIB(50+2),TRBDEP(50)		
000030	000	C	*** HYDEND IS A SPECIAL CASE FOR THE EPA PESTICIDE STUDY ***		
000031	000		COMMON /NEW/ IJK,CHK,XM(20),YM(20),HYDEND		
000032	000	C			31
000033	000		RFAL LEN		3
000034	000		DIMENSION ARRAY(33),ATEMP(10)		31
000035	000		DIMENSION ALFNM(100),WIDTHM(100),RADM(100),VELM(100),AM(100),		
000036	000		IHYDRAM(100)		
000037	000		DIMENSION HEADM(70),SURFM(70),QF1M(70),QF2M(70)		
000038	000		DIMENSION ATIDE(8)		
000039	000		DATA ASTERK,BLANK/4H****,4H		
000040	000	C	***** END	*****	3
000041	000	C	*****	*****	3
000042	000	C			3
000043	000	C	***** ZERO ALL THE INPUT DATA VARIABLES	*****	3
000044	000		NTCYC=0		3
000045	000		PERIOD=0		3
000046	000		QINT=0.		4
000047	000		DELT=0.		4
000048	000		WIND=0.		4
000049	000		WDIR=0.		4
000050	000		NQSWRT=0		4
000051	000		NJSW=0		4
000052	000		NJGW=0		4
000053	000		NQCYC=0		4

```

***** INH *****
000054      000      NHCYC=0          49
000055      000      NT=0           50
000056      000      DELTQ=0.       51
000057      000      ICYC=0         52
000058      000      NCYC=0         53
000059      000      NEXIT=0        54
000060      000      NJ=0           55
000061      000      NC=0           56
000062      000      NTRIB=0        57
000063      000      DO 100 I=1,50    58
000064      000      TRBDEP(I)=0.   59
000065      000      ITRIB(I,1)=0.  60
000066      000      100   ITRIB(I,2)=0. 61
000067      000      DO 120 L=1,IZ12 62
000068      000      DO 110 II=1,10   63
000069      000      A0(L,L+II)=0.  64
000070      000      A0(2,L+II)=0.  65
000071      000      110   A0(3,L+II)=0. 66
000072      000      QINST(L)=0.    67
000073      000      120   JSW(L)=0.    68
000074      000      DO 130 I=1,IZ13 69
000075      000      130   JGW(I)=0.    70
000076      000      DO 140 I=1,30   71
000077      000      140   ALPHA(I)=BLANK 72
000078      000      DO 160 J=1,IZ5  73
000079      000      H(J)=0.        74
000080      000      AS(J)=0.       75
000081      000      VOL(J)=0.     76
000082      000      X(J)=0.        77
000083      000      Y(J)=0.        78
000084      000      DEP(J)=0.     79
000085      000      QIN(J)=0.     80
000086      000      QOU(J)=0.     81
000087      000      DO 150 K=1,IZ6 82
000088      000      NIEMP(K)=0.   83
000089      000      IPPOINT(J,K)=0. 84
000090      000      150   NCHAN(J,K)=0. 85
000091      000      160   CONTINUE     86
000092      000      DO 170 I=1,IZ9 87
000093      000      LEN(I)=0.      88
000094      000      NJUNC(I+1)=0. 89
000095      000      NJUNC(I+2)=0. 90
000096      000      R(I)=0.        91
000097      000      P(I)=0.        92
000098      000      A(I)=0.        93
000099      000      AK(I)=0.       94
000100      000      Q(I)=0.        95
000101      000      V(I)=0.        96
000102      000      FWIND(I)=0.   97
000103      000      NCLOS(I)=0.   98
000104      000      170   CONTINUE     99
000105      000      C               *****          100
000106      000      C               *****          101
000107      000      C               *****          102
000108      000      C               ***** START OF THE INPUT PROGRAM ***** 103
000109      000      C               *****          104
000110      000      C               *****          105

```

```

***** 1000 *****

000111    000      N7=120
000112    000      180  CONTINUE
000113    000      C      READ ALL HYDRAULIC DATA CARDS AND ECHO WRITE THEM
000114    000      READ (N5,740) (ALPHA(I),I=1,20)
000115    000      WRITE (N6,750) (ALPHA(I),I=1,20)
000116    000      C      IS THIS THE END OF THE DATA DECK?
000117    000      IF (ALPHA(1).EQ.,ASTERK) GO TO 190
000118    000      C      WRITE DATA TO SCRATCH FILE N24 TO BE USED FOR INPUT TO
000119    000      C      THE CODE
000120    000      WRITE (N24,740) (ALPHA(I),I=1,20)
000121    000      GO TO 180
000122    000      190  CONTINUE
000123    000      WRITE (N6,760)
000124    000      END FILE N24
000125    000      C      REWIND SCRATCH FILE SO THAT THE CODE CAN READ FROM IT
000126    000      REWIND N24
000127    000      C      SET UP EQUIVALENCE SO THAT READING IS DONE FROM SCRATCH FILE
000128    000      N5=N24
000129    000      C      **** READ IN CARD GROUP H0 ****
000130    000      C      **** TITLE CARD ? ****
000131    000      C      READ (N5,770) ALPHA
000132    000      **** END ****
000133    000      C      **** READ IN CARD GROUP H1 ****
000134    000      C      HYDRAULIC CONTROL CARD
000135    000      C      READ (N5,780) NTCYC,PFRIOD,QINT,DELT,EVAP,WIND,WDIR,NQSWRT,N
000136    000      C      1JSW,NJGW,NTRIB
000137    000      C      READ (N5,790) NTCYC,PFRIOD,QINT,DELT,EVAP,WIND,WDIR,NQSWRT,N
000138    000      C      1JSW,NJGW,NTRIB
000139    000      C      EVAPM=EVAP
000140    000      C      CONVERT EVAP FROM MM/MONTH TO INCHES/MONTH
000141    000      C      EVAP=.03937*EVAP
000142    000      C      WINDM=WIND
000143    000      C      CONVERT WIND FROM METERS/SEC TO MPH
000144    000      C      WIND=.236*WIND
000145    000      C      IF (NTRIB.LE.50) GO TO 200
000146    000      C      WRITE (6,650) NTRIB
000147    000      C      STOP
000148    000      200  CONTINUE
000149    000      C      IPERID=PFRIOD+0.1
000150    000      C      IQINT=QINT*3600.+0.1
000151    000      C      IDELT=DELT+0.1
000152    000      C      NQCYC=(IPERID*3600)/IQINT
000153    000      C      NHCYC=IQINT/IDELT
000154    000      C      NINT=(IPERID*3600)/IDELT
000155    000      C      NPDEL=(NINT+50)/100
000156    000      C      DELTQ=DELT*FLOAT(NHCYC)
000157    000      C      **** END ****
000158    000      C      **** READ IN CARD GROUP H2 ****
000159    000      C      A LIST OF NJSW JUNCTION NUMBERS WHERE TIME-VARYING INFLOWS
000160    000      C      ARE LOCATED
000161    000      C      IF (NJSW.LF.0) GO TO 210
000162    000      C      READ (N5,790) (JSW(L),L=1,NJSW)
000163    000      C      CONTINUE
000164    000      210  **** END ****
000165    000      C      **** READ IN CARD GROUP H3 ****
000166    000      C      **** END ****
000167    000      C      **** READ IN CARD GROUP H3 ****

```

```

***** INH *****
000168    000   C      SPECIFY NJGW CONTROLLED NODE TYPES
000169    000   C      READ (N5,790) (JGW(I),I=1,NJGW)
000170    000   C      ***** READ IN CARD GROUP H4
000171    000   C      ***** ARE THERE ANY TIDAL FLATS *****
000172    000   C      ***** IF (NTRIB,LE,0) GO TO 230
000173    000   C      ***** DO 220 I=1+NTRIB
000174    000   C      ***** CONTINUE
000175    000   C      ***** SPECIFY THE CHANNEL AND JUNCTION NUMBERS FOR THE TIDAL FLATS ***
000176    000   C      READ (N5,660) ITRIB(I,1),ITRIB(I,2)
000177    000   C      CONTINUE
000178    000   C      CONTINUE
000179    000   C      ***** PRINT OUT PAGE ONE THE CONTROL DATA *****
000180    000   C      ***** END *****
000181    000   C      ***** PRINT OUT PAGE ONE THE CONTROL DATA *****
000182    000   C      ***** PRINT OUT PAGE ONE THE CONTROL DATA *****
000183    000   C      WRITE (N7,800) ALPHA
000184    000   C      WRITE (N7,810) NTCYC
000185    000   C      WRITE (N7,820) NOCYC
000186    000   C      WRITE (N7,830) NHCYC
000187    000   C      WRITE (N7,840) DELT
000188    000   C      WRITE (N7,710) EVAPM
000189    000   C
000190    000   C      EVAP=EVAP/(12.*30.*86400.)
000191    000   C      WRITE (N7,860) WINDM,WDIR
000192    000   C      WRITE (N7,870) NOSWRT
000193    000   C      IF (NTRIB,LE,0) GO TO 240
000194    000   C      WRITE (N7,670) NTRIB
000195    000   C      WRITE (N7,690) (ITRIB(I,1),ITRIB(I,2),I=1,NTRIB)
000196    000   C      CONTINUE
000197    000   C      ***** END *****
000198    000   C
000199    000   C      ***** READ CARD GROUP H5 *****
000200    000   C      ***** READ IN THE JUNCTION INFORMATION *****
000201    000   C
000202    000   C
000203    000   C      NJ=0
000204    000   C      DO 250 I=1,I75
000205    000   C      READ(N5,890) J,HEAD,SURF,QF1,QF2,DT
000206    000   C      ***** DID WF READ IN A CARD GROUP H6 CARD *****
000207    000   C      IF (J,GT,I25) GO TO 260
000208    000   C      DT=-DT
000209    000   C      HEADM(J)=HEAD
000210    000   C      CONVERT HEAD FROM METERS TO FEET
000211    000   C      HEAD=3.28*HEAD
000212    000   C      SURFM(J)=SURF
000213    000   C      CONVERT SURF FROM KM**2 TO MILLIONS OF SQ FEET
000214    000   C      SURF=10.744*SURF
000215    000   C      QF1M(J)=QF1
000216    000   C      QF2M(J)=QF2
000217    000   C      CONVERT QF1 AND QF2 FROM CURIC METERS/SEC TO CFS
000218    000   C      QF1=35.314*QF1
000219    000   C      QF2=35.314*QF2
000220    000   C      DTM=DT
000221    000   C      CONVERT DT FROM METERS TO FEET
000222    000   C      DT=3.28*DT
000223    000   C      NJ=NJ+1
000224    000   C      IF (J,NF,NJ) WRITE (N6,720)

```

***** TNH *****

000225	000	H(J)=HEAD	187
000226	000	AS(J)=SURF	188
000227	000	QIN(J)=QF1	189
000228	000	QOU(J)=QF2	190
000229	000 C	NOTE THAT VARIABLE DEP IS NOT RIVER DEPTH	
000230	000	DEP(J)=DT	193
000231	000 250	CONTINUE	194
000232	000 260	CONTINUE	195
000233	000 C	ARE THERE ANY JUNCTIONS WITH TIME-VARYING INFLOWS?	
000234	000	IF (NJSW.LE.0) GO TO 280	196
000235	000	DO 270 L=1,NJSW	197
000236	000	J=JSW(L)	198
000237	000 270	QINST(L)=QIN(J)	199
000238	000 280	CONTINUE	200
000239	000 C	***** END *****	201
000240	000 C		202
000241	000 C	***** READ CARD GROUP H7 *****	203
000242	000 C	***** READ IN THE CHANNEL INFORMATION *****	204
000243	000 C		205
000244	000 C		206
000245	000	NC=0	207
000246	000	DO 360 I=1,I79	208
000247	000	READ (N5,80) N,(NTEMP(K),K=1,2),ALEN,WIDTH,RAD,COEF,VEL	209
000248	000 C	***** DID WE READ IN A CARD GROUP H8 CARD *****	211
000249	000	IF (N.GT.I79) GO TO 370	212
000250	000	RAD=-RAD	210
000251	000	ALENM(I)=ALEN	
000252	000 C	CONVERT ALEN FROM METERS TO FEET	
000253	000	ALEFN=3.28*ALEN	
000254	000	WIDTHM(I)=WIDTH	
000255	000 C	CONVERT WIDTH FROM METERS TO FEET	
000256	000	WIDTH=3.28*WIDTH	
000257	000	RADM(I)=RAD	
000258	000 C	CONVERT RAD FROM METERS TO FEET	
000259	000	RAD=3.28*RAD	
000260	000	VELM(I)=VEL	
000261	000 C	CONVERT VEL FROM METERS/SEC TO FPS	
000262	000	VEL=3.28*VEL	
000263	000	NC=NC+1	213
000264	000	IF (N.NE.NC) WRITE (N6,900)	214
000265	000	N=NC	215
000266	000	LEN(N)=ALEN	216
000267	000	B(N)=WIDTH	217
000268	000	K=MAX0(NTEMP(1),NTEMP(2))	218
000269	000 C	CONVENTION USED ASSIGNS A NEGATIVE VALUE TO THE RIVER BOTTOM ELEVATION (RAD), WHEREAS HEAD (WATER SURFACE ELEVATION) AND WATER DEPTH ARE POSITIVE	
000270	000 C	RIVER DEPTH IS EQUAL TO HEAD MINUS BOTTOM ELEVATION, BUT BECAUSE OF THE SIGN CONVENTION FOR THE LATTER (RAD), THE TWO TERMS ARE ADDED	
000271	000 C		
000272	000 C		
000273	000 C		
000274	000 L		
000275	000	HYDRAD(N)=RAD+H(K)	219
000276	000 C	CONVERT HYDRAD TO METRIC UNITS FOR OUTPUT	
000277	000	HYDRAM(N)=HYDRAD(N)/3.28	
000278	000	IFLAG=0	
000279	000	IF (NTRIB.LE.0) GO TO 310	221
000280	000	DO 290 IL=1,NTRIB	222
000281	000	IF (N.FN.JTRIB(IL+1)) GO TO 300	223

```

***** INH *****
000282      000    290    CONTINUE          224
000283      000    GO TO 310          225
000284      000    300    IFLAG=1          226
000285      000    IJN=ITRIH(I,L,?)          227
000286      000    TRADEF(I,L)=RAD
000287      000    C
000288      000    CONVENTION USED ASSIGNS A NEGATIVE VALUE TO THE JUNCTION BOTTOM
000289      000    ELEVATION (DT=DEP), WHEREAS HEAD (WATER SURFACE ELEVATION)
000290      000    AND WATER DEPTH ARE POSITIVE
000291      000    RIVER DEPTH IS EQUAL TO HEAD MINUS BOTTOM ELEVATION, BUT BECAUSE
000292      000    OF THE SIGN CONVENTION FOR THE LATTER (DEP), THE TWO TERMS
000293      000    ARE ADDED
000294      000    HYDRAD(N)=H(IJN)+DEP(IJN)          229
000295      000    C
000296      000    CONVERT HYDRAD TO METRIC UNITS FOR OUTPUT
000297      000    310    HYDRAM(N)= HYDRAD(N)/3.28          230
000298      000    C
000299      000    CONTINUE
000300      000    CROSS-SECTIONAL AREA = DEPTH*WIDTH          231
000301      000    A(N)=HYDRAD(N)*WIDTH
000302      000    AM(N)=A(N)/10.744          232
000303      000    R(N)=RAD          233
000304      000    AK(N)=COEF          234
000305      000    V(N)=VEL
000306      000    C
000307      000    STORE THE NUMBERS OF THE JUNCTIONS AT EACH END OF CHANNEL N
000308      000    IN ARRAY NJUNC(N,I)          235
000309      000    NJUNC(N,1)=MIN0(NTFMP(1),NTEMP(2))
000310      000    NJUNC(N,2)=MAX0(NTFMP(1),NTEMP(2))          236
000311      000    K=NJUNC(N,1)          237
000312      000    IF (K.EQ.0) GO TO 360          238
000313      000    J=NJUNC(N,2)          239
000314      000    IF (IFLAG.EQ.1) GO TO 320          240
000315      000    C
000316      000    CONVENTION USED ASSIGNS A NEGATIVE VALUE TO THE RIVER BOTTOM
000317      000    ELEVATION (RAD), WHEREAS HEAD (WATER SURFACE ELEVATION)
000318      000    AND WATER DEPTH ARE POSITIVE          241
000319      000    HYDRAD(N)=RAD+(H(J)+H(K))/2.0
000320      000    C
000321      000    CONVERT HYDRAD TO METRIC UNITS FOR OUTPUT
000322      000    HYDRAM(N)= HYDRAD(N)/3.28          242
000323      000    CROSS-SECTIONAL AREA = DEPTH*WIDTH
000324      000    A(N)=HYDRAD(N)*WIDTH
000325      000    AM(N)=A(N)/10.744          243
000326      000    320    CONTINUE          244
000327      000    DO 330 J=1*I26          245
000328      000    IF (IPOINT(K,J)).EQ.NJUNC(N,2) GO TO 350          246
000329      000    IF (IPOINT(K,J)).EQ.0 GO TO 340          247
000330      000    330    CONTINUE          248
000331      000    IPOINT(K,J)=NJUNC(N,2)
000332      000    NC=NC-1          249
000333      000    NCHAN(K,J)=NC          250
000334      000    GO TO 360          251
000335      000    ***** THERE IS A REDUNDANT CHANNEL *****          252
000336      000    350    NC=NC-1          253
000337      000    WRITE (N6,730) N,M          254
000338      000    M=NCHAN(K,J)
000339      000    LEN(M)=ALEN          255
000340      000    R(M)=R(M)+WIDTH          256
000341      000    R(M)=RAD          257
000342      000    C
000343      000    CROSS-SECTIONAL AREA = DEPTH*WIDTH          258
000344      000    A(M)=HYDRAD(N)*R(M)
000345      000    AM(M)=A(N)/10.744          259
000346      000    HYDRAD(M)=HYDRAM(N)

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***** INH *****
000339    000   C      CONVERT HYDRAD TO METRIC UNITS FOR OUTPUT
000340    000   C      HYDRAM(N)= HYDRAD(N)/3.28
000341    000   C      AK(1)=COFF
000342    000   C      V(M)=VFL
000343    000   360   CONTINUE
000344    000   370   CONTINUE
000345    000   C      ***** OUTPUT PAGE ONE THE CHANNEL INFORMATION *****
000346    000   C      END
000347    000   C      **** OUTPUT PAGE TWO THE CHANNEL INFORMATION *****
000348    000   C      WRITE (N7,H00) ALPHA
000349    000   C      WRITE (N7,I40)
000350    000   DO 460 N=1,NC
000351    000   C      ASSIGN DEFAULT VALUE OF 0.018 TO MANNING'S COEFFICIENT, UNLESS
000352    000   C      IT HAS BEEN PREVIOUSLY SPECIFIED
000353    000   IF (AK(1)).LE.0.0) AK(N)=0.018
000354    000   C      DOES THIS CHANNEL HAVE A WIDTH GREATER THAN ZERO?
000355    000   IF (B(N).GT.0.) GO TO 400
000356    000   K=NJUNC(N,1)
000357    000   NJUNC(N+1)=0
000358    000   IDEL=0
000359    000   DO 390 J=1,IZ6
000360    000   IF (IPOINT(K,J).EQ.0) GO TO 390
000361    000   IF (IPOINT(K,J).NE.NJUNC(N+2)) GO TO 380
000362    000   WRITE (N7,I20) N,K,NJUNC(N+2)
000363    000   NCHAN(K,J)=0
000364    000   IPOINT(K,J)=0
000365    000   NJUNC(N+2)=0
000366    000   GO TO 460
000367    000   380   CONTINUE
000368    000   390   CONTINUE
000369    000   400   CONTINUE
000370    000   K=NJUNC(N,2)
000371    000   DO 430 J=1,IZ6
000372    000   IF (IPOINT(K,J).EQ.NJUNC(N+1)) GO TO 410
000373    000   GO TO 420
000374    000   410   CONTINUE
000375    000   IF (NJUNC(N,1).NE.0) GO TO 450
000376    000   420   CONTINUE
000377    000   IF (IPOINT(K,J).EQ.0) GO TO 440
000378    000   430   CONTINUE
000379    000   440   CONTINUE
000380    000   IPOINT(K,J)=NJUNC(N,1)
000381    000   NCHAN(K,J)=N
000382    000   450   CONTINUE
000383    000   TF=1000.
000384    000   IF (R(N).GT.-2.) TF=0.75*LEN(N)/SQRT(32.2*(R(N)+2.))
000385    000   XMK=BLANK
000386    000   IF (TF.LT.DFLT) XMK=ASTERK
000387    000   C      WRITE CHANNEL DATA
000388    000   C      WRITE (N7,I30) N,ALENM(N),WIDTHM(N),AM(N),AK(N),VELM(N),HYDRAM(N)
000389    000   C      +(NJUNC(N,K),K=1,2),TF,XMK
000390    000   460   CONTINUE
000391    000   C      **** OUTPUT PAGE THREE JUNCTION INFORMATION *****
000392    000   C      **** OUTPUT PAGE THREE JUNCTION INFORMATION *****
000393    000   C      **** OUTPUT PAGE THREE JUNCTION INFORMATION *****
000394    000   C      WRITE (N7,H00) ALPHA
000395    000   C      WRITE (N7,I40)

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***** INH *****

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000396    000      ATOT=0.          311
000397    000      DO 470 J=1,NJ          312
000398    000 C       USE ATOT TO SUM SURFACE AREAS
000399    000      ATOT=ATOT+AS(J)          313
000400    000 C       WRITE JUNCTION DATA
000401    000      WRITE (N7,950) J,HEADM(J),SURFM(J),QF1M(J),QF2M(J),(NCHAN(J,K),K=1
000402    000      1,I26)
000403    000 470  CONTINUE          316
000404    000 C       WRITE TOTAL SURFACE AREA
000405    000      ATOM=ATOT/10.744
000406    000      WRITE (N7,960) ATOM
000407    000 C       ##### END #####
000408    000 C
000409    000 C       ##### OUTPUT PAGE FOUR + CONTROL NODE INFORMATION #####
000410    000      WRITE (N7,900) ALPHA          320
000411    000 C       THE IF ARE NJGW CONTROLLED NODES          321
000412    000      WRITE (N7,470) NJGW          322
000413    000      DO 580 J=1,NJGW          323
000414    000      DO 480 II=1,10          324
000415    000      AN(2,J,II)=0.          325
000416    000 C       ZERO OUT ARRAY A0
000417    000 480  AN(1,J,II)=0.          326
000418    000      WRITE (N7,480) J          327
000419    000      IJK=JGW(J)          328
000420    000 C       WHAT TYPE OF CONTROLLED NODE?
000421    000      GO TO (490,500,510,520,540,550), IJK          329
000422    000 C
000423    000 C       ##### WTER TYPE CONTROLLED NODE #####
000424    000 C       READ A TITLE CARD AND A DATA CARD
000425    000 490  READ (N5,990) (ARRAY(I),I=1,20),A0(1,J,1),A0(1,J,2),A0(1,J,3)          332
000426    000      WRITE (N6,1000) (ARRAY(I),I=1,20),A0(1,J,1),A0(1,J,2),A0(1,J,3)          333
000427    000      WRITE (N7,1010) A0(1,J,1),A0(1,J,2),A0(1,J,3)          334
000428    000      CONTINUE
000429    000      GO TO 580          335
000430    000 C       ##### END #####
000431    000 C
000432    000 C       ##### A TIDALLY CONTROLLED NODE #####
000433    000 C
000434    000 C       CALL TIIDE TO READ DATA AND GENERATE REGRESSION COEFFICIENTS TO
000435    000 C       SIMULATE A TIDAL CYCLE
000436    000 500  CALL TIIDE(ATEMP)
000437    000 C
000438    000 C       WRITE COEFFICIENTS
000439    000      DO 499 I=1,8
000440    000 499  ATIDE(I)=ATEMP(I)/3.28
000441    000      WRITE (N7,1020) (ATIDE(I),I=1,8)
000442    000      GO TO 560
000443    000 C       ##### END #####
000444    000 C
000445    000 C       ##### DAM WHICH IS OPERATED VIA A Q VS H POLICY #####
000446    000 C
000447    000 C       CALL REGRES TO READ DATA AND PERFORM REGRESSION
000448    000 510  CALL REGRES (ATEMP)          345
000449    000 C
000450    000 C       CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000451    000      A1=ATEMP(1)/35.314
000452    000      A2=ATEMP(2)/10.758
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***** INH *****
000453    000      A3=ATEMP(3)/3.28
000454    000      A4=ATEMP(4)
000455    000      A5=ATEMP(5)*4.28
000456    000      A6=ATEMP(6)*10.758
000457    000      A8=ATEMP(8)*115.83
000458    000      A7=ATEMP(7)*35.314
000459    000      A9=ATEMP(9)*379.92
000460    000      A10=ATEMP(10)*1246.14
000461    000      C PRINT THE MFTPTC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000462    000      WRITE(N7,1030) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10
000463    000      GO TO 560
000464    000      C ***** END *****
000465    000      C ***** DAM WHERE THE Q VS T AND H VS T CURVES ARE KNOWN**
000466    000      C FIND H VS T FUNCTION
000467    000      C
000468    000      C
000469    000      520  CHK=1.
000470    000      C CALL REGRES TO READ DATA AND PERFORM REGRESSION
000471    000      CALL REGRES(ATEMP)
000472    000      CHK=0.
000473    000      C
000474    000      C CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000475    000      A1=ATEMP(1)/3.28
000476    000      A2=ATEMP(2)/3.28
000477    000      A3=ATEMP(3)/3.28
000478    000      A4=ATEMP(4)/3.28
000479    000      A5=ATEMP(5)/3.28
000480    000      A6=ATEMP(6)/3.28
000481    000      A7=ATEMP(7)/3.28
000482    000      A8=ATEMP(8)/3.28
000483    000      A9=ATEMP(9)/3.28
000484    000      A10=ATEMP(10)/3.28
000485    000      C PRINT THE METRIC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000486    000      WRITE(N7,1040) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10
000487    000      DO 530 I=1,10
000488    000      530  A0(P,J,I)=ATEMP(I)
000489    000      C ***** END *****
000490    000      C FIND Q VS T FUNCTION
000491    000      C
000492    000      CHK=P.
000493    000      C CALL REGRES TO READ DATA AND PERFORM REGRESSION
000494    000      CALL REGRES(ATEMP)
000495    000      CHK=0.
000496    000      C
000497    000      C CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000498    000      A1=ATEMP(1)/35.314
000499    000      A2=ATEMP(2)/35.314
000500    000      A3=ATEMP(3)/35.314
000501    000      A4=ATEMP(4)/35.314
000502    000      A5=ATEMP(5)/35.314
000503    000      A6=ATEMP(6)/35.314
000504    000      A7=ATEMP(7)/35.314
000505    000      A8=ATEMP(8)/35.314
000506    000      A9=ATEMP(9)/35.314
000507    000      A10=ATEMP(10)/35.314
000508    000      C PRINT THE METRIC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000509    000      WRITE(N7,1050) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10

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***** INH *****
000510      000      GO TO 560                                358
000511      000      C      *****          END          ***** 359
000512      000      C
000513      000      C      ***** DAM WHERE THE H VS T CURVE IS KNOWN  ***** 360
000514      000      C
000515      000      C      CALL REGRES TO READ DATA AND PERFORM REGRESSION
000516      000      540      CALL REGRES (ATEMP)                362
000517      000      C
000518      000      C      CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000519      000      C      A1=ATEMP(1)/3.28
000520      000      C      A2=ATEMP(2)/3.28
000521      000      C      A3=ATEMP(3)/3.28
000522      000      C      A4=ATEMP(4)/3.28
000523      000      C      A5=ATEMP(5)/3.28
000524      000      C      A6=ATEMP(6)/3.28
000525      000      C      A7=ATEMP(7)/3.28
000526      000      C      A8=ATEMP(8)/3.28
000527      000      C      A9=ATEMP(9)/3.28
000528      000      C      A10=ATEMP(10)/3.28
000529      000      C      PRINT THE METRIC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000530      000      C      WRITE(N7,1060) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10
000531      000      C      GO TO 560
000532      000      C      *****          END          ***** 364
000533      000      C
000534      000      C      ***** DAM WHERE THE Q VS T CURVE IS KNOWN  ***** 365
000535      000      C
000536      000      C      CALL REGRES TO READ DATA AND PERFORM REGRESSION
000537      000      550      CALL REGRES (ATEMP)                366
000538      000      C
000539      000      C      CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000540      000      C      A1=ATEMP(1)/35.314
000541      000      C      A2=ATEMP(2)/35.314
000542      000      C      A3=ATEMP(3)/35.314
000543      000      C      A4=ATEMP(4)/35.314
000544      000      C      A5=ATEMP(5)/35.314
000545      000      C      A6=ATEMP(6)/35.314
000546      000      C      A7=ATEMP(7)/35.314
000547      000      C      A8=ATEMP(8)/35.314
000548      000      C      A9=ATEMP(9)/35.314
000549      000      C      A10=ATEMP(10)/35.314
000550      000      C      PRINT THE METRIC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000551      000      C      WRITE(N7,1070) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10
000552      000      C      *****          END          ***** 367
000553      000      C
000554      000      560      DO 570 I=1,10                370
000555      000      C      TRANSFER REGRESSION COEFFICIENTS TO ARRAY A0
000556      000      570      A0(I,J,I)=ATEMP(I)                371
000557      000      580      CONTINUE
000558      000      C      *****          END          ***** 372
000559      000      C      *****          END          ***** 373
000560      000      C
000561      000      C
000562      000      C
000563      000      C      ***** OUTPUT PAGE FIVE •HYDROGRAPH NODE INFORMATION *****
000564      000      C      ARE THERE TIME-VARYING INPUT NODES?
000565      000      C      TF (NJSW,LF,0) GO TO 610
000566      000      C      WRITE (N7,F00) ALPHA                374
                                         *****          END          ***** 375
                                         *****          END          ***** 376
                                         *****          END          ***** 377
                                         *****          END          ***** 378
                                         *****          END          ***** 379
                                         *****          END          ***** 380
                                         *****          END          ***** 381
                                         *****          END          ***** 382

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***** IJH *****
000567    000      WRITE (N7+1040) NJSW          383
000568    000      DO 600 L=1,NJSW          384
000569    000      J=JSW(L)
000570    000      WRITE (N7+1040) J          385
000571    000      C
000572    000      C   CHK=3.
000573    000      C   CALL REGRES TO READ DATA AND PERFORM REGRESSION
000574    000      C   CALL REGRES (ATEMP)          387
000575    000      C   CHK=0.
000576    000      C
000577    000      C   CONVERT COEFFICIENTS SO THAT THEY CORRESPOND TO METRIC VALUES
000578    000      C   A1=ATEMP(1)/35.314
000579    000      C   A2=ATEMP(2)/35.314
000580    000      C   A3=ATEMP(3)/35.314
000581    000      C   A4=ATEMP(4)/35.314
000582    000      C   A5=ATEMP(5)/35.314
000583    000      C   A6=ATEMP(6)/35.314
000584    000      C   A7=ATEMP(7)/35.314
000585    000      C   A8=ATEMP(8)/35.314
000586    000      C   A9=ATEMP(9)/35.314
000587    000      C   A10=ATEMP(10)/35.314
000588    000      C   PRINT THE METRIC EQUIVALENTS OF THE REGRESSION COEFFICIENTS
000589    000      C   WRITE(N7+1100) A1,A2,A3,A4,A5,A6,A7,A8,A9,A10
000590    000      C   DO 590 I=1,10          389
000591    000      C   TRANSFER REGRESSION COEFFICIENTS TO ARRAY A0
000592    000      590  A0(3*L+I)=ATEMP(I)          390
000593    000      600  CONTINUE          391
000594    000      610  CONTINUE          392
000595    000      C   *****
000596    000      C
000597    000      C   *****
000598    000      C   PREPARE HYDRODYNAMIC INPUT TAPE          *****
000599    000      C   WRITE (N7+1110) ASTERK          395
000600    000      C   WRITE (N7) NTCYC,PERIOD,QINT,DELT,WIND,WDIR,NQSWRT,NJSW,NJGW
000601    000      C   1,(JSW(L),QINST(L),((A0(1,L,N)+I=1,3),N=1,10),L=1,I212),(JGW(L),L=1
000602    000      C   2,I213),(A1*PHA(I),I=1,30),NQCYC,NHCYC,NT,DELTO,ICYC,NCYC,NFXIT,NJ,N
000603    000      C   3C,((INCHAN(I,II),IPOINT(I,II),II=1,I26)*H(I)+H(I),H(I),H(I),H(I),AS
000604    000      C   4(I)*VOL(I)*X(I),Y(I),DEP(I),QIN(I),QOU(I),QIN(I),QOU(I),I=1,NJ),(((
000605    000      C   5N,JUNC(N,L)*L=1,2),LEN(N),B(N),R(N)+A(N),A(N)+AK(N)+Q(N),Q(N),
000606    000      C   6V(N)*V(N),V(I)),FWIND(N),NCLOS(N),N=1,NC),FVAP,NTRIB,(TRBDEP(I),ITR
000607    000      C   7IB(I,1)*ITRIB(I,2),I=1,50),HYDEND
000608    000      C   *** HYDEND IS A SPECIAL CASE FOR THE EPA PESTICIDE STUDY ***
000609    000      C   IF (NTRIB .EQ. 0) GO TO 621
000610    000      C   WRITE(6,690) NTRIB          406
000611    000      C   DO 620 I=1,NTRIB
000612    000      C   TRRDIM=TRRDIFP(I)/3.28
000613    000      620  CONTINUE
000614    000      621  CONTINUE
000615    000      -  END FILE N7          409
000616    000      C   REWIND N7          410
000617    000      C   *****
000618    000      C
000619    000      C
000620    000      C   PRINT OUT THE HYDRODYNAMIC INPUT DATA
000621    000      C   READ(N7+1110)ZDUMMY
000622    000      630  READ (N7+1120) ARRAY          416
000623    000      C   IF (ARRAY(1),EQ,ASTERK) GO TO 640          417

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***** INH *****

000624	000	WRITE (N6,1120) ARRAY	418
000625	000	GO TO 630	419
000626	000	640 WRITE (N6,1130)	420
000627	000	N5=5.	421
000628	000	RETURN	
000629	000	C	425
000630	000	C	426
000631	000	C ***** FORMAT STATEMENT 950 MUST BE CHANGED *****	427
000632	000	C ***** WHENEVER PARAMETER T76 IS CHANGED *****	428
000633	000	C	429
000634	000	C	430
000635	000	C	431
000636	000	650 FORMAT (' YOU REQUESTED TOO MANY TIDE FLATS! ',I5,' TO BE EXACT(JO 18 ABORTED) //')	432
000637	000	FORMAT (2I5)	433
000638	000	660 FORMAT(' THIS PROBLEM HAS',I5,' TIDE FLAT CHANNEL(S).',// 1) ARE (IS)',I3,' CHANNEL NO. CHARACTERISTIC',I5X,I JUNCTION NUMBER 2 ' ')	434
000639	000	670	
000640	000	1 ARE (IS)',I3,' CHANNEL NO. CHARACTERISTIC',I5X,I JUNCTION NUMBER 2 ' ')	436
000641	000	680 FORMAT (I10,10X,I5)	437
000642	000	690 FORMAT('//,IX,' THERE ARE',I5,' TIDE FLAT CHANNELS',//)	438
000643	000	700 FORMAT(3X,'CHANNEL',I3,', IS A TIDE FLAT CHANNEL, WITH NODE',I3,', B EING THE TIDE FLAT.',I2X,', BOTTOM ELEVATION OF THE CHANNEL IS ' 2,1PE12.5)	
000644	000	710 FORMAT (1H0,'THE EVAPORATION RATE IS ',IPE10.3,', (MM/MONTH) ')	
000645	000	720 FORMAT (' THE JUNCTION INFORMATION IS OUT OF ORDER!')	442
000646	000	730 FORMAT ('CHANNELS',I5,' AND ',I5,' ARE REDUNDANT!')	443
000647	000	740 FORMAT (20A4)	444
000648	000	750 FORMAT (24X,20A4)	445
000649	000	760 FORMAT (IH1)	446
000650	000	770 FORMAT (15A4)	447
000651	000	780 FORMAT (I5,3F5.0+5X,3F5.0,4I5)	448
000652	000	790 FORMAT (20I5)	449
000653	000	800 FORMAT (1H1,15A4,20X,20H BATTTELLE NORTHWEST ,/1X,15A4,19X,21H RICH LAND, WASHINGTON,/ ,80X,20H HYDRODYNAMIC MODEL //)	450
000654	000	810 FORMAT (15H0DAYS SIMULATED,I4)	451
000655	000	820 FORMAT (29H0WATER QUALITY CYCLES PFR DAY,I4)	452
000656	000	830 FORMAT (43H0INTEGRATION CYCLES PER WATER QUALITY CYCLE,I4)	453
000657	000	840 FORMAT (30H0LENGTH OF INTEGRATION STEP IS ,F6.0,8H SECONDS)	454
000658	000	850 FORMAT (15H0WIND VELOCITY,F5.0,22H M/SEC WIND DIRECTION,F5.0,19H D EGREES FROM NORTH)	455
000659	000	860 FORMAT (15H0WRITE CYCLE STARTS AT THF,I4,11H TIME CYCLE//)	456
000660	000	870 FORMAT (I5,F10.2,-6PF10.2,0PF2F10.2,F10.2)	457
000661	000	880 FORMAT (3I5,10X,5F10.0)	458
000662	000	890 FORMAT (45H CHANNEL INPUT INFORMATION OUT OF ORDER)	459
000663	000	900 FORMAT (108H CHANNEL LENGTH WIDTH ARFA MANNING VELOCI TY HYD RADIUS JUNCTIONS AT FDNS MAX INT/67H NUMBER	460
000664	000	910 1TY (M) (M) (M**?) COFF. (MPS) (M),31X,'	461
000665	000	920 3X .001'//)	462
000666	000	930 FORMAT (BH CHANNEL,I4,4H JOINING,I4,4H AND,I4,38H DELETED DUE TO Z ERO OR NEGATIVE WIDTH)	463
000667	000	940 FORMAT (I5,F11.0,F9.0,-3PF10.0,0PF9.3,F10.2,F13.1,I19,I6,F16.0,1X, 1A4)	464
000668	000	950 FORMAT (124H JUNCTION INITIAL HEAD SURFACE AREA INPUT OU INPUT CHANNELS ENTERING JUNCTION	465
000669	000	960 2 /127H NUMBER (M) (SQUARE KM) (CMS) (CMS)	466
000670	000	970 3)	467
000671	000	980 4)	468
000672	000		469
000673	000		470
000674	000		471
000675	000		
000676	000		
000677	000		
000678	000		
000679	000		
000680	000		475

***** I JH *****

000681	000	950	FORMAT (1H+<PF13.2,-6PF15.2,0P2F10.0+I10.5I6)	477
000682	000	960	FORMAT (E20.6)	478
000683	000	970	FORMAT (//+1H THIS PROBLEM HAS .15,20H CONTROLLED NODES ,/)	479
000684	000	980	FORMAT (16H0JUNCTION NUMBER,15)	480
000685	000	990	FORMAT (20A4,+3F10.0)	481
000686	000	1000	FORMAT (1H+<PA4/30H THE INPUT WEIR CONSTANTS ARE /5H A1= ,E10.4,+2 1X,5H A2= ,E10.4,+2X,5H A3= ,E10.4,/1)	482
000687	000	1010	FORMAT (1H+<PX,10H IS A WEIR/34H THE CONTROLLING WEIR FORMULA IS 1 .! DELH=DELT/AREA*(INFLOW-A1*(HFAD-A2+DELH/?)**A3)!,/1X,!WHERE A 21 = !,E12.5,! A2 = !,E12.5,! A3 = !,E12.5,! AND THE CONSTANT 35 CORRESPOND TO METRIC DATA!)	483
000691	000	1020	FORMAT (1H+<2PX,30H IS A TIDALLY INFLUENCED NODE /50H THE PERIODIC 1 STAGE-TIME HISTORY IS GIVEN BY ! H(T)=0.5*A1 + A2*COS(T) + 2A3*COS(2*T) + A4*COS(3*T) + A5*SIN(T) + A6*SIN(2*T) + A7*SIN(3*T) 3+A8*SIN(4*T) !,!/ WHERE A1=!,E10.4,! A2=!,E10.4,! A3=!,E10.4 4,! A4=!,E10.4,! A5=!,E10.4,! A6=!,E10.4,! A7=!,E10.4,! A 58=!,E10.4,!/1X,!AND THE CONSTANTS CORRESPOND TO METRIC DATA!)	486
000698	000	1030	FORMAT (1H+<2PX,55H IS A DAM WHICH IS OPERATED ACCORDING TO A Q VS 1 H CURVE/62H THE CONTROLLING Q VS H CURVE IS FIT BY THE FOLLOWING 2FUNCTION /76H Q=A1+A2*T+A3*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+A8* 3H**7+A9*T**8+A10*T**9 /11H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= 4 ,E10.4,+6H A4= ,E10.4,+6H A5= ,E10.4,+7X,4HA6= ,E10.4,+6H A7= ,E1 50.4,+6H A8= ,E10.4,+6H A9= ,E10.4,+7H A10= ,E10.4,/1X,!AND THE CO 6NSTANTS CORRESPOND TO METRIC DATA!)	491
000705	000	1040	FORMAT (1H+<2PX,60H IS A DAM WHOSE HEAD AND OUTFLOW ARE KNOWN FUNC 1TIONS OF TIME/57H THE HEAD VS TIME CURVE IS FIT BY THE FOLLOWING 2FUNCTION /76H H=A1+A2*T+A3*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+A8* 3T**7+A9*T**8+A10*T**9 /11H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= ,E 4 ,E10.4,+6H A4= ,E10.4,+6H A5= ,E10.4,+7X,4HA6= ,E10.4,+6H A7= ,E 510.4,+6H A8= ,E10.4,+6H A9= ,E10.4,+7H A10= ,E10.4,/1X,!AND THE C 6ONSTANTS CORRESPOND TO METRIC DATA!)	495
000712	000	1050	FORMAT (30H THE OUTFLOW VS TIME CURVE IS FIT BY /76H Q=A1+A2*T+A 13*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+A8*T**7+A9*T**8+A10*T**9 /1 21H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= ,E10.4,+6H A4= ,E10.4,+6 3H A5= ,E10.4,+7X,4HA6= ,E10.4,+6H A7= ,E10.4,+6H A8= ,E10.4,+6H A 49= ,E10.4,+7H A10= ,E10.4,/1X,!AND THE CONSTANTS CORRESPOND TO ME 5TRIC DATA!)	500
000718	000	1060	FORMAT (1H+<2PX,50H IS A DAM WHOSE HEAD IS A KNOWN FUNCTION OF TIM 1E ,/57H THE HEAD VS TIME CURVE IS FIT BY THE FOLLOWING FUNCTION , 2/76H H=A1+A2*T+A3*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+AR*T**7+A9* 3T**8+A10*T**9 /11H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= ,E10.4, 4 ,E10.4,+6H A4= ,E10.4,+6H A5= ,E10.4,+7X,4HA6= ,E10.4,+6H A7= ,E10.4,+6H 5A8= ,E10.4,+6H A9= ,E10.4,+7H A10= ,E10.4,/1X,!AND THE CONSTANTS 6CORRESPOND TO METRIC DATA!)	505
000725	000	1070	FORMAT (1H+<2PX,50H IS A DAM WHOSE FLOW IS A KNOWN FUNCTION OF TIM 1E ,/57H THE FLOW VS TIME CURVE IS FIT BY THE FOLLOWING FUNCTION , 2/76H Q=A1+A2*T+A3*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+AR*T**7+A9* 3T**8+A10*T**9 /11H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= ,E10.4, 4 ,E10.4,+6H A4= ,E10.4,+6H A5= ,E10.4,+7X,4HA6= ,E10.4,+6H A7= ,E10.4,+6H 5A8= ,E10.4,+6H A9= ,E10.4,+7H A10= ,E10.4,/1X,!AND THE CONSTANTS 6CORRESPOND TO METRIC DATA!)	510
000732	000	1080	FORMAT (//+1H THIS PROBLEM HAS .15,21H HYDROGRAPH INPUTS ,/)	52
000733	000	1090	FORMAT (16H0JUNCTION NUMBER,15)	52
000734	000	1100	FORMAT (1H+<PX,30H IS A HYDROGRAPH INPUT NODE /62H THE HYDROGRA 1PH INPUT CURVE IS FIT BY THE FOLLOWING FUNCTION /76H Q=A1+A2*T+A3 2*T**2+A4*T**3+A5*T**4+A6*T**5+A7*T**6+AR*T**7+A9*T**8+A10*T**9 /1 3H WHERE A1= ,E10.4,+6H A2= ,E10.4,+6H A3= ,E10.4,+6H A4= ,E10.4,+6H	52

***** IJH *****

000738	000	4, A5= ,E10.4,/7X,4HA6= ,E10.4,6H, A7= ,E10.4,6H, A8= ,E10.4,6H, A9	526
000739	000	5= ,E10.4,7H, A10= ,E10.4,/1X,'AND THE CONSTANTS CORRESPOND TO MET	
000740	000	6RIC DATA')	
000741	000	1110 FORMAT (A4)	528
000742	000	1120 FORMAT (33A4)	529
000743	000	1130 FORMAT (35H1END OF HYDRODYNAMIC INPUT PROGRAM)	530
000744	000	END	-

END ELT.

RHDG,P ***** MAIN *****

***** MAIN *****

ELT.L IMAIN.MAIN

```
000001    000    C      ##### MAIN PROGRAM FOR EXPLORF-1 INPUT      #####
000002    000    C      ##### BATTELLE NORTHWEST 11/9/71      #####
000003    000    C      ##### ****
000004    000    C      THIS PROGRAM CALLS INH
000005    000    C
000006    000    C      THIS EXECUTIVE PROGRAM MAKES I/O ASSIGNMENTS AND CALLS
000007    000    C      THE MAIN INPUT SUBROUTINE INH
000008    000    C
000009    000    C
000010    000    C      ##### ASSIGN THE COMMON DATA      #####
000011    000    C      COMMON /TAPES/N5,N6,N20,N22,N24
000012    000    C      COMMON/PARAMS/IZ5,IZ6,IZ9,I712,I713
000013    000    C
000014    000    C      ##### CONTROL AND TITLE INFORMATION      #####
000015    000    C      COMMON /PTTNT/ NJ,NC,NJGW,NTCYC,NQSWRT,NQCYC,DELTQ,PERIOD,
000016    000    C      JALPHA(30),DEP(70),IPOINT(70,6),AS(70),EVAP
000017    000    C      COMMON/DUAL/NCHAN(70,6),LEN(100),NJUNC(100,2),JGW(20)
000018    000    C
000019    000    C      REAL LEN
000020    000    C
000021    000    C      ##### ASSIGN THE UNIT NUMBERS AND REWIND      #####
000022    000    C
000023    000    C      IZ5=70
000024    000    C      IZ6=6
000025    000    C      IZ9=100
000026    000    C      IZ12=20
000027    000    C      IZ13=20
000028    000    C
000029    000    C      N5=5
000030    000    C      N6=6
000031    000    C      N20=2
000032    000    C      THE UNIVAC 1100 DOES NOT ALLOW THE USE OF LOGICAL UNIT 1 SINCE IT IS
000033    000    C      THE SYSTEM PUNCH FILE.
000034    000    C      N24 = 4
000035    000    C
000036    000    C      REWIND N20
000037    000    C      REWIND N24
000038    000    C      ##### END      #####
000039    000    C
000040    000    C      ##### HYDRAULIC INPUT      #####
000041    000    C
000042    000    C      CALL INH
000043    000    C
000044    000    C      REWIND N24
000045    000    C      REWIND N20
000046    000    C      ##### END      #####
000047    000    C      STOP
000048    000    C      END
```

END ELT.

HDG,P ***** PICTUR *****

***** PICTUR *****

*ELT,L IMAINT,PICTUR

000001	000	SUBROUTINE PICTUR (N,M,MCOL,XX,YY,ARK,ISYM,CARD1)	
000002	000	C THIS ROUTINE IS CALLED BY REGRES AND CALLS SORT AND SORDER	2
000003	000	C PROGRAMMED BY JE SCHLOSSER 1965 MODIFIED BY CA OSTER 1966	3
000004	000	C PRESENTS A PICTURE OF DATA ON PRINTED OUTPUT, TWO OPTIONS BEING	4
000005	000	C AVAILABLE	
000006	000	C 1 MCOL POSITIVE	5
000007	000	C 2 MCOL NEGATIVE, IN WHICH CASE XINCREMENTS ARE TAKEN AS EQUAL	6
000008	000	C 10 Y INCREMENTS AS DETERMINED BY M	7
000009	000	C	8
000010	000	C DICTIONARY	9
000011	000	C	10
000012	000	C VARIABLE DEFINITION	11
000013	000	C N NUMBER OF POINTS TO PLOT (MAXIMUM OF 500)	12
000014	000	C M MAXIMUM NUMBER OF LINES	13
000015	000	C MCOL MAXIMUM NUMBER OF COLUMNS	14
000016	000	C	15
000017	000	C XX(I) X COORDINATE FOR ITH POINT	16
000018	000	C YY(I) Y COORDINATE FOR ITH POINT	17
000019	000	C ARK(I) MARKER FOR ITH POINT	18
000020	000	C ISYU(I) PRIORITY DESIGNATOR FOR MARKER USED ON I-TH POINT	19
000021	000	C (LOWER SUBSCRIPT INDICATES HIGHER PRIORITY)	20
000022	000	C	21
000023	000	C	22
000024	000	DIMENSION XX(2),YY(2),XYM(3,500),PX(6),ALF(107),ARK(2),	23
000025	000	IILF(107),ISYM(5),IXYM(3,500)	24
000026	000	DIMENSION CARD1(20)	
000027	000	EQUIVALENCE (IILF+ALF),(BLANK,LANKBA),(IXYM,XYM)	26
000028	000	C	27
000029	000	EXTERNAL SORDER	30
000030	000	DATA BLANK/1H /	28
000031	000	C	29
000032	000	N=MAX0(MIN0(500,N),2)	31
000033	000	XYM(1,2)=1.01	32
000034	000	XYM(2,2)=1.01	33
000035	000	XYM(3,2)=BLANK	34
000036	000	XMIN=1.0E37	35
000037	000	XMAX=-1.0E37	36
000038	000	DO 100 I=1,N	37
000039	000	XYM(1,I)=XX(I)	38
000040	000	XYM(2,I)=YY(I)	39
000041	000	XYM(3,I)=ARK(I)	40
000042	000	XMIN=AMIN1(XMIN,XYM(1,I))	41
000043	000	XMAX=AMAX1(XMAX,XYM(1,I))	42
000044	000	100 CONTINUE	43
000045	000	CALL SORT (XYM,N,3,SORDER)	44
000046	000	YMIN=XYM(2,N)	45
000047	000	YMAX=XYM(2,1)	46
000048	000	DYLOG=ALOG10(10./FLOAT(M)*1.0E5)	47
000049	000	IF ((YMAX-YMIN).EQ.0.) GO TO 110	48
000050	000	DYLOG=ALOG10((YMAX-YMIN)/FLOAT(M)*1.0E5)	49
000051	000	110 CONTINUE	50
000052	000	APPROX=DYLOG-ATINT(DYLOG)	51
000053	000	120 I=2,10	52

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***** PICTURE *****

000054      000      FI=I          53
000055      000      IF (APPROX=ALOG10(FI)) 130,130,120    54
000056      000      120      CONTINUE    55
000057      000      130      EXACT=F1*10.0** (INT(DYLOG)-5) 56
000058      000      IF (MCOL) >0.14*,140    57
000059      000      140      DXLOG=ALOG10((XMAX-XMIN)/FLOAT(MCOL/2)*1.0E5) 58
000060      000      XAPROX=DXLOG-AINT(DXLOG)    59
000061      000      IF (XAPROX-.3010) 150,150,160    60
000062      000      150      XEXACT=2.0*10.0** (INT(DXLOG)-5) 61
000063      000      GO TO 190    62
000064      000      160      IF (XAPROX-.6990) 170,170,180    63
000065      000      170      XEXACT=5.0*10.0** (INT(DXLOG)-5) 64
000066      000      GO TO 190    65
000067      000      180      XEXACT=10.0** (INT(DXLOG)-4) 66
000068      000      190      CONTINUE    67
000069      000      XACT=XEXACT/2.0    68
000070      000      GO TO 210    69
000071      000      200      XACT=EXACT/2.0    70
000072      000      210      TENX=20.0*XACT    71
000073      000      TENE=10.0*FXACT    72
000074      000      MAXYI=(YMAX/TENE)+(0.5+SIGN(0.5,YMAX))    73
000075      000      MAXXI=(XMAX/TENX)+(0.5+SIGN(0.5,XMAX))    74
000076      000      MINYI=(YMIN/TENE)-(0.5+SIGN(0.5,-YMIN))    75
000077      000      MINXI=(XMIN/TENX)-(0.5+SIGN(0.5,-XMIN))    76
000078      000      YFIRST=TENF*FLOAT(MAXYI)    77
000079      000      XFIRST=TENX*FLOAT(MINXI)    78
000080      000      LINES=10*(MAXYI-MINYI)+1    79
000081      000      KOLS=20*(MAXXI-MINXI)    80
000082      000      IF (KOLS=500) 230,230,220    81
000083      000      220      WRITE (6,490) KOLS    82
000084      000      KOLS=500    83
000085      000      230      IF (LINES=401) 250,250,240    84
000086      000      240      WRITE (6,500)    85
000087      000      RETURN    86
000088      000      CONTINUE    87
000089      000      LEAF=(KOLS+99)/100    88
000090      000      DO 430 L=1,LEAF    89
000091      000      DO 260 I=1,6    90
000092      000      PX(I)=5.*TENX*FLOAT(L-1)+TENX*FLOAT(I-1)+XFIRST    91
000093      000      260      CONTINUE    92
000094      000      WRITE (6,440) CARD1    93
000095      000      WRITE (6,480) PX    94
000096      000      WRITE (6,470)    95
000097      000      DEX=XACT/2.0    96
000098      000      DEL=EXACT/2.0    97
000099      000      DDD=DEX+2.0*XACT    98
000100      000      J=1    99
000101      000      DO 420 I=1,LINES    100
000102      000      YPLOT=YFIRST-EXACT*FLOAT(I-1)    101
000103      000      DO 270 JK=1,107    102
000104      000      ALF(JKL)=RLANK    103
000105      000      280      IF (J-N) 290,290,380    104
000106      000      290      IF (XYM(1,I)-PX(1)) 370,300,300    105
000107      000      300      CONTINUE    106
000108      000      IF (XYM(2,I)-(YPLOT+DEL)) 310,310,380    107
000109      000      310      IF (XYM(2,I)-(YPLOT-DEL)) 380,320,320    108
000110      000      320      CONTINUE    109

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***** PICTURE *****

000111	000	IF (XYM(1,J)-PX(6)-DDD) 330,330,370	110
000112	000	CONTINUE	111
000113	000	KOL=INT((XYM(1,J)+DEX-PX(1))/XACT)+4	112
000114	000	IF ((KOL.GT.107).OR.(KOL.LT.1)) GO TO 370	113
000115	000	IXYM3J=IXYM(3,J)	114
000116	000	ILFKOL=ILF(KOL)	115
000117	000	IF (ILFKOL.EQ.LANKBA) GO TO 360	116
000118	000	ISYM1=0	117
000119	000	ISYM2=0	118
000120	000	DO 340 IIYY=1,5	119
000121	000	IF (ILFKOL.EQ.ISYM(IIYY)) ISYM1=IIYY	120
000122	000	IF (IXYM3J.EQ.ISYM(IIYY)) ISYM2=IIYY	121
000123	000	340 CONTINUE	122
000124	000	ISYMM=MIND(ISYM1,ISYM2)	123
000125	000	IF (ISYMM) 370,370,350	124
000126	000	350 ILF(KOL)=ISYM(ISYMM)	125
000127	000	GO TO 370	126
000128	000	360 ALF(KOL)=XYM(3,J)	127
000129	000	370 J=J+1	128
000130	000	GO TO 280	129
000131	000	380 CONTINUE	130
000132	000	IF (MOD(I-1,10).NE.0) GO TO 390	131
000133	000	WRITE (6,450) YPLOT,ALF	132
000134	000	GO TO 410	133
000135	000	390 IF (MOD(I-1,5).NE.0) GO TO 400	134
000136	000	WRITE (6,510) ALF	135
000137	000	GO TO 410	136
000138	000	400 WRITE (6,460) ALF	137
000139	000	410 CONTINUE	138
000140	000	420 CONTINUE	139
000141	000	WRITE (6,470)	140
000142	000	WRITE (6,480) PX	141
000143	000	430 CONTINUE	142
000144	000	RETURN	143
000145	000	C	144
000146	000	C	145
000147	000	C	146
000148	000	440 FORMAT (/////////////10X,19A4,A2//)	
000149	000	450 FORMAT (1X,F9.3,2H *,107A1,1H*)	
000150	000	460 FORMAT (11X,1H1,107A1,1H1)	
000151	000	470 FORMAT (1H0,14X,1H*,5(20H - - - + - - - *),/1H)	
000152	000	480 FORMAT (11X,F7.2,*5(13X,F7.2))	
000153	000	490 FORMAT (48H0ONLY THE FIRST 500 COLUMNS OF A PLOT REQUIRING 13.25H 1COLUMNS WILL BE PRINTED.)	152
000154	000	500 FORMAT(1X,'THERE IS A LIMIT OF 400 LINES!')	153
000155	000	510 FORMAT (11X,1H*,107A1,1H*)	
000156	000	END	
000157	000		-

END ELT.

BHDG,P ***** D *****

***** Q *****

•ELT.L IMINT.Q

000001 000 FUNCTION Q (B,C)
000002 000 C THIS FUNCTION IS CALLED BY SORT
000003 000 DIMFNSION H(5), C(5)
000004 000 Q=C(2)-H(?)
000005 000 RETURN
000006 000 END

END ELT.

•HDG,P ***** REGR *****

2
3
4
•

***** REGR *****

@ELT,L IMINT,REGR

```
000001    000      FUNCTION REGR(M,K,Y,N+A+B)
000002    000      C      THIS FUNCTION IS CALLED BY REGRES AND CALLS SIMUL
000003    000      C      FUNCTION PEGR, WHICH CARRIES OUT AN NTH-ORDER POLYNOMIAL
000004    000      C      REGRESSION ON M DATA POINTS CONTAINED IN THE X AND Y ARRAYS.
000005    000      C      THE FUNCTION NORMALLY RETURNS THE STANDARD DEVIATION S OF THE
000006    000      C      POINTS AROUND THE REGRESSION CURVE. THE REGRESSION COEFFICIENTS
000007    000      C      ARE PLACED IN A AND B(1)...B(N). HOWEVER, IF THE SIMULTANEOUS
000008    000      C      EQUATION SOLVING POUTINE SIMUL ENCOUNTERS A NEAR-SINGULAR
000009    000      C      MATRIX, THE FUNCTION RETURNS THE VALUE 0.0
000010    000      C
000011    000      C.....MATRIX CONTAINING THE COEFFICIENTS
000012    000      C      CYX.....C(I,Y) VECTOR
000013    000      C      CYY.....C(Y,Y) VECTOR
000014    000      C      DET.....DETERMINANT OF THE COEFFICIENT MATRIX C.
000015    000      C      EPS.....TOLERANCE USED BY THE FUNCTION SIMUL
000016    000      C      SIMUL....FUNCTION FOR SOLVING SIMULTANEOUS EQUATIONS
000017    000      C      SX,SYX...VECTOR CONTAINING SUMMATIONS X*I AND X**I * Y
000018    000      C      SY,SYY...VECTOR CONTAINING SUMMATIONS Y AND Y**2
000019    000      C
000020    000      C      DIMENSION C(51,51),SX(100),SYX(51),CYX(51),X(100),Y(100),R(51)
000021    000      C      DATA EPS/ 1.0E-20/
000022    000      C      DATA MM/100/,NN/51/
000023    000      C
000024    000      C      .... COMPUTE SUMS OF POWERS AND PRODUCTS .....
000025    000      C      NTWO=2*N
000026    000      C      NP1=N+1
000027    000      C      SY=0.0
000028    000      C      SYY=0.0
000029    000      C      DO 100 I=1,N
000030    000      C      NP1=N+I
000031    000      C      SX(I)=0.0
000032    000      C      SX(NP1)=0.0
000033    000      100    SYX(I)=0.0
000034    000      C      DO 120 J=1,M
000035    000      C      SY=SY+Y(J)
000036    000      C      SYY=SYY+Y(J)**2
000037    000      C      DUM=1.0
000038    000      C      DO 110 J=1,N
000039    000      C      DUM=DUM*X(J)
000040    000      C      SX(J)=SX(J)+DUM
000041    000      110    SYX(J)=SYX(J)+Y(I)*DUM
000042    000      C      DO 120 J=NP1,NTWO
000043    000      C      DUM=DUM*X(I)
000044    000      120    SX(J)=SX(J)+DUM
000045    000      C
000046    000      C      .... COMPUTE COEFFICIENTS C(I+J) .....
000047    000      C      FM=FLOAT(M)
000048    000      C      CYY=SYY-SY*SY/FM
000049    000      C      DO 130 I=1,N
000050    000      C      CYX(I)=SYX(I)-SY*SX(I)/FM
000051    000      C      C(I,NP1)=CYX(I)
000052    000      C      DO 130 J=1,N
000053    000      C      IPJ=I+J
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***** REGRES *****

000054    000    130    C(I,J)=SX(IPJ)-SX(I)*SX(J)/FM      53
000055    000    C
000056    000    C      ..... CALL ON SIMUL TO SOLVE SIMULTANEOUS EQUATIONS .... 54
000057    000    DET=SIMUL(N,C,B,EPS,I,NN)                      55
000058    000    WRITE (6,160) DET                                56
000059    000    IF (DET.NE.0.0) GO TO 140                         57
000060    000    REGRE=0.0                                       58
000061    000    RETURN                                         59
000062    000    C
000063    000    C      ..... COMPUTE INTERCEPT A AND STANDARD DEVIATION S .... 60
000064    000    140    DUM=SY                                     61
000065    000    TEMP=CYY                                    62
000066    000    DO 150 I=1,N                               63
000067    000    DUM=DUM-R(I)*SX(I)                         64
000068    000    150    TEMP=TEMP-R(I)*CYX(I)                  65
000069    000    A=DUM/FM                                    66
000070    000    DENOM=FLOAT(M)-FLOAT(N)-1.0                 67
000071    000    S=AHS(TEMP/DENOM)                           68
000072    000    S=DSQRT(S)                                 69
000073    000    IF (S.EQ.0.) S=EPS                         70
000074    000    REGRE=S                                  71
000075    000    RETURN                                         72
000076    000    C
000077    000    C
000078    000    C
000079    000    160    FORMAT (13H0      DET = ,E14.8)          73
000080    000    END                                           74
                                         -

```

END ELT.

@HDG,P ***** REGRES *****

***** RFRGRFS *****

DELT+L IMAINT,REGRES

000001	000	SUBROUTINE REGRES (ATEMP)	1
000002	000	C THIS ROUTINE IS CALLED BY INH AND CALIS PICTUR AND REGR	
000003	000	C POLYNOMIAL REGRESSION WITH PLOTTING.	
000004	000	C	
000005	000	C THIS MAIN PROGRAM READS THE HORIZONTAL AND VERTICAL COORDINATES	6
000006	000	C OF 'M' DATA POINTS INTO THE X AND Y ARRAYS. THE LEAST AND	7
000007	000	C GREATEST VALUES OF X SHOULD BE STORED IN X(1) AND X(M) RESPEC-	8
000008	000	C TIVELY. THE FUNCTION REGR IS USED TO PERFORM SUCCESSIVE NTH-	9
000009	000	C ORDER REGRESSIONS, FROM N = MIN THROUGH N = MAX. IN EACH	10
000010	000	C CASE, THE REGRESSION CURVE IS PLOTTED AGAINST THE ORIGINAL	11
000011	000	C DATA POINTS.	12
000012	000	C	13
000013	000	C A.....REGRESSION COEFFICIENT(INTERCEPT)	14
000014	000	C B.....VECTOR CONTAINING REGRESSION COEFFICIENTS	15
000015	000	C DELTAX...X-SPACING FOR 26 POINTS ON THE REGRESSION CURVE	16
000016	000	C M.....NUMBER OF DATA POINTS	17
000017	000	C MAX,MIN..UPPER AND LOWER LIMITS ON ORDER OF REGRESSION	18
000018	000	C N.....ORDER, N, OF POLYNOMIAL REGRESSION	19
000019	000	C REGR....FUNCTION FOR PERFORMING NTH ORDER REGRESSION	20
000020	000	C S.....STANDARD DEVIATION OF THE POINTS ABOUT THE REGRESSION	21
000021	000	C LINE. IF SIMUL ENCOUNTERS A NEAR-SINGULAR MATRIX, S IS	22
000022	000	C RETURNED ZERO AS A WARNING.	23
000023	000	C X,Y.....VECTORS CONTAINING THE X AND Y COORDINATES OF THE DATA	
000024	000	C POINTS.	25
000025	000	C	
000026	000	COMMON /TAPES/N5,N6,N7,N18,N20,N22,N24	
000027	000	C *** HYDEND IS A SPECIAL CASE FOR THE EPA PESTICIDE STUDY ***	
000028	000	COMMON /NFW/ I,J,K,CHK,XM(20),YM(20),HYDEND	
000029	000	DIMENSION ARRAY(50)	27
000030	000	DIMENSION X(100),Y(100),R(55),ARK(100),ISYM(5),CARD4(20)	
000031	000	DIMENSION ATEMP(10)	29
000032	000	C *** HYDEND IS A SPECIAL CASE FOR THE EPA PESTICIDE STUDY ***	
000033	000	NAMELIST /CARD1/ M,MIN,MAX,X,Y,HYDEND	
000034	000	DATA STAR/1H*/	31
000035	000	DATA ASTER/4H****/	
000036	000	DATA CONST/4H CON/	
000037	000	DATA ARRAY/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,2H10,2H11,2H12,2H13	33
000038	000	1,2H14,2H15,2H16,2H17,2H18,2H19,2H20,2H21,2H22,2H23,2H24,2H25,2H26,	34
000039	000	2H27,2H28,2H29,2H30,2H31,2H32,2H33,2H34,2H35,2H36,2H37,2H38,2H39,2	35
000040	000	3H40,2H41,2H42,2H43,2H44,2H45,2H46,2H47,2H48,2H49,2H50/	36
000041	000	DATA MMM/100/,NN/55/,III/25/,JJJ/100/	
000042	000	C	38
000043	000	C CARD1 IS TITLE CARD FOR PLOTTING	
000044	000	C READ AND CHECK COORDINATES X(1)...X(M), Y(1)...Y(M),	
000045	000	C AND LOWEST AND HIGHEST ORDERS MIN AND MAX	
000046	000	C	42
000047	000	C CHK IS A DUMMY VARIABLE	
000048	000	C CHK = 1 REGRES WAS CALLED TO FIND H FOR Q VS T AND H VS T DAM	
000049	000	C CHK = 2 REGRES WAS CALLED TO FIND Q FOR Q VS T AND H VS T DAM	
000050	000	C CHK = 3 RFRGRFS WAS CALLED TO EVALUATE HYDROGRAPH NODES	
000051	000	A=0.0	43
000052	000	DO 100 I=1,NN	44
000053	000	B(I)=0.0	45

***** RFGRFS *****

000054	000	READ (N5,310) CARD4	46
000055	000	WRITE (6,310) CARD4	47
000056	000	IF (CARD4(1).NE.CONST) GO TO 110	
000057	000	DECODE (18,220,CARD4(1)) A	
000058	001	IF (CHK.EQ.3.) GO TO 105	
000059	001	GO TO (200,200,101,102,103,104),IJK	
000060	001	C	
000061	001	C Q IS CONSTANT (Q VS H)	
000062	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000063	000	101 AM=A	
000064	000	A=35.314*A	
000065	000	GO TO 200	
000066	000	C	
000067	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000068	000	102 AM=A	
000069	000	IF (CHK .EQ. 2.) GO TO 202	
000070	000	C H IS CONSTANT (Q VS T AND H VS T)	
000071	000	A=3.28*A	
000072	000	GO TO 200	
000073	000	C	
000074	000	C Q IS CONSTANT (Q VS T AND H VS T)	
000075	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000076	000	202 A=35.314*A	
000077	000	GO TO 200	
000078	000	C	
000079	000	C H IS CONSTANT (H VS T)	
000080	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000081	000	103 AM=A	
000082	000	A=3.28*A	
000083	000	GO TO 200	
000084	000	C	
000085	000	C Q IS CONSTANT (Q VS T)	
000086	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000087	000	104 AM=A	
000088	000	A=35.314*A	
000089	000	GO TO 200	
000090	000	C	
000091	000	C HYDROGRAPH INPUT IS CONSTANT	
000092	000	C STORE MFTRIC VALUE IN AM. CONVERT A TO ENGLISH UNITS	
000093	000	105 AM=A	
000094	000	A=35.314*A	
000095	000	GO TO 200	
000096	000	C*****THE FOLLOWING ELEMENT MUST BE REMADE IN THE PROGRAM, SEE APPENDIX	50
000097	000	C*****G.7 IN FORTRAN(ASCII) MANUAL. TO ALLOW A NAMELIST READ FROM A	51
000098	000	C*****LOGICAL UNIT OTHER THAN 5 ON THE UNIVAC 1100.	52
000099	000	C***** NASM,SI IMAINT,FPSCT	53
000100	000	C***** FPSCT 33.111,0	54
000101	000	C***** END	55
000102	000	110 READ (N5,CARD1,FRR=211,END=212)	56
000103	000	IF (MAX.LT.MIN) MAX=MIN	57
000104	000	IF (MIN.GE.(M-1)) GO TO 120	58
000105	000	IF (MAX.GE.(M-1)) MAX=M-1	59
000106	000	GO TO 1201	60
000107	000	120 MAX=M-1	61
000108	000	MIN=MAX	62
000109	000	1201 IF (CHK .EQ. 3.) GO TO 125	63
000110	000	C CHECK THE TYPE OF CONTROLLED NODE	64

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***** RFGRES *****
000111    000      GO TO (130,130,121,122,123,124), IJK
000112    000      121 CONTINUE
000113    000      C   Q VS H
000114    000      DO 221 I=1,M
000115    000      XM(I)=X(I)
000116    000      YM(I)=Y(I)
000117    000      X(I)=3.28*X(I)
000118    000      221 Y(I)=35.314*Y(I)
000119    000      GO TO 130
000120    000      122 CONTINUE
000121    000      C   H VS T AND Q VS T
000122    000      IF(CHK .GT. 1.) GO TO 322
000123    000      C   CONVERT H FROM METERS TO FEET
000124    000      DO 222 I=1,M
000125    000      XM(I)=X(I)
000126    000      YM(I)=Y(I)
000127    000      222 X(I)=3.28*X(I)
000128    000      GO TO 130
000129    000      322 CONTINUE
000130    000      IF (CHK .GT. 2.) GO TO 125
000131    000      C   CONVERT Q FROM CMS TO CFS
000132    000      DO 422 I=1,M
000133    000      XM(I)=X(I)
000134    000      YM(I)=Y(I)
000135    000      422 X(I)=35.314*X(I)
000136    000      GO TO 130
000137    000      123 CONTINUE
000138    000      C   H VS T
000139    000      C   CONVERT H FROM METERS TO FEET
000140    000      DO 223 I=1,M
000141    000      XM(I)=X(I)
000142    000      YM(I)=Y(I)
000143    000      223 X(I)=3.28*X(I)
000144    000      GO TO 130
000145    000      124 CONTINUE
000146    000      C   Q VS T
000147    000      C   CONVERT Q FROM CMS TO CFS
000148    000      DO 224 I=1,M
000149    000      XM(I)=X(I)
000150    000      YM(I)=Y(I)
000151    000      224 X(I)=35.314*X(I)
000152    000      GO TO 130
000153    000      125 CONTINUE
000154    000      C   HYDROGRAPH NODE INFORMATION
000155    000      C   CONVERT FLOWS FROM CMS TO CFS
000156    000      DO 225 I=1,M
000157    000      XM(I)=X(I)
000158    000      YM(I)=Y(I)
000159    000      225 Y(I)=35.314*Y(I)
000160    000      130 CONTINUE
000161    000      IF (MIN.LF.0) MIN=1
000162    000      IF (MAX.LF.0) MAX=1
000163    000      IF(CARD4(19).EQ.ASTER) GO TO 140
000164    000      C
000165    000      WRITE(6,260) M,(XM(I)*YM(I),I=1,M)      58
000166    000      WRITE(6,270) MIN,MAX                      59
000167    000      140 CONTINUE                                60
                                                62
                                                65

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***** REGRES *****

000168      000      DO 150 I=1,M          66
000169      000      ARK(I)=STAR          67
000170      000      ISYM(1)=STAR          68
000171      000      DO 190 N=MIN,MAX        69
000172      000      IF(CARD4(19).EQ.ASTER) GO TO 160
000173      000      WRITE (6,250) CARD4          71
000174      000      WRITE (6,280) N          72
000175      000      160 CONTINUE          73
000176      000      C
000177      000      C      USE FUNCTION REGR TO PERFORM NTH-ORDER REGRESSION 74
000178      000      C
000179      000      S=REGR(M,X,Y,N,A+B)          76
000180      000      IF (S.NE.0.0) GO TO 170          77
000181      000      WRITE (6,290) CARD4          78
000182      000      GO TO 190          79
000183      000      170 CONTINUE          80
000184      000      IF(CARD4(19).EQ.ASTER) GO TO 190
000185      000      WRITE(6,300) S,AM+(I,B(I),I=1,N)          81
000186      000      C
000187      000      C      COMPUTE 26 POINTS LYING ON REGRESSION CURVE 84
000188      000      C
000189      000      DELTAX=(X(M)-X(1))/25.0          86
000190      000      MP1=M+1          87
000191      000      MP26=M+26          88
000192      000      DO 180 I=MP1,MP26          89
000193      000      STEPS=FLOAT(I)-FLOAT(M)-1.0          90
000194      000      X(I)=X(1)+STEPS*DELTAX          91
000195      000      Y(I)=A          92
000196      000      ARK(I)=ARRAY(N)          93
000197      000      DO 180 J=1,N          94
000198      000      180 Y(I)=Y(I)+B(J)*X(I)**J          95
000199      000      ISYM(2)=ARRAY(N)          96
000200      000      C
000201      000      C      PLOT REGRESSION CURVE AGAINST ORIGINAL POINTS 97
000202      000      C
000203      000      CALL PICTUR (M+26,III,JJ,I,X,Y,ARK,ISYM,CARD4)          98
000204      000      190 CONTINUE          100
000205      000      200 CONTINUE          101
000206      000      ATEMP(I)=A          102
000207      000      DO 210 I=2,10          103
000208      000      210 ATEMP(I)=B(I-1)          104
000209      000      RETURN          105
000210      000      211 WRITE (6,230) CARD4          106
000211      000      STOP          107
000212      000      212 WRITE (6,240) CARD4          108
000213      000      STOP          109
000214      000      C
000215      000      C      FORMATS FOR INPUT AND OUTPUT STATEMENTS 110
000216      000      C
000217      000      C
000218      000      C
000219      000      220 FORMAT (6X,F12.1)
000220      000      230 FORMAT (' ERROR IN NAMFLIST INPUT TO REGRES //,20A4)
000221      000      240 FORMAT (' END OF FILE ENCOUNTERED IN REGRES //,20A4)
000222      000      250 FORMAT (1H //20A4)
000223      000      260 FORMAT (34H POLYNOMIAL REGRESSION, WITH M = ,12.12H DATA POINTS// 121
000224      000      18X,5H X(I),8X,5H Y(I)//(2F13.2))          122

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***** REGRES *****

000225	000	270	FORMAT (58H0 THE LOWEST AND HIGHEST ORDER POLYNOMIALS TO BE TRIED	123
000226	000		IARE//6X,7H MIN = ,I3,5X,7H MAX = ,I3)	124
000227	000	280	FORMAT (32H POLYNOMIAL REGRESSION OF ORDER/IH0,5X,7H N = ,I3)	125
000228	000	290	FORMAT (69H0 MATRIX C IS NEAR-SINGULAR. REGRESSION COEFFICIENTS	126
000229	000		1NOT DETERMINED/IH 20A4)	-
000230	000	300	FORMAT (1H0,5X,5H S = ,F10.6/6X,5H A = ,F10.6//(6X,3H B(,I2,4H) =	128
000231	000		1,F11.6)	129
000232	000	310	FORMAT (20A4)	-
000233	000		END	-

END ELT.

@HDG,P ***** STMUL *****

***** SIMUL *****

ELT,L IMANT,SIMUL

000001	000	FUNCTION SIMUL (N,A,X,EPS,INDIC,NRC)	?
000002	000	C THIS FUNCTION IS CALLED BY REGR	4
000003	000	C	5
000004	000	C WHEN INDIC IS NEGATIVE, SIMUL COMPUTES THE INVERSE OF THE N BY	3
000005	000	C N MATRIX A IN PLACE. WHEN INDIC IS ZERO, SIMUL COMPUTES THE	4
000006	000	C N SOLUTIONS X(1)...X(N) CORRESPONDING TO THE SET OF LINEAR	5
000007	000	C EQUATIONS WITH AUGMENTED MATRIX OF COEFFICIENTS IN THE N BY	6
000008	000	C N+1 ARRAY A AND IN ADDITION COMPUTES THE INVERSE OF THE	7
000009	000	C COEFFICIENT MATRIX IN PLACE AS ABOVE. IF INDIC IS POSITIVE,	8
000010	000	C THE SET OF LINEAR EQUATIONS IS SOLVED BUT THE INVERSE IS NOT	9
000011	000	C COMPUTED IN PLACE. THE GAUSS-JORDAN COMPLETE ELIMINATION METHOD	10
000012	000	C IS EMPLOYED WITH THE MAXIMUM PIVOT STRATEGY. ROW AND COLUMN	11
000013	000	C SUBSCRIPTS OF SUCCESSIVE PIVOT ELEMENTS ARE SAVED IN ORDER IN	12
000014	000	C THE IROW AND JCOL ARRAYS RESPECTIVELY. K IS THE PIVOT COUNTER.	13
000015	000	C PIVOT THE ALGEBRAIC VALUE OF THE PIVOT ELEMENT, MAX	14
000016	000	C THE NUMBER OF COLUMNS IN A AND DETERMINE THE DETERMINANT OF THE	15
000017	000	C COEFFICIENT MATRIX. THE SOLUTIONS ARE COMPUTED IN THE (N+1)TH	16
000018	000	C COLUMN OF A AND THEN UNSCRAMBLED AND PUT IN PROPER ORDER IN	17
000019	000	C X(1)...X(N) USING THE PIVOT SUBSCRIPT INFORMATION AVAILABLE	18
000020	000	C IN THE IROW AND JCOL ARRAYS. THE SIGN OF THE DETERMINANT IS	19
000021	000	C ADJUSTED, IF NECESSARY, BY DETERMINING IF AN ODD OR EVEN NUMBER	20
000022	000	C OF PAIRWISE INTERCHANGES IS REQUIRED TO PUT THE ELEMENTS OF THE	21
000023	000	C JORD ARRAY IN ASCENDING SEQUENCE WHERE JORD(IROW(I)) = JCOL(I).	22
000024	000	C IF THE INVERSE IS REQUIRED, IT IS UNSCRAMBLED IN PLACE USING	23
000025	000	C Y(1)...Y(N) AS TEMPORARY STORAGE. THE VALUE OF THE DETERMINANT	24
000026	000	C IS RETURNED AS THE VALUE OF THE FUNCTION. SHOULD THE PIVOT	25
000027	000	C PIVOT OF LARGEST MAGNITUDE BE SMALLER IN MAGNITUDE THAN EPS,	26
000028	000	C THE MATRIX IS CONSIDERED TO BE SINGULAR AND A TRUE ZERO IS	27
000029	000	C RETURNED AS THE VALUE OF THE FUNCTION.	28
000030	000	C	29
000031	000	C A.....AUGMENTED MATRIX OF COEFFICIENTS, A=(AIJ)	30
000032	000	C DETER....DETERMINANT OF THE ORIGINAL COEFFICIENT MATRIX	31
000033	000	C EPS.....MINIMUM ALLOWABLE MAGNITUDE FOR A PIVOT ELEMENT	32
000034	000	C I,J.....ROW AND COLUMN SUBSCRIPTS, RESP.	33
000035	000	C TNDTC....COMPUTATIONAL SWITCH	34
000036	000	C MAX.....NUMBER OF COLUMNS IN A, EITHER N OR N+1	35
000037	000	C N.....NUMBER OF ROWS IN A	36
000038	000	C X.....VECTOR OF SOLUTIONS	37
000039	000	C	38
000040	000	C AIJCK....ATC(K)	39
000041	000	C INTCH....NUMD	40
000042	000	C INTCH....NUMBER OF PAIRWISE INTERCHANGES REQD TO ORDER J-VECTOR	41
000043	000	C IPI,KM1,NM1...I+1, K-1, AND N-1, RESP.	41
000044	000	C IROW....VECTOR OF PIVOT ELEMENT ROW SUBSCRIPTS, R(K)	42
000045	000	C ICOL....VECTOR OF PIVOT ELEMENT COLUMN SUBSCRIPTS, C(K)	43
000046	000	C IROW1,IROWJ,IROWK	44
000047	000	C JC0LT,JC0LJ,JC0LK...R(I),R(J),R(K),C(I),C(J),C(K), RESP.	45
000048	000	C ISCAN,JSCAN....INDICES USED IN PIVOT SEARCH OF VECTORS C AND R	46
000049	000	C JORD....THE J VECTOR	47
000050	000	C JTEMP....TEMPORARY VARIABLE USED IN ORDERING THE J VECTOR	48
000051	000	C K.....CYCLE COUNTER AND PIVOT ELEMENT SUBSCRIPT	49
000052	000	C NRC....ROW AND COLUMN DIMENSIONS OF STORAGE FOR THE A-MATRIX	50
000053	000	C PIVOT....PIVOT ELEMENT	51

***** SIMUL *****

000054	000	C	Y.....VECTOR USED IN UNSCRAMBLING THE INVERSE MATRIX	53
000055	000	C		54
000056	000		DIMENSION IROW(50),JCOL(50),IORD(50),Y(50),A(NRC,NRC),X(50)	55
000057	000	C		56
000058	000		MAX=N	57
000059	000		IF (INDIC.GE.0) MAX=N+1	58
000060	000	C		59
000061	000	C	.....IS N LARGER THAN 50	60
000062	000		IF (N.LE.50) GO TO 100	61
000063	000		WRITE (6,240)	62
000064	000		SIMUL=0.	63
000065	000		RETURN	64
000066	000	C		65
000067	000	C	..... BEGIN ELIMINATION PROCEDURE	66
000068	000	100	DETER=1.	67
000069	000		DO 170 K=1,N	68
000070	000		KM1=K-1	69
000071	000	C		70
000072	000	C	..... SEARCH FOR THE PIVOT ELEMENT	71
000073	000		PIVOT=0.	72
000074	000		DO 130 I=1,N	73
000075	000		DO 130 J=1,N	74
000076	000	C	..... SCAN IROW AND JCOL ARRAYS FOR INVALID PIVOT SUBSCRIPTS	75
000077	000		IF (K.EQ.1) GO TO 120	76
000078	000		DO 110 ISCAN=1,KM1	77
000079	000		DO 110 JSCAN=1,KM1	78
000080	000		IF (I.EQ.IROW(ISCAN)) GO TO 130	79
000081	000	110	IF (J.EQ.JCOL(JSCAN)) GO TO 130	80
000082	000	120	IF (DABS(A(I,J)).LE.DABS(PIVOT)) GO TO 130	81
000083	000		PIVOT=A(I,J)	82
000084	000		IROW(K)=I	83
000085	000		JCOL(K)=J	84
000086	000	130	CONTINUE	85
000087	000	C		86
000088	000	C	..... INSURE THAT SELECTED PIVOT IS LARGER THAN EPS	87
000089	000		IF (DABS(PIVOT).GT.EPS) GO TO 140	88
000090	000		SIMUL=0.	89
000091	000		RETURN	90
000092	000	C		91
000093	000	C	..... UPDATE THE DETERMINANT VALUE	92
000094	000	140	IROWK=IROW(K)	93
000095	000		JCOLK=JCOL(K)	94
000096	000		DETER=DETER*PIVOT	95
000097	000	C		96
000098	000	C	..... NORMALIZE PIVOT ROW ELEMENTS	97
000099	000		DO 150 J=1,MAX	98
000100	000	150	A(IROWK,J)=A(IROWK,J)/PIVOT	99
000101	000	C		100
000102	000	C	..... CARRY OUT ELIMINATION AND DEVELOP INVERSE	101
000103	000		A(IROWK,JCOLK)=1./PIVOT	102
000104	000		DO 170 I=1,N	103
000105	000		AIJCK=A(I,JCOLK)	104
000106	000		IF (I.EQ.IROWK) GO TO 170	105
000107	000		A(I,JCOLK)=-AIJCK/PIVOT	106
000108	000		DO 160 J=1,MAX	107
000109	000	160	A(I,J)=A(I,J)-AIJCK*A(IROWK,J)	108
000110	000	170	CONTINUE	109

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***** STMJ1 *****

000111    000    C
000112    000    C      .... ORDER SOLUTION VALUES (IF ANY) AND CREATE JORD ARRAY .....
000113    000    DO 180 I=1,N
000114    000    IROWI=IROW(I)
000115    000    JCOLI=JCOL(I)
000116    000    JORD(IROWI)=JCOLI
000117    000    180    IF (INDIC.GE.0) X(JCOLT)=A(IROWI,MAX)
000118    000    C
000119    000    C      .... ADJUST SIGN OF DETERMINANT .....
000120    000    TNTCH=0
000121    000    NM1=N-1
000122    000    DO 190 I=1,NM1
000123    000    IP1=I+1
000124    000    DO 190 J=IP1,N
000125    000    IF (JORD(J).GE.JORD(I)) GO TO 190
000126    000    JTEMP=JORD(J)
000127    000    JORD(J)=JORD(I)
000128    000    JORD(I)=JTEMP
000129    000    INTCH=INTCH+1
000130    000    190    CONTINUE
000131    000    IF (INTCH/2*2.NE.INTCH) DETER=-DETER
000132    000    C
000133    000    C      .... IF INDIC IS POSITIVE RETURN WITH RESULTS .....
000134    000    IF (INDIC.LE.0) GO TO 200
000135    000    SIMUL=DETER
000136    000    RETURN
000137    000    C
000138    000    C      .... IF INDIC IS NEGATIVE OR ZERO, UNSCRAMBL THE INVERSE
000139    000    FIRST BY ROWS .....
000140    000    200    DO 220 J=1,N
000141    000    DO 210 I=1,N
000142    000    IROWI=IROW(I)
000143    000    JCOLI=JCOL(I)
000144    000    210    Y(JCOLI)=A(IROWI,J)
000145    000    DO 220 I=1,N
000146    000    220    A(I,J)=Y(I)
000147    000    C      .... THEN BY COLUMNS .....
000148    000    DO 240 I=1,N
000149    000    DO 230 J=1,N
000150    000    IROWJ=IPOW(J)
000151    000    JCOLJ=JCOL(J)
000152    000    230    Y(IROWJ)=A(I+JCOLJ)
000153    000    DO 240 J=1,N
000154    000    240    A(I,J)=Y(J)
000155    000    C
000156    000    C      .... RETURN FOR INDIC NEGATIVE OR ZERO .....
000157    000    SIMUL=DETER
000158    000    RETURN
000159    000    C
000160    000    C      .... FORMAT FOR OUTPUT STATEMENT .....
000161    000    C
000162    000    C
000163    000    C
000164    000    250    FORMAT (10H0N TOO HIGH)
000165    000    END

```

END ELT.

***** SORDER *****

@FLT.L JMAINT.SOPDFP

```
000001      000      FUNCTION SORDER (FIRST,SECOND)
000002      000      C      THIS FUNCTION IS CALLED BY SORT
000003      000      DIMENSION FIRST(3),SECOND(3)
000004      000      SORDER=FIRST(2)-SECOND(2)
000005      000      RETURN
000006      000      END
```

END ELT.

@HDG,P ***** SORT *****

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-

***** SORT *****

@ELT,L IMAINT.SORT

000001	000	SUBROUTINE SORT (M,N,ITEM,Q)	
000002	000	C	THIS ROUTINE IS CALLED BY PICTUR AND CALLS Q AND SORDER
000003	000	C	
000004	000	C	ALGORITHM 245 - TREESORT 3 FROM ACM, DEC. 1964
000005	000	C	VOL 7 NUMBER 12, PAGE 701
000006	000	C	
000007	000	C	PROGRAMMED BY JE SCHLOSSER
000008	000	C	
000009	000	C	
000010	000	C	GENERAL PURPOSE INTERNAL SORT SUBROUTINE
000011	000	C	
000012	000	C	EXAMPLE OF USE - - - ASSUME - N ITEMS OF 5 WORDS EACH
000013	000	C	TO BE SORTED IN ASCENDING
000014	000	C	ORDER ON THE SECOND WORD.
000015	000	C	MAIN PROGRAM
000016	000	C	DIMENSION A(5,1000) N IS LESS THAN OR EQUAL TO 1000
000017	000	C	A CONTAINS THE ITEMS TO BE SORTED
000018	000	C	
000019	000	C	EXTERNAL Q Q IS A FUNCTION SURROUTINE WHICH WILL RETURN
000020	000	C	*
000021	000	C	A POSITIVE NUMBER IF THE FIRST ITEM (FIRST
000022	000	C	ARGUMENT) IS TO SORT AHEAD OF THE SECOND
000023	000	C	ITEM (SECOND ARGUMENT). SEE EXAMPLE BELOW.
000024	000	C	
000025	000	C	CALL SORT (A,N,5,Q) ARGUMENT MEANING
000026	000	C	*
000027	000	C	FIRST ARRAY CONTAINING ITEMS
000028	000	C	*
000029	000	C	SECOND NUMBER OF ITEMS
000030	000	C	*
000031	000	C	THIRD NUMBER OF WORDS PFR ITEM
000032	000	C	*
000033	000	C	FOURTH FUNCTION SUBROUTINE TO
000034	000	C	*
000035	000	C	DEFINE SORT ORDER
000036	000	C	
000037	000	C	
000038	000	C	FUNCTION Q(B,C) WRITE A FUNCTION SURROUTINE SUCH AS THIS.
000039	000	C	DIMENSION B(5),C(5) IT SHOULD RETURN A POSITIVE RESULT IF
000040	000	C	Q=C(2)-B(2) THE FIRST ARGUMENT SHOULD SORT AHEAD
000041	000	C	OF THE SECOND ARGUMENT. THIS ROUTINE
000042	000	C	RETURNS PRODUCES AN ASCENDING SORT ON THE SECOND
000043	000	C	END WORD OF THE ITEMS.
000044	000	C	
000045	000	C	NOTE - - THE MAXIMUM NUMBER OF WORDS PFR ITEM IS LIMITED
000046	100	C	BY THE UTIMENSION OF KOPY. THIS LIMIT IS PRESENTLY 100.
000047	000	C	
000048	000	C	APPROXIMATE SPEED IS 250 ITEMS PFR SECOND.
000049	110	C	INTEGER 0
000050	000	C	DIMENSION KOPY (100)
000051	000	C	DIMENSION M(ITEM*N)
000052	000	C	IF (N-1) 320,320+100
000053	000	C	K=N/2+1
		C	L=N/2-1
		C	IF (L) 210,210+110
		C	CONTINUE
		C	DO 200 II=1,I
		C	I=K-II
		C	TSET
		C	ISSET

***** SORT *****

000054	000	DO 120 IQ=1,ITEM	53
000055	000	120 KOPY(IQ)=M(IQ,IS)	54
000056	000	130 J=2*IS	55
000057	000	IF (J.GT.NS) GO TO 180	56
000058	000	IF (J.GE.NS) GO TO 150	57
000059	000	IF (Q(M(1,J+1),M(1,J))) 140,150,150	58
000060	000	140 J=J+1	59
000061	000	150 IF (Q(M(1,J),KOPY)) 160,180,180	60
000062	000	160 DO 170 IQ=1,ITEM	61
000063	000	170 M(IQ,IS)=M(IQ,J)	62
000064	000	IS=J	63
000065	000	GO TO 130	64
000066	000	180 DO 190 IQ=1,ITEM	65
000067	000	190 M(IQ,IS)=KOPY(IQ)	66
000068	000	200 CONTINUE	67
000069	000	210 NPLUS=N+2	68
000070	000	DO 310 II=2,N	69
000071	000	I=NPLUS-II	70
000072	000	IS=1	71
000073	000	NS=I	72
000074	000	DO 220 IQ=1,ITEM	73
000075	000	220 KOPY(IQ)=M(IQ,IS)	74
000076	000	230 J=2*IS	75
000077	000	IF (J.GT.NS) GO TO 280	76
000078	000	IF (J.GE.NS) GO TO 250	77
000079	000	IF (Q(M(1,J+1),M(1,J))) 240,250,250	78
000080	000	240 J=J+1	79
000081	000	250 IF (Q(M(1,J),KOPY)) 260,280,280	80
000082	000	260 DO 270 IQ=1,ITEM	81
000083	000	270 M(IQ,IS)=M(IQ,J)	82
000084	000	IS=J	83
000085	000	GO TO 230	84
000086	000	280 DO 290 IQ=1,ITEM	85
000087	000	290 M(IQ,IS)=KOPY(IQ)	86
000088	000	DO 300 IT=1,ITEM	87
000089	000	LAZY=M(IT,1)	88
000090	000	M(IT,1)=M(IT,I)	89
000091	000	M(IT,I)=LAZY	90
000092	000	300 CONTINUE	91
000093	000	310 CONTINUE	92
000094	000	320 CONTINUE	93
000095	000	RETURN	94
000096	000	END	-

END ELT.

JHDP,P ***** TIDE *****

***** TIDE *****

@FLT.L IMINT.TIDE

```
000001      000      SUBROUTINE TIDE (FEET)
000002      000      C   THIS ROUTINE IS CALLED BY INH AND CALLS GAUSS
000003      000      C   THIS PROGRAM USES GAUSSIAN ELIMINATION TO GENERATE
000004      000      C   AN EXPRESSION FOR TIDAL HEIGHT
000005      000      C
000006      000      C
000007      000      C   INPUT CONSISTS OF TCYC, THE LENGTH OF THE TIDAL CYCLE IN HOURS,
000008      000      C   AS WELL AS THE HEIGHT IN METERS OF THE HIGH HIGH, LOW LOW,
000009      000      C   LOW HIGH, AND HIGH LOW TIDES.  THE TIMES AT WHICH THESE TIDES
000010      000      C   OCCUR ARE INPUT IN DECIMAL FORM AND STORED IN THE ARRAY 'T',
000011      000      C   WHILE THE HEIGHTS ARE STORED IN THE ARRAY 'TIDH'
000012      000      C   DIMENSION A(8,9), T(4), TIDH(4), THETA(4), RESULT(8), FEET(8)
000013      000      C   DIMENSION TITLE(33), TT(50), YY(50)
000014      000      COMMON /PTINT/ NJ, NC, NJGW, NTCYC, NQSWRT, NQCYC, DELTQ, PERIOD,
000015      000      1ALPHA(30), DEP(70), IPOINT(70,6), AS(70), EVAP
000016      000      COMMON /NEW/ IJK, CHK, XM(20), YM(20)
000017      000      EQUIVALENCE (TT(4), T(4)), (TIDH(4), YY(4))
000018      000      C   ##### NAMELIST CARDS FOR INPUT OF DATA      *****
000019      000      NAMELIST /CARD1/ TT, YY
000020      000      C   SET N5=1 SO THAT INPUT WILL BE FROM SCRATCH FILE
000021      000      N5=1
000022      000      N6=6
000023      000      C   SET LENGTH OF CYCLE
000024      000      TCYC=PERIOD
000025      000      READ (N5,320) (TITLE(I), I=1,20)
000026      000      WRITE (N6,330) (TITLE(I), I=1,20)
000027      000      READ (N5,CARD1,FRR=291,END=292)
000028      000      C   CONVERT TIMES TO ANGLES IN RADIANS
000029      000      DO 10 IA=1,4
000030      000      10 THETA(IA)=T(IA)*2.*3.14159/TCYC
000031      000      C   SET UP MATRIX 'A' OF COEFFICIENTS
000032      000      DO 30 IB=1,8
000033      000      IC=IB-4
000034      000      IF (IC .LE. 0) GO TO 20
000035      000      C   FOR EQUATIONS USING F'(X)
000036      000      A(IB+1)=0.0
000037      000      A(IB+2)=-SIN(THETA(IC))
000038      000      A(IB+3)=-2.*SIN(2.*THETA(IC))
000039      000      A(IB+4)=-3.*SIN(3.*THETA(IC))
000040      000      A(IB+5)=COS(THETA(IC))
000041      000      A(IB+6)=2.*COS(2.*THETA(IC))
000042      000      A(IB+7)=3.*COS(3.*THETA(IC))
000043      000      A(IB+8)=4.*COS(4.*THETA(IC))
000044      000      A(IB+9)=0.0
000045      000      GO TO 30
000046      000      C   FOR EQUATIONS USING F(X)
000047      000      20 A(IB+1)=0.5
000048      000      A(IB+2)=COS(THETA(IB))
000049      000      A(IB+3)=COS(2.*THETA(IB))
000050      000      A(IB+4)=COS(3.*THETA(IB))
000051      000      A(IB+5)=SIN(THETA(IB))
000052      000      A(IB+6)=SIN(2.*THETA(IB))
000053      000      A(IB+7)=SIN(3.*THETA(IB))
```

```

***** TIDE *****

000054      000      A(IR,8)=SIN(4.*THETA(IR))
000055      000      A(IR,9)=TIDH(IR)
000056      000      30 CONTINUE
000057      000      C
000058      000      CALL GAUSS (A,RESULT)
000059      000      C
000060      000      DO 35 I=1,8
000061      000      35 FEET(I)=RESULT(I)*3.28
000062      000      WRITE(6,200) TCYC
000063      000      DO 40 ID=1,4
000064      000      40 WRITE(6,300) T(ID), TIDH(ID)
000065      000      C      WRITE OUT THE CALCULATED COEFFICIENTS
000066      000      WRITE(6,400) RESULT
000067      000      WRITE(6,500)
000068      000      C      CALCULATE TIDE HEIGHTS FOR 10 DEGREE INTERVALS THROUGH A FULL TIDE CYCLE
000069      000      DO 50 IC=1,36
000070      000      ANGLE=FLOAT(10*IC)
000071      000      BANGLE=ANGLE*2.*3.14159/360.
000072      000      VALUE=0.5*RESULT(1)+COS(BANGLE)*RESULT(2)+COS(2.*BANGLE)*RESULT(3)
000073      000      1      +COS(3.*BANGLE)*RESULT(4)+SIN(BANGLE)*RESULT(5)+SIN(2.*BANGLE)*
000074      000      2      RESULT(6)+SIN(3.*BANGLE)*RESULT(7)+SIN(4.*BANGLE)*
000075      000      3      RESULT(8)
000076      000      ATIME=(ANGLE/360.)*TCYC
000077      000      50 WRITE(6,600) ANGLE,ATIME,VALUE
000078      000      WRITE(6,601)
000079      000      GO TO 293
000080      000      291 CONTINUE
000081      000      WRITE(6,602)
000082      000      602 FORMAT(2X,'ERROR IN NAMELIST---NO FUNCTION GENERATED')
000083      000      GO TO 293
000084      000      292 CONTINUE
000085      000      WPITE(6,603)
000086      000      603 FORMAT(2X,'END OF FILE ENCOUNTERED IN READING DATA---NO FUNCTION G
000087      000      1ENERATED')
000088      000      293 CONTINUE
000089      000      RETURN
000090      000      320 FORMAT(20A4)
000091      000      330 FORMAT(1H ,20A4)
000092      000      200 FORMAT(2X,'TIDAL CYCLE LASTS',F7.2,1X,'HOURS',//,1X,
000093      000      1'INPUT STAGE TIME PAIRS',/,6X,'HOURS',5X,'METERS')
000094      000      400 FORMAT(1H0,'COEFFICIENTS FOR AN EQUATION OF FORM',6X,'F(X) = 0.5*A
000095      000      11 + A2*COS(THETA) + A3*COS(2*THETA)',/,45X,' + A4*COS(3*THETA) + A
000096      000      25*SIN(THETA) + A6*SIN(2*THETA)',/,45X,' + A7*SIN(3*THETA) + A8*SIN
000097      000      3(4*THETA),',/,40X,'WHERE F(X) HAS UNITS OF METERS, ARE AS FOLLOWS
000098      000      4',/,5X,'A1 = ',F8.3,/,5X,'A2 = ',F8.3,/,5X,'A3 = ',F8.3,/,5X,
000099      000      5'A4 = ',F8.3,/,5X,'A5 = ',F8.3,/,5X,'A6 = ',F8.3,/,5X,
000100      000      6'A7 = ',F8.3,/,5X,'A8 = ',F8.3)
000101      000      500 FORMAT(4RH1)FUNCTION VALUES LISTED FOR 10 DEGREE INCREMENTS,/,/
000102      000      19X,'DEGREES',13X,'TIME(HRS)',5X,'HEIGHT(METERS)')
000103      000      600 FORMAT(1H ,5X,F12.2,2(5X,F12.4))
000104      000      601 FORMAT(1H1)
000105      000      300 FORMAT(4(1H ,2X,F10.2))
000106      000      END

```

END EIT.

***** FIND *****

@ELT,L HMAINT.FIND

```
000001      000      SUBROUTINE FIND(ILAST,NJP,DUM,NJW,HP,NJ)
000002      000      C      THIS ROUTINE IS CALLED BY HYDPLT
000003      000      COMMON /TAPES/N5,N6,N20,N22,N24
000004      000      DIMENSION DUM(600),NJW(20),HP(20,200)
000005      000      READ (N24) (DUM(I),I=1,NJ)
000006      000      DO 100 I=1,NJP
000007      000      NP=NJW(I)
000008      000      HP(I,ILAST)=DUM(NP)
000009      000      100  CONTINUE
000010      000      RETURN
000011      000      END
```

END ELT.

@HDG,P ***** GENFUN *****

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***** GENFUN *****

DELT,L HMAINT.GENFUN

000001	000	SUBROUTINE GENFUN (Z1,Z2,IY,IX,73)	1
000002	000	C	2
000003	000	C **** BATTELLE NORTHWEST 11/9/71 ****	3
000004	000	C **** **** **** **** **** **** **** ****	4
000005	000	C THIS ROUTINE IS CALLED BY HYDCAL	
000006	000	C	6
000007	000	C **** ASSIGN THE COMMON DATA ****	7
000008	000	C COMMON /TAPES/N5,N6,N20,N22,N24	8
000009	000	C COMMON/PARAMS/I75,I76,I29,I712,I713	9
000010	000	C	10
000011	000	C **** CONTROL AND TITLE INFORMATION ****	11
000012	000	C COMMON /PRINT/ NJ,NC,NTCYC,NQCYC,DELTO,PERIOD,ALPHA(30), 1DEP(70),NQSWRT	12
000013	000	C	
000014	000	C COMMON/QIJAI,NCHAN(70,6),AS(70),LEN(100),NJUNC(100,2)	
000015	000	C COMMON/WIN/QINT,DELT,WIND,WDIR,NJSW,NJGW,NHCYC,NT,ICYC,NCYC,W, 1NEXIT,JSW(20),JGW(20),A0(3,20,10)	
000016	000	C	16
000017	000	C	17
000018	000	C **** JUNCTION INFORMATION ****	18
000019	000	C	19
000020	000	C COMMON/H50/H(70),HN(70),HT(70),HBAR(70),HAVE(70), 1IPOINT(70,6),VOL(70),X(70),Y(70),QIN(70),QOU(70), 2QINST(20),QINRAR(70),QOURAR(70)	
000021	000	C	
000022	000	C	
000023	000	C **** CHANNEL INFORMATION ****	23
000024	000	C	24
000025	000	C	25
000026	000	C COMMON/B72/B(100),R(100),A(100),AT(100),AK(100),Q(100),QBAR(100), 1QAVE(100),V(100),VT(100),VBAR(100),FWIND(100),NTEMP(6), 2PNCLOS(100)	
000027	000	C	
000028	000	C	
000029	000	C REAL LEN	29
000030	000	C	30
000031	000	C **** END ****	31
000032	000	C **** **** **** **** **** **** **** ****	32
000033	000	C	
000034	000	C	33
000035	000	C IF (IY.EQ.2) GO TO 200	34
000036	000	C	35
000037	000	C **** CONTROLLED NODE FUNCTIONS DESIRED ****	36
000038	000	C IJK=JGW(IX)	37
000039	000	C GO TO (100,120,130,170,140,140), IJK	38
000040	000	C	39
000041	000	C **** WIER FORMULA DESIRED ****	40
000042	000	C CONTINUE	41
000043	000	Z2M=0.	42
000044	000	CON=Z3/AS(IX)	
000045	000	DHLM=0.	44
000046	000	DO 110 ICT=1,1?	
000047	000	CM=CON*10.744	46
000048	000	DHM=(Z2M+DHLM)/2.	
000049	000	DHLM=Z2M	
000050	000	Z2M=-CM*Z1/35.314	
000051	000	H2M=(H(IX)/3.28)+DHM/2.-A0(1,IX,2)	
000052	000	IF (H2M .LE. 0) GO TO 110	
000053	000	Z2M=CM*(-Z1/35.314-A0(1,IX,1)*(H2M)**A0(1,IX,3))	

```

***** GFNFUN *****
000054    000      Z2=72M*3.78
000055    000      110      CONTINUE
000056    000      RETURN
000057    000      C      *****
000058    000      C
000059    000      C      *****
000060    000      120      Z2=0.5*A0(1,IX,1)+A0(1,IX,2)*COS(W*Z1)+A0(1+IX,3)*COS(2.*W*Z1)+A0(1,IX,4)*COS(3.*W*Z1)+A0(1,IX,5)*SIN(W*Z1)+A0(1,IX,6)*SIN(2.*W*Z1)+A0(1+IX,7)*SIN(3.*W*Z1)+A0(1,IX,8)*SIN(4.*W*Z1)
000061    000
000062    000
000063    000      RETURN
000064    000      C      *****
000065    000      C
000066    000      C      *****
000067    000      130      TX=Z1
000068    000      GU TO 150
000069    000      C      *****
000070    000      C      *****
000071    000      140      CONTINU
000072    000      TX=Z1/3600.
000073    000      150      I1=1
000074    000      I2=IX
000075    000      IRETUR=1
000076    000      GO TO 220
000077    000      160      CONTINUE
000078    000      Z2=Z2
000079    000      RETURN
000080    000      C      *****
000081    000      C
000082    000      C
000083    000      C      *****
000084    000      170      CONTINUE
000085    000      TX=Z3/3600.
000086    000      I1=1
000087    000      I2=IX
000088    000      IRETUR=2
000089    000      GO TO 220
000090    000      180      CONTINUE
000091    000      Z2=Z2
000092    000      I1=2
000093    000      IRETUR=3
000094    000      GO TO 220
000095    000      190      CONTINUE
000096    000      Z1=Z2
000097    000      RETURN
000098    000      C      *****
000099    000      C
000100    000      C
000101    000      C      *****
000102    000      200      CONTINUE
000103    000      TX=Z1/3600.
000104    000      I1=3
000105    000      I2=IX
000106    000      IRETUR=4
000107    000      GO TO 220
000108    000      210      CONTINU
000109    000      Z2=Z2
000110    000      RETURN

```

```

***** GFNFUN *****
000111    000    C    *****          END      *****
000112    000    C
000113    000    C
000114    000    C    *****          GENERATE THE FUNCTION      *****
000115    000    P20  CONTINUE
000116    000
000117    000
000118    000
000119    000
000120    000    C    *****          END      *****
000121    000    C
000122    000    END

```

END ELT.

HHDG,P ***** HYDCAI *****

***** HYDCAL *****

@ELT,L HMAINT.HYDCAL

000001	000	SUBROUTINE HYDCAL	1
000002	000	C THIS ROUTINE IS CALLED BY HMAINV (OR HMAINT)	
000003	000	C AND CALLS GENFUN	
000004	000	C BATTELLE NORTHWEST 11/9/71	
000005	000	C	5
000006	000	C	6
000007	000	C ASSIGN THE COMMON DATA	
000008	000	COMMON /TAPFS/N5,N6,N20+N22,N24	8
000009	000	COMMON/PARAMS/IZ5,IZ6+IZ9+IZ12,IZ13	9
000010	000	C	10
000011	000	C CONTROL AND TITLE INFORMATION	
000012	000	COMMON /PRINT/ NJ,NC,NTCYC,NQCYC,DELTA,PERIOD,ALPHA(30), 1DEP(70),NOSWRT	1
000013	000	COMMON/QHAL/NCHAN(70,6),AS(70),LEN(100),NJUNC(100,2)	
000014	000	COMMON/QIN/QINT,DELT,WIND,WDIR,NJSW,NJGW,NHCYC,NT,ICYC,NCYC,W, 1NEXIT,JSW(20),JGW(20),A0(3,20,10)	
000015	000		11
000016	000		12
000017	000	C JUNCTION INFORMATION	13
000018	000	C	14
000019	000	C	15
000020	000	COMMON/H50/H(70),HN(70),HT(70),HBAR(70),HAVE(70), 1IPOINT(70,6),VOL(70),X(70),Y(70),QIN(70)+QOU(70)+ 2QINST(20),QINRAR(70),QOUBAR(70)	
000021	000		16
000022	000		17
000023	000	C CHANNEL INFORMATION	18
000024	000	C	19
000025	000	C	20
000026	000	COMMON/B72/B(100),R(100),A(100),AT(100),AK(100),Q(100),QBAR(100), 1QAVE(100),V(100),VT(100),VBAR(100),FWIND(100),NTEMP(6), 2NCLOS(100)	
000027	000		21
000028	000		22
000029	000	COMMON/NTR/NTRIB,TRBDEP(50),ITRIB(50,2)	
000030	000	C	23
000031	000	REAL LEN	24
000032	000	REAL LAM	25
000033	000	DIMENSION ARRAY(33)	26
000034	000	DIMENSION RSAV(100)	27
000035	000	C EN'	28
000036	000	C	29
000037	000	C	30
000038	000	DATA ASTERK/4H****/	31
000039	000	C	32
000040	000	C	33
000041	000	C INPUT AND PRINT THE INPUT HYDRAULIC DATA	34
000042	000	C	35
000043	000	100 CONTINUE	4
000044	000	READ (N20,1100) ARRAY	4
000045	000	IF (ARRAY(1).EQ.ASTERK) GO TO 110	4
000046	000	WRITE (N6,1100) ARRAY	4
000047	000	GO TO 100	4
000048	000	110 CONTINUE	4
000049	000	READ (N20) NTCYC,PERIOD,QINT,DELT,WIND,WDIR,NOSWRT,NJSW,NJGW 1+(JSW(L),QINST(L),((A0(I,L,N)+I=1,3),N=1,10),L=1,IZ12),(JGW(L),L=1 2,J713),(ALPHA(I),I=1,30),NQCYC,NHCYC,NT,DELTA,ICYC,NCYC,NEXIT,NJ,N 3C,((NCHAN(I,IT),IPOINT(I,IT),IT=1,TZ6),H(I),HN(J),HT(I),HBAR(I),HA 4VF(I),AS(I),VOL(T),X(I)/Y(I),DEF(I),OTN(I),QOU(I),QINRAR(I),QOUBAR	4
000050	000		5
000051	000		5
000052	000		5
000053	000		5

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***** HYDCAI. *****

000054    000      S(I)+I=1,NJ)+((NJUNC(N,L)+L=1,2),LEN(N),R(N),R(N),A(N),AT(N),AK(N),
000055    000      6Q(N),QBAR(N),QAVE(N),V(N),VT(N),VBAR(N),FWIND(N),NCLOS(N),N=1,NC),
000056    000      7,EVAP,NTRIB,(TRADEP(I),ITRIB(I,1),ITRIB(I,2),I=1,50),HYDEND
000057    000      C *** HYDEND IS A SPECIAL CASE - FPA PESTICIDE STUDY ***
000058    000      C
000059    000      C
000060    000      C
000061    000      C      WRITE OUT HYDRAULIC DATA TO QUALITY TAPE
000062    000      C      REWIND N22
000063    000      C      WRITE (N22) (ALPHA(I),I=1,30),NJ,NC,NQCYC,DELTQ,NTCYC,NQSWRT,NJGW,
000064    000      C      1EVAP,((NCHAN(J,K),K=1,IZ6),DEP(J),AS(J),J=1,NJ),(LEN(N),(NJUNC(N,K
000065    000      C      2),K=1,2),N=1,NC),PERIOD,(JGW(I),I=1,NJGW)
000066    000      C      WRITE (N22) ((IPPOINT(J,K),K=1,IZ6),J=1,NJ)
000067    000      C
000068    000      C
000069    000      C      INITIALIZATION
000070    000      C      NJGW1=NJGW+1
000071    000      C      DELT2=DELT/2.0
000072    000      C      W=6.2832/(3600.*PERIOD)
000073    000      C      T=0.0
000074    000      C      TIME=0.
000075    000      C
000076    000      C
000077    000      C      THIS LOOP CALCULATES THE CONTROLLED NODE INITIAL CONDITIONS
000078    000      DO 180 J=1,NJGW
000079    000      IJK=JGW(J)
000080    000      GO TO (180,120+130,140,150,160), IJK
000081    000      C      WIER RELATIONS REQUIRE NO CALCULATION AT THIS POINT
000082    000      C      1801
000083    000      C      TIDAL CONTROL STAGE
000084    000      C
000085    000      C      USE GENFUN TO CALCULATE INITIAL VALUES
000086    000      120    CALL GENFUN (T,H(J),1,J,T)
000087    000      C
000088    000      C      Q(J)=0.
000089    000      C      GO TO 170
000090    000      C      DAM IS OPERATED VIA A Q VS H CURVE
000091    000      C
000092    000      C      USE GENFUN TO CALCULATE INITIAL VALUES
000093    000      130    CALL GENFUN (H(J),Q(J),1,J,TIME)
000094    000      C
000095    000      C      GO TO 170
000096    000      C      DAM WHOSE HEAD AND OUTFLOW ARE KNOWN FUNCTIONS OF TIME
000097    000      C
000098    000      C      USE GENFUN TO CALCULATE INITIAL VALUES
000099    000      140    CALL GENFUN (H(J),Q(J),1,J,TIME)
000100    000      C
000101    000      C      GO TO 170
000102    000      C      DAM WHOSE HEAD IS A KNOWN FUNCTION OF TIME AND WHOSE OUTFLOW IS
000103    000      C      DETERMINED FROM A MASS BALANCE
000104    000      C
000105    000      C      USE GENFUN TO CALCULATE INITIAL VALUES
000106    000      150    CALL GENFUN (TIME,H(J),1,J,TIME)
000107    000      C
000108    000      C      Q(J)=0.
000109    000      C      GO TO 170
000110    000      C      DAM WHOSE OUTFLOW IS A KNOWN FUNCTION OF TIME AND WHOSE HEAD IS

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***** HYDCAL *****

000111    000   C      DETERMINED FROM A MASS BALANCE          98
000112    000   C
000113    000   C      USE GENFUN TO CALCULATE INITIAL VALUES
000114    000   160   CALL GENFUN (TIME,Q(J)+1,J,TIME)           99
000115    000   C
000116    000   170   V(J)=0.                                     100
000117    000   180   CONTINUF                                101
000118    000   C
000119    000   C
000120    000   C      COMPUTE THE CHANNEL CONSTANTS          103
000121    000   DO 241 N=1,NC
000122    000   241   RSAV(N)=-R(N)
000123    000   DO 240 N=1,NC
000124    000   C      CHECK TO BE SURE THAT IF THERE IS NO NODE NUMBER ASSIGNED TO
000125    000   C      THE END OF A GIVEN CHANNEL THAT THE CHANNEL IS ADJACENT TO
000126    000   C      A CONTROLLED NODE
000127    000   IF ((NJUNC(N,1).EQ.0).AND.(N,LF,NJGW)) GO TO 190 106
000128    000   IF (NJUNC(N,1).LE.0) GO TO 240                  107
000129    000   190   CONTINUE                                 108
000130    000   C      MODIFY MANNING'S COEFFICIENT
000131    000   AK(N)=32.1739*AK(N)**2/2.208196                109
000132    000   NL=NJUNC(N,1)                                 110
000133    000   NH=NJUNC(N,2)                                 111
000134    000   IF (N.LE.NJGW) NL=NH                         112
000135    000   C      COMPUTE AVG RIVER DEPTH IN CHANNEL USING AVG HEAD (FROM NODES)
000136    000   C      AND RIVER BOTTOM ELEVATION (NOTE THAT SIGN CONVENTION)
000137    000   C      MAKES BOTTOM ELEVATION NEGATIVE)
000138    000   R(N)=R(N)+(H(NL)+H(NH))/2.                      113
000139    000   C      ***** ARE THERE ANY TIDAL FLATS *****
000140    000   IF (INTRIR,LE.0) GO TO 220                  114
000141    000   DO 200 I=1,NTRIR                            115
000142    000   IF (N.EQ.ITRIB(I,1)) GO TO 210                116
000143    000   200   CONTINUE                                117
000144    000   GO TO 220                                118
000145    000   210   IJN=ITRIR(I,2)                         119
000146    000   IF (IJN.EQ.NL) IHJN=NH                     120
000147    000   IF (IJN.EQ.NH) IHJN=NL                     121
000148    000   C      RIVER DEPTH IS THE DIFFERFNE BETWEEN HEAD AND BOTTOM
000149    000   C      ELEVATION (NOTE THAT DEP IS NEGATIVE)
000150    000   R(N)=H(IJN)+TRBDEP(I)
000151    000   IF (H(IHJN).LT.H(IJN)) GO TO 220            123
000152    000   C      COMPUTE AVG RIVER DEPTH (NOTE SIGN CONVENTION)
000153    000   R(N)=(H(IHJN)+H(IJN))/2.+TRRDEP(I)
000154    000   220   CONTINUE                                125
000155    000   C      AREA = WIDTH*DEPTH
000156    000   A(N)=B(N)*R(N)                           126
000157    000   IF (WIND,LF,0.0) GO TO 230                127
000158    000   C      CALCULATE WIND FORCE
000159    000   FWIND(N)=-WIND**2*COS(WDIR/57.-ATAN2((X(NH)-X(NL)),(Y(NH)-Y(NL)))) 128
000160    000   1*8.64E-6
000161    000   230   CONTINUE                                129
000162    000   AT(N)=A(N)                                 130
000163    000   QAVF(N)=0.                                131
000164    000   240   CONTINUE                                132
000165    000   C
000166    000   C
000167    000   C      ***** COMPUTE THE NODAL VOLUMES *****          135
000168    000   C

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***** HYDCAL *****

000168    000      DO 260 J=1,NJ          137
000169    000      VOL(J)=0.             138
000170    000      IF (AS(J),EQ.0.) GO TO 260 139
000171    000      VOL(J)=(H(J)+DEP(J))*AS(J)
000172    000      CONTINUE
000173    000      260      C      *****          END      *****
000174    000      C
000175    000      C
000176    000      C      ***** START OF OUTER DO LOOP *****
000177    000      C      *****
000178    000      C      NT=THE DAILY CYCLE NUMBER        156
000179    000      C      NTCYC=THE NUMBER OF DAILY CYCLES TO BE SIMULATED 157
000180    000      C      *****
000181    000      C      *****
000182    000      C
000183    000      C
000184    000      DO 910 NT=1,NTCYC          160
000185    000      HOUR=0.0
000186    000      C
000187    000      C
000188    000      C      ***** START OF THE 2ND OF THREE NESTED DO LOOPS *****
000189    000      C      *****
000190    000      C      NQ=THE QUALITY CYCLE NUMBER        168
000191    000      C      NQCYC=THE NUMBER OF QUALITY CYCLES PER DAILY CYCLE 169
000192    000      C      *****
000193    000      C      *****
000194    000      C
000195    000      C
000196    000      DO 900 NQ=1,NQCYC          174
000197    000      C
000198    000      C      ***** INITIALIZE THE OUTPUT ARRAYS FOR THE SWQUAL ROUTINE 176
000199    000      DO 270 N=1,NC          177
000200    000      VBAR(N)=0.             178
000201    000      270      QBAR(N)=0.
000202    000      DO 280 J=1,NJ          180
000203    000      HBAR(J)=0.
000204    000      QINBAR(J)=0.
000205    000      QOUHAR(J)=0.
000206    000      280      CONTINUE
000207    000      C      *****          END      *****
000208    000      C
000209    000      C
000210    000      C      ***** START OF THE THIRD OF THREE NESTED DO LOOPS *****
000211    000      C      *****
000212    000      C      NHH=THE HYDRAULIC CYCLE COUNTER        190
000213    000      C      NHCYC=THE NUMBER OF HYDRAULIC CYCLES PER QUALITY CYCLE 191
000214    000      C      *****
000215    000      C      *****
000216    000      C
000217    000      C
000218    000      DO 860 NHH=1,NHCYC          196
000219    000      C      *****
000220    000      C      TIME IS THE TIMING VARIABLE THAT BEGINS AFTER THE FLOW PATTERNS 198
000221    000      C      HAVE REACHED EQUILIBRIUM           199
000222    000      C      *****
000223    000      C      IF (NT.LT.NQSWRT) GO TO 300          201
000224    000      C      TIME=TIME+DELT

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***** HYDCAL *****

000225      000      TIM2=TIME-DELT2          203
000226      000      C
000227      000      C      ***** HYDROGRAPH INPUTS *****
000228      000      IF (NJSW.EQ.0) GO TO 300    205
000229      000      DO 290 L=1,NJSW
000230      000      J=NJW(L)
000231      000      C
000232      000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000233      000      C      CALL GENFUN (TIME,QIN(J),2,L,TIME)          209
000234      000      C      *** SPECIAL CASE - EPA PESTICIDE STUDY
000235      000      C      THE TEST FOR EQUALITY BETWEEN NON-INTGERS MAY NOT BE MEANINGFUL.
000236      000      C      IF (TIME.GT.HYDEND.AND.HYDEND.NE. 0.0) QIN(J) = 0.0
000237      000      C      IF(QIN(J).LT.0.0) QIN(J) = 0.0          PEST
000238      000      C
000239      000      290      QIN(J)=QINST(L)+QIN(J)          210
000240      000      C      ***** END *****
000241      000      C
000242      000      C
000243      000      C      ***** INITIALIZATION *****
000244      000      300      CONTINUE          INITIALIZATION      *****
000245      000      T2=T+DELT2          214
000246      000      T=T+DELT          215
000247      000      DO 310 N=1,NC          216
000248      000      NCLOS(N)=0          217
000249      000      DO 310 M=1,2          218
000250      000      310      NJUNC(N,M)=IARS(NJUNC(N,M))          219
000251      000      DO 320 J=1,NJ          220
000252      000      AS(J)=ABS(AS(J))          221
000253      000      DO 320 K=1,IZ6          222
000254      000      320      NCHAN(J,K)=IARS(NCHAN(J,K))          223
000255      000      NTIMS=0          224
000256      000      C      ***** END *****
000257      000      C
000258      000      C      ***** COMPUTATION OF VELOCITIES AT 1/2 DELT *****
000259      000      C      ***** AND FLOWS AT 1/4 DELT *****
000260      000      330      CONTINUE          225
000261      000      NDRY=0          226
000262      000      NTIMS=NTIMS+1          227
000263      000      C      ++++++ THE FIRST NJGW CHANNELS ARE CONNECTED TO THE NJGW CONTROLLED
000264      000      C      NUDES AND MUST BE TREATED SEPARATELY. CHECK THE REST          228
000265      000      C      ++++++ OF THE CHANNELS TO SEE IF THEY HAVE DRIED UP, AND, IF THEY
000266      000      C      HAVE, SKIP THE CALCULATIONS. ++++++
000267      000      DO 380 N=NJGW1,NC          229
000268      000      IF (NJUNC(N,1).LE.0) GO TO 380          230
000269      000      C      ++++++ DRY CHANNEL CHECK (DRY IMPLYING THAT DEPTH IS LESS THAN 0.01
000270      000      C      ++++++ METERS OR 0.033 FEET) ++++++
000271      000      IF (R(N).GE.0.001) GO TO 340          231
000272      000      VT(N)=0.0          232
000273      000      Q(N)=0.0          233
000274      000      GO TO 380          234
000275      000      340      CONTINUE          235
000276      000      NL=NJUNC(N,1)          236
000277      000      NH=NJUNC(N,2)          237
000278      000      C      ++++++ DELTH = DIFFERENCE BETWEEN HEADS AT THE NODES AT EACH END OF THE
000279      000      C      ++++++ CHANNEL (BEGINNING OF TIMESTEP) ++++++
000280      000      DELTH=H(NH)-H(NL)
000281      000      DELT2=DEP('NL')-DEP('NH')

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***** HYDCAL *****

000282	000	DELH=0.5*(H(NH)-HT(NH)+H(NL)-HT(NL))	
000283	000	DELTY=DELTB-DELTZ	
000284	000	C ++++++ ARE THERE ANY TRIBUTARY CHANNELS? ++++++	
000285	000	IF (NTRIB.LE.0) GO TO 370	245
000286	000	DO 350 IL=1,NTRIB	246
000287	000	C ++++++ IS CHANNEL N A TRIBUTARY CHANNEL? ++++++	
000288	000	IF (N.EQ.ITRIB(IL,1)) GO TO 360	247
000289	000	350 CONTINUE	248
000290	000	GO TO 370	249
000291	000	C ***** IJN=NUMBER OF THE TIDE FLAT NODE *****	
000292	000	IJN=ITRIB(IL,2)	250
000293	000	IF (IJN.FQ.NL) IHJN=NH	251
000294	000	IF (IJN.EQ.NH) IHJN=NL	252
000295	000	DELTZ=2.*((DEP(IJN)-TRBDEP(IL))	
000296	000	IF (IHJN.LT.IJN) DELTZ=-DELTZ	
000297	000	DELTY=DELTB-DELTZ	
000298	000	IF (H(IJN).GT.H(IHJN)) DELH=H(IJN)-HT(IJN)	
000299	000	IF (H(IJN).GT.H(IHJN)) DELTY=0.0	
000300	000	IF (H(IJN).GT.H(IHJN)) R(N)=H(IJN)+TRBDEP(IL)	
000301	000	IF (H(IJN).GT.H(IHJN)) A(N)=R(N)*B(N)	
000302	000	370 CONTINUE	256
000303	000	C	
000304	000	TEMP=AK(N)/(R(N)**1.3333)	
000305	000	TEMP=TEMP*DELTZ	
000306	000	HCHAN=(H(NH)+H(NL))/2.	
000307	000	C	
000308	000	DELV1= V(N)/R(N)*(DELH/DELTZ+V(N)*DELTY/LEN(N))	
000309	000	V2=V(N)+DELTZ*DELV1	
000310	000	C	
000311	000	DELV2=-32.1739*DELTZ/LEN(N)	
000312	000	V2=V2+DELTZ*DELV2	
000313	000	C	
000314	000	DELV4=-32.1739*(DELTB-DELTZ)/LEN(N)	
000315	000	V2=V2+DELTZ*DELV4	
000316	000	C	
000317	000	DELV3=0.5*((1./TEMP+2.*ABS(V2))-SQRT((1./TEMP+ABS(2.*V2))**2-4.*V2	
000318	000	1**2))	
000319	000	DELV3=-SIGN(DELV3,V2)	
000320	000	VT(N)=V2+DELV3	
000321	000	C	
000322	000	C	
000323	000	O(N)=VT(N)*A(N)	265
000324	000	380 CONTINUE	266
000325	000	C ***** END *****	267
000326	000	C	268
000327	000	***** CONTROLLED NODE CALCULATIONS *****	269
000328	000	***** FLOW AT 1/4 DELT AND HEAD AT 1/2 DELT *****	270
000329	000	***** ***** ***** ***** ***** ***** ***** *****	271
000330	000	DO 470 J=1,NJGW	272
000331	000	C	
000332	000	+++++ CALCULATE NET FLOW OUT OF NODE (SUMQ) DUE TO FLOWS	
000333	000	+++++ CALCULATED IN ADJACENT CHANNELS +++++	
000334	000	SUMQ=0.	273
000335	000	DO 400 K=1,I76	274
000336	000	IF (NCHAN(J,K).EQ.J) GO TO 400	275
000337	000	IF (NCHAN(J,K).LE.0) GO TO 400	276
000338	000	N=NCHAN(J,K)	277

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***** HYDCAL *****

000339    000      IF (J.NE.NJINC(N,1)) GO TO 390          278
000340    000      SUMQ=SUMQ+Q(N)                         279
000341    000      GO TO 400                         280
000342    000      390      SUMQ=SUMQ-Q(N)                         281
000343    000      400      CONTINUE                         282
000344    000      C
000345    000      C      ++++++ NET FLOW OUT ++++++
000346    000      SUMQ=SUMQ+QOU(J)-QIN(J)+EVAP*AS(J)        283
000347    000      IJK=JGW(J)                         284
000348    000      C      ++++++ WHAT TYPE OF CONTROLLED NODE? ++++++
000349    000      GO TO (410,420,430,440,450,460), IJK        285
000350    000      C      WEIR RELATIONSHIP                         286
000351    000      C
000352    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000353    000      410      CALL GENFUN (SUMQ,DELHH,1,J,DELT2)        287
000354    000      C
000355    000      Q(J)=-DELHH*AS(J)/DELT2-SUMQ             288
000356    000      IF (Q(J).LT.0.) Q(J)=0.                  289
000357    000      VT(J)=0.                         290
000358    000      C      ++++++ CHANGE HEAD TO ACCOMODATE NET FLOW ++++++
000359    000      HT(J)=H(J)+DFLHH                         291
000360    000      GO TO 470                         292
000361    000      C      TIDAL CONTROL STAGE                         293
000362    000      C
000363    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000364    000      420      CALL GENFUN (T2,HT(J),1,J,T2)           294
000365    000      C
000366    000      Q(J)=-SUMQ-(HT(J)-H(J))*AS(J)/DELT2       295
000367    000      VT(J)=0.                         296
000368    000      GO TO 470                         297
000369    000      C      DAM IS OPERATED ACCORDING TO A Q VS H OPERATION POLICY        298
000370    000      C
000371    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000372    000      430      CALL GENFUN (H(J),Q(J),1,J,TIM2)        299
000373    000      C
000374    000      C      ++++++ NET FLOW ++++++
000375    000      SUMQ=SUMQ+Q(J)                         300
000376    000      C      ++++++ CHANGE HEAD TO ACCOMODATE NET FLOW ++++++
000377    000      HT(J)=H(J)-DFLT2*SUMQ/AS(J)           301
000378    000      VT(J)=0.                         302
000379    000      GO TO 470                         303
000380    000      C      DAM WHOSE HEAD AND OUTFLOW ARE KNOWN FUNCTIONS OF TIME        304
000381    000      C
000382    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000383    000      440      CALL GENFUN (HT(J),Q(J),1,J,TIM2)        305
000384    000      C
000385    000      VT(J)=0.                         306
000386    000      GO TO 470                         307
000387    000      C      DAM WHOSE HEAD IS A KNOWN FUNCTION OF TIME AND WHOSE OUTPUT IS        308
000388    000      C      DETERMINED FROM A MASS BALANCE                         309
000389    000      C
000390    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000391    000      450      CALL GENFUN (TIM2,HT(J),1,J,TIM2)        310
000392    000      C
000393    000      Q(J)=-SUMQ-(HT(J)-H(J))*AS(J)/DFLT2       311
000394    000      IF (Q(J).LT.0.) Q(J)=0.                  312
000395    000      VT(J)=0.                         313

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***** HYDCAL *****

000396    000      GO TO 470                                         314
000397    000      C      DAM WHOSE OUTFLOW IS A KNOWN FUNCTION OF TIME AND WHOSE HEAD IS 315
000398    000      C      DETERMINED FROM A MASS BALANCE                         316
000399    000      C
000400    000      C      ++++++ USE SUBROUTINE GENFUN TO GENERATE FUNCTIONAL VALUES ++++++
000401    000      460      CALL GENFUN (TIM2,Q(J)+1,J,TIM2)                      317
000402    000      C
000403    000      C      ++++++ NET FLOW +++++
000404    000      SUMQ=SUMQ+Q(J)
000405    000      C      ++++++ CHANGE HEAD TO ACCOMODATE NET FLOW ++++++
000406    000      HT(J)=H(J)-DELT2*SUMQ/AS(J)                                319
000407    000      VT(J)=0,
000408    000      470      CONTINUE
000409    000      C      ***** END *****                                         322
000410    000      C      ***** **** ***** ***** ***** ***** ***** ***** ***** 323
000411    000      C
000412    000      C      ***** REGULAR NODES STAGE AT 1/2 DELT ***** 324
000413    000      DO 510 J=NJGW1,NJ
000414    000      C
000415    000      C      ++++++ CALCULATE NET FLOW OUT OF NODE (SUMQ) DUE TO FLOWS
000416    000      C      ++++++ CALCULATED IN ADJACENT CHANNELS ++++++
000417    000      SUMQ=0.                                              327
000418    000      DO 490 K=1,I76                                         328
000419    000      IF (NCHAN(J,K).LE.0) GO TO 490                         329
000420    000      N=NCHAN(J,K)
000421    000      IF (J,NE,NJUNC(N,1)) GO TO 480                         331
000422    000      SUMQ=SUMQ+Q(N)                                         332
000423    000      GO TO 490                                         333
000424    000      480      SUMQ=SUMQ-Q(N)                                         334
000425    000      490      CONTINUE                                         335
000426    000      C
000427    000      IF (AS(J),LE.0.) GO TO 510                                         336
000428    000      C      ++++++ NET FLOW OUT ++++++
000429    000      SUMQ=SUMQ+QOU(J)-QTIN(J)+EVAP*AS(J)                      337
000430    000      C      ++++++ CHANGE HEAD TO ACCOMODATE NET FLOW ++++++
000431    000      HT(J)=H(J)-DELT2*SUMQ/AS(J)                                338
000432    000      C      ++++++ IS HEAD GREATER THAN BOTTOM ELEVATION (IS THERE WATER PRESENT)? +
000433    000      IF (HT(J)+DEP(J).GT.0.) GO TO 510                         339
000434    000      C      ++++++ NODE IS DRY, SO SET HEAD EQUAL TO BOTTOM ELEVATION
000435    000      C      (BUT CHANGE SIGN) ++++++
000436    000      HT(J)=-DEP(J)                                         340
000437    000      VOL(J)=0.                                         341
000438    000      AS(J)=-AS(J)                                         342
000439    000      DO 500 K=1,I76                                         343
000440    000      NX=NCHAN(J,K)
000441    000      IF (NX,LE.0) GO TO 500                                         344
000442    000      IF (NX,LE,NJGW) GO TO 500                         345
000443    000      C      ++++++ MARK AS A DRY CHANNEL ++++++
000444    000      NCLOS(NX)=1                                         346
000445    000      500      CONTINUE                                         347
000446    000      C      ++++++ MARK AS A DRY NODE ++++++
000447    000      NDPRY=NDRY+1                                         348
000448    000      510      CONTINUE                                         349
000449    000      IF (NDRY,FQ,0) GO TO 560                         350
000450    000      IF (INTIMS.GT.?) GO TO 560                         351
000451    000      DO 550 N=NJGW1,NC                                         352
000452    000      IF (NJUNC(N,1),LE.0) GO TO 550                         353
000453    000

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***** HYDCAL *****
000453      000      IF (NCLOS(N).NE.1) GO TO 550
000454      000      Q(N)=0.
000455      000      V(N)=0.
000456      000      VT(N)=0.0
000457      000      DO 540 I=1,2
000458      000      II=NJUNC(N,I)
000459      000      DO 520 J=1,IZ6
000460      000      TF (NCHAN(II,J),EQ,N) GO TO 530
000461      000      520  CONTINUF
000462      000      GO TO 540
000463      000      530  NCHAN(II,J)=-N
000464      000      540  NJUNC(N,I)=-II
000465      000      550  CONTINUE
000466      000      GO TO 330
000467      000      560  CONTINUE
000468      000      C      #####*
000469      000      C      #####*
000470      000      C      ##### COMPUTATION OF CROSSECTIONAL AREA AND FLOW AT 1/2 D
000471      000      C      ##### AND VELOCITIES AT THE FULL DELT #####
000472      000      DO 630 N=NJGW1,NC
000473      000      TF (NJUNC(N,1).LE.0) GO TO 630
000474      000      NL=NJUNC(N,1)
000475      000      NH=NJUNC(N,2)
000476      000      C      ++++++ HEAD INCREMENT = AVG OF THE CHANGE IN HEAD OVER ONE-HALF
000477      000      C      ++++++ TIMESTEP AT THE TWO CHANNEL ENDS ++++++
000478      000      DELH=0.5*(HT(NH)-H(NH)+HT(NL)-H(NL))
000479      000      DELTH=HT(NH)-HT(NL)
000480      000      DELTZ=DEP(NL)-DEP(NH)
000481      000      DELTY=DELTH-DELTZ
000482      000      RNT=R(N)+DELH
000483      000      HCHAN=(HT(NH)+HT(NL))/2.
000484      000      AT(N)=A(N)+B(N)*DELH
000485      000      C      ##### ARE THERE ANY TIDAL FLATS #####
000486      000      IF (NTRIB,LE,0) GO TO 590
000487      000      DO 570 IL=1,NTRIB
000488      000      C      ##### IS CHANNEL N A TIDE FLAT CHANNEL #####
000489      000      TF (N.E0.,ITRIB(IL,1)) GO TO 580
000490      000      570  CONTINUF
000491      000      GO TO 590
000492      000      580  IJN=ITRIB(IL,2)
000493      000      IF (IJN,EQ,NH) IHJN=NL
000494      000      JF (IJN ,EQ, NL) IHJN=NH
000495      000      DELTZ=2.* (DEP(IJN)-TRBDEP(IL))
000496      000      IF (IHJN+LT.IJN) DELTZ=-DELTZ
000497      000      DELTY=DELTH-DELTZ
000498      000      IF (HT(IJN).GT,HT(IHJN)) DELTY=0.0
000499      000      IF (HT(IJN).GT,HT(IHJN)) DELH=HT(IJN)-H (IJN)
000500      000      RNT=HT(IJN)+TRBDEP(IL)
000501      000      IF (HT(IJN).GT,HT(IHJN)) RNT=(HT(IJN)+HT(IJN))/2.+TRBDEP(IL)
000502      000      AT(N)=B(N)*RNT
000503      000      590  CONTINUF
000504      000      C      ##### DRY CHANNEL CHECK (UNDER 0.1 FEET) #####
000505      000      C      ++++++ IF CHANNEL IS DRY, SET VELOCITY AND FLOW TO ZERO ++++++
000506      000      IF (RNT.GT.0.001) GO TO 600
000507      000      V(N)=0.
000508      000      Q(N)=0.
000509      000      GO TO 510

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***** HYDCAI *****

000510    000   600  CONTINUE
000511    000   TEMP=AK(N)/(RNT**1.3333)
000512    000   TEMP=TEMP*DELT
000513    000   C
000514    000   DELV1=(VT(N)/RNT)*(DELH/DELT2+VT(N)*DELTY/LEN(N))
000515    000   V(N)=V(N)+DELT*DELV1
000516    000   C
000517    000   DELV2=-32.1739*DELTZ/LEN(N)
000518    000   V(N)=V(N)+DELT*DELV2
000519    000   C
000520    000   DELV4=-32.1739*(DELTH-DELTZ)/LEN(N)
000521    000   V(N)=V(N)+DELT*DELV4
000522    000   C
000523    000   DELV3=0.5*((1./TEMP+2.*ARS(V(N)))-SQRT((1./TEMP+2.*ARS(V(N)))*2-
000524    000   14.*V(N)**2))
000525    000   DELV3=-SIGN(DELV3+V(N))
000526    000   V(N)=V(N)+DELV3
000527    000   C
000528    000   C
000529    000   C
000530    000   C      ++++++ CALCULATE FLOW BASED ON NEW VELOCITY (AVERAGE PREVIOUS
000531    000   C      ++++++ FLOW AND CURRENT VALUE ++++++
000532    000   Q(N)=0.5*(Q(N)+V(N)*AT(N))
000533    000   610  CONTINUE
000534    000   C      ++++++***** SUM THE CHANNEL FLOWS
000535    000   C      ++++++ NT = DAILY CYCLE NUMBER ++++++
000536    000   IF (NT,LT,NOSWRT) GO TO 620
000537    000   QBAR(N)=QBAR(N)+Q(N)
000538    000   VBAR(N)=VRPAR(N)+V(N)
000539    000   620  CONTINUE
000540    000   C      ++++++***** CHECK FOR EXCESSIVE VELOCITIES
000541    000   RAN=R(N)/3.28
000542    000   VAN=V(N)/3.28
000543    000   IF (ABS(VAN) .LT. 10.0) GO TO 630
000544    000   WRITE(N6,1110) NT,NQ,NHH,RAN,VAN,N
000545    000   630  CONTINUE
000546    000   C      ++++++***** END
000547    000   C
000548    000   C      ++++++***** CONTROLLED NODE CALCULATIONS AT FULL TIME STEP *****
000549    000   C      ++++++***** *****
000550    000   DO 740 J=1*NJGW
000551    000   C
000552    000   C      ++++++ CALCULATE NET FLOW OUT OF NODE (SUMQ) DUE TO FLOWS
000553    000   C      ++++++ CALCULATED IN ADJACENT CHANNELS ++++++
000554    000   SUMQ=0.
000555    000   DO 650 K=1,I76
000556    000   IF (NCHAN(I,K).EQ.J) GO TO 650
000557    000   IF (NCHAN(J,K).LE.0) GO TO 650
000558    000   N=NCHAN(J,K)
000559    000   IF (J.NE.NJINC(N+1)) GO TO 640
000560    000   SUMQ=SUMQ+Q(N)
000561    000   GO TO 650
000562    000   640  SUMQ=SUMQ-Q(N)
000563    000   650  CONTINUE
000564    000   C
000565    000   C      ++++++ NET FLOW OUT ++++++
000566    000   SUMQ=SUMQ+QOU(J)-QIN(J)+FVAP*AS(J)

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***** HYDCAL *****

000567    000      IJK=JGW(J)                                435
000568    000      C ++++++ WHAT TYPE OF CONTROLLED NODE? ++++++
000569    000      GO TO (660,680,690,700,710,720), IJK          436
000570    000      C WEIR RELATIONSHIP                         437
000571    000      C
000572    000      C ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000573    000      660 CALL GENFUN (SUMQ+DELHH+1,J,DELT)           438
000574    000      C
000575    000      Q(J)=-DELHH*AS(J)/DELT-SUMQ                439
000576    000      IF (Q(J).LT.0.) Q(J)=0.                      440
000577    000      V(J)=0.                                     441
000578    000      C ++++++ CHANGE HEAD TO ACCOMMODATE NET FLOW ++++++
000579    000      HN(J)=H(J)+DELHH                           442
000580    000      C ++++++ CALCULATE VOLUME CHANGE ++++++
000581    000      670 DVOL=(HN(J)-H(J))*AS(J)                  443
000582    000      C ++++++ NEW VOLUME ++++++
000583    000      VOL(J)=VOL(J)+DVOL                          444
000584    000      GO TO 730                                 445
000585    000      C TIDAL CONTROL STAGE                     446
000586    000      C
000587    000      C ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000588    000      680 CALL GENFUN (T,HN(J)+1,J+T)             447
000589    000      C
000590    000      Q(J)=-SUMQ-(HN(J)-H(J))*AS(J)/DELT        448
000591    000      V(J)=0.                                     449
000592    000      GO TO 670                                 450
000593    000      C DAM OPERATED ACCORDING TO A Q VS H OPERATING POLICY 451
000594    000      C
000595    000      C ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000596    000      690 CALL GENFUN (HT(J),QJ2+1,J,TIME)         452
000597    000      C
000598    000      Q(J)=(Q(J)+QJ2)/2.                         453
000599    000      C ++++++ NET FLOW OUT ++++++
000600    000      SUMQ=SUMQ+Q(J)                           454
000601    000      C ++++++ CHANGE HEAD TO ACCOMMODATE NET FLOW ++++++
000602    000      HN(J)=H(J)-DELT*SUMQ/AS(J)                 455
000603    000      V(J)=0.                                     456
000604    000      GO TO 670                                 457
000605    000      C DAM WHOSE HEAD AND OUTFLOW ARE KNOWN FUNCTIONS OF TIME 458
000606    000      C
000607    000      C ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000608    000      700 CALL GENFUN (HN(J),QJ2+1,J,TIME)         459
000609    000      C
000610    000      Q(J)=(Q(J)+QJ2)/2.                         460
000611    000      V(J)=0.                                     461
000612    000      GO TO 670                                 462
000613    000      C DAM WHOSE HEAD IS A KNOWN FUNCTION OF TIME AND WHOSE OUTFLOW 463
000614    000      C IS DETERMINED FROM A MASS BALANCE            464
000615    000      C
000616    000      C ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000617    000      710 CALL GENFUN (TIME,HN(J)+1,J,TIME)         465
000618    000      C
000619    000      Q(J)=-SUMQ-(HN(J)-H(J))*AS(J)/DELT        466
000620    000      IF (Q(J).LT.0.) Q(J)=0.                      467
000621    000      V(J)=0.                                     468
000622    000      GO TO 670                                 469
000623    000      C DAM WHOSE OUTFLOW IS A KNOWN FUNCTION OF TIME AND WHOSE HEAD IS 470

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***** HYDCAI *****
000624    000      C      COMPUTED FROM A MASS BALANCE          471
000625    000      C
000626    000      C      ++++++ USE GENFUN TO CALCULATE FUNCTIONAL VALUES ++++++
000627    000      720      CALL GFUNFUN (TIME,QJ2,I,J,TIME)          472
000628    000      C
000629    000      Q(J)=(Q(J)+QJ2)/2.                         473
000630    000      C      ++++++ NET FLOW OUT ++++++
000631    000      SUMQ=SUMQ+Q(J)                           474
000632    000      C      ++++++ CHANGE HEAD TO ACCOMMODATE NET FLOW ++++++
000633    000      HN(J)=H(J)-DELT*SUMQ/AS(J)                 475
000634    000      V(J)=0.                                     476
000635    000      GO TO 670                                477
000636    000      C
000637    000      C      ***** SUM THE CHANNEL FLOWS FOR THE CONTROL NODES *****
000638    000      730      IF (NT,LT,NQSWRT) GO TO 740          480
000639    000      QRAR(J)=QRAR(J)+Q(J)                      481
000640    000      VHAR(J)=VHAR(J)+V(J)                      482
000641    000      C      ***** END *****                         483
000642    000      C
000643    000      740      CONTINUE                            484
000644    000      C      ***** END *****                         485
000645    000      C      ***** ***** ***** ***** ***** ***** ***** 486
000646    000      C
000647    000      C      ***** COMPUTATION OF NODAL STAGE AND VOLUME AT FULL DELT 489
000648    000      DO 770 J=HJGW1,NJ                         490
000649    000      C
000650    000      C      ++++++ CALCULATE NET FLOW OUT OF NODE (SUMQ) DUE TO FLOWS 491
000651    000      C      ++++++ CALCULATED IN ADJACENT CHANNELS ++++++
000652    000      SUMQ=0.                                     492
000653    000      HN(J)=-DEP(J)
000654    000      IF (AS(J).LE.0.) GO TO 770                493
000655    000      DO 760 K=1,IZ6                            494
000656    000      IF (NCHAN(J,K).LE.0) GO TO 760            495
000657    000      N=NCHAN(J,K)
000658    000      IF (J,NE,NJUNC(N,1)) GO TO 750            496
000659    000      SUMQ=SUMQ+Q(N)                          497
000660    000      GO TO 760                                498
000661    000      750      SUMQ=SUMQ-Q(N)                  499
000662    000      760      CONTINUE                            500
000663    000      C
000664    000      C      ++++++ NET FLOW OUT ++++++
000665    000      SUMQ=SUMQ+QOU(J)-QIN(J)+EVAP*AS(J)        502
000666    000      C      ++++++ CHANGE HEAD BASED ON CALCULATED NET FLOW ++++++
000667    000      HN(J)=H(J)-DELT*SUMQ/AS(J)                 503
000668    000      HT(J)=0.5*(HN(J)+H(J))
000669    000      VOL(J)=VOL(J)-DELT*SUMQ                   504
000670    000      770      CONTINUE                            505
000671    000      C      ***** END *****                         506
000672    000      C
000673    000      C      ***** SUM NODAL VOLUMES AND FLOWS          508
000674    000      IF (NT,LT,NQSWRT) GO TO 790                509
000675    000      DO 780 J=1,NJ                                510
000676    000      HHAR(J)=HRAR(J)+HN(J)                      511
000677    000      QINBAR(J)=QINBAR(J)+QIN(J)                  512
000678    000      QOUTBAR(J)=QOUTBAR(J)+QOU(J)                  513
000679    000      780      CONTINUE                            514
000680    000      790      CONTINUE                            515

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***** HYDCAL *****

000681    000   C      *****          END          *****
000682    000   C
000683    000   C      ***** CALCULATE THE HYDRAULIC RADIUS AND CHANNEL CROSSECT 518
000684    000   C      ***** AREA AT THE FULL DELT          *****
000685    000   DO 840 N=NJGW1,NC
000686    000   IF (NJUNC(N,1).EQ.0) GO TO 840
000687    000   NL=IABS(NJUNC(N,1))
000688    000   NH=IABS(NJUNC(N,2))
000689    000   C      ***** CALCULATE HEAD INCREMENT AS THE AVERAGE OF THE CHANGE
000690    000   C      ***** IN HEAD AT EACH END OF THE CHANNEL OVER ONE-HALF TIMESTEP ++
000691    000   C      DELH=0.5*(HN(NH)-H(NH)+HN(NL)-H(NL))          524
000692    000   C      ***** ARE THERE ANY TIDAL FLATS *****
000693    000   IF (NTRIR.LE.0) GO TO 830
000694    000   DO 800 IL=1,NTRIR
000695    000   C      ***** IS CHANNEL N A TIDE FLAT CHANNEL *****
000696    000   IF (N.EQ.ITRIR(IL+1)) GO TO 810
000697    000   800   CONTINUE
000698    000   GO TO 830
000699    000   810   IJN=ITRIR(IL,2)
000700    000   IF (IJN.EQ.NL) IHJN=NH
000701    000   IF (IJN.EQ.NH) IHJN=NL
000702    000   R(N)=HN(IJN)+TRBDEP(IL)
000703    000   IF (HN(IHJN).GT.HN(IJN)) R(N)=(HN(IHJN)+HN(IJN))/2.+TRRDEP(IL)
000704    000   C      ***** CALCULATE CROSS-SECTIONAL AREA BASED ON NEW RADIUS *****
000705    000   C      A(N)=R(N)*R(N)          535
000706    000   C      GO TO 840          536
000707    000   830   CONTINUE          540
000708    000   C      ***** CALCULATE NEW RADIUS BY ADDING HEAD INCREMENT TO OLD VALUE *****
000709    000   C      R(N)=R(N)+DELH          541
000710    000   C      ***** CALCULATE NEW CROSS-SECTIONAL AREA BASED ON HEAD INCREMENT *****
000711    000   C      A(N)=A(N)+H(N)*DELH          542
000712    000   840   CONTINUE          543
000713    000   C      *****          END          *****
000714    000   C
000715    000   C      ***** SHIFT THE NODAL ARRAYS          *****
000716    000   DO 850 J=1,NJ
000717    000   850   H(J)=HN(J)
000718    000   C      *****          END          *****
000719    000   C
000720    000   C
000721    000   C      ***** STATEMENT 860 IS THE END OF ONE HYDRAULIC CYCLE *****
000722    000   860   CONTINUE          552
000723    000   C      *****
000724    000   C
000725    000   C      ***** AVERAGE THE FLOWS AND VELOCITIES          *****
000726    000   C      ***** FOR USE BY THE PRINTOUT AND SWQUAL          *****
000727    000   C      ***** IF NOSWRT DAILY CYCLES HAVE NOT ELAPSED, DO NOT BEGIN PRINTING ++
000728    000   C      IF (INT.LT.NQSWR) GO TO 900          553
000729    000   C      DO 880 N=1,NC          559
000730    000   C      ***** THE AVERAGE FLOW FOR THIS QUALITY CYCLE *****
000731    000   C      QBAR(N)=QBAR(N)/FLOAT(NHCYC)          563
000732    000   C      ***** THE AVFRAGE VELOCITY FOR THIS QUALITY CYCLE *****
000733    000   C      VBAR(N)=VBAR(N)/FLOAT(NHCYC)          564
000734    000   C      ***** QAVE = DAILY CYCLE AVERAGE FLOW *****
000735    000   C      QAVF(N)=QAVF(N)+QBAR(N)/FLOAT(NQCYC)          565
000736    000   880   CONTINUE          566
000737    000   DO 890 J=1,NJ          567

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***** HYDCAL *****

000738    000   C  ++++++ QUALITY CYCLE AVERAGE FLOW INTO THE NODE ++++++
000739    000   C      QINBAR(J)=QINBAR(J)/FLOAT(NHCYC)                                568
000740    000   C  ++++++ QUALITY CYCLE AVERAGE FLOW OUT OF THE NODE ++++++
000741    000   C      QOUBAR(J)=QOUBAR(J)/FLOAT(NHCYC)                                569
000742    000   C  ++++++ AVERAGE HEAD AT THE NODF DURING A QUALITY CYCLE ++++++
000743    000   C      HBAR(J)=HRAR(J)/FLOAT(NHCYC)                                570
000744    000   C
000745    000   C  ++++++ EVALUATE THE MAGNITUDE AND SIGN OF THE NFT FLOW ++++++
000746    000   C      IF (QINBAR(J).EQ.0.) GO TO 890                                571
000747    000   C      IF (QOUBAR(J).EQ.0.) GO TO 890                                572
000748    000   C      QINBAR(J)=QINBAR(J)-QOUBAR(J)                                573
000749    000   C      QOUNAR(J)=0.                                574
000750    000   C      IF (QINBAR(J).GT.0.) GO TO 890                                575
000751    000   C      QOUBAR(J)=-QINBAR(J)                                576
000752    000   C      QINBAR(J)=0.                                577
000753    000   C
000754    000   890  CONTINUE
000755    000   C  ***** END *****                                         *****
000756    000   C
000757    000   C  ***** WRITE OUT THE HYDRAULIC INFORMATION *****
000758    000   C  ***** FOR USE BY THE SWQUAL PROGRAM *****
000759    000   C      WRITE (N2) NT,NQ,(HRAR(J),VOL(J),QINBAR(J),QOUBAR(J),J=1,NJ),(QBA
000760    000   C      1R(N),VBAR(N),N=1,NC)
000761    000   C  ***** END *****
000762    000   C
000763    000   C  ***** WRITE THE HYDRAULIC INFORMATION *****
000764    000   C  ***** TO FAST DRUM FOR LATER USE *****
000765    000   C  ***** BY THE PRINTING AND PLOT PROGRAM *****
000766    000   C      WRITE (N24) NT,NQ
000767    000   C      WRITE (N24) (HBAR(J),J=1,NJ)
000768    000   C      WRITE (N24) (VOL(J),J=1,NJ)
000769    000   C      WRITE (N24) (QINBAR(J),J=1,NJ)
000770    000   C      WRITE (N24) (QOUBAR(J),J=1,NJ)
000771    000   C      WRITE (N24) (QBAR(N),N=1,NC)
000772    000   C      WRITE (N24) (VBAR(N),N=1,NC)
000773    000   C  ***** END *****
000774    000   C
000775    000   C  ***** STATEMENT 900 IS THE END OF ONE QUALITY CYCLE *****
000776    000   900  CONTINUE
000777    000   C  ***** *****
000778    000   C
000779    000   C
000780    000   C  ***** STATEMENT 910 IS THE END OF ONE DAILY CYCLE*****
000781    000   910  CONTINUE
000782    000   C  *****
000783    000   C
000784    000   C
000785    000   C      END FILE N22
000786    000   C      REWIND N20
000787    000   C      REWIND N22
000788    000   C      READ (5,1020) IDECK
000789    000   C      IF (IDECK.EQ.0) GO TO 1010
000790    000   C      PUNCH 1030, (ALPHA(I),I=1,30)
000791    000   C      EVAPM=EVAP/0.03937
000792    000   C      WINDM=WIND/2.236
000793    000   C      PUNCH 1040, NTCYC,PERIOD,QINT,DELT,EVAPM,WINDM,WDIR,NOSWRIT,NJSW,
000794    000   C      TJJGW,NTRIR

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***** HYDCAL *****

000795    000      IF (NJSW.LE.0) GO TO 920          617
000796    000      PUNCH 1050, (JSW(L),L=1+NJSW)   618
000797    000      CONTINUE                           619
000798    000      PUNCH 1050, (JGW(L),L=1+NJGW)   620
000799    000      IF (INTRIB.LE.0) GO TO 940        621
000800    000      DO 930 I=1,NTRIB                  622
000801    000      PUNCH 1060, ITRIB(I,1),ITRIB(I,2) 623
000802    000      930      CONTINUE                   624
000803    000      940      CONTINUE                   625
000804    000      DO 950 J=1,NJ                      626
000805    000      RAD=-DEP(J)                     627
000806    000      HAM=H(J)/3.28
000807    000      AS(J)=ABS(AS(J))
000808    000      ASM=AS(J)/10.744
000809    000      QIM=QIN(J)/35.314
000810    000      QDM=QOU(J)/35.314
000811    000      RAM=-DEP(J)/3.28
000812    000      PUNCH 1070, J,HAM,ASM,QIM,QDM,RAM,X(J)+Y(J)
000813    000      950      CONTINUE                   629
000814    000      PUNCH 1080
000815    000      DO 1000 N=1,NC                  630
000816    000      IF (INTRIB.LE.0) GO TO 980        631
000817    000      DO 960 IL=1,NTRIB                 632
000818    000      IF (ITRIB(IL,1),EQ.N) GO TO 970    633
000819    000      960      CONTINUE                   634
000820    000      GO TO 980
000821    000      970      IJN=ITRIB(IL,2)           635
000822    000      RAD=0.5*(-DEP(IJN)-TRBDEP(IL)) 636
000823    000      GO TO 990
000824    000      980      NH=NJUNC(N+1)            637
000825    000      NL=NJUNC(N,2)
000826    000      IF (NH.EQ.0) NH=NL                638
000827    000      IF (NL.EQ.0) NL=NH                639
000828    000      RAD=0.5*(-DEP(NL)-DEP(NH))    640
000829    000      990      CONTINUE                   641
000830    000      AK(N)=ABS(AK(N))
000831    000      R(N)=ABS(R(N))
000832    000      NJUNC(N,1)=IABS(NJUNC(N,1))
000833    000      NJUNC(N,2)=IABS(NJUNC(N,2))
000834    000      LEN(N)=ABS(LFN(N))
000835    000      RAD=RSAV(N)
000836    000      AK(N)=SORT(AK(N)*2.208196/32.1739) 642
000837    000      LAM=LEN(N)/3.28
000838    000      WAM=R(N)/3.28
000839    000      RAM=RAD/3.28
000840    000      VAM=V(N)/3.28
000841    000      PUNCH 1090, N,NJUNC(N,1),NJUNC(N,2)+LAM,WAM,RAM,AK(N),VAM
000842    000      1000      CONTINUE                   643
000843    000      PUNCH 1080
000844    000      1010      CONTINUE                   644
000845    000      WRITE (N6,1120)                         645
000846    000      C      *****
000847    000      C      *****
000848    000      C      *****
000849    000      C      *****
000850    000      RFTURN
000851    000      C      *****

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***** HYDCAI *****

000852	000	C	658
000853	000	C	659
000854	000	1020 FORMAT (15)	660
000855	000	1030 FORMAT (15,4)	661-
000856	000	1040 FORMAT (15,3F5.0+5X,3F5.0,4I5)	662
000857	000	1050 FORMAT (20I5)	663
000858	000	1060 FORMAT (2I5)	664
000859	000	1070 FORMAT (15,F10.3,-6PF10.5,0P2F10.2+F10.2+5X,-3P2F10.3)	PEST
000860	000	1080 FORMAT (5H99999)	666
000861	000	1090 FORMAT (3I5,10X,5F10.4)	PEST
000862	000	1100 FORMAT (3I4)	668
000863	000	1110 FORMAT ('0 V OVER 10 MPS, TIDAL CYCLE',I4,'! QUALE CYCLE',I4,'! HYDRO	
000864	000	' CYCLE',I4,'! DEPTH',E10.4,'! V',E10.4,'! CHANNEL',15)	670
000865	000	1120 FORMAT (3RH)COMPLETION OF THE HYDRAULIC PROGRAM)	671
000866	000	END	

END ELT.

@HDG,P ***** HYDPLT *****

***** HYDPLT *****

RELT,L HMAINT.HYDPLT

```
000001    000      SUBROUTINE HYDPLT          1
000002    000      C   THIS ROUTINE IS CALLED BY HMAINV (OR HMAINT) 2
000003    000      C   AND CALLS FIND AND PICTO 3
000004    000      C   ***** HYDRAULIC PROGRAM PRINTING      *****
000005    000      C   ***** AND PLOTTING PROGRAM      *****
000006    000      C
000007    000      C   ***** BATTELLE NORTHWEST 11/9/71      *****
000008    000      C   ***** ***** ***** ***** ***** ***** 6
000009    000      C
000010    000      C
000011    000      C   ***** ASSIGN THE COMMON DATA      *****
000012    000      C   COMMON /TAPES/N5,N6,N20+N22,N24      *****
000013    000      C   COMMON/PARAMS/IZ5,IZ6,IZ9,IZ12,IZ13      *****
000014    000      C
000015    000      C   ***** CONTROL AND TITLE INFORMATION      *****
000016    000      C   COMMON /PRINT/ NJ,NC,NTCYC,NQCYC,DELTQ,PERIOD,ALPHA(30), 10
000017    000      C   IDEP(70),NOSWRT
000018    000      C   COMMON/NT/NTP,NQP,DUM(600),HP(20,200),VOLP(20,200),TIMEP(200), 11
000019    000      C   IQINP(20,200),QOUNP(20,200),QP(20,200),VP(20,200),XX(400),YY(400), 12
000020    000      C   ZARK(400),XYM(3,500)
000021    000      C   DIMENSION ICH(6),SPACE(6),NJW(20),NCW(20),ISYM(5) 2
000022    000      C   DIMENSION CARD1(66) 2
000023    000      C   DIMENSION PUNTIT(20) 2
000024    000      C   DATA STAR/1H*,PERID/1H*,VFE/1HV*,QUU/1HQ/ 2
000025    000      C   DATA (SPACF(I),I=1,6)/6*1H /
000026    000      C   DATA BLANK/1H /
000027    000      C
000028    000      C
000029    000      C   ***** ASK THE USER WHICH INFORMATION      *****
000030    000      C   ***** HE WISHES TO PRINT AND PLOT      *****
000031    000      100  CONTINUE
000032    000      100  READ (NS,450,END=110) RUNIT
000033    000      100  GO TO 120
000034    000      110  RETURN
000035    000      120  CONTINUE
000036    000      120  READ (NS,510) IDAY1,IDAYL,NJP
000037    000      120  IF (IDAY1.LE.0) IDAY1=1
000038    000      120  IF (IDAY1.GT.NOSWRT) IDAY1=NOSWR,
000039    000      120  IF (IDAYL.GT.NTCYC) IDAYL=NTCYC
000040    000      120  IF ((IDAYL-IDAY1).GT.6) IDAYL=IDAY1+6
000041    000      120  IF (IDAY1.GT.IDAYL) IDAYL=IDAY1
000042    000      120  IF (NJP.GT.20) WRITE (N6,500)
000043    000      120  NJP=MIND(20,NJP)
000044    000      120  READ (NS,520) (NJW(I),I=1,NJP)
000045    000      120  READ (NS,530) NCP
000046    000      120  IF (NCP.GT.20) WRITE (N6,540)
000047    000      120  NCP=MIND(20,NCP)
000048    000      120  READ (NS,520) (NCW(I),I=1,NCP)
000049    000      120  READ (NS,460) NPLOTS
000050    000      120  WRITE (6,470) (RUNIT(KITE),KITE=1,20)
000051    000      120  WRITE (6,480) ALPHA
000052    000      120  WRITE (N6,550) IDAY1, IDAYL, NJP, (NJW(I),I=1,NJP)
000053    000      120  WRITE (N6,560) NCP, (NCW(I),I=1,NCP)
```

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***** HYDPI T *****

000054    000      IF (NPLOTS.EQ.0) WRITE (6,490)
000055    000      C *****
000056    000      C
000057    000      C
000058    000      C *****
000059    000      REWIND N24
000060    000      130 READ (N24) NTP,NQP
000061    000      IF (NTP.GE.IDAY1) GO TO 140
000062    000      READ (N24)
000063    000      READ (N24)
000064    000      READ (N24)
000065    000      READ (N24)
000066    000      READ (N24)
000067    000      READ (N24)
000068    000      GO TO 130
000069    000      140 CONTINUE
000070    000      DO 160 ND=IDAY1, IDAYL
000071    000      DO 150 NQC=1, NQCYC
000072    000      ILAST=(NTP-IDAY1)*NQCYC+NQP
000073    000      TIMEP(ILAST)=(FLOAT((NTP-1)*NQCYC+NQP)-0.5)/FLOAT(NQCYC)
000074    000      CALL FIND (ILAST,NJP+DUM,NJW+HP,NJ)
000075    000      CALL FIND (ILAST,NJP+DUM,NJW,VOLP,NJ)
000076    000      CALL FIND (ILAST,NJP+DUM,NJW,QINP,NJ)
000077    000      CALL FIND (ILAST,NJP,DUM,NJW,QOUP,NJ)
000078    000      CALL FIND (ILAST,NCP+DUM,NCW,QP,NC)
000079    000      CALL FIND (ILAST,NCP,DUM,NCW,VP,NC)
000080    000      IF ((ND.EQ.IDAYL).AND.(NQC.EQ.NQCYC)) GO TO 170
000081    000      READ (N24) NTP,NQP
000082    000      150 CONTINUE
000083    000      IF (ND.EQ.IDAYL) GO TO 170
000084    000      160 CONTINUE
000085    000      C *****
000086    000      C
000087    000      C
000088    000      C *****
000089    000      170 CONTINUE
000090    000      IWHOLE=NJP/3
000091    000      IPART=NJP-IWHOLE*3
000092    000      IF (IWHOLE.EQ.0) GO TO 210
000093    000      DO 200 I=1,IWHOLE
000094    000      IL=(I-1)*3
000095    000      WRITE (6,470) (RUNTIT(KITE),KITE=1,20)
000096    000      WRITE (6,480) ALPHA
000097    000      DO 180 IK=1,3
000098    000      180 ICH(IK)=NJW(IL+IK)
000099    000      WRITE (N6,470) (SPACE(L),ICH(L),L=1,3)
000100    000      WRITE (N6,580) (SPACE(L),L=1,3)
000101    000      WRITE (N6,590) (SPACE(L),L=1,3)
000102    000      DO 190 IDAY=IDAY1, IDAYL
000103    000      IL1=IL+1
000104    000      IL3=IL+3
000105    000      ID=(IDAY-IDAY1)*NQCYC+
000106    000      TDL=ID-1+NQCYC
000107    000      DO 188 II=IL1,IL3
000108    000      DO 188 L=10,TDL
000109    000      HP(II,L)=HP(II,L)/3.28
000110    000      VOLP(II,L)=VOLP(II,L)/35.314

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***** HYDPLT *****

000111	000	QINP(IL,L)=QINP(IL,L)/35.314	
000112	000	QOUP(IL,L)=QOUP(IL,L)/35.314	
000113	000	WRITE(N6,600) IDAY	
000114	000	WRITE(N6,610) (TIMEP(L)+(HP(IL,L)*VOLP(IL,L)+QINP(IL,L)+QOUP(IL,L)	
000115	000	1+IL=IL1,IL3),L=ID,IDL)	
000116	000	DO 189 IL=IL1,IL3	
000117	000	DO 189 L=ID,IDL	
000118	000	HP(IL,L)=HP(IL,L)*3.28	
000119	000	VOLP(IL,L)=VOLP(IL,L)*35.314	
000120	000	QINP(IL,L)=QINP(IL,L)*35.314	
000121	000	QOUP(IL,L)=QOUP(IL,L)*35.314	
000122	000	190 CONTINUE	110
000123	000	200 CONTINUE	111
000124	000	IF (IPART.LE.0) GO TO 260	112
000125	000	210 ILL=IWHOLE*3+IPART	113
000126	000	IL1=IWHOLE*3+1	114
000127	000	DO 220 I=ILL,ILL	115
000128	000	J=I-IL1+1	116
000129	000	ICH(J)=NJW(I)	117
000130	000	WRITE (6,470) (RUNTIT(KITE),KITE=1,20)	118
000131	000	WRITE (6,480) ALPHA	119
000132	000	WRITE (N6,570) (SPACE(L),ICH(L),L=1,IPART)	120
000133	000	WRITE (N6,580) (SPACE(L),L=1,IPART)	121
000134	000	WRITE (N6,590) (SPACE(L),L=1,IPART)	122
000135	000	DO 250 IDAY=IDAY1+IDAYL	123
000136	000	IL1=IWHOLE*3+1	124
000137	000	ILL=IWHOLE*3+IPART	125
000138	000	ID=(IDAY-IDAY1)*NQCYC+1	126
000139	000	IDL=ID-1+NOCYC	127
000140	000	WRITE(N6,600) IDAY	
000141	000	GO TO (230,240), IPART	129
000142	000	230 CONTINUE	
000143	000	DO 231 L=ID,IDL	
000144	000	HP(IL1,L)=HP(IL1,L)/3.28	
000145	000	VOLP(IL1,L)=VOLP(IL1,L)/35.314	
000146	000	QINP(IL1,L)=QINP(IL1,L)/35.314	
000147	000	QOUP(IL1,L)=QINP(IL1,L)/35.314	
000148	000	WRITE(N6,620) (TIMEP(L)+HP(IL1,L)*VOLP(IL1,L)+QINP(IL1,L)+QOUP(IL1	
000149	000	L,L)+L=ID,IDL)	
000150	000	DO 232 L=ID,IDL	
000151	000	HP(IL1,L)=HP(IL1,L)*3.28	
000152	000	VOLP(IL1,L)=VOLP(IL1,L)*35.314	
000153	000	QINP(IL1,L)=QINP(IL1,L)/35.314	
000154	000	QOUP(IL1,L)=QINP(IL1,L)/35.314	
000155	000	GO TO 250	
000156	000	240 CONTINUE	132
000157	000	DO 241 IL=IL1,ILL	
000158	000	DO 241 L=ID,IDL	
000159	000	HP(IL,L)=HP(IL,L)/3.28	
000160	000	VOLP(IL,L)=VOLP(IL,L)/35.314	
000161	000	QINP(IL,L)=QINP(IL,L)/35.314	
000162	000	QOUP(IL,L)=QOUP(IL,L)/35.314	
000163	000	WRITE(N6,630) (TIMEP(L)+(HP(IL,L)*VOLP(IL,L)+QINP(IL,L)+QOUP(IL,L)	
000164	000	1,IL=IL1,ILL),L=ID,IDL)	
000165	000	DO 242 IL=IL1,ILL	
000166	000	DO 242 L=ID,IDL	
000167	000	HP(IL,L)=HP(IL,L)*3.28	

***** HYDPI T *****

000168	000	VOLP(I1,L)=VOLP(I1,L)*35.314	
000169	000	QINP(I1,L)=QINP(I1,L)*35.314	
000170	000	242 QOUP(I1,L)=QOUP(I1,L)*35.314	135
000171	000	250 CONTINUE	136
000172	000	260 CONTINUE	137
000173	000	C *****	137
000174	000	C	138
000175	000	C	139
000176	000	C ***** WRITE OUT THE CHANNEL DATA TO THE PRINTER *****	140
000177	000	IWHOLE=NCP/6	141
000178	000	IPART=NCP-IWHOLE*6	142
000179	000	IF (IWHOLE.EQ.0) GO TO 300	143
000180	000	DO 290 I=1,IWHOLE	144
000181	000	WRITE (6,470) (RUNIT(KITE),KITE=1,20)	145
000182	000	WRITE (6,480) ALPHA	146
000183	000	IL=(I-1)*6	147
000184	000	DO 270 IK=1,6	148
000185	000	ICH(IK)=NCW(IL+IK)	149
000186	000	WRITE (N6,640) (SPACE(L),ICH(L),L=1,6)	150
000187	000	WRITE (N6,650) (SPACE(L),L=1,6)	151
000188	000	WRITE (N6,660) (SPACE(L),L=1,6)	152
000189	000	DO 280 IDAY=IDAY1,IDA	153
000190	000	IL1=IL+1	154
000191	000	IL3=IL+6	155
000192	000	ID=(IDAY-IDAY1)*NQCYC+1	156
000193	000	IDL=ID-1+NQCYC	157
000194	000	DO 278 I1=IL1,IL3	
000195	000	DO 278 L=ID,IDL	
000196	000	QP(I1,L)=QP(I1,L)/35.314	
000197	000	278 VP(I1,L)=VP(I1,L)/3.28	
000198	000	WRITE(N6,600) IDAY	
000199	000	WRITE(N6,670) (TIMEP(L),(QP(I1,L)+VP(I1,L),I1=IL1,IL3),L=ID,IDL)	
000200	000	DO 279 I1=IL1,IL3	
000201	000	DO 279 L=ID,IDL	
000202	000	QP(I1,L)=QP(I1,L)*35.314	
000203	000	279 VP(I1,L)=VP(I1,L)*3.28	
000204	000	280 CONTINUE	160
000205	000	290 CONTINUE	161
000206	000	IF (IPART.LE.0) GO TO 380	162
000207	000	300 ILL=IWHOLE*6+IPART	163
000208	000	IL1=IWHOLE*6+1	164
000209	000	DO 310 I=ILL+ILL	165
000210	000	J=I-ILL+1	166
000211	000	310 ICH(J)=NCW(I)	167
000212	000	WRITE (6,470) (RUNIT(KITF),KITF=1+20)	168
000213	000	WRITE (6,480) ALPHA	169
000214	000	WRITE (N6,640) (SPACE(I),ICH(L),L=1,IPART)	170
000215	000	WRITE (N6,650) (SPACE(L),L=1,IPART)	171
000216	000	WRITE (N6,660) (SPACE(L),L=1,IPART)	172
000217	000	DO 370 IDAY=IDAY1,IDA	173
000218	000	ID=(IDAY-IDAY1)*NQCYC+1	174
000219	000	IDL=ID-1+NQCYC	175
000220	000	DO 318 I1=ILL+ILL	
000221	000	DO 318 L=ID,IDL	
000222	000	QP(I1,L)=QP(I1,L)/35.314	
000223	000	318 VP(I1,L)=VP(I1,L)/3.28	
000224	000	WHITE(N6,600) IDAY	

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***** HYDPLT *****

000225      000      GO TO (320,330,340,350,360), IPART          177
000226      000      320  CONTINUE
000227      000      WRITE(N6,680) (TIMEP(L), (QP(T1,L), VP(I1,L), I1=IL1, ILL)+L=ID,IDL) 178
000228      000      GO TO 368
000229      000      330  CONTINUE
000230      000      WRITE(N6,690) (TIMEP(L), (QP(T1,L), VP(I1,L), I1=IL1, ILL)+L=ID,IDL) 181
000231      000      GO TO 368
000232      000      340  CONTINUE
000233      000      WRITE(N6,700) (TIMEP(L), (QP(T1,L), VP(I1,L), I1=IL1, ILL)+L=ID,IDL) 184
000234      000      GO TO 368
000235      000      350  CONTINUE
000236      000      WRITE(N6,710) (TIMEP(L), (QP(T1,L), VP(I1,L), I1=IL1, ILL)+L=ID,IDL) 187
000237      000      GO TO 368
000238      000      360  CONTINUE
000239      000      WRITE(N6,720) (TIMEP(L), (QP(T1,L), VP(I1,L), I1=IL1, ILL)+L=ID,IDL) 190
000240      000      368  CONTINUE
000241      000      DO 369 I1=IL1,ILL
000242      000      DO 369 L=ID,IDL
000243      000      QP(I1,L)=QP(I1,L)*35.314
000244      000      369  VP(I1,L)=VP(I1,L)*3.28
000245      000      370  CONTINUE
000246      000      380  CONTINUE
000247      000      C      *****CALCULATE THE NUMBER OF POINTS TO BE PLOTTED *****
000248      000      C      END
000249      000      C      ****SET UP THE SYMBOL PRIORITIES FOR PICTUR *****
000250      000      C      IF (NPLOTS.EQ.0) GO TO 100
000251      000      NPOINT=(IDAYL-IDAY1+1)*NQCYC
000252      000      ****END
000253      000      C      ****SET UP THE OUTER DO LOOP FOR THE JUNCTION PLOTS ***
000254      000      C      DO 390 I=1,4
000255      000      C      ISYM(I)=STAR
000256      000      390  ISYM(5)=BLANK
000257      000      C      ****SET UP THE APPRAYS AND ALPHA NECESSARY *****
000258      000      C      FOR THE PICTUR SUBROUTINE
000259      000      C      ****END
000260      000      C      ****SET UP THE APPRAYS AND ALPHA NECESSARY *****
000261      000      C      FOR THE PICTUR SUBROUTINE
000262      000      C      DO 410 J=1,NJP
000263      000      C      HMAX=0.
000264      000      C      DO 400 K=1,NPOINT
000265      000      C      XX(K)=TIMEP(K)
000266      000      C      YY(K)=HP(J,K)
000267      000      C      HMAX=AMAX1(HMAX,ABS(HP(J,K)))
000268      000      C      ARK(K)=STAR
000269      000      400  XX(NPOINT+1)=XX(NPOINT)
000270      000      C      XX(NPOINT+2)=YY(NPOINT)
000271      000      C      YY(NPOINT+1)=1.5*HMAX
000272      000      C      YY(NPOINT+2)=-1.5*HMAX
000273      000      C      ARK(NPOINT+1)=BLANK
000274      000      C      ARK(NPOINT+2)=BLANK
000275      000      C      NPOIN=NPOINT+2
000276      000      C      DO 405 IJI=1,NPOIN

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*****	HYPDFT	*****				
000282	000	405	YY(IJT)=YY(IJI)/3.28			
000283	000	C	*****	END	*****	230
000284	000	C				231
000285	000		ENCODE (53+730,CARD1) IJUNC			
000286	000		ENCODE (45+740,CARD1(34)) IJUNC			
000287	000		CALL PICTO (NPOIN,25,50,ISYM,CARD1,RUNIT)			232
000288	000	410	CONTINUE			233
000289	000	C	*****	END	*****	234
000290	000	C				235
000291	000	C	***** SET UP THE SYMBOL PRIORITIES FOR PICTUR *****		*****	236
000292	000		ISYM(1)=STAR			237
000293	000	C	*****	END	*****	238
000294	000	C				239
000295	000	C				240
000296	000	C	***** SET UP THE OUTER DO LOOP FOR THE CHANNEL PLOTS ****		****	241
000297	000		DO 440 J=1,NCP			242
000298	000	C	***** SEARCH FOR QMAX AND VMAX		*****	243
000299	000		QMAX=0.0			244
000300	000		DO 420 I=1,NPOINT			245
000301	000		QMAX=AMAX1(ABS(QP(J,I)),QMAX)			246
000302	000	420	CONTINUE			247
000303	000	C	*****	END	*****	248
000304	000	C				249
000305	000	C	***** SET UP THE ARRAYS AND ALPHA NECESSARY *****		*****	250
000306	000	C	***** FOR THE PICTUR SUBROUTINE		*****	251
000307	000		ICHN=NCW(J)			252
000308	000		DO 430 K=1,NPOINT			253
000309	000		YY(K)=QP(J,K)/1000.			254
000310	000		ARK(K)=STAH			255
000311	000	430	CONTINUE			256
000312	000		YY(NPOINT+1)=1.50*QMAX/1000.			257
000313	000		YY(NPOINT+2)=-1.50*QMAX/1000.			258
000314	000		IN=NPOINT+2			
000315	000		DO 435 I=1,IN			
000316	000	435	YY(1)=YY(I)/35.314			
000317	000	C	*****		*****	261
000318	000	C	*****	END	*****	262
000319	000	C				263
000320	000		ENCODE (53+750,CARD1) ICHN			
000321	000		ENCODE (47+760,CARD1(34)) ICHN			
000322	000		CALL PICTO (NPOIN,25,50,ISYM,CARD1,RUNIT)			264
000323	000	440	CONTINUE			265
000324	000	C	*****	END	*****	266
000325	000	C				267
000326	000	C				268
000327	000		GO TO 100			269
000328	000	C	*****	END	*****	270
000329	000	C				271
000330	000	C				272
000331	000	C				273
000332	000	450	FORMAT (20A4)			274
000333	000	460	FORMAT (15)			275
000334	000	470	FORMAT (1H),25X,20A4)			276
000335	000	480	FORMAT (1H),15A4,20X,20HRATTELL NORTHWEST ,/1X,15A4,19X,21H RICH			277
000336	000		LAND, WASHINGTON,/81X,20HEXPLORE-1 CODE ./81X,20HHYDRODYNAMIC			278
000337	000		2C MODEL ,/)			279
000338	000	490	FORMAT (' AS REQUESTED THE PLOTS WILL BE SUPPRESSED.')			280

***** HYDOLT *****

000339	000	500	FORMAT (' YOU CANNOT MONITOR MORE THAN 20 NODES AT ONE TIME ')	281
000340	000	510	FORMAT (2I10./I10)	282
000341	000	520	FORMAT (2D14)	283
000342	000	530	FORMAT (I10)	284
000343	000	540	FORMAT (' YOU CANNOT MONITOR MORE THAN 20 CHANNELS AT ONE TIME ')	285
000344	000	550	FORMAT (1H0,'FOR WHAT SPAN OF DAYS DO YOU WISH LINEPRINTER AND PLO	286
000345	000		LT INFORMATION// I WISH TO LOOK AT THE DATA STARTING WITH DAY',I5,	287
000346	000		2' AND ENDING WITH DAY',I5.'// HOW MANY NODAL POINTS DO YOU WISH TO	288
000347	000		MONITOR// I WISH TO MONITOR ',I5,' NODES// FOR WHICH NODES DO	289
000348	000		YOU WISH LINEPRINTER AND PLOT INFORMATION// I WISH TO MONITOR TH	290
000349	000		SE FOLLOWING NODES //2015./2015)	291
000350	000	560	FORMAT (//,' HOW MANY CHANNELS DO YOU WISH TO MONITOR // I WISH T	292
000351	000		10 MONITOR ',I5,' CHANNELS // FOR WHICH CHANNELS DO YOU WISH LINE	293
000352	000		PRINTER AND PLOT INFORMATION // I DESIRE PLOT AND LINEPRINTER INF	294
000353	000		FORMATION FOR THE FOLLOWING CHANNELS //2015/2015)	295
000354	000	570	FORMAT (2Z2X,A1,'JUNCTION',I4,A1,27X,'JUNCTION',I4,A1,27X,'JUNCTION'	
000355	000		A1,14,1)	
000356	000	580	FORMAT (6X,A1,'TIME',4X,'HEAD',6X,'VOLUME',4X,'INFLOW',3X,'OUTFLOW'	
000357	000		\$,A1,3X,'HEAD',6X,'VOLUME',4X,'INFLOW',3X,'OUTFLOW',A1,3X,'HEAD',6X	
000358	000		\$,'VOLUME',4X,'INFLOW',3X,'OUTFLOW')	
000359	000	590	FORMAT (5X,A1,'(DAYS) (M) (M#3) (CMS) (CMS)',A1,'(M)	
000360	000		\$ (M) (M#3) (CMS) (CMS)',A1,'(M) (M#3)	
000361	000		\$ (CMS) (CMS)')	
000362	000	600	FORMAT (1H0,11H'DAY NUMBER ',I4,1)	
000363	000	610	FORMAT (1PF12.4,2E11.4,2E9.2,2F11.4,2F9.2,2E11.4,2E9.2)	
000364	000	620	FORMAT (1PF12.4,2E11.4,2E9.2)	
000365	000	630	FORMAT (1PF12.4,2E11.4,2E9.2,2E11.4,2E9.2)	
000366	000	640	FORMAT (1H0,16X,A1,BCHANNEL ,I4,A1,7X,BCHANNEL ,I4,A1,7X,BCHANNEL	30
000367	000		1EL ,I4,A1,7X,BCHANNEL ,I4,A1,7X,BCHANNEL ,I4,A1,7X,BCHANNEL ,I4	30
000368	000		2)	31
000369	000	650	FORMAT (7X,A1,4HTIME,18H FLOW VELOCITY,A1,19H FLOW VELOC	31
000370	000		ITY,A1,19H FLOW VELOCITY,A1,19H FLOW VELOCITY,A1,19H	31
000371	000		2 FLOW VELOCITY,A1,19H FLOW VELOCITY)	31
000372	000	660	FORMAT (5X,A1,'(DAYS) (CMS) (M/SEC)',A1,'(CMS) (M/SEC)',	
000373	000		A1,'(CMS) (M/SEC)',A1,'(CMS) (M/SEC)',A1,'(CMS)	
000374	000		2(M/SFC)',A1,'(CMS) (M/SEC)')	
000375	000	670	FORMAT (E12.4,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3)	31
000376	000	680	FORMAT (E12.4,2E9.3)	31
000377	000	690	FORMAT (F12.4,2E9.3,2X,2E9.3)	31
000378	000	700	FORMAT (E12.4,2E9.3,2X,2E9.3,2X,2E9.3)	32
000379	000	710	FORMAT (F12.4,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3)	32
000380	000	720	FORMAT (F12.4,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3,2X,2E9.3)	32
000381	000	730	FORMAT (' PLOT OF THE HEAD VERSUS TIME CURVE FOR JUNCTION ',I4)	
000382	000	740	FORMAT (' (HEAD IS IN METERS AND THE TIME IS IN DAYS) ')	
000383	000	750	FORMAT (' PLOT OF THE FLOW VERSUS TIME CURVE FOR CHANNEL',I4,' ')	
000384	000	760	FORMAT (' FLOW IN (THOUSANDS OF CMS) AND TIME IN (DAYS) ')	
000385	000		END	

END ELT.

***** MAIN *****

@ELT,I HMAIN,MAIN

000001	000	C	MAIN PROGRAM TO COORDINATE THE CALCULATION AND PLOTTING PROGRAM	
000002	000	C	THIS PROGRAM CALLS HYDCAL AND HYDPLT	
000003	000	C	SCRATCH UNITS ARE SCRATCH TAPES	?
000004	000	C		
000005	000	C		
000006	000	C	THIS EXECUTIVE PROGRAM MAKES I/O ASSIGNMENTS AND CALLS THE	
000007	000	C	CALCULATION SUBROUTINE HYDCAL AND THE PRINT-PLOT	
000008	000	C	PROGRAM HYDPLT	
000009	000	C		
000010	000	C		
000011	000		COMMON /TAPES/N5,N6,N20,N22,N24	3
000012	000		COMMON/PARAMS/I25,I26,I29,I712,I713	4
000013	000	C		5
000014	000		N5=5	6
000015	000		N6=6	7
000016	000	C		8
000017	000		I25=70	
000018	000		I26=6	10
000019	000		I29=100	
000020	000		I712=20	12
000021	000		I713=20	13
000022	000		N20=2	14
000023	000		N22=N20	15
000024	000		N24=4	
000025	000		REWIND N20	17
000026	000		REWIND N22	18
000027	000		REWIND N24	19
000028	000	C		
000029	000		CALL HYDCAL	20
000030	000	C		
000031	000		CALL HYDPLT	21
000032	000	C		
000033	000		STOP	22
000034	000		END	-

END ELT.

@HDG,P ***** PICTO *****

***** PICTO *****

©ELT.L HMAINT.PICTO

000001	000	SUBROUTINE PICTO (N,M,MCOL,ISYM,CARD1,RUNIT)	
000002	000	C THIS ROUTINE IS CALLED BY HYDPLT AND CALLS SORT	2
000003	000	C PROGRAMMED BY JE SCHLOSSER 1965 MODIFIED BY CA OSTER 1966	3
000004	000	C PRESENTS A PICTURE OF DATA ON PRINTED OUTPUT, TWO OPTIONS BEING	4
000005	000	C AVAILABLE	
000006	000	C 1 MCOL POSITIVE	5
000007	000	C 2 MCOL NEGATIVE, IN WHICH CASE XINCREMENTS ARE TAKEN AS EQUAL	6
000008	000	C TO Y INCREMENTS AS DETERMINED BY M	7
000009	000	C	8
000010	000	C DICTIONARY	9
000011	000	C	10
000012	000	C VARIABLE DEFINITION	11
000013	000	C N NUMBER OF POINTS TO PLOT (MAXIMUM OF 500)	12
000014	000	C M MAXIMUM NUMBER OF LINES	13
000015	000	C MCOL MAXIMUM NUMBER OF COLUMNS	14
000016	000	C	15
000017	000	C XX(I) X COORDINATE FOR ITH POINT	16
000018	000	C YY(I) Y COORDINATE FOR ITH POINT	17
000019	000	C ARK(I) MARKER FOR ITH POINT	18
000020	000	C ISYM(I) PRIORITY DESIGNATOR FOR MARKER USED ON I-TH POINT	19
000021	000	C (LOWER SUBSCRIPT INDICATES HIGHER PRIORITY)	20
000022	000	C	21
000023	000	C	22
000024	000	C ***** RATTÉLLE NORTHWEST 11/9/71 *****	23
000025	000	C *****	24
000026	000	C	25
000027	000	C	26
000028	000	C ***** ASSIGN THE COMMON DATA *****	27
000029	000	C COMMON /TAPES/NS,N6,N20,N22,N24	28
000030	000	C COMMON/PARAMS/IZ5,IZ6,IZ9,IZ12,IZ13	29
000031	000	C	30
000032	000	C ***** CONTROL AND TITLE INFORMATION *****	31
000033	000	C COMMON /PRINT/ NJ,NC,NTCYC,NOCYC,DELTA,PERTON,ALPHA(30),	32
000034	000	I1EP(70),NQSWRT	
000035	000	COMMON/NT/NTP,NQP,DUM(600),HP(20,200),VOLP(20,200),TIMEP(200),	
000036	000	101NP(20,200),QOUP(20,200),QP(20,200),VP(20,200),XX(400),YY(400),	
000037	000	PARK(400),XYM(3,500)	
000038	000	DIMENSION IXYM(3,500)	37
000039	000	EQUIVALENCE (IXYM,XYM)	38
000040	000	DIMENSION PX(6),ALF(107),ILF(107),ISYM(5)	39
000041	000	DIMENSION CARD1(66)	
000042	000	DIMENSION RUNIT(20)	41
000043	000	EQUIVALENCE (ILF,ALF),(BLANK,LANKRA)	42
000044	000	EXTERNAL ORDER	46
000045	000	C	43
000046	000	DATA BLANK/1H	44
000047	000	C	45
000048	000	KILL=0	47
000049	000	11=MAX0(MIN0(500,N),2)	48
000050	000	XYM(1,2)=1.01	49
000051	000	XYM(2,2)=1.01	50
000052	000	XYM(3,2)=BLANK	51
000053	000	XYM=1.0E37	52

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***** PICTO *****

000054    000      XMAX=-1.0E37          53
000055    000      DO 100 I=1,N          54
000056    000      XYM(1,I)=X(I)          55
000057    000      XYM(2,I)=Y(I)          56
000058    000      XYM(3,I)=APK(I)         57
000059    000      XMIN=AMIN1(XMIN,XYM(1,I)) 58
000060    000      XMAX=AMAX1(XMAX,XYM(1,I)) 59
000061    000      100      CONTINUE          60
000062    000      CALL SORT (XYM,N,3,SORDER)   61
000063    000      YMIN=XYM(2,N)           62
000064    000      YMAM=XYM(2,1)           63
000065    000      DYLOG=ALOG10((YMAX-YMIN)/FLOAT(M)*1.0E5) 64
000066    000      APPROX=DYLOG-AINT(DYLOG)    65
000067    000      DO 110 I=2,10          66
000068    000      FI=I
000069    000      IF (APPROX=ALOG10(FI)) 120,120,110 68
000070    000      110      CONTINUE          69
000071    000      120      EXACT=FI*10.0***(INT(DYLOG)-5) 70
000072    000      130      IF (MCOL) 200,140,140 71
000073    000      140      DXLOG=ALOG10((XMAX-XMIN)/FLOAT(MCOL/2)*1.0E5) 72
000074    000      XAPROX=DXLOG-AINT(DXLOG)    73
000075    000      IF (XAPROX-.3010) 150,150,160 74
000076    000      150      XEXACT=2.0*10.0***(INT(DXLOG)-5) 75
000077    000      GO TO 190          76
000078    000      160      IF (XAPPROX-.6990) 170,170,180 77
000079    000      170      XEXACT=5.0*10.0***(INT(DXLOG)-5) 78
000080    000      GO TO 190          79
000081    000      180      XEXACT=10.0***(INT(DXLOG)-4) 80
000082    000      190      CONTINUE          81
000083    000      XACT=XEXACT/2.0        82
000084    000      GO TO 210          83
000085    000      200      XACT=EXACT/2.0        84
000086    000      210      TENX=20.0*XACT        85
000087    000      TENE=10.0*FXACT        86
000088    000      MAXYI=(YMAX/TENE)+(0.5+SIGN(0.5,YMAX)) 87
000089    000      MAXXI=(XMAX/TENX)+(0.5+SIGN(0.5,XMAX)) 88
000090    000      MINYI=(YMIN/TENE)-(0.5+SIGN(0.5,-YMIN)) 89
000091    000      MINXI=(XMIN/TFNX)-(0.5+SIGN(0.5,-XMIN)) 90
000092    000      YFIRST=TFNE*FLOAT(MAXYI)        91
000093    000      XFIRST=TFNX*FLOAT(MINXI)        92
000094    000      LINES=10*(MAXYI-MINYI)+1        93
000095    000      KOLS=20*(MAXXI-MINXI)        94
000096    000      IF (KOLS-500) 230,230,220        95
000097    000      220      WRITE (6,530) KOLS        96
000098    000      KOLS=500          97
000099    000      230      IF (LINES-401) 250,250,240        98
000100    000      240      WRITE (6,540)          99
000101    000      RETURN          100
000102    000      250      CONTINUE          101
000103    000      KILL=KILL+1          102
000104    000      IF (KILL.GT.500) GO TO 260        103
000105    000      IF (KOLS.GE.75) GO TO 260        104
000106    000      MCOL=MCOL+1          105
000107    000      GO TO 130          106
000108    000      260      LEAF=(KOLS+99)/100        107
000109    000      IF (LEAF.LE.1) GO TO 270        108
000110    000      MCOL=MCOL-1          109

```

***** PICTD *****

000111	000	GO TO 140	110
000112	000	DO 450 I=1+LFAF	111
000113	000	DO 280 J=1+5	112
000114	000	PX(1)=5.*TENX*FLOAT(L-1)+TENY*FLOAT(I-1)+XFIRST	113
000115	000	280 CONTINUE	114
000116	000	WRITE (6,470) (PUNIT(KITE),KITE=1,20)	115
000117	000	WRITE (6,460) ALPHA	116
000118	000	WRITE (6,480) (CARD1(ISTAT),ISTAT=1,66)	117
000119	000	WRITE (6,520) PX	118
000120	000	WRITE (6,510)	119
000121	000	DEX=EXACT/2.0	120
000122	000	DFL=FXACT/2.0	121
000123	000	DDD=DEX+2.0*EXACT	122
000124	000	J=1	123
000125	000	DO 440 I=1+LINES	124
000126	000	YPLLOT=YFIRST-EXACT*FLOAT(I-1)	125
000127	000	DO 290 JK=1,107	126
000128	000	290 ALF(J,JK)=BLANK	127
000129	000	300 IF (J-N) 310+310+400	128
000130	000	310 IF (XYM(1,J)-PX(1)) 390,320+320	129
000131	000	320 CONTINUE	130
000132	000	IF (XYM(2,J)-(YPLLOT+DEL)) 330,330+400	131
000133	000	330 IF (XYM(2,J)-(YPLLOT-DEL)) 400,340+340	132
000134	000	340 CONTINUE	133
000135	000	IF (XYM(1,J)-PX(6)-DDD) 350,350+390	134
000136	000	350 CONTINUE	135
000137	000	KOL=INT((XYM(1,J)+DEX-PX(1))/XACT)+4	136
000138	000	IF ((KOL.GT.107).OR.(KOL.LT.1)) GO TO 390	137
000139	000	IIXYM3J=IIXYM(3,J)	138
000140	000	ILFKOL=ILF(KOL)	139
000141	000	IF (ILFKOL.EQ.BLANKBA) GO TO 380	140
000142	000	ISYM1=0	141
000143	000	ISYM2=0	142
000144	000	DO 360 IIYY=1,5	143
000145	000	IF (ILFKOL.EQ.ISYM(IIYY)) ISYM1=IIYY	144
000146	000	IF (IIXYM3J.EQ.ISYM(IIYY)) ISYM2=IIYY	145
000147	000	360 CONTINUE	146
000148	000	ISYMM=MIND(ISYM1+ISYM2)	147
000149	000	IF (ISYMM) 390,340+370	148
000150	000	370 ILF(KOL)=ISYM(ISYMM)	149
000151	000	GO TO 340	150
000152	000	380 ALF(KOL)=IIXYM(3,J)	151
000153	000	390 J=J+1	152
000154	000	GO TO 300	153
000155	000	400 CONTINUE	154
000156	000	IF (MOD(I-1,10).NE.0) GO TO 410	155
000157	000	WRITE (6,490) YPLLOT,ALF	156
000158	000	GO TO 430	157
000159	000	410 IF (MOD(I-1,5).NE.0) GO TO 420	158
000160	000	WRITE (6,550) ALF	
000161	000	GO TO 430	160
000162	000	420 WRITE (6,500) ALF	161
000163	000	430 CONTINUE	162
000164	000	440 CONTINUE	163
000165	000	WRTTF (6,510)	164
000166	000	WRTTF (6,520) PX	165
000167	000	450 CONTINUE	166

***** PICTO *****

000168	000	RETURN	167
000169	000	C	168
000170	000	C	169
000171	000	C	170
000172	000	460 FORMAT (1H0,15A4,20X,20HBATTELLE NORTHWEST ,/1X,15A4,19X,21H RICH 1LAND, WASHINGTON,/,,81X,20HEXPLORE-) CODE ,/81X,20HHYDRODYNAMI	171
000173	000	2C MODEL ,/)	172
000174	000	470 FORMAT (1H1,25X,20A4)	173
000175	000	480 FORMAT (1H0//33A4,/33A4///)	174
000176	000	490 FORMAT (1X,F9.3,2H *,107A1,1H*)	175
000177	000	500 FORMAT (11X,1H1,107A1,1H1)	176
000178	000	510 FORMAT (1H0,14X,1H*, 5(20H - - - + - - - *),,1H)	177
000179	000	520 FORMAT (11X,F7.2,5(13X,F7.2))	178
000180	000	530 FORMAT (4RH0ONLY THE FIRST 500 COLUMNS OF A PLOT REQUIRING 13.25H	179
000181	000	1COLUMNS WILL BE PRINTED.)	180
000182	000	540 FORMAT(1X,'THERE IS A LIMIT OF 400 LINES!')	181
000183	000	550 FORMAT (11X,1H*,107A1,1H*)	182
000184	000	END	-
000185	000		
000186	000		
000187	000		

END ELT.

#HDR,P ***** SORDER *****

***** SORDER *****

REFLT,L HMAINT,SORDER

```
000001      000      FUNCTION SORDER (FIRST,SECOND)
000002      000      C      THIS FUNCTION IS CALLED BY SORT
000003      000      DIMENSION FIRST(3),SECOND(3)
000004      000      SORDER=FIRST(2)-SECOND(2)
000005      000      RETURN
000006      000      END
```

END ELT.

REFLG,P ***** SORT *****

2
3
4
-

***** SORT *****

RELTL HMAINT.SORT

000001	000	SUBROUTINE SORT (M,N,ITEM,Q)	2
000002	000	C THIS ROUTINE IS CALLED BY PICTUR AND CALLS Q AND SORDER	3
000003	000	C	4
000004	000	C ALGORITHM 245 - TREESORT 3 FROM ACM, DEC. 1964	5
000005	000	C VOL 7 NUMBER 12, PAGE 701	6
000006	000	C	7
000007	000	C PROGRAMMED BY JE SCHLOSSER	8
000008	000	C	9
000009	000	C	10
000010	000	C GENERAL PURPOSE INTERNAL SORT SUBROUTINE	11
000011	000	C	12
000012	000	C EXAMPLE OF USE - - - ASSUME - N ITEMS OF 5 WORDS EACH	13
000013	000	C TO BE SORTED IN ASCENDING	14
000014	000	C ORDER ON THE SECOND WORD.	15
000015	000	C MAIN PROGRAM	16
000016	000	C DIMENSION A(5,1000) N IS LESS THAN OR EQUAL TO 1000	17
000017	000	C A CONTAINS THE ITEMS TO BE SORTED	18
000018	000	C	19
000019	000	C EXTERNAL Q Q IS A FUNCTION SUBROUTINE WHICH WILL RETURN	20
000020	000	C . A POSITIVE NUMBER IF THE FIRST ITEM (FIRST	21
000021	000	C ARGUMENT) IS TO SORT AHEAD OF THE SECOND	22
000022	000	C ITEM (SECOND ARGUMENT). SEE EXAMPLE BELOW.	23
000023	000	C	24
000024	000	C CALL SORT (A,N,5,Q) ARGUMENT MEANING	25
000025	000	C . FIRST ARRAY CONTAINING ITEMS	26
000026	000	C . SECOND NUMBER OF ITEMS	27
000027	000	C . THIRD NUMBER OF WORDS PER ITEM	28
000028	000	C . FOURTH FUNCTION SUBROUTINE TO	29
000029	000	C . DEFINE SORT ORDER	30
000030	000	C	31
000031	000	C FUNCTION Q(R,C) WRITE A FUNCTION SUBROUTINE SUCH AS THIS.	32
000032	000	C DIMENSION R(5),C(5) IT SHOULD RETURN A POSITIVE RESULT IF	33
000033	000	C Q=C(2)-R(2) THE FIRST ARGUMENT SHOULD SORT AHFAD	34
000034	000	C RETURN OF THE SECOND ARGUMENT. THIS ROUTINE	35
000035	000	C END PRODUCES AN ASCENDING SORT ON THE SECOND	36
000036	000	C WORD OF THE ITEMS.	37
000037	000	C	38
000038	000	C NOTE - - THE MAXIMUM NUMBER OF WORDS PER ITEM IS LIMITED	39
000039	000	C BY THE DIMENSION OF KOPY. THIS LIMIT IS PRESENTLY 100.	40
000040	000	C	41
000041	000	C APPROXIMATE SPEED IS 250 ITEMS PER SECOND.	42
000042	000	INTEGER O	43
000043	000	DIMENSION KOPY (100)	44
000044	000	DIMENSION M(ITEM*N)	45
000045	000	IF (N-1) 320,320,100	46
000046	000	100 K=N/2+1	47
000047	000	L=N/2-1	48
000048	000	IF (L) 210,210,110	49
000049	000	110 CONTINUE	50
000050	000	DO 200 II=1,L	51
000051	000	I=K-II	52
000052	000	JS=I	
000053	000	NS=N	

***** SORT *****

000054	000	DO 120 IQ=1,ITEM	53
000055	000	120 KOPY(IQ)=M(IQ,IS)	54
000056	000	130 J=2*IS	55
000057	000	IF (J.GT.NS) GO TO 180	56
000058	000	IF (J.GE.NS) GO TO 150	57
000059	000	IF (Q(M(1,J+1),M(1,J))) 140,150,150	58
000060	000	140 J=J+1	59
000061	000	150 IF (Q(M(1,J),KOPY)) 160,180,180	60
000062	000	160 DO 170 IQ=1,ITEM	61
000063	000	170 M(IQ,IS)=M(IQ,J)	62
000064	000	IS=J	63
000065	000	GO TO 130	64
000066	000	180 DO 190 IQ=1,ITEM	65
000067	000	190 M(IQ,IS)=KOPY(IQ)	66
000068	000	200 CONTINUE	67
000069	000	210 NPLUS=N+2	68
000070	000	DO 310 IT=2*N	69
000071	000	I=NPLUS-IT	70
000072	000	IS=1	71
000073	000	NS=J	72
000074	000	DO 220 IQ=1,ITEM	73
000075	000	220 KOPY(IQ)=M(IN,IS)	74
000076	000	230 J=2*IS	75
000077	000	IF (J.GT.NS) GO TO 280	76
000078	000	IF (J.GE.NS) GO TO 250	77
000079	000	IF (Q(M(1,J+1),M(1,J))) 240,250,250	78
000080	000	240 J=J+1	79
000081	000	250 IF (Q(M(1,J),KOPY)) 260,280,280	80
000082	000	260 DO 270 IQ=1,ITEM	81
000083	000	270 M(IQ,IS)=M(IQ,J)	82
000084	000	IS=J	83
000085	000	GO TO 230	84
000086	000	280 DO 290 IQ=1,ITEM	85
000087	000	290 M(IQ,IS)=KOPY(IQ)	86
000088	000	DO 300 IT=1,ITEM	87
000089	000	LAZY=M(IT,1)	88
000090	000	M(IT,I)=M(IT,I)	89
000091	000	M(JT,I)=LA/Y	90
000092	000	300 CONTINUE	91
000093	000	310 CONTINUE	92
000094	000	320 CONTINUE	93
000095	000	RETURN	94
000096	000	END	.

END ELT.