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Accuracy of Computed Water Surface Profiles

Appendix D
Data Management and Processing Procedures

February 1987

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13. ABSTRACT *(Maximum 200 words)*
The purpose of the Water Surface Profile Error Analysis Study is to determine guidelines which indicate the effect that geometric accuracy and boundary friction accuracy have on computed water surface profiles. The study procedures and results are documented in RD-26 and RD-26A. This appendix describes only the data management and processing portion of the study. To analyze the accuracy of computer water surface profiles as a function of several variables, the Monte-Carlo simulation technique was applied. This technique required over 40,000 executions of HEC-2. The input data to and the results from HEC-2 had to be systematically and automatically manipulated and processed. A preprocessor program (SETUP) modified simplified HEC-2 input data to do the following: simulate errors in measuring geometry and in determining roughness coefficients, interpolate intermediate cross-sections, optionally determine topographic cross-sections, and automatically submit the manipulated input data as a "batch" computer job. A postprocessor (H2POST) reads HEC-2 computed results, forms a unique data base label to identify each computed profile, and stores the computed profile in a data base file (HECDSS data file) using that label. An error computational program (COMPER) accesses the HECDSS data file, calculates errors in computed water surface elevations between a base "error'free" profile and other manipulated data set profile and formats the results (as well as pertinent identifiers) for input to a relational data management system file. The relational data management system (INFO) is used to store computed errors and stream characteristics and write reports containing errors and characteristics that meet user specified criteria. The reports are then used as input to regression software (HEC's Multiple Linear Regression Program or the personal computer software package STATGRAPHICS). This appendix describes the details of data processing, the assumptions that were made, and the software that was developed and applied to meet the study needs.

14. SUBJECT TERMS
Water surface profile accuracy, Monte-Carlo simulation, data management, manipulated input data, post-processing HEC-2 results, data storage system, relation database

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ACCURACY OF COMPUTED WATER SURFACE PROFILES

Appendix D
Data Management and Processing Procedures

I. General Overview
A. Study Objective

The object of the profile accuracy study is to determine guidelines which indicate the effect of geometric accuracy and boundary roughness estimation on computed water surface profiles. To achieve this, an excess of 100 HEC-2 data sets have been collected from U.S. Army Corps of Engineers District and Division offices. These data sets provide the necessary information for computing steady state water surface profiles. The data sets were modified in several ways to obtain simple, clean data which represent general hydraulic conditions and not special, localized conditions. Also removed are any specialized options and associated data cards. The result is a data base of HEC-2 input data sets containing simple and concise information. These data sets are called the "actual" data sets.

In addition to studying the effects of geometric accuracy on computed profiles, HEC also evaluated the effects of the friction loss accuracy on profiles. The Manning's coefficients supplied with the data sets are assumed to be the correct (or historically calibrated) values. The Manning's coefficients are then systematically changed to simulate errors in their estimation.

A Monte-Carlo simulation technique has been implemented to systematically modify elevations and Manning's coefficients to evaluate the consequence of errors in determining these parameters. Initial evaluations indicated cross-section spacing significantly effects computational results. To achieve the goals of this study, it was required that some tool or tools be available to:

1 Decrease the distance between cross-sections by interpolating new sections (computation points) between the existing actual sections.

2 Generate topographic cross-sections from the actual cross-sections (which are comprised of spot elevations) for contour intervals of 2, 5, and 10 feet.

3 Adjust elevations and Manning's coefficients.

4 Compute new water surface profiles using the manipulated data sets.

5 Compute the difference between the base condition profile and all of the alternative profiles (also called the "error").

6 Compute statistics of the errors and statistics of the aggregated statistics of the errors.

7 Explain the errors by performing regression analyses using the statistics of the aggregated statistics of the errors.

B. Computer Programs Utilized

Figure one summarizes the steps needed to meet the above requirements. Several tools are used to meet these requirements. These tools consist of a mixture of commercial software, standard HEC software, and newly developed software. An existing, internal-use program (INTSEC) interpolates cross-sections. It has been converted to a subroutine of a newly developed program (SETUP) which creates topographic cross-sections, adjusts elevations and Manning's coefficients, generates JCL (job control language), generates disk file names and areas, and submits HEC-2 jobs.

HEC-2 is a standard HEC program available to the general public. It computes steady state water surface profiles. A data base management system (HECDSS) facilitates the storage and management of all computed water surface profiles on computer disk. HECDSS is an HEC developed product that is generalized in nature but has limited availability outside of the Corps. A newly developed, special purpose program (H2POST) is the data transport mechanism between HEC-2 and the HECDSS data base.

Errors (or the difference in water surface elevations between the base condition and manipulated data sets) are computed by a newly developed, special purpose program (COMPER). COMPER accesses the HECDSS data base (which is not human readable), computes the errors, and generates an ASCII file (human readable) file.

A commercially available product (INFO, written by Henco Software) reads the ASCII files and stores the data in a data base file (not human readable) from which the results can be selectively managed for further processing. INFO is a relational data base software system which allows multiple files to be related to each other through some common variable. It also allows selective retrieval of data based on some user specified criteria, sorting of data, and generation of reports.

Two existing software tools are used to evaluate the errors by regression analysis: MLRP (the Hydrologic Engineering Center's Multiple Linear Regression Program) and STATGRAPHICS (a commercially available product that is personal computer based). The report generation capability of INFO produces an ASCII file that another newly developed, special purpose program (INFORM) converts into a format acceptable by either STATGRAPHICS or MLRP.

In summary, the bulk of the data manipulation is performed by program SETUP (a newly developed, special purpose program), the water surface profile computations by HEC-2 (an existing, general purpose, publicly available program), and the error analysis by either STATGRAPHICS (commercially available, PC based package) or MLRP (an existing, general purpose, publicly available program). Several newly developed, special purpose programs, an internal HEC program, and some limited availability data management software bond the major computational tools together by manipulating data through a series of computer files. Figure two illustrates in detail the required steps to manage data for this study.

Figure 1: General Data Management

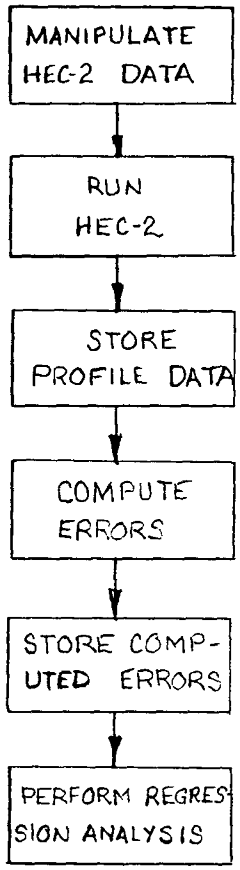
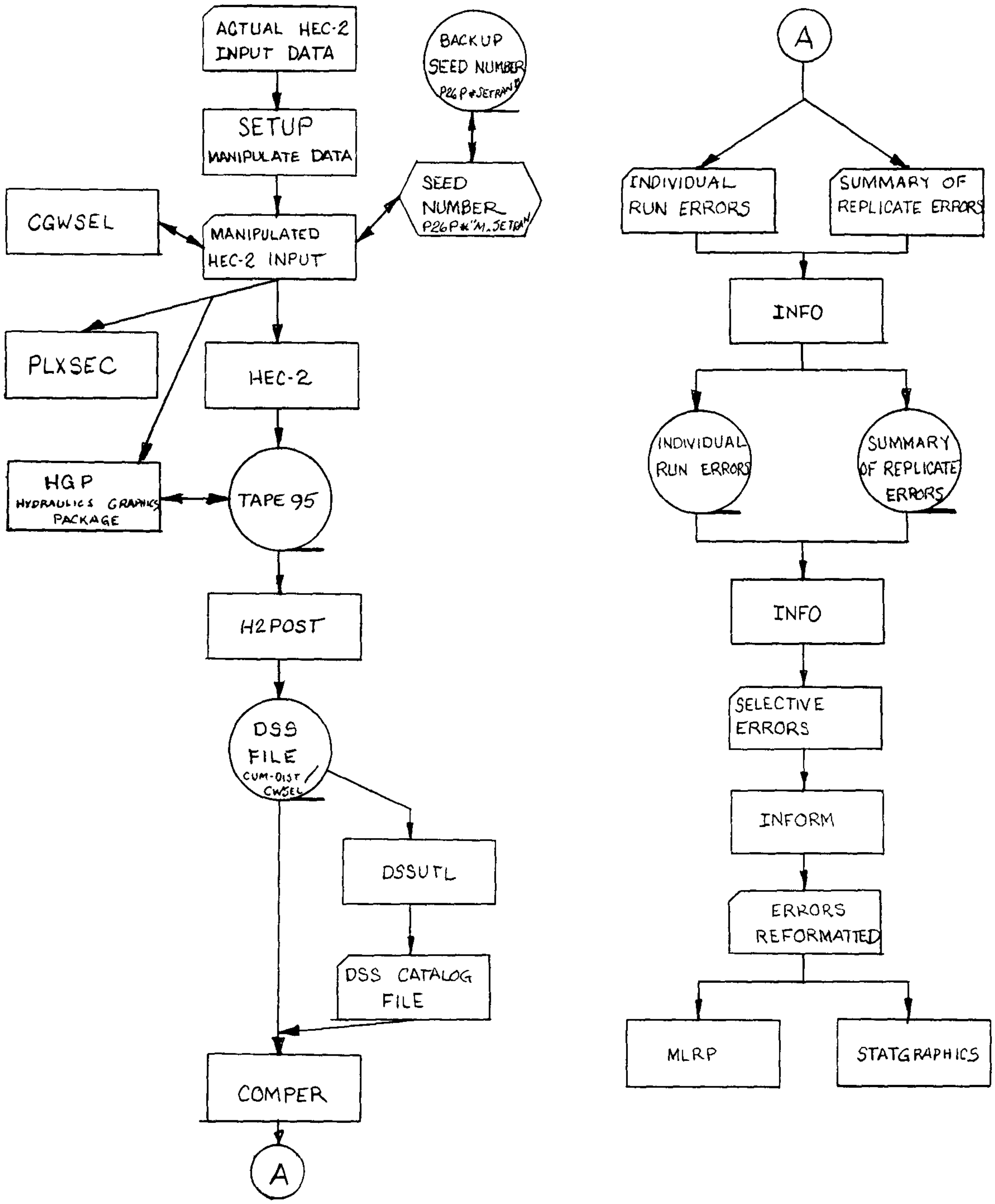


Figure 2: Detailed Schematic of Data Management



II. Permanent File Description

The Study requires an enormous number of files which contain a mixture of data, JCL (job control language), output, and program source code. Table 1 summarizes many of the files used in the study.

Table 1: Summary of File Names

File name	Description
P26M*Sxxxx	Actual HEC-2 input data set. "xxxx" is a four character location identifier. For example, the Dardenne Creek is identified as "P26M*S05S1".
P26M*SxxxxMnn	HEC-2 data file containing manipulated (or adjusted) data sets. "xxxx" is the same four character location identifier used for the actual data set above. "M" identifies the file as a manipulated data set. "nn" is an index number.
P26M*SxxxxOnn	HEC-2 output data file containing printout from manipulated (or adjusted) data sets. "xxxx" is the same four character location identifier used for the actual data set above. "O" identifies the file as a manipulated data set. "nn" is an index number.
P26M*SxxxxI	Temporary HEC-2 input data set created for cross-section interpolation program. "xxxx" is a four character location identifier.
P26M*SxxxxB	Temporary HEC-2 input data set created by the cross-section interpolation program. "xxxx" is a four character location identifier.
P26M* W5	Temporary HEC-2 binary output file (so called TAPE95). Exists only for the duration of each HEC-2 execution.
P26M*SxxxxZ	HECDSS data file containing computed profiles for location "Sxxxx". "xxxx" is a four character location identifier. "Z" identifies it as a DSS file.
P26M*SxxxxZC	HECDSS catalog file containing labels of computed profiles for location "Sxxxx". "xxxx" is a four character location identifier. "ZC" identifies it as a DSS catalog file.
P26M*IRUNiii	Individual run error statistics. "iii" is an index number for a given location. It is related to the location identifier "Sxxxx". (See table 2)
P26M*ISUMiii	Summary of individual run error statistics. "iii" is an index number for a given location. It is related to the location identifier "Sxxxx". (See table 2)

Table 1 (cont.)

File name	Description
P26M*IBADiii	List of individual run error statistics that are faulty. "iii" is an index number for a given location. It is related to the location identifier "Sxxxx". (See table 2)
P26M*FHA001IN	INFO data base file containing the results of individual runs for all locations (not human readable).
P26M*FHA005IN	INFO data base file containing the results of the summary statistics of profile accuracy error (not human readable).
P26P*M SETRAN	Monitor common block (resident) containing current seed number for random number generator.
P26P*SETRANB	Backup disk file containing seed number used at the start of the current SETUP job execution.
P26C*RAN1	Program allows user to view and then reset the seed number in monitor common block P26P*M SETRAN.
P26C*RAN2	Program allows user to test random number generator.
P26M*SEARCH	Searches a Harris map listing and generates a list of files: DSS, Modified HEC-2 input, and/or output.
P26M*RDSECT	Searches a Harris map listing and generates a condensed listing of file names, disk sectors, and totals.
P26P*SETUP	Program reads actual HEC-2 data sets, generates modified data sets, and submits them for batch execution.
P26P*HEC2	Water surface profile program. Slightly modified version of standard program (less printout and more (300) GR points.
P26P*COMPER	Program computes profile errors. Accesses DSS data files and generates ASCII output files for further processing by INFO.
P26P*INTSEC	Program interpolates additional HEC-2 cross-sections. Converted to subroutine for this study and included with program SETUP.
P26P*MLRP	Multiple Regression Program (MLRP). Slightly modified version of standard program (allows 10,000 observations).
SYS*DSSUTL	HECDSS utility program for cataloging files and editing or tabulating DSS data.

Table 1 (cont.)

File name	Description
HLIB*HGPM	Macro to run the Hydraulics Graphics Package and get plots of cross-sections, profiles, or variable versus variable using TAPE95 from HEC-2.
SYS*DSPLAY	HECDSS utility program for plotting profiles stored in DSS data files "SxxxxZ".
P26P*PLXSEC	Program to plot cross-sections contained in HEC-2 manipulated data sets "SxxxxMnn".
P26P*CGWSEL	Program to modify the estimated starting water surface elevation on the J1 card in HEC-2 manipulated input data sets "SxxxxMnn".
1000SYSS*HECLIB or HECC*HECLIB	Library of software for HECDSS data storage system.
SYST*INFO	Henco Software's relational data management software.
P26M*GENJCL	Program generates JCL for each location for certain operations including executing DSSUTL, COMPER, and INFO. One set of JCL is generated for each location.
P26M*GENLIS	Program generates JCL which intern can generate HEC-2 input files when manual corrective file generation is necessary. It also generates input for DSSUTL for either all or selected locations.
P26M*UTLELM	Scans MATHPK input containing "GET" commands and eliminates any reference to "GETting" base condition data which includes original sections. Used to eliminate base condition results incorrectly computed.
P26M*VEFHWii	Verified listing of HEC-2 manipulated data sets contained on backup tape "ii". "ii" ranges from "01" to "16". Data is stored in Harris KEEP/FETCH format --- system dependent.
P26C*RNCOMPER	Macro to rename the executable program for COMPER from the work qualifier P26C into the production qualifier P26P.
P26C*RNH2POST	Macro to rename the executable program for H2POST from the work qualifier P26C into the production qualifier P26P.
P26C*RNINFORM	Macro to rename the executable program for INFORM from the work qualifier P26C into the production qualifier P26P.
P26C*RNMATHPK	Macro to rename the executable program for MATHPK from the work qualifier P26C into the production qualifier P26P.

Table 1 (cont.)

File name	Description
P26C*RNSETUP	Macro to rename the executable program for SETUP from the work qualifier P26C into the production qualifier P26P.
P26C*RNSTATOP	Macro to rename the executable program for STATOP from the work qualifier P26C into the production qualifier P26P.
P26M*J.UTL000	Framework JCL file for cataloging DSS files. Copy this into each locations JCL file; then edit it with output from program GENJCL, KASE=2.
P26M*J.CMP000	Framework JCL file for computing errors in water surface profiles. Copy this file into each locations JCL file; then edit it with output from program GENJCL, KASE=2.
P26M*J.INF000	Framework JCL file for entering data into the INFO data base. Copy this file into each locations JCL file; then edit it with output from program GENJCL, KASE=2.

A. HEC-2 Manipulated Input Files

The number of data files "SxxxxMnn" vary by location --- some have as few as 4 input files and some as many as 31. There are in excess of 800 files of HEC-2 manipulated data. For each input file, there is an associated output file "SxxxxOnn" which has not been archived. The index "nn" starts at "00" (zero,zero) and is incremented automatically by SETUP as needed. Separate documentation exists for SETUP.

B. File Naming Conventions

The programs listed above usually have several different associated files. The following conventions are used to identify files:

Prefix	Description
J.	JCL to compile and vulcanize (link) program.
F.	FORTRAN source code for program.
J2	JCL to either compile part of the program and vulcanize it and/or execute test data.
I.	Test data.
I2	Additional test data.
JT	JCL to execute programs that test program subroutines.
T.	FORTRAN source code for program that tests subroutines.
M.	FORTRAN source code of subroutines for MATHPK (old version).
N.	FORTRAN source code of subroutines for MATHPK (new version).
S.	FORTRAN source code of subroutines for SETUP.

Suffix	Description
O	Output file for JCL file "J.----".
O2	Output file for JCL file "J2----".

Some example file names for the program SETUP are listed below:

File	Description
P26C*J.SETUP	Compile the entire SETUP program and vulcanize it.
P26C*J2SETUP	Compile part of the SETUP program and vulcanize it.
P26C*F.SETUP	FORTRAN source for program (may consist entirely of $ADD cards).
P26C*SETUPO	Output file for JCL in file P26C*J.SETUP.
P26C*SETUPO2	Output file for JCL in file P26C*J2SETUP.
P26C*T.GENRT3	FORTRAN source for program which tests SETUP subroutine GENRT3 --- the subroutine that generates the T3 card for a manipulated HEC-2 input data set.
P26C*S.GENRT3	FORTRAN source for SETUP subroutine GENRT3 --- the subroutine that generates the T3 card for a manipulated HEC-2 input data set.
P26C*JTGENRT3	JCL to compile and vulcanize the program that tests SETUP subroutine GENRT3.

III. Manipulation of HEC-2 data

As previously mentioned, the actual HEC-2 input data sets are stored in active disk storage areas with the file names "Sxxxx", where "xxxx" is a four character location identifier. All of the HEC-2 manipulated data files use this five character identifier in the file names. There are additional JCL and output files that use a program related three character code plus a three character location numeric code for file names. The numeric location code is related to the five character alphanumeric code as shown in table 2. The selection of the three character numeric code is somewhat arbitrary but is somewhat related to the order of the number of replicates for each location.

Table 2: Cross-reference List of Locations

Location Identifier	Numeric Index	Number of Replicates
S20S2	001	5
S02M1	002	3
S06M1	003	5
S14M1	005	3
S15M2	006	4
S04M2	007	4
S06M2	008	3
S07M2	009	3
S10M2	010	4
S18M2	011	3
S22M2	012	4
S26M2	013	3
S29M2	014	4
S30M2	015	3
S37M2	016	4
S42M2	017	5
S44M2	018	3
S07M1	019	7
S10M1	020	10
S12M1	021	9
S02M2	022	9
S09M2	023	10
S14M2	024	8
S31M2	025	9
S41M2	026	6
S46M2	027	6
S47M2	028	9
S52M2	029	8
S01M3	030	6
S05M3	031	10
S01S1	032	6

Table 2 (cont.)

Location Identifier	Numeric Index	Number of Replicates
S10S1	033	10
S15S1	034	10
S20S1	035	6
S02S2	036	10
S04S2	037	10
S08S2	038	6
S09S2	039	7
S12S2	040	10
S13S2	041	7
S17S2	042	6
S19S2	043	8
S13M1	044	12
S16M1	045	12
S17M1	046	20
S01M2	047	20
S12M2	048	20
S48M2	049	12
S49M2	050	20
S50M2	051	15
S51M2	052	15
S02S1	053	15
S04S1	054	15
S06S1	055	15
S08S1	056	15
S11S1	057	15
S13S1	058	15
S14S1	059	20
S16S1	060	20
S17S1	061	12
S18S1	062	15
S19S1	063	20
S21S1	064	20
S03S2	065	15
S07S2	066	15
S11S2	067	15
S18S2	068	12
S02S3	069	12
S10F2	070	30
S12F2	071	30
S03M1	072	30
S13M2	073	30
S33M2	074	30
S53M2	075	30
S09S1	076	30
S12S1	077	30
S23S1	078	30
S10S2	079	30

Table 2 (cont.)

Location Identifier	Numeric Index	Number of Replicates
S01S3	080	30
S04M1	081	60
S05M1	082	60
S09M1	083	60
S11M1	084	60
S03M2	085	60
S05M2	086	60
S08M2	087	60
S16M2	088	60
S54M2	089	60
S55M2	090	60
S56M2	091	60
S04M3	092	60
S03S1	093	60
S07S1	094	60
S22S1	095	60
S05S2	096	60
S06S2	097	60
S05S1	101	5
S01S2	102	5

A. Example Use of Location Numeric Index

Some example applications using the numeric index include: execution of DSSUTL to catalog a DSS file, execution of COMPER to compute profile errors, and execution of INFO to input computed errors into the INFO data base. A specific example for DSSUTL includes the following files:

Location................	S02M1	(Cape La Croix Creek)
Numeric index...........	002	
DSSUTL JCL file..........	J.UTL002	
DSSUTL OUTPUT file.......	UTL0002	
DSSUTL JCL file..........	JAUTL002	
DSSUTL Output file.......	UTLOA002	

B. Generation of Disk Files For Manipulated HEC-2 Data

The location identifier is used for all HEC-2 manipulated data sets. Included with the input data is the JCL to execute HEC-2, the JCL to execute the postprocessor H2POST, and the input data to H2POST. SETUP begins by checking for the existence of HEC-2 manipulated data files starting with "00". For example, for location S02S1, SETUP begins looking for disk file name

"S02S1M00", and if found, checks for file name "S02S1M01", and continues until the disk file doesn't exist (up until "99"). This process is very system dependent and utilizes Harris Computer System intrinsic functions. Upon finding the nonoccurrence of the file, SETUP generates the input file (such as "S02S1M03") and an output file (such as "S02S1003"). To streamline processing, input data files are generated with a fairly large granule size (500 to 2,000 sectors). The granule size is an input data option to SETUP. The output files contain HEC-2 output that is suppressed to the maximum so they are generated with a smaller granule size (40 to 120 sectors). The user cannot specify the granule size of output files as a SETUP input data option but may modify, recompile, and then vulcanize the program.

C. Disk Space Limitations

SETUP generates massive amounts of input data to HEC-2. As a result, it is critical to properly manage the computer system disk space. The Hydrologic Engineering Center's Harris computer system includes four disk packs each containing in excess of one million sectors of space (on the order of 300 million bytes). The entire staff use this system so only a portion of it can be used in the Profile Accuracy Study. The primary study user is assigned 900,000 sectors of space which is not disk pack specific. The disk packs typically have between 200,000 and 700,000 sectors of available space. When one user generates massive amounts of disk space, it is critical that the user properly distribute it among the available packs. The current operating system will abort the system if a user requests space on a full disk pack. If this happens, a computer operator must reboot the system. This causes severe disruptions to other users and, if it occurs at night, the system remains down until the next business day. Therefore, SETUP contains an input option that allows the user to specify the disk pack on which the HEC-2 manipulated input data file is to be generated. The Study requires in excess of 6.8 billion sectors of disk space for input data alone (on the order of 2.3 trillion bytes). Since all manipulated data files are archived, only part of the data sets can be generated and executed before they are archived on magnetic tape and eliminated from the disk.

D. Executing SETUP and HEC-2 Jobs

There is no "best" procedure for doing this. Only the computer operator is able to check the distribution of available disk space among the disk packs, so a remote user can only guess the current status. Two possible scenarios for processing data include: (1) Generate as much HEC-2 input as possible during the day, archive it on tape at the end of the day, and execute HEC-2 all night long; or (2) Configure the JCL files so that SETUP generates a moderate amount of HEC-2 input data before quitting, allowing HEC-2 to execute, and then when HEC-2 is finished, restart SETUP execution. Since HEC has no evening computer operator and no automated tape handlers, the first scenario seemed best. However, the 900,000 sectors of disk space is large enough compared to the clock time required for processing that scenario two actually works best. Scenario two minimizes the number of files that accumulate in the computer system input queue and prevents the user from reaching the users disk space limit until virtually all of the requested HEC-2 runs are complete. However, scenario two also requires the user to monitor the status of the jobs often because if one job aborts, future jobs are not submitted. This problem is minimized by judiciously selecting low job priorities so that only two to three HEC-2 jobs run concurrently and additional jobs are directed to the input queue for later processing. Using this approach, only SETUP job abortions will stop the automatic job submission process. SETUP contains an input option which allows the user to specify the job priority for the HEC-2 jobs. Selection of priority "0" (zero) and occasionally "1" (one) gives best results under scenario two. However, during normal business hours, this low priority results in very low processing speeds since most other HEC staff members submit jobs with priorities ranging from four to nine.

E. HEC-2 Data Content

The actual HEC-2 data sets are very simple in nature --- they do not include any bridges, channel improvements, or other complications. The input cards include the necessary title and job cards (T1, T2, T3, J1, J2, and J5), the discharge specifications (QT card), the roughness coefficients (NC card --- no NH cards), and the geometry cards (X1 and GR cards only). Some utility programs developed for this study rely on the assumption that the GR cards immediately follow the X1 cards. The plotting program PLXSEC is one of these programs. If data were supplied with, for example, a X2 card, PLXSEC would generate erroneous results or would abort.

F. Assumptions About The 100 Year Discharge

Many of the actual HEC-2 data sets contain discharges for both the ten percent chance exceedance as well as the one percent chance exceedance events. The Profile Accuracy Study evaluated only the one percent chance exceedance event. When both discharges are present, two sets of T1 through J2 cards are required, one at the front of the data file and one near the end of the data file. If two sets of T1 through J2 cards are included in the actual data sets, SETUP assumes the first set is for the ten percent chance exceedance event, the second set for the one percent chance exceedance event, and swaps those input data records before manipulating the data.

G. Interpolating Cross-sections

Early in the study, it was determined that spacing between cross-sections has a significant effect on computed profiles. The program INTSEC interpolates cross-sections between input HEC-2 cross-sections based on a user supplied maximum allowable spacing. INTSEC is incorporated into SETUP as a subroutine to expedite processing. The user has the option of either retaining the original with the interpolated cross-sections or including just the interpolated sections in the HEC-2 data deck generated by INTSEC. The original implementation of this option was incorrect, so early results that were supposed to contain the original sections really did not.

H. Generating Topographic Cross-sections

After interpolating cross-sections, SETUP optionally generates topographic cross-sections. The user invokes this option by entering the command "METHOD,T" for topographic cross-section method, and sets the contour interval by entering the "ELEVATION" command and including a positive number or numbers. This study used contour intervals of two, five, and ten feet. If the user enters a contour interval of "0" (zero), spot elevations are used. In conjunction with generating topographic sections, SETUP allows the user to graphically display the original section plotted with the topographic section. Stations are not adjusted and the first and last coordinates are extrapolated. As a result, many topographic sections begin with a negative station --- usually undesirable from the standpoint of HEC-2. However, the input data sets are so basic in content that HEC-2 is able to properly compute results with the negative stations. SETUP uses the minimum channel elevation as the lowest contour interval. The user requests one of two methods for determining all other intervals: (1) All intervals are integer multiples of the contour interval above the minimum elevation, or (2) The second interval is the first elevation above the minimum elevation that is an integral of the interval above zero. For example, if the minimum channel elevation is 426 feet and the contour interval is ten feet, the following elevations are used for contour intervals:

Interval Number	Method 1 Elevation	Method 2 Elevation
1	426	426
2	436	430
3	446	440
4	456	450
.	...	...

When generating topographic sections especially for two foot intervals, it usually requires more coordinate points than in the original, actual data sets. The version of HEC-2 and the topographic generation routine used in this study allow a maximum of 300 coordinate points. The standard HEC-2 program allows only 100 coordinate points. After generation of topographic sections, SETUP must determine new bank stations since the new geometric coordinates do not correspond with the original spot elevation coordinates. SETUP determines the bank stations by selecting the topographic station that is nearest to the original bank station in the spot elevation data set. Occasionally, it will compute a left and right station at the same coordinate point. This occurs on small, steep streams which are modeled using sections having total heights that are less than the contour interval. This problem has been encountered very late in the study. The solution that has been implemented is the creation of the program STATOP which scans the HEC-2 input data deck for this condition, and then corrects it by moving the stations one coordinate point towards the outer section limits. This logic could easily be moved into program SETUP but has not been done because of manpower constraints.

I. Selecting The Starting Water Surface Elevation

SETUP contains two options for specifying the starting water surface elevation on the J1 card: (1) Compute the starting elevation by normal depth --- the elevation on the J1 card in the actual data set will be used as the original estimate of normal depth; and (2) Use the starting water surface elevation as calculated by the actual data set. If using option (2), the actual data set must have already been successfully run using HEC-2. The calculated elevation is stored in the HECDSS file associated with each location. SETUP retrieves it by opening the HECDSS file and retrieving the profile for the actual data set. The actual data set is assumed to be generated using the following input parameters (the appropriate SETUP command is shown in parentheses):

Actual cross-sections only (SP 0)
Spot elevations (MEthod,P)
No elevation adjustments (ELevation,0)
No Manning's coefficient adjustment (N,0; SDN,L; PE,S)

The assumed part F of the HECDSS pathname (data label) is:

0000- 0- 0-P L

SETUP instructs HEC-2 to compute normal depth if it cannot find a data record with these specifications. It must be remembered, the normal depth elevation is the same for all data sets in which neither the elevations or roughness coefficients have been adjusted. However, if either have been adjusted, then the calculated normal depth will be different than that for the actual or base condition. When computing normal depth, SETUP instructs HEC-2 to use field J1.9 (variable WSEL) as the first estimate of normal depth. Some of the data sets for this study have been extracted from larger data sets --- some of the sections at either the lower end and/or the upper end of the reach have been removed. In some cases, field J1.9 has not been adjusted. As a result, the estimated elevation is below the thalweg of the first cross-section. For these cases, HEC-2 overrides the value in field J1.9 with an elevation one foot above the thalweg. In several cases, this is an unsatisfactory elevation for the HEC-2 procedure which determines normal depth. Rather than converging, HEC-2 iterates in an diverging mode and fails to determine normal depth. It prints the error message "3790", then continues with the next job. Several large data sets repeatedly failed in this mode. The computed profile is written to the HECDSS data file and is stored with all zeros for elevation and cumulative distance. Because the program does not abort and because there is so much data, it initially is not apparent that there has been a computational failure. Discussions later describe tools that are used to uncover this problem and identify it. Apparently, there are in existence, personal versions of HEC-2 that contain more sophisticated code and do not fail to converge under the described conditions. Under normal applications, this type of failure would cause minor inconveniences. However, the Profile Accuracy Study, as finally formulated, required in excess of 41,000 executions of HEC-2. If the researcher were to spend one minute evaluating each run, it would require in excess of 680 hours or 85 eight-hour days to review all of the runs. Obviously, the whole scheme of things required a great deal of automation in processing the runs and the maximum degree of robustness in computer program executions.

J. Generating JCL To Execute HEC-2

As previously mentioned, the disk files containing manipulated (or adjusted) HEC-2 input data also contain the JCL to execute HEC-2 and H2POST, the HEC-2 postprocessor. Harris computers allow the user to identify each job with a "job name" which consists of a maximum twelve characters. Initially, all jobs were submitted with the same jobname --- "FHWA". However, the large number of jobs and associated calculations caused system problems which could only be resolved by rebooting the system. As a result, it became apparent that it is advantageous to give each job a unique identifier for a job name. All jobs are now identified by the disk file name. For example, if the disk file name for location S02M1 is "S02M1M03", the job name entered on the Harris $JOB card is "S02M1M03". This job name is also entered on a Harris comment job control statement at the end of the manipulated HEC-2 data deck along with the control cards "$XT" and "/DT". This allowed the researcher to easily identify all jobs in execution or in the input que, and to also use macros and Harris "Sage" tools to quickly verify that the HEC-2 jobs had successfully executed by searching for these commands. These JCL commands are automatically generated by SETUP at the same time the disk files are generated for the adjusted HEC-2 input and output.

K. Generating Manipulated Data Sets

1. Generating Random Numbers

In addition to interpolating cross-sections, SETUP adjusts elevations and roughness coefficients using a Monte-Carlo simulation technique. To do this, SETUP needs random numbers uniformly generated between zero and one. The random numbers are entered into equations that generate a normally distributed error term. SETUP utilizes the following routines to generate the random numbers:

```
      FUNCTION XNORM(JSEED)
      INTEGER *6 JSEED
      XNORM=0
      DO 100 I=1,12
      XNORM=XNORM+RAND(JSEED)
100   CONTINUE
      XNORM=XNORM-6.0
      RETURN
      END
```

```
FUNCTION RAND(JSEED)
INTEGER *6 ICON1,ICON2,ICON3,JSEED
COMMON /GEN/ICON1,ICON2,ICON3,CON3
JSEED=JSEED*ICON1
IF(JSEED.LT.0)JSEED=JSEED+ICON3
RAND=FLOAT(JSEED)*CON3
RETURN
END
```

where the following definitions are used:

JSEED An integer *6 seed number for generating random number.

ICON1 An integer *6 constant. An appropriate number for the Harris is: 8388611

ICON2 An integer *6 constant. An appropriate number for the Harris is: 70368744177663

ICON3 An integer *6 constant. An appropriate number for the Harris is: ICON3 = ICON2 + 1 or 70368744177664

CON3 A floating point constant. An appropriate number of the Harris is: .1421085472 E-13

ISEED The initial value for JSEED. An appropriate value for use on the Harris is: 759821. Although the initial value for JSEED is not critical, this value should be large enough to generate the longest string of random numbers possible before the same string is repeated.

The SETUP program generates the random numbers for use in the Profile Accuracy Study. If the seed number is initialized every time SETUP is executed, then the adjusted HEC-2 data sets would contain data initially adjusted by the same random number. This would cause a bias in the starting water surface elevation in all of the data sets. As an alternative, the seed number is initialized only once. Then, rather than initializing the seed again in subsequent executions of SETUP, the seed calculated at the end of the previous SETUP job is used as the initial seed for the current execution of SETUP. Several alternative methods are available for accomplishing this. The Harris computer system includes a "monitor common" capability. The user may generate a disk area which is defined as a "monitor common" which can contain data and can exist as either a resident or nonresident block. User programs contain a normal labeled common block identified as monitor common. Any data contained in the block is available simultaneously to any program which contains the same monitor common block. By making it a resident monitor common block, the data will always remain on the system. A nonresident block exists only if a program is actively accessing it. SETUP contains the resident monitor common block "SETRAN" which is identified as disk area "P26P*SETRAN". A Harris map listing shows the disk area as: "0000P26P*M SETRAN". The seed number is stored in this monitor common block and it is updated every time SETUP requests a random number. If the user wishes to generate adjusted HEC-2 input that can later be duplicated, then the user must submit only one SETUP job at a time. Otherwise, there is no absolute limit to the number of jobs that can run simultaneously while progressing through one cycle of random numbers. Associated with the monitor common block is a backup disk area named "P26P*SETRANB". At the conclusion of every job, SETUP stores the last seed number it used in the backup disk area. If a SETUP job should abort, P26P*SETRANB contains the seed number used at the start of the aborted job. It also provides a means for supplying a seed if for some reason, the value in the monitor common block gets corrupted. The seed in monitor common SETRAN can be reset by executing program P26C*RAN1. The validity of the random number generator can be tested by executing program P26C*RAN2.

2. Adjustment Equations

The following equations are used to adjust the Manning's roughness coefficient:

$$SD=A+B*\ln(n)$$

where:

SD is the standard deviation for Manning's coefficient.
A is the user defined coefficient.
B is the user defined coefficient.
ln(n) is the natural logarithm of the Manning's coefficient entered on an "NC" record in the HEC-2 input data deck.

$$ERRORN=K*SD$$

$$N_{adjusted} = e^{(\ln(n)+ERRORN)}$$

where:

ERRORN is the incremental adjustment.
K is a normalized random deviate.
SD is the standard deviation as computed above.

If the user enters the Harris execution time option of "C", SETUP will use one random number for all adjustments of Manning's coefficient. This produces consistently high or low friction loss estimates, depending upon the random number which is generated. During the Profile Accuracy Study, this option has not been used. Instead, one random number is used to adjust all three Manning's coefficients on the NC record --- the left overbank, the channel, and the right overbank values. Each time a "NC" card is encountered, a new random number is generated. To implement the alternative "C" option, the user enters the following to execute SETUP:

P26P*SETUP.C

SETUP contains default coefficients which are accessed by entering the alpha characters: L, M, and/or H. The user may also enter numeric coefficients. The coefficients indicate the accuracy with which the Manning's coefficients are known. The default coefficients are:

Option	Keyword	Accuracy	A	B
L	Low	Perfect	0.0	0.0
M	Medium	Good	.2909	.0493
H	High	Poor	.5818	.0986

The following equations are used to adjust geometric elevations entered on HEC-2 "GR" cards:

ERRORE=K*SD

where:

K is a normalized, random deviate. A new random deviate is generated for each elevation ordinate.

SD is the standard deviation of the distribution of errors. It varies as a function of the survey accuracy and the type of mapping (either spot elevations or topographic mapping).

$$EL_{adjusted} = EL_{GR\ card} + ERRORE$$

where:

$EL_{GR\ card}$ is the elevation ordinate entered in the actual HEC-2 data set.

ERRORE is the error as computed above.

$EL_{adjusted}$ is the new "adjusted" elevation ordinate used in the manipulated HEC-2 data deck.

Below is a list of standard deviations used in the Profile Accuracy Study:

Cross-section Type	Accuracy (in feet)	Standard Deviation
Spot elevations	0	0
Spot elevations	1	.15
Spot elevations	2	.30
Spot elevations	5	.60
Spot elevations	10	1.50
Topographic	0	.00
Topographic	1	.30
Topographic	2	.60
Topographic	5	1.50
Topographic	10	3.00

3. Formatting Adjusted Values

The SETUP subroutine "CFORMT" generates the FORTRAN format statement used to "write" the adjusted values for elevation and Manning's coefficients to the manipulated HEC-2 input data file. The basic goal of CFORMT is to maintain the maximum number of significant digits possible. This is dependent upon the number of columns available in the HEC-2 data field. All fields contain eight columns except NC.1, field one of the NC card and GR.1, field one of the GR card. CFORMT also contains logic to print information in the users output file if the adjusted number is too large (or too small) to fit into the assigned data field. Thus, format statements are generated for every adjusted value. This requires significant processing time but generates reliable output results. Other methods of writing adjusted output probably would be nearly as reliable but would not retain the same accuracy. For example, elevations could all be written to the nearest tenth of a foot. Rather than assessing the effect of accuracy, all numbers are written to maximum possible accuracy. One drawback of this method is that the adjusted HEC-2 input data is virtually impossible to read without first running a program (such as HEC-2) to print the numbers with blank separators.

4. Generating T3 Card Information

When generating data, SETUP writes user specified parameters to the T3 record. This data is written to the HEC-2 output binary file "TAPE95" from which H2POST reads that data and uses it to form a label (HECDSS pathname) which describes the computed water surface profile stored in the HECDSS data base. HEC-2 writes columns nine through thirty-two to TAPE95 and also writes the same columns above the summary tables, if they are requested. Table three describes the information written to the T3 card.

Table 3: T3 Card Information

Column(s)	Description
1-2	The card code "T3".
9-13	The location identifier "Sxxxx", where "xxxx" is a four character location identifier. For example, the location Cape La Croix Creek is identified by "S02M1".
16-19	The maximum allowable distance between cross-sections (zero filled). This is used for interpolating cross-sections. If the user enters 500 foot spacing, then columns 16-19 would contain "0500".
20-21	The survey accuracy in feet (blank filled). For example, if the user enters two foot accuracy, columns 20-21 would contain " 2".

T3 Card Information (con't.)

Column(s)	Description
22-23	The Manning's coefficient adjustment index (blank filled). A zero indicates that Manning's coefficients are not adjusted. Otherwise, it is just an index from zero through ninety-nine. If the user enters an index of "3", then columns 22 through 23 would contain " 3".
24-24	Type of survey data. Either "P" for spot elevations or "T" for topographic contour mapping.
25-25	Type of adjustment: S Elevations and n values are both adjusted. N Only n values are adjusted. E Only elevations are adjusted. (blank) Neither elevations or n values are adjusted.
26-26	Either "O" (oh) if the original actual cross-sections are included or "blank" if only the interpolated cross-sections are included.
27-27	Method used to generate topographic cross-sections. Either "blank" for the even method or "X" for the non-even method. See SETUP documentation for more information.

5. Suppressing HEC-2 Printout

All HEC-2 actual data sets include the J5 card with "-10" in fields one and two. This suppresses all detailed printout for all cross-sections. All HEC-2 data sets should also contain either a "0" (zero) or a "+1" in field J2.1 (the first field of the J2 card). However, some data sets contain "-1" and generate excessive output. Therefore, SETUP sets field J2.1 to "+1" in the manipulated data sets to suppress summary printout.

L. Input to HEC-2 Post-processor H2POST

After SETUP writes all of the manipulated HEC-2 data for one job to the disk file "SxxxxMnn", it must write the JCL to execute H2POST, the HEC-2 post processor that reads TAPE95 and stores the computed water surface profile in a DSS data file. H2POST reads several records of input:

Record	Description
1	Optional alternative name. SETUP allows the user to enter an alternative name to differentiate this set of data from others that have identical characteristics except, for example, such things as the method of random number use. The alternative name is used as part "D" of the HECDSS pathname. All of the final results used in the Profile Accuracy Study are executed with a blank alternative name.
2	The "A" and "B" coefficients used to adjust the Manning's coefficients. Also, the number of default coefficients (fixed at three by SETUP). The parameters are written in data fields of ten columns. Field Description 1 Coefficient "A" 2 Coefficient "B" 3 Number of default coefficients (3)
3	The default "A" coefficients (3 coefficients)
4	The default "B" coefficients (3 coefficients)
5	The starting seed number for this data set. The seed number that existed in the monitor common block SETRAN at the time the first Manning's coefficient or elevation value was adjusted. This seed number is stored in the HECDSS data file in the "header".

M. Submitting HEC-2 Jobs

At this point, SETUP has generated all the necessary manipulated HEC-2 input data for one job and the JCL to execute it as well as H2POST. SETUP will continue to generate additional sets of similar data until all of the users specifications have been met. At that point, SETUP will either submit that disk area "SxxxxMnn" as a batch Harris job using the Harris intrinsic subroutine "IJOB", or SETUP disconnects from that disk file and awaits the users specifications for additional disk areas and jobs. The user then may "IJ" (or submit) that disk file later at any time by using Harris JCL.

N. Example Execution of SETUP

At this point, it would be very valuable to show an example execution of SETUP and the resulting manipulated HEC-2 data deck. For demonstration purposes, two HEC-2 jobs will be generated and submitted. Table four summarizes the required SETUP commands and the definition used in this example.

Table 4: Example SETUP Commands

SETUP command	Run 1	Run 2
MEthod	ME,P	ME,PT
SPacing	SP.E 500	SP.E 500
ELevation	EL,0	EL,2
N-pert index	N,0	N,1-2
PErturbation	PE,S	PE,S
SDN-value	SDN,L	SDN,H
PRiority	PR,4	PR,4
GRanule	GR,40	GR,200
PAck	PA,1	PA,1
EXecute	EX.I,SO2M1	EX.I,SO2M1

Run 1 generates the base condition --- neither the elevation ordinates nor the Manning's coefficients will be adjusted (EL,0 and N,0 and SDN,L). Run 1 uses spot elevations (ME,P) whereas Run 2 will use both spot elevations as well as topographic mapping (ME,PT). Both runs use cross-sections spaced a maximum of 500 feet apart and the original sections are not included in the manipulated data set (SP.E 500). The jobs will be executed immediately for location SO2M1 (EX.I,SO2M1), at Harris priority four (PR,4), and the manipulated input data files are generated on pack 1 (PA,1). Run 2 will adjust the elevations using a survey accuracy of two feet (EL,2), and will generate two replicates for spot elevations and two replicates for topographic mapping that simultaneously adjust both elevations and Manning's coefficients (N,1-2 and PE,S), using coefficients indicating the user has poor accuracy in determining the Manning's coefficients (SDN,H).

To begin the example, SETUP will be executed. It will generate two manipulated data files, one for run 1 and one for run 2. Run 2 will actually contain four HEC-2 jobs. Below is listed the example job stream for executing SETUP.

```
$JOB J.SET002 P26D RDC PRI=4 OUT=P26M*SET0002
$MO QL=P26M PS=256 LP=60
$
P26P*SETUP
ME,P
SP.E 500
EL 0
N 0
PE S
SDN L
PR 4
GR 40
PA 1
EX.I SO2M1
ME PT
```

```
EL 2
N 1-2
SDN H
GR 200
EX.I S02M1
FINISH
```

Notice that not all commands are entered for run 2 --- any command not entered maintains its previous setting. The output from the above set of JCL is listed below.

Table 5
Example SETUP Output

```
1$JOB J.SET002 P26D CARL PRI=4 OUT=P26M*SET0002          4 FEB 86 15:23:03
 ===> $MO QL=P26M PS=256 LP=60
 ===> $
 ===> P26P*SETUP


 SEED NUMBER AT START OF SETUP IS:  18063125645133
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 ME,P

 TOPOGRAPHIC CONTOURS WILL NOT BE USED.

 POINT ELEVATIONS WILL BE USED.
 SP.E 500
 EL 0
 N 0

    1 N-VALUE REPLICATES ENTERED.
     0
 PE S

 ELEVATION AND N-VALUE PERTURBATIONS WILL OCCUR SIMULTANEOUSLY.

 ELEVATION AND N-VALUE PERTURBATIONS WILL NOT OCCUR INDEPENDENTLY.
 SDN L
 PR 4

 NEW JOB CARD PRIORITY FOR HEC-2 RUNS:    4
 GR 40

 NEW GRANULE SIZE FOR HEC-2 INPUT DATA FILE:     40
 PA 1

 NEW DISK PACK FOR HEC-2 INPUT DATA FILES:  1
 EX.I S02M1

 LOCATION I.D. SET TO----> 0000P26M*S02M1

 HEC-2 INPUT DATA WILL BE WRITTEN TO FILE: 0000P26M*S02M1M00
 HEC-2 OUTPUT WILL BE WRITTEN TO FILE: 0000P26M*S02M1O00
 HEC-2 RESULTS WILL BE WRITTEN TO THE DSS FILE: 0000P26M*S02M1Z
       171 HEC-2 ACTUAL INPUT RECORDS READ.
 INTSEC: END OF RUN DATA ON FILE W6

 RUN NUMBER    1
 SURVEY TYPE       SPACING   ELEVATION   N-VALUE   PERTURBATION       N COEFFS. A          B
 SPOT ELEVATIONS       500           0         0   NO PERTURBATIONS
 ME PT

 TOPOGRAPHIC CONTOURS WILL BE USED.

 POINT ELEVATIONS WILL BE USED.

 EL 2
 N 1-2

    2 N-VALUE REPLICATES ENTERED.
     1    2
 SDN H
 GR 200

 NEW GRANULE SIZE FOR HEC-2 INPUT DATA FILE:   200
```

Table 5 (continued)
Example SETUP Output

```
EX.I S02M1

LOCATION I.D. SET TO----> 0000P26M*S02M1

HEC-2 INPUT DATA WILL BE WRITTEN TO FILE: 0000P26M*S02M1M01
HEC-2 OUTPUT WILL BE WRITTEN TO FILE: 0000P26M*S02M1O01
HEC-2 RESULTS WILL BE WRITTEN TO THE DSS FILE: 0000P26M*S02M1Z
      171 HEC-2 ACTUAL INPUT RECORDS READ.
INTSEC: END OF RUN DATA ON FILE W6

NUMBER OF HEC-2 INPUT RECORDS AFTER CONVERTING TO TOPO:      494
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

RUN NUMBER    1
SURVEY TYPE        SPACING   ELEVATION   N-VALUE   PERTURBATION      N COEFFS. A         B
TOPOGRAPHIC            500           2         1   SIMULTANEOUS           0.5818    0.0986

RUN NUMBER    2
SURVEY TYPE        SPACING   ELEVATION   N-VALUE   PERTURBATION      N COEFFS. A         B
TOPOGRAPHIC            500           2         2   SIMULTANEOUS           0.5818    0.0986
      171 HEC-2 ACTUAL INPUT RECORDS READ.
INTSEC: END OF RUN DATA ON FILE W6

RUN NUMBER    3
SURVEY TYPE        SPACING   ELEVATION   N-VALUE   PERTURBATION      N COEFFS. A         B
SPOT ELEVATIONS        500           2         1   SIMULTANEOUS           0.5818    0.0986

RUN NUMBER    4
SURVEY TYPE        SPACING   ELEVATION   N-VALUE   PERTURBATION      N COEFFS. A         B
SPOT ELEVATIONS        500           2         2   SIMULTANEOUS           0.5818    0.0986
FINISH

TERMINATE PROCESSING OF SETUP

SEED NUMBER WRITTEN TO BACKUP DISK:  59661508456013
STOP

1$EOJ    (SUPPLIED BY COURTESY OF HARRIS)
0******JOB EXITED ON  4 FEB 86 15:24:54   ******
0******CPU TIME=       0MINS   44.14SECS  ******
0******CONNECT TIME=       1MINS   52SECS  ******
```

Table 5 (continued)
Example SETUP Output

```
$JOB,S02M1M00,0000P26D,RDC,P=4,OUT=0000P26M*S02M1O00 ,RQ
$MO QL=0000P26M,LP=60,PS=500
$ INPUT FILE= 0000P26M*S02M1M00
P26P*HEC2
T1      CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3      S02M1  0500 0 0P
J1    -10       3       0       0    .001       0       0       0   358.8
J2     +1       0      -1
J5    -10     -10
NC    .07     .05     .05       0      .5
QT      2    5294    9154
X1    470      23    1700    1815       0       0       0
GR    360       0     352      90     350     170     346     290     345     330
GR    346     410     358     580   360.3     690     358     820     356     870
GR    354    1100     346    1210     346    1420   346.7    1610     346    1700
GR    334    1745   332.8    1760     334    1778     350    1815     352    1835
GR    356    1853     358    1990     370    2220
QT      2    5298    9339
NC    .06     .08    .055
X1   2.01      34   1199.   1324.   385.7   434.8   500.0
GR  360.2      0.   354.3     58.   353.8     63.   352.2    120.   349.2    204.
                                    ...
                                    ...
                                    ...
                                    ...
                                    ...
NC    .07    .075    .055
X1  23.02      44   1114.   1181.   134.2   402.7   500.0
GR  389.8      0.   387.7     77.   386.4    154.   386.0    187.   384.6    230.
GR  382.7    292.   382.4    307.   380.9    384.   379.5    461.   379.2    484.
GR  377.9    538.   376.8    583.   377.4    615.   378.6    676.   376.9    691.
GR  375.9    700.   377.5    758.   377.6    768.   378.7    922.   379.4    999.
GR  380.0   1050.   380.3   1075.   380.3   1114.   378.0   1117.   374.2   1130.
GR  371.2   1139.   367.3   1147.   366.8   1148.   364.8   1154.   366.7   1158.
GR  370.7   1172.   372.2   1175.   380.8   1181.   380.3   1230.   378.0   1334.
GR  377.8   1424.   378.1   1543.   377.7   1692.   377.9   1759.   376.5   1774.
GR  378.5   1785.   382.3   1807.   389.4   1841.   396.9   1930.
QT      2    6511   11333
EJ


ER
P26P*H2POST,TAPE71=0000P26M*S02M1Z

 0.0000000 0.0000000         3
 0.0000000 0.2909000 0.5818000
 0.0000000 0.0493000 0.0986000
      18063125645133
$     - - - S02M1M00 - - -
$XT
/DT
```

Table 5 (continued)
Example SETUP Output

```
$JOB,S02M1M01,0000P26D,RDC,P=4,OUT=0000P26M*S02M1O01 ,RQ
$MO QL=0000P26M,LP=60,PS=500
$ INPUT FILE= 0000P26M*S02M1M01
P26P*HEC2
T1      CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3      S02M1  0500 2 1TS
J1   -10       3       0       0    .001       0       0       0   358.8
J2     1       0      -1
J5   -10     -10
NC.02319.0185736.0185736       0      .5
QT     2    5294    9154
X1   470       541700.0001815.000       0       0       0
GR362.27-22.5000360.5148.0000000358.248122.50000356.939845.00000354.985767.50000
GR352.5990.00000350.3174170.0000348.8312230.0000345.1181290.0000347.1216410.0000
GR349.48438.3333348.7514466.6667353.2213495.0000354.5552523.3333356.9944551.6667
GR358.50580.0000360.6479675.6522359.5747706.9565357.4338820.0000355.9149870.0000
GR353.241100.000350.67081127.500350.21531155.000347.53171182.500346.76331210.000
GR345.191420.000345.91601700.000344.34901707.500341.87171715.000340.97021722.500
GR337.121730.000336.06341737.500334.35411745.000333.28811760.000334.46921778.000
GR336.041782.625338.71201787.250339.97281791.875342.26081796.500343.69931801.125
GR346.081805.750347.03061810.375349.02201815.000352.31591835.000353.01441844.000
GR355.651853.000357.63251990.000361.56672028.333361.05482066.667363.12932105.000
GR365.252143.333367.69062181.667369.54642220.000372.52222258.333
QT     2    5298    9339
NC.05889.0783767.0540068
X1  2.01       421201.9761321.327   385.7   434.8   500.0
GR362.66-17.6949359.83411.966102358.275321.62712355.442141.28814354.715461.00000
GR351.92125.6000349.9822181.6000349.7329309.3077350.7014342.7021353.8977375.0426
GR355.46407.3830355.0482552.4444353.7993622.0556352.2326779.9804349.6173809.7843
GR347.88839.5882346.06131201.976343.63651206.554342.40171211.133339.55191215.711
GR339.301221.889336.38931229.667335.35701238.000332.92911252.000333.63371255.882
```

more data

```
GR369.201490.618367.55581494.982365.19341499.345363.66921508.000363.73501512.000
GR363.081516.455365.16421525.235368.09521525.706370.39671526.176371.60151526.647
GR374.231527.118376.17331527.588378.84271528.059380.57051528.529383.10951529.000
GR382.091543.000385.23171641.333385.19061688.250388.60331717.000390.51531737.833
GR391.711758.667
NC.09641.1040082.0739714
X1 23.02       451114.3911180.442   134.2   402.7   500.0
GR390.65-7.33333388.582166.00000385.7035187.0000383.3532249.5789381.7750327.5333
GR379.99433.5000377.6641533.8462378.9088645.5000378.6930681.2941376.8266699.1000
GR376.46703.6250378.6554824.0000379.96151050.000380.89191114.391377.41571117.000
GR376.541123.842374.76811130.600371.36141136.600370.76921141.462367.40961145.564
GR366.561150.400364.16471154.000365.60661156.526367.99681162.550370.63111169.550
GR371.451174.600374.19751176.256376.98471177.651378.11301179.047379.42251180.442
GR380.021243.565378.91731334.000377.95871503.333378.42431580.250378.37671782.250
GR379.221793.684381.73061805.263384.81651815.141386.10531824.718388.61571834.296
```

```
GR389.551848.120392.10151871.853394.27921895.587395.31611919.320398.26331943.053
QT     2    6511   11333
EJ



ER
P26P*H2POST,TAPE71=0000P26M*S02M1Z

 0.5818000 0.0986000         3
 0.0000000 0.2909000 0.5818000
 0.0000000 0.0493000 0.0986000
      18063125645133
P26P*HEC2
T1      CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3      S02M1  0500 2 2TS
J1   -10       3       0       0    .001       0       0       0   358.8
J2     1       0      -1
J5   -10     -10
NC.08774.0612208.0612208       0      .5
QT     2    5294    9154
X1   470      541700.0001815.000       0       0       0
GR361.80-22.5000360.1527.0000000357.206322.50000355.337045.00000354.790867.50000
GR352.2890.00000349.1369170.0000346.7342230.0000346.0592290.0000346.0932410.0000
GR347.57438.3333350.2509466.6667351.9825495.0000355.0146523.3333356.7031551.6667
GR358.03580.0000360.6631675.6522360.7670706.9565357.9613820.0000356.5649870.0000
GR355.281100.000350.91251127.500350.48681155.000347.08391182.500346.15561210.000
GR345.231420.000345.04321700.000344.23711707.500342.35531715.000340.19781722.500
GR338.331730.000335.92391737.500334.85831745.000333.11681760.000335.06611778.000
GR336.601782.625339.06071787.250339.31881791.875342.45871796.500344.73751801.125
GR347.001805.750347.81671810.375349.69051815.000352.78421835.000354.54031844.000
GR355.461853.000356.99221990.000360.04712028.333362.31672066.667363.71772105.000
GR366.482143.333367.87542181.667371.58312220.000371.75872258.333
QT     2    5298    9339
NC.03666.0466878.0340756
X1  2.01      421201.9761321.327   385.7   434.8   500.0
GR362.20-17.6949360.61871.966102358.375021.62712356.496241.28814354.528261.00000
GR351.50125.6000350.2028181.6000349.7754309.3077351.7413342.7021353.3691375.0426
GR356.17407.3830355.4020552.4444353.7116622.0556352.4955779.9804350.2533809.7843
GR349.20839.5882346.52281201.976343.22821206.554342.26651211.133339.45361215.711
GR338.141221.889336.74151229.667332.94811238.000332.26611252.000334.06461255.882
```

more data

Table 5 (continued)
Example SETUP Output

```
GR375.38703.6250377.4611824.0000380.81531050.000380.54801114.391378.04031117.000
GR375.591123.842374.51041130.600372.30881136.600370.09641141.462368.06921145.564
GR366.511150.400365.67111154.000365.23981156.526367.92251162.550369.93151169.550
GR372.041174.600373.48141176.256376.42091177.651378.47061179.047380.44511180.442
GR380.691243.565377.34451334.000377.09041503.333378.57141580.250378.48021782.250
GR380.281793.684381.81011805.263383.44821815.141385.85021824.718388.05551834.296
GR390.591848.120391.75651871.853394.62591895.587396.83171919.320399.16761943.053
QT     2    6511    11333
EJ


ER
P26P*H2POST,TAPE71=0000P26M*S02M1Z

 0.5818000 0.0986000         3
 0.0000000 0.2909000 0.5818000
 0.0000000 0.0493000 0.0986000
      56102650592765
P26P*HEC2
T1      CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3      S02M1  0500 2 1PS
J1   -10       3       0       0    .001       0       0       0   358.8
J2     1       0      -1
J5   -10     -10
NC.05132.0378552.0378552       0      .5
QT     2    5294    9154
X1   470      23    1700    1815       0       0       0
GR359.83        0351.2586       90349.5946      170346.3871     290344.6729     330
GR345.42      410358.0356      580360.5349      690358.0090     820355.7754     870
GR353.78     1100346.2553     1210346.0855     1420346.5410    1610346.2137    1700
GR334.31     1745332.8850     1760333.7666     1778350.3432    1815351.9147    1835
GR355.72     1853358.0544     1990369.5531     2220
QT     2    5298    9339
NC.05001.0655579.0460784
X1  2.01      34   1199.   1324.   385.7   434.8   500.0
GR360.26        0.353.9480      58.353.7221      63.352.0724    120.349.1720    204.
GR348.14      233.349.2133     289.351.1531     333.356.1165    409.357.2614    486.
GR355.40      578.354.8470     613.351.7829     776.352.4664    777.346.6707    853.
GR347.55     1001.347.5278    1132.348.2229    1135.347.0789   1199.339.1551   1218.

                                   more data

GR379.61      908.379.6661     984.379.5259     997.379.4578   1197.379.2467   1296.
GR380.82     1363.380.7259    1396.379.7740    1446.374.5373   1451.371.9715   1472.
```

Table 5 (continued)
Example SETUP Output

```
GR371.47   1488.366.0660   1500.364.9207   1502.363.2062   1512.363.3562   1514.
GR364.77   1523.364.6942   1525.382.1626   1529.382.3646   1543.381.3127   1572.
GR382.29   1598.383.4571   1632.385.2880   1674.386.0206   1693.386.2431   1698.
GR386.75   1701.387.4006   1707.388.1162   1717.390.9150   1742.
NC.07322.0785288.0573402
X1 23.02       44   1114.   1181.   134.2   402.7   500.0
GR389.39      0.387.3459     77.386.3001    154.385.8808    187.384.7140    230.
GR382.89    292.381.9887    307.380.6398    384.379.6243    461.379.2172    484.
GR377.62    538.376.7096    583.377.7156    615.378.3954    676.377.3921    691.
GR375.71    700.377.5433    758.377.2729    768.378.1422    922.379.2872    999.
GR380.16   1050.380.5152   1075.380.4080   1114.378.0484   1117.373.6406   1130.
GR371.09   1139.366.7588   1147.367.1492   1148.365.0849   1154.366.7145   1158.
GR370.58   1172.372.2193   1175.381.0469   1181.379.6849   1230.377.6688   1334.
GR377.07   1424.377.8550   1543.377.3244   1692.378.1359   1759.376.6325   1774.
GR378.29   1785.382.2141   1807.389.6558   1841.396.9891   1930.
QT     2    6511    11333
EJ


ER
P26P*H2POST,TAPE71=0000P26M*S02M1Z

 0.5818000 0.0986000         3
 0.0000000 0.2909000 0.5818000
 0.0000000 0.0493000 0.0986000
      59377839569277
$    - - - S02M1M01 - - -
$XT
/DT
MONEY
```

IV. Execution of HEC-2

A. Number of Replicates

The program SETUP generates the JCL for and the input to HEC-2 as explained above. There has also been discussion about the execution priorities and the relationship between SETUP and HEC-2. Several schemes have been hypothesized for analyzing the data. The adopted scheme requires a minimum number of replicates at each location to eliminate any bias due to small sample size. Table two above lists the number of required replicates for each location. The only difference between two replicates for one location is the random numbers used for the Monte Carlo simulation. Thus, for location S02M1, there are three replicates for each combination of cross-section type, survey accuracy, and Manning's coefficient accuracy. For location S02M1, the required number of HEC-2 jobs are shown in table six.

Table 6: Required Number of HEC-2 Jobs

Job	Description
1	Base condition
2-7	Spot elevations EL of 0, SDN of M and H, 3 replicates. (1 elev.) * (2 SDN) * (3 repl.) = 6
8-34	Spot elevations EL of 2,5,10, SDN of L,M, and H, 3 replicates. (3 elev.) * (3 SDN) * (3 repl.) = 27
35-61	Topographic mapping with of EL 2,5,10, SDN of L,M, and H, and 3 replicates. (3 elev.) * (3 SDN) * (3 repl.) = 27

Thus, location S02M1 requires 61 HEC-2 jobs. The total number of HEC-2 jobs can be calculated using the following equation:

No. of Jobs = Nreplicates * 20 + 1

For location S07S1, the number of required HEC-2 jobs is:

No. of Jobs = 60 * 20 + 1 = 1201

B. Grouping of HEC-2 Jobs

Initially, the HEC-2 jobs were divided into four disk files and were grouped into the categories listed above in table five. However, this became impractical for locations requiring a large number of replicates (greater than 20). The resulting manipulated HEC-2 data files became very large (greater than 60,000 sectors) and many files exceeded 100,000 sectors or the equivalent of 33,600,000 bytes (the maximum allowable file size on HEC's Harris computer). A later scheme divided the HEC-2 jobs among 21 disk files. For automation, it is preferable to use the same number of files for every location even though locations having few replicates would have much smaller files than locations having many replicates. Also, several SETUP jobs are required for locations having many replicates. Otherwise, individual execution times become too large (greater than two hours). The following printout demonstrates the output from the example job submitted above. Notice that the output is severely limited and that HEC-2 is modified to eliminate the banner page.

C. Archiving Manipulated HEC-2 Data Sets

Once the manipulated HEC-2 data set is generated, it is normally submitted. At any time, even concurrently with it executing, the input data file may be archived to tape. For the Profile Accuracy Study, all manipulated HEC-2 data sets are archived on 6250 BPI magnetic tape. Files are stored in the Harris system KEEP/FETCH format. To retrieve data, the user must use Harris equipment. This format has been selected because of its efficiencies both in storage space and processing time. Sixteen tapes are required to store all of the manipulated data sets at 6250 BPI (bits per inch). HEC acquired a Harris 1000 just prior to the generation of these data sets. Prior to that, HEC used an in-house Harris 500. It could not store data at 6250 BPI but at only 800 or 1600 BPI. If the 6250 BPI storage capability was not available, it would be impractical to archive manipulated HEC-2 data sets.

D. Temporary Binary Storage of HEC-2 Results

HEC-2 writes on the order of 65 variables to FORTRAN unit 95, also called TAPE95, (see documentation for HEC-2). These variables are written in a "binary" format which means the file cannot be listed directly by the user. Included in these variables are the calculated water surface elevation, and the stream length in the left overbank, right overbank, and channel. Unit 95 exists only for the duration of the HEC-2 job --- it is assigned to a temporary disk file. The user may save it in a permanent file. For the Profile Accuracy Study, this is generally impossible because of the gross amount of data that is processed. There is simply not enough disk space available to both save unit 95 as well as generate and process all of the HEC-2 data. As a result, a postprocessor program has been written to read unit 95 and save only selected results as described below.

Table 7
Example HEC-2 Output

```
1$JOB S02M1M00 0000P26D CARL P=4 OUT=0000P26M*S02M1O00 RQ          4 FEB 86 15:23:54
 ===> $MO QL=0000P26M,LP=60,PS=500
 ===> $ INPUT FILE= 0000P26M*S02M1M00
 ===> P26P*HEC2


 THIS RUN EXECUTED  4 FEB 86   15:24:11
 ---------------------------------------------------------------------------------
 T1      CAPE LA CROIX CREEK - FHA STUDY
 T2   S02M1   4.8 MI  Q 100= 9154 - 11333
 T3      S02M1  0500 0 0P

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      -10.        3.        0.        0.  0.001000     0.00       0.0        0.   358.800     0.000

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       1.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 J5  LPRNT    NUMSEC                     *********REQUESTED SECTION NUMBERS*********

     -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000


 STOP
 ===> P26P*H2POST,TAPE71=0000P26M*S02M1Z
                  -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
 -----DSS---ZWRITE FILE  71, VERS.   3   /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 0-P   L/
                  -----DSS---ZCLOSE FILE   71
                             NO. RECORDS=      62
                             FILE SIZE=     18986 WORDS,     170 SECTORS
                             PERCENT INACTIVE=  0.00
 STOP
 ===> $    - - - S02M1M00 - - -
 ===> $XT
0******CPU TIME=       0MINS    5.19SECS  ******
 ===> /DT
    4 FEB 86 15:24:28
```

```
1$JOB S02M1M01 0000P26D CARL P=4 OUT=0000P26M*S02M1001 RQ         4 FEB 86 15:25:14
 ===> $MO QL=0000P26M,LP=60,PS=500
 ===> $ INPUT FILE= 0000P26M*S02M1M01
 ===> P26P*HEC2


 THIS RUN EXECUTED  4 FEB 86   15:25:25
 ------------------------------------------------------------------------------
 T1      CAPE LA CROIX CREEK - FHA STUDY
 T2   S02M1   4.8 MI  Q 100= 9154 - 11333
 T3      S02M1  0500 2 1TS

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      -10.        3.        0.        0.  0.001000     0.00       0.0        0.   358.800     0.000

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       1.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 J5  LPRNT     NUMSEC                  ********REQUESTED SECTION NUMBERS********

     -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000


 STOP
 ===> P26P*H2POST,TAPE71=0000P26M*S02M1Z
                  -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
 -----DSS---ZWRITE FILE  71, VERS.   1   /FHWA/S02M1/CUM DIST-ELEVATION//0500- 2- 1-TS  H/
                  -----DSS---ZCLOSE FILE   71
                             NO. RECORDS=      63
                             FILE SIZE=     19288 WORDS,    173 SECTORS
                             PERCENT INACTIVE=  0.00
 STOP
 ===> P26P*HEC2


 THIS RUN EXECUTED  4 FEB 86   15:25:38
 ------------------------------------------------------------------------------
 T1      CAPE LA CROIX CREEK - FHA STUDY
 T2   S02M1   4.8 MI  Q 100= 9154 - 11333
 T3      S02M1  0500 2 2TS

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      -10.        3.        0.        0.  0.001000     0.00       0.0        0.   358.800     0.000

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

       1.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

 J5  LPRNT     NUMSEC                  ********REQUESTED SECTION NUMBERS********

     -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
```

```
STOP
===> P26P*H2POST,TAPE71=0000P26M*S02M1Z
                 -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
-----DSS---ZWRITE FILE  71, VERS.   1   /FHWA/S02M1/CUM DIST-ELEVATION//0500- 2- 2-TS  H/
                 -----DSS---ZCLOSE FILE   71
                            NO. RECORDS=       64
                            FILE SIZE=     19590 WORDS,     175 SECTORS
                            PERCENT INACTIVE=  0.00
STOP
===> P26P*HEC2



THIS RUN EXECUTED  4 FEB 86   15:25:52
--------------------------------------------------------------------------------
T1     CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3     S02M1  0500 2 1PS

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

     -10.        3.        0.        0.  0.001000     0.00       0.0        0.   358.800    0.000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      1.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

J5  LPRNT     NUMSEC                        *********REQUESTED SECTION NUMBERS*********

    -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000



STOP
===> P26P*H2POST,TAPE71=0000P26M*S02M1Z
                 -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
-----DSS---ZWRITE FILE  71, VERS.   1   /FHWA/S02M1/CUM DIST-ELEVATION//0500- 2- 1-PS  H/
                 -----DSS---ZCLOSE FILE   71
                            NO. RECORDS=       65
                            FILE SIZE=     19892 WORDS,     178 SECTORS
                            PERCENT INACTIVE=  0.00
STOP
```

```
===> P26P*HEC2



THIS RUN EXECUTED  4 FEB 86   15:26:08
-------------------------------------------------------------------------------
T1      CAPE LA CROIX CREEK - FHA STUDY
T2   S02M1   4.8 MI  Q 100= 9154 - 11333
T3      S02M1  0500 2 2PS

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

     -10.        3.        0.        0.  0.001000    0.00      0.0        0.    358.800    0.000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      1.000     0.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

J5  LPRNT     NUMSEC                        *********REQUESTED SECTION NUMBERS*********

    -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000



STOP
===> P26P*H2POST,TAPE71=0000P26M*S02M1Z
                  -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
-----DSS---ZWRITE FILE  71, VERS.   1   /FHWA/S02M1/CUM DIST-ELEVATION//0500- 2- 2-PS  H/
                  -----DSS---ZCLOSE FILE   71
                             NO. RECORDS=      66
                             FILE SIZE=     20194 WORDS,     181 SECTORS
                             PERCENT INACTIVE=  0.00
STOP
===> $    - - - S02M1M01 - - -
===> $XT
0******CPU TIME=       0MINS   17.98SECS  ******
===> /DT
   4 FEB 86 15:26:27
```

V. Permanent storage of HEC-2 profiles

A. HECDSS Data File Description

Each HEC-2 job is followed by a H2POST job. The program H2POST reads the unit 95 (or TAPE95) generated by HEC-2, reads some input generated by SETUP, makes some calculations, and then stores profile results in a HECDSS data file. All HECDSS data files are generated as "random" access (multiple users allowed) and with a fairly large granule size of 200. There is one HECDSS file for every location. The HECDSS data file name is the location identifier with a "Z" appended. For example, the HECDSS data file for location S02M1 is S02M1Z. There is an associated HECDSS catalog file whose name is the location identifier with a "ZC" appended (for example, S02M1ZC).

B. Data Saved

The input read by H2POST is described above under the SETUP program. It consists of an optional alternative name (left blank for the primary Study analyses), "A" and "B" coefficients used in the adjustment of Manning's coefficient, and the seed number at the start of the HEC-2 job. H2POST computes cumulative stream distance by assigning the most downstream cross-section the distance of zero, and computing the distance from it to all upstream sections using the channel reach length. H2POST also computes the number of sections at which critical depth occurs by calculating the difference between variable one (CWSEL, computed water surface elevation) and variable two (CRIWS, critical water surface elevation). If the absolute value of the result is less than 0.0001 feet, H2POST decides that critical depth has been assumed by HEC-2.

C. Profile Labeling (HECDSS Pathname)

H2POST forms the label for each HEC-2 profile. This label (called a pathname by the HECDSS software system) is used to identify each profile --- one profile is stored and identified by one label. The information used in the pathname is retrieved from the HEC-2 T3 card, input to H2POST as generated by SETUP, and some hardwired information. The pathname label is comprised of six parts identified by the alpha characters A through F. Table eight lists the information and the source of the information used in the pathname.

Table 8: HECDSS Pathname Parts for Profile Data

Pathname Part	Source	Description
A	Hardwired	Job identification --- "FHWA".
B	HEC-2 T3 card	The location identifier "Sxxxx". An example identifier is "S02M1".
C	Hardwired	Data label --- "CUM DISTANCE-ELEVATION".
D	H2POST input	Coefficients "A" and "B" used in the Manning's coefficient if one of the default coefficients was not used.
E	H2POST input	Alternative name. "Blank" used for major portion of Study.
F	HEC-2 T3 card & H2POST input	Information such as the cross-section spacing, survey accuracy, mapping type, n adjustment index, and n value accuracy. See below documentation for more information.

Part F of the HECDSS pathname contains the descriptors to differentiate between the user supplied options and parameters as described below. The column location refers to that within part F only and not the whole pathname.

Part F of the HECDSS Pathname

Column(s)	Description
1-4	Indicates the cross-section spacing in feet, zero filled. For example, if the actual data were used, these columns would be filled with "0000".
5	The character "-".
6-7	The elevation (or survey accuracy) in feet. For topographic sections, indicates the contour interval. For example, if the survey accuracy is two feet, these columns would contain " 2".
8	The character "-".
9-10	The n-value adjustment index. This is strictly an index except that a value of "0" (zero) indicates the n-values were not adjusted. It allows a comparison between profiles whose only difference is the random numbers used to adjust the n-values.
11	The character "-".
12	Cross-section indicator to identify the type of cross-section used: P For spot elevations. T For topographic or contour elevations.
13	Indicator of the type of adjustment used: S For simultaneous adjustments. The elevations and the n-values are adjusted simultaneously (both are adjusted in one run of HEC-2). N The n values only are adjusted (user specified "PE,I". If the n-value index is set to "0" (zero), the n-values are not adjusted although this character implies that they are. E The elevation values only (not n values) are adjusted (user specified "PE,I". If the elevation value is set to "0" (zero), the elevations are not adjusted although this character implies that they are. blank If this column is blank (or not included), it indicates that both the elevation adjustment and the n-value index have been set to zero --- neither parameter is adjusted.

Column(s)	Description
14	Indicates the original cross-sections have been retained in the HEC-2 input data deck. O ("oh") Original sections are retained. blank If this column is blank (or not included), only the interpolated sections are retained in the HEC-2 input data.
15	Indicates the method which is used to develop the cross-section from topographic (or contour mapping) information. X Indicates that the "non-even" method of determining contour elevations is used. blank If left blank (or not included in part F), indicates that the "even" method of determining contour elevations is used.
16	Indicates the coefficients used in the equation for adjusting Manning's coefficient. L The coefficients for the "lower" n value standard deviation are used. These coefficients are stored internally within SETUP. See the discussion for Part E of the DSS pathname for more information. M The coefficients for the "average" n value standard deviation are used. H The coefficients for the "higher" n value standard deviation are used. U The user input coefficients that are not within the range of "lower", "average", or "higher" as internally defined by SETUP. SETUP uses the coefficients as entered by the user and stores them in Part E of the DSS pathname.

D. Contents of HECDSS Data Record

HECDSS data records have two parts: (1) the data part which in this case contains the profile data, and (2) the header part which contains miscellaneous information describing the data including an indicator of data type, units of data, and the number of coordinate points. The profile data consists of two variables: the cumulative river distance which is the independent variable and the computed water surface elevation which is the dependent variable. The data is stored in the HECDSS "paired function" convention format (see HECDSS documentation for more detail). When H2POST stores profile data, the header is defined as follows:

Table 9: HECDSS Header for Profile Data

Word	Type	Length (characters)	Use
1	Integer	-	Flag indicating data convention, equals "2" for paired function.
2	Integer	-	Length of header in words = 38.
3	Integer	-	Number of coordinate pairs, equals the number of cross-sections in the HEC-2 data set.
4	Integer	-	Number of times the 1st variable (cum dist) repeats = 1.
5	Integer	-	Number of times the 2nd variable (elevation) repeats = 1.
6	Integer	-	Variable to appear on horizontal axis (cum dist.) = 1.
7-10	Character	8	Units of data for 1st variable (cum dist) = "FEET".
11-14	Character	8	Units of data for 2nd variable (elevation) = "FEET".
15-16	Character	4	Data type of first variable (cum dist) = "UNT" for untransformed.
17-18	Character	4	Data type of second variable (elevation) = "UNT" for untransformed.
19	Integer	-	Number of cross-sections at which critical depth is assumed.
20-21	Integer*6	-	Seed number at start of this HEC-2 job.
22-30	-	-	Not used.
31-34	Character	8	Label for 1st dependent variable curve (elevation) = "CWSEL".
35-38	Character	8	Label for 2nd dependent variable curve (cross-section number) = "SECT ID". This is a holdover from earlier operations when the cross-section number for each section was written to the HECDSS data file.

VI. Computation of Errors

A. Errors Computed

The computation of errors requires several steps. As the study progressed, researchers reformulated the regression model. This changed the method in which profile errors are calculated. There is several "layers" of error calculations: (1) The error or difference at each cross-section between the base profile and that associated with adjusted data, (2) Statistics of that difference such as the maximum, mean, minimum, and absolute mean error for that one profile, and (3) Statistics of the statistics for a set of replicates at one location. The third layer of error analysis is best described by a table. Location S02M1 required three replicates to generate a sufficient sample size for regression analysis. One set of replicates contains three profiles for this location. One set contains the same survey accuracy, the same type of mapping, the same cross-section spacing, and the same accuracy in Manning's coefficient --- the only difference between each profile in a set is the random numbers used in the adjustment of the elevations and Manning's coefficients. The final statistics used in regression analysis are computed from the statistics associated with each profile in one set of replicates. The following table describes this process for one example.

B. Example Error Computation

Given:

Location: S02M1
Mapping type: Spot elevations
Cross-section spacing: 500 feet
Survey accuracy: 2 feet
Type of adjustment: elevations and n value simultaneously
N value accuracy: Poor, SDN = H
Number of required replicates: 3

Results:

Replicate no.	Mean Absolute	SD of Mean Abs	Max Abs	Mean	SD of Mean
1	0.665	0.636	2.674	0.063	0.923
2	0.367	0.341	1.857	-0.013	0.504
3	0.297	0.227	0.876	-0.006	0.376
Mean	0.443	0.401	1.802	0.015	0.601
Sum Squares	0.076	0.089	1.621	0.003	0.164

The last ten numbers above associated with "Mean" and "Sum Squares" are stored in the INFO data base file "FHWSUMRY" and are used in the regression analysis. The statistics associated with each replicate (1-3) are stored in the INFO data base file "FHWRUNS". The errors computed at each cross-section are not stored anywhere, but may be computed using the profile data stored in the HECDSS data file. In the table above, the "Mean" is simply the geometric mean of the replicates. For example, the "Mean" of the maximum absolute error is:

$$(2.674 + 1.857 + 0.876) / 3 = 1.802$$

The "Sum Squares" is simply the "Mean" as calculated above subtracted from the value for each replicate. For example, the "Sum Squares" for the maximum absolute error is computed as follows:

Replicate Number	Maximum Absolute Error - Mean	Squared Difference
1	2.674 - 1.802 = 0.872	0.760
2	1.857 - 1.802 = 0.055	0.003
3	0.876 - 1.802 = -0.926	0.857
Sum of Squares		1.621

C. Base Profile Description

To compute the errors, a base profile must be established. Early in the study, it was determined that the profile computations are sensitive to the spacing of cross-sections. To remove the effect of spacing, all base condition profiles are computed with the maximum allowable spacing of 500 feet between sections. This is used as the "error free" profile instead of that computed using the actual data set as supplied by District and Division offices. The base condition profile is identified in the HECDSS data base by the pathname part F of:

0500- 0- 0-P L

D. Computation of Errors With MATHPK

The regression model initially formulated requires the calculation of only the errors at each cross-section and the statistics for each run --- it did not require the computation of the statistics of the statistics of each set of replicates. As a result, a second generation MATHPK program was partially developed to calculate the errors. MATHPK is a HECDSS utility program that can retrieve data from a HECDSS data file, calculate statistics of the data, compute various arithmetic operations, route hydrographs by hydrologic methods, and store results back into a HECDSS data file. The first generation of MATHPK deals basically with uniform time series data such as hydrograph data. This second generation MATHPK manipulates paired function data as well. The benefits of using MATHPK to compute errors include the capability to easily select only certain profiles or all profiles for error analyses and the command structure is generalized allowing great flexibility in operations. The short example input data to MATHPK below shows how it is used to compute errors:

```
OP S02M1Z
GET BASE /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 0-P   L/
COMP ALTBASE=BASE
COMP ERROR=BASE
COMP ERRORABS=BASE
GET ALT /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-PS  H/
$ADD FHWCOMPI
GET ALT /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-PS  H/
$ADD FHWCOMPI
GET ALT /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 3-PS  H/
$ADD FHWCOMPI
FINISH
```

The entry "$ADD FHWCOMPI" is a Harris capability. It enters all of file "FHWCOMPI" into the users input as if the content of that file were physically entered. Originally, the macro capability of HEC'S FORTRAN callable subroutine "PREAD" was to be used in MATHPK. However, MATHPK uses FORTRAN-77 compatible routines only. At the time, PREAD and the associated macro and function capabilities had not been upgraded to FORTRAN-77 standards and this prevented their use. Basically, the input above opens the HECDSS data file, retrieves the base profile, dimensions the variables ALTBASE, ERROR, and ERRORABS, and enters the base condition cumulative river distance as curve one by using the "COMPUTE" command. Then, each adjusted alternative profile is retrieved from the HECDSS data file using the GET command and the errors and statistics computed by the commands in file "FHWCOMPI". It is listed below.

```
ALTBASE(,2)=TABLE(ALTBASE(,1),ALT(,1),ALT(,2))
ERROR(,2)=BASE(,2)-ALTBASE(,2)
ERRORABS(,2)=ABS(ERROR(,2))
MEANABSERROR=MEAN(ERRORABS(,2))
SDABSERROR=SD(ERRORABS(,2))
MAXABSERROR=MAX(ERRORABS(,2))
MEANERROR=MEAN(ERROR(,2))
SDERROR=SD(ERROR(,2))
FHWOUT
```

The "TABLE" command performs table-lookup interpolation of the adjusted profile, the error and absolute error at each section is computed, the mean, standard deviation, maximum, geometric mean, and standard deviation are then computed for one profile. The command "FHWOUT" is a study specific command that forces MATHPK to call a specialized subroutine "FHWOUT" that was added to MATHPK to generate ASCII records that act as input to the INFO data base. The subscript (,2) instructs MATHPK to access only the second curve (elevation) for calculations. The first curve is cumulative river distance. It is accessed by the reference (,1).

E. Computation of Errors With COMPER

When the regression model was changed, it became clear that it would be easier to develop some new, disposable software which would compute the necessary errors and error statistics. The program COMPER was developed to meet this need. COMPER computes the errors associated with each individual HEC-2 job as well as the summary statistics for each set of replicates. They are written to separate files for input to the INFO data base. The following section describes entering the data into the INFO data base and the variables entered. At this point, it only need be known that there are those two separate sets of error calculations. The example previously shown demonstrates those error calculations. COMPER accesses the HECDSS catalog file, reads the base condition profile, eliminates any profile that does not contain 500 foot spacing between cross-sections, eliminates any profile that has a non-blank alternative name (pathname part D), computes the error statistics associated with each run, then computes the error statistics for each set of replicates for one location, and writes output results to three different FORTRAN units. Two FORTRAN units contain the error statistics as explained above and the third unit contains error statistics for individual runs that are rejected. Rejected statistics result when HEC-2 has terminated with a program generated error, such as "DATA ERROR 3790". The "rejected" statistics are entered into an INFO data file "REJECTS" so that the researcher can determine exactly which profiles at which locations have failed. Below is an example execution of COMPER. First, the JCL and input data is listed:

```
$JOB,CMP002,P26D,RDC,PRI=4,OUT=P26M*CMP0002
$     J.CMP002
$MO QL=P26M LP=60 PS=256
$
PURGE IRUN002 ISUM002 IBAD002
GE IRUN002 PR PW PD G=100 P=1
GE ISUM002 PR PW PD G=8
GE IBAD002 PR PW PD G=8
$
$AS 5=*0
$AS 6=*3
$AS 29=*3
$AS 1=IRUN002
$AS 2=ISUM002
$AS 11=IBAD002
P26P*COMPER
S02M1
STOP
$
$XT
/DT
```

The file IRUN002 contains the statistics of the errors for each profile, the file ISUM002 contains the statistics of each set of replicates, and the file IBAD002 contains any rejected (or faulty) error statistics. The JCL above generates error statistics for only location S02M1, but additional locations also could have been entered. The output from the above execution of COMPER is shown below:

```
1$JOB CMP002 P26D CARL PRI=4 OUT=P26M*CMP0002          5 FEB 86 16:49:32
 ===> $     J.CMP002
 ===> $MO QL=P26M LP=60 PS=256
 ===> $
 ===> PURGE IRUN002 ISUM002 IBAD002
 $EL,IRUN002
0******JOBCNTRL ER  2170 : AREA DOES NOT EXIST
 $EL,ISUM002
0******JOBCNTRL ER  2170 : AREA DOES NOT EXIST
 $EL,IBAD002
0******JOBCNTRL ER  2170 : AREA DOES NOT EXIST
 END OF PURGE
 ===> GE IRUN002 PR PW PD G=100 P=1
 ===> GE ISUM002 PR PW PD G=8
 ===> GE IBAD002 PR PW PD G=8
 ===> $
 ===> $AS 5=*0
 ===> $AS 6=*3
 ===> $AS 29=*3
 ===> $AS 1=IRUN002
 ===> $AS 2=ISUM002
 ===> $AS 11=IBAD002
 ===> P26P*COMPER

      0 RECORDS READ IN FHW REJECT FILE.
                  -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z

 GET READY TO READ BASE PROFILE,  NCPN=      50
 PATHNAME:
 /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 0-P   L/

 NUMBER OF ORDINATES IN BASE PROFILE:       51
 S02M1,,0500, 2, 1,P,S, , ,H,0.6951,0.4070,1.8329,-0.4170,0.6935,68793411146157,0,
 S02M1,,0500, 2, 2,P,S, , ,H,0.5815,0.4660,1.6751,-0.2016,0.7215,59377839569277,0,
 S02M1,,0500, 2, 3,P,S, , ,H,0.6860,0.4344,1.7680,-0.4647,0.6697,59661508456013,0,

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 MASTER SUMMARY OF ERRORS  --- (INPUT TO MLRP)
 S02M1,,0500, 2,P,S,H,3,0.6542,0.4358,1.7587,-0.3611,0.6949,0.0080,0.0017,0.0126,0.03
                  -----DSS---ZCLOSE FILE   71
                             NO. RECORDS=       4
                             FILE SIZE=      2058 WORDS,     19 SECTORS
                             PERCENT INACTIVE= 26.13
 STOP
 ===> $
 ===> $XT
0******CPU TIME=       0MINS    0.95SECS  ******
 ===> /DT
    5 FEB 86 16:50:47
```

In this example, S02M1 is a very incomplete data set --- there is information for one set of replicates. This is simply an example and does not correspond to results used in the final regression analysis. The files IRUN002, ISUM002, and IBAD000 are then used as input to the INFO data base. It is important to note that before COMPER is run, the HECDSS utility program DSSUTL must be executed to get an abbreviated catalog listing of the data file. COMPER uses the abbreviated catalog file to generate a list of profiles to retrieve. If either a "full" listing or an updated listing is not obtained, COMPER will not properly compute profile errors. To get a correct catalog listing, the user should enter the following commands:

```
SYS*DSSUTL
S02M1Z
CA.NA O=ABCDEF
FINISH
```

VII. Storage of Computed Errors

A. Use of INFO

As previously mentioned, the INFO data management software provides the vehicle for storing, manipulating, and retrieving the computed error statistics for the Profile Accuracy Study. INFO is distributed by HENCO SOFTWARE, INC., 100 Fifth Avenue, Waltham, MA 02154. It is a "fourth generation programming language" that helps the user to store, maintain, manipulate and report any type of information. One outstanding feature of this information management system is the capability to generate separate files and then relate them by the use of one, common variable. This is why it is sometimes called a "relational" information management system. This will become clearer after reviewing the files listed below. One limitation of INFO is that it prohibits simultaneous, multiple user access to the data base --- INFO jobs cannot run concurrently. For the Profile Accuracy Study, there is one JCL file to enter error statistics for each location. To update several locations, the user must employ a chaining process --- at the conclusion of one INFO job, it must initiate processing of the next job.

B. Example Definition of INFO Data File

The example below demonstrates defining a INFO "data file" named "FHWMAS" and then adding data records to it. FHWMAS contains the location characteristics. Computed error statistics are added in a similar fashion --- the only difference is the INFO input and output data files accessed. The first INFO job defines the data file "FHWMAS".

Example JCL to execute INFO and define the data file FHWMAS:

```
$JOB INFO P26D RDC PRI=9 OUT=P26M*FHWMASIO
$MO QL=P26M LP=60 PS=256
$
*INFO
*FHWAJOB
DEFINE FHWMAS
LOCATION,5,5,C
LENGTH,6,6,F,3
SLOPE,6,6,F,1
CLASS,2,2,C
Q100START,6,6,I
Q100END,6,6,I
REACH-N,7,7,F,4
CHANNEL-N,7,7,F,4
OVERBANK-N,7,7,F,4
TOP-WIDTH,8,8,F,1
HYDRAULIC-DEPTH,6,6,F,2
STREAM,20,20,C
DISTRICT,4,4,C
Q100MEAN,6,6,I

QUIT
STOP
```

Output from the above JCL file:

```
1$JOB INFO P26D CARL PRI=9 OUT=P26M*FHWMASIO          6 FEB 86  9:28:55
 ===> $MO QL=P26M LP=60 PS=256
 ===> $
 ===> *INFO
    6 FEB 86   HARRIS INFO REVISION 8.5
    INFO  8.52 04/08/83 52.74-63*
    ENTER USER NAME> *FHWAJOB

    ENTER COMMAND >  DEFINE FHWMAS
    ITEM NAME,WIDTH [,OUTPUT WIDTH] ,TYPE [,DECIMAL PLACES] [,PROT.LEVEL]
       1
    ITEM NAME> LOCATION,5,5,C
       6
    ITEM NAME> LENGTH,6,6,F,3
      12
    ITEM NAME> SLOPE,6,6,F,1
      18
    ITEM NAME> CLASS,2,2,C
      20
    ITEM NAME> Q100START,6,6,I
      26
    ITEM NAME> Q100END,6,6,I
      32
    ITEM NAME> REACH-N,7,7,F,4
      39
    ITEM NAME> CHANNEL-N,7,7,F,4
      46
    ITEM NAME> OVERBANK-N,7,7,F,4
      53
    ITEM NAME> TOP-WIDTH,8,8,F,1
      61
    ITEM NAME> HYDRAULIC-DEPTH,6,6,F,2
      67
    ITEM NAME> STREAM,20,20,C
      87
    ITEM NAME> DISTRICT,4,4,C
      91
    ITEM NAME> Q100MEAN,6,6,I
      97
    ITEM NAME>

    ENTER COMMAND >  QUIT
    ENTER USER NAME> STOP
1$EOJ    (SUPPLIED BY COURTESY OF HARRIS)
0******JOB EXITED ON  6 FEB 86  9:29:05   ******
0******CPU TIME=        0MINS    0.81SECS  ******
0******CONNECT TIME=       0MINS   11SECS  ******
```

C. Example of Adding Data To An Existing INFO Data File

Example JCL to execute INFO and "add" data records to the data file "FHWMAS" is shown below. The "ADD" command does not check for the previous existence of identical records. If the user adds data at various times, the user must ensure that all previous records are to be retained. If not, they must be purged.

```
1$JOB FHWA P26D CARL PRI=9 OUT=P26M*FHW01          6 FEB 86
10:54:19
 ===> $MO QL=P26M LP=60 PS=256
 ===> INFO
    6 FEB 86   HARRIS INFO REVISION 8.5
    INFO  8.52 04/08/83 52.74-63*
    ENTER USER NAME> FHWAJOB

    ENTER COMMAND >  SEL FHWMAS
          0 RECORD(S) SELECTED

    ENTER COMMAND >  ADD FROM FHWMASD
        140 RECORD(S) ADDED

    ENTER COMMAND >  QUIT
    ENTER USER NAME> STOP
 ===> $XT
0******CPU TIME=       0MINS    4.38SECS  ******
 ===> /DT
    6 FEB 86 10:54:38
1$EOJ    (SUPPLIED BY COURTESY OF HARRIS)
0******JOB EXITED ON  6 FEB 86 10:54:38   ******
0******CPU TIME=       0MINS    4.39SECS  ******
0******CONNECT TIME=      0MINS   20SECS  ******
```

The above example adds records from the file FHWMASD. Below is a partial listing of that file. Notice that the data is entered in a free-format mode. It has been found that INFO is particularly sensitive in the "batch" (or control point) mode. If too many blanks separate data values or if the input record becomes too long, parts of the data are skipped. Therefore, all input data files to INFO, such as the file FHWMASD listed below, are generated in a fashion that all of the data is compacted --- in as much as possible, all unnecessary blanks are omitted. The "," comma is accepted as the data separator. Interactive executions of INFO did not seem sensitive to the above mentioned problems.

```
S01F2,10.308,1.3,F2,30290,30290,0.0834,0.069,0.0890,1945.69,11.76,SILVER CREEK,SLD,0,
S02F2,10.027,1.2,F2,30290,33390,0.0857,0.069,0.0890,5807.56,15.51,SILVER CREEK,SLD,0,
S03F2,6.376,1.0,F2,33760,33735,0.0829,0.059,0.0860,3592.43,13.08,SILVER CREEK,SLD,0,
S04F2,9.910,1.9,F2,61000,61000,0.0474,0.044,0.0507,3258.50,8.70,BIG RIVER,SLD,0,
```

D. Example INFO Directory and List of Files, Reports, and Programs

When discussing the program COMPER, reference was made to entering data to INFO but the exact format was not explained. The format is a function of the definition of INFO files. The example below shows an execution of INFO to get a "directory" of all files, programs, and reports in the FHWAJOB data base. It also demonstrates listing files and determining the variables contained in each data file.

```
1$JOB INFO P26D CARL PRI=4 RQ OUT=P26M*INFOO          6 FEB 86  8:39:07
 ===> $     J.INF
 ===> $MO QL=P26M LP=60 PS=256
 ===> $
 ===> *INFO
    6 FEB 86   HARRIS INFO REVISION 8.5
    INFO  8.52 04/08/83 52.74-63*
    ENTER USER NAME> FHWAJOB

    ENTER COMMAND >  DIR
    TYPE NAME                                INTERNAL NAME    NO. RECS LENGTH EXTERNL
     DF  FHWRUNS                               FHA000IN          40788    102
     DF  FHWMAS                                FHA001IN            140     96
     DF  NCOEFF                                FHA002IN              3      9
     RP  MLRP1                                 FHA003IN             26    210
     PG  GOMLRP                                FHA004IN              8    210
     DF  FHWSUMRY                              FHA005IN           1940    126
     RP  MLRP2                                 FHA006IN             34    210
     DF  REJECTS                               FHA007IN              -     39
     RP  STATGRAF1                             FHA008IN             30    210
     RP  REJECT                                FHA009IN             24    210
     DF  INDEX                                 FHA010IN             98     18
     PG  CHECK                                 FHA011IN             18    210
     PG  CLEAR                                 FHA012IN             14    210
     PG  CHECK1                                FHA013IN             28    210
     PG  CHECK2                                FHA014IN             38    210
```

ENTER COMMAND > SEL FHWMAS
140 RECORD(S) SELECTED

ENTER COMMAND > ITEMS
DATAFILE NAME: FHWMAS 2/ 6/1986
14 ITEMS: STARTING IN POSITION 1

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	PROT	KEY	OCCURS	INDEX
1	LOCATION	5	5	C	-	4	-	-	-
6	LENGTH	6	6	F	3	4	-	-	-
12	SLOPE	6	6	F	1	4	-	-	-
18	CLASS	2	2	C	-	4	-	-	-
20	Q100START	6	6	I	-	4	-	-	-
26	Q100END	6	6	I	-	4	-	-	-
32	REACH-N	7	7	F	4	4	-	-	-
39	CHANNEL-N	7	7	F	4	4	-	-	-
46	OVERBANK-N	7	7	F	4	4	-	-	-
53	TOP-WIDTH	8	8	F	1	4	-	-	-
61	HYDRAULIC-DEPTH	6	6	F	2	4	-	-	-
67	STREAM	20	20	C	-	4	-	-	-
87	DISTRICT	4	4	C	-	4	-	-	-
91	Q100MEAN	6	6	I	-	4	-	-	-

ENTER COMMAND > SEL FHWRUNS
40788 RECORD(S) SELECTED

ENTER COMMAND > ITEMS
DATAFILE NAME: FHWRUNS 2/ 6/1986
17 ITEMS: STARTING IN POSITION 1

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	PROT	KEY	OCCURS	INDEX
1	LOCATION	5	5	C	-	4	-	-	-
6	ALTERNATIVE	16	16	C	-	4	-	-	-
22	SPACING	5	5	I	-	4	-	-	-
27	ELEVATION	3	3	I	-	4	-	-	-
30	N-PERT-INDEX	3	3	I	-	4	-	-	-
33	X-SECT-TYPE	1	1	C	-	4	-	-	-
34	PERT-TYPE	1	1	C	-	4	-	-	-
35	ORIG-SECT	1	1	C	-	4	-	-	-
36	TOPO-METHOD	1	1	C	-	4	-	-	-
37	N-FLAG	1	1	C	-	4	-	-	-
38	EMEANABS	9	9	F	3	4	-	-	-
47	ESDABS	9	9	F	3	4	-	-	-
56	EMAXABS	9	9	F	3	4	-	-	-
65	EMEAN	9	9	F	3	4	-	-	-
74	ESD	9	9	F	3	4	-	-	-
83	SEED	16	16	I	-	4	-	-	-
99	NUMCRITICAL	4	4	I	-	4	-	-	-

```
ENTER COMMAND >  SEL NCOEFF
      3 RECORD(S) SELECTED

ENTER COMMAND >  ITEMS
DATAFILE NAME: NCOEFF                                                    2/ 6/1986
   2 ITEMS: STARTING IN POSITION     1
COLUMN    ITEM NAME          WIDTH OUTPUT  TYPE N.DEC  PROT  KEY  OCCURS INDEX
     1  N-FLAG                   1      1    C     -     4     -      -     -
     2  ALPHA                    6      6    F     1     4     -      -     -

ENTER COMMAND >  SEL FHWSUMRY
   1940 RECORD(S) SELECTED

ENTER COMMAND >  ITEMS
DATAFILE NAME: FHWSUMRY                                                  2/ 6/1986
  18 ITEMS: STARTING IN POSITION     1
COLUMN    ITEM NAME          WIDTH OUTPUT  TYPE N.DEC  PROT  KEY  OCCURS INDEX
     1  LOCATION                 5      5    C     -     4     -      -     -
     6  ALTERNATIVE             16     16    C     -     4     -      -     -
    22  SPACING                  5      5    I     -     4     -      -     -
    27  ELEVATION                3      3    I     -     4     -      -     -
    30  X-SECT-TYPE              1      1    C     -     4     -      -     -
    31  PERT-TYPE                1      1    C     -     4     -      -     -
    32  N-FLAG                   1      1    C     -     4     -      -     -
    33  NREPLICATE               3      3    I     -     4     -      -     -
    36  MEMEANABS                9      9    F     3     4     -      -     -
    45  MESDABS                  9      9    F     3     4     -      -     -
    54  MEMAXABS                 9      9    F     3     4     -      -     -
    63  MEMEAN                   9      9    F     3     4     -      -     -
    72  MESD                     9      9    F     3     4     -      -     -
    81  SEMEANABS                9      9    F     3     4     -      -     -
    90  SESDABS                  9      9    F     3     4     -      -     -
    99  SEMAXABS                 9      9    F     3     4     -      -     -
   108  SEMEAN                   9      9    F     3     4     -      -     -
   117  SESD                     9      9    F     3     4     -      -     -

ENTER COMMAND >  SEL REJECTS
      0 RECORD(S) SELECTED

ENTER COMMAND >  ITEMS
DATAFILE NAME: REJECTS                                                   2/ 6/1986
  10 ITEMS: STARTING IN POSITION     1
COLUMN    ITEM NAME          WIDTH OUTPUT  TYPE N.DEC  PROT  KEY  OCCURS INDEX
     1  LOCATION                 5      5    C     -     4     -      -     -
     6  ALTERNATIVE             16     16    C     -     4     -      -     -
    22  SPACING                  5      5    I     -     4     -      -     -
    27  ELEVATION                3      3    I     -     4     -      -     -
    30  N-PERT-INDEX             3      3    I     -     4     -      -     -
    33  X-SECT-TYPE              1      1    C     -     4     -      -     -
    34  PERT-TYPE                1      1    C     -     4     -      -     -
    35  ORIG-SECT                1      1    C     -     4     -      -     -
    36  TOPO-METHOD              1      1    C     -     4     -      -     -
    37  N-FLAG                   1      1    C     -     4     -      -     -
```

```
ENTER COMMAND >  SEL INDEX
     98 RECORD(S) SELECTED

ENTER COMMAND >  ITEMS
DATAFILE NAME: INDEX                                                   2/ 6/1986
   5 ITEMS: STARTING IN POSITION    1
COLUMN   ITEM NAME        WIDTH OUTPUT  TYPE N.DEC  PROT  KEY  OCCURS INDEX
    1  LOCATION              5      5    C      -     4     -     -     -
    6  INDEX                 4      4    I      -     4     -     -     -
   10  NREPLICATES           3      3    I      -     4     -     -     -
   13  COMPREPL              3      3    I      -     4     -     -     -
   16  MINREPL               3      3    I      -     4     -     -     -

ENTER COMMAND >  TYPE MLRP1
FORM NAME: MLRP1                                                       2/ 6/1986
LINE>    1 COLUMN>   2 'DT       ',,
        ,          ,
LINE>    1 COLUMN>  10 LOCATION,5,,
LOC   ,        ,
LINE>    1 COLUMN>  16 $1HYDRAULIC-DEPTH,8,2,,
 HYD-DEP,          ,
LINE>    1 COLUMN>  25 $1Q100START,8,0,,
    Q100,          ,
LINE>    1 COLUMN>  34 $1SLOPE,8,1,,
   SLOPE,          ,
LINE>    1 COLUMN>  43 $2ALPHA,8,1,,
   ALPHA,          ,
LINE>    1 COLUMN>  52 ELEVATION,8,0,,
    ELEV,          ,
LINE>    1 COLUMN>  61 $1TOP-WIDTH,8,1,,
 TOP-WID,          ,
LINE>    1 COLUMN>  70 $1REACH-N,8,4,,
 REACH-N,          ,
LINE>    1 COLUMN>  79 EMAXABS,8,3,,
 EMAXABS,          ,
LINE>    1 COLUMN>  88 EMEANABS,8,3,,
EMEANABS,          ,


ENTER COMMAND >  TYPE GOMLRP
PROGRAM NAME: GOMLRP                                                   2/ 6/1986
10000  PROGRAM SECTION ONE
10001 SELECT FHWSUMRY
10002 RELATE FHWMAS 1 BY LOCATION
10004 RELATE NCOEFF 2 BY N-FLAG
```

```
ENTER COMMAND >  TYPE MLRP2
FORM NAME: MLRP2                                                    2/ 6/1986
LINE>   1 COLUMN>   2 'DT ',,
    ,     ,
LINE>   1 COLUMN>   5 LOCATION,5,,
LOC   ,       ,
LINE>   1 COLUMN>  11 $1HYDRAULIC-DEPTH,8,2,,
 HYD-DEP,         ,
LINE>   1 COLUMN>  20 $1Q100MEAN,8,0,,
    Q100,         ,
LINE>   1 COLUMN>  29 $1SLOPE,8,1,,
   SLOPE,         ,
LINE>   1 COLUMN>  38 $2ALPHA,8,1,,
   ALPHA,         ,
LINE>   1 COLUMN>  47 ELEVATION,8,0,,
    ELEV,         ,
LINE>   1 COLUMN>  56 $1TOP-WIDTH,8,1,,
 TOP-WID,         ,
LINE>   1 COLUMN>  65 $1REACH-N,8,4,,
 REACH-N,         ,
LINE>   1 COLUMN>  74 MEMEANABS,9,3,,
   MEMEAB,         ,
LINE>   1 COLUMN>  84 MESDABS,9,3,,
   MESDAB,         ,
LINE>   1 COLUMN>  94 MEMAXABS,9,3,,
   MEMXAB,         ,
LINE>   1 COLUMN> 104 MEMEAN,9,3,,
     MEME,         ,
LINE>   1 COLUMN> 114 MESD,9,3,,
     MESD,         ,
'ERROR SUMMARY TO MLRP'
```

```
ENTER COMMAND >  TYPE STATGRAF1
FORM NAME: STATGRAF1                                                        2/ 6/1986
LINE>   1 COLUMN>   2 '|',,
 ,  ,
LINE>   1 COLUMN>   3 LOCATION,5,,
LOC  ,       ,
LINE>   1 COLUMN>   9 $1HYDRAULIC-DEPTH,8,2,,
  HYDDEP,        ,
LINE>   1 COLUMN>  18 $1Q100MEAN,8,0,,
    Q100,        ,
LINE>   1 COLUMN>  27 $1SLOPE,8,1,,
   SLOPE,        ,
LINE>   1 COLUMN>  36 $2ALPHA,8,1,,
   ALPHA,        ,
LINE>   1 COLUMN>  45 ELEVATION,8,0,,
    ELEV,        ,
LINE>   1 COLUMN>  54 $1REACH-N,8,4,,
       N,        ,
LINE>   1 COLUMN>  63 MEMEANABS,9,3,,
   MEMEAB,         ,
LINE>   1 COLUMN>  73 MESDABS,9,3,,
  MESDABS,         ,
LINE>   1 COLUMN>  83 MEMAXABS,9,3,,
 MEMAXABS,         ,
'ERROR SUMMARY TO MLRP'

ENTER COMMAND >  TYPE REJECT
FORM NAME: REJECT                                                           2/ 6/1986
LINE>   1 COLUMN>   2 LOCATION,5,,
LOCAT,      ,
LINE>   1 COLUMN>   8 ALTERNATIVE,16,,
ALTERNATIVE     ,                ,
LINE>   1 COLUMN>  25 SPACING,,
SPACI,      ,
LINE>   1 COLUMN>  31 ELEVATION,,
ELE,    ,
LINE>   1 COLUMN>  35 N-PERT-INDEX,,
N-I,    ,
LINE>   1 COLUMN>  39 X-SECT-TYPE,,
S,  ,
LINE>   1 COLUMN>  41 PERT-TYPE,,
P,  ,
LINE>   1 COLUMN>  43 ORIG-SECT,,
O,  ,
LINE>   1 COLUMN>  45 TOPO-METHOD,,
T,  ,
LINE>   1 COLUMN>  47 TOPO-METHOD,,
T,  ,
LINE>   1 COLUMN>  49 N-FLAG,,
S,  ,
'ABORTED HEC-2 RUNS'
```

```
ENTER COMMAND >  TYPE CHECK
PROGRAM NAME: CHECK                                                    2/ 6/1986
10000  PROGRAM SECTION ONE
10001 RUN CLEAR
10002 SEL FHWSUMRY
10003 REL INDEX 1 BY LOCATION
10004 DISPLAY 'ENTER LOCATION'
10005 ACCEPT $CHR1
10006 RES FOR LOCATION EQ $CHR1
10007 DISPLAY $NOSEL
10009 DISPLAY LOCATION,ELEVATION,X-SECT-TYPE,N-FLAG,NREPLICATE,$1NREPLICATES

ENTER COMMAND >  TYPE CLEAR
PROGRAM NAME: CLEAR                                                    2/ 6/1986
10000  PROGRAM SECTION ONE
10001 SEL INDEX
20000 PROGRAM SECTION TWO
20001 CALC COMPREPL = 0
20002 CALC MINREPL = 999
40000 PROGRAM SECTION THREE

ENTER COMMAND >  TYPE CHECK1
PROGRAM NAME: CHECK1                                                   2/ 6/1986
10000  PROGRAM SECTION ONE
10001 SEL FHWSUMRY
10002 REL INDEX 1 BY LOCATION
10003 FILES
20000 PROGRAM SECTION TWO
20001 CALC $1COMPREPL = $1COMPREPL + 1
20002 DISPLAY $1COMPREPL,LOCATION,NREPLICATE
20003 IF NREPLICATE LT $1MINREPL
20004 CALC $1MINREPL = NREPLICATE
20005 ENDIF
40000 PROGRAM SECTION THREE
40001 FILES
```

```
ENTER COMMAND >  TYPE CHECK2
    PROGRAM NAME: CHECK2                                                      2/ 6/1986
    10000  PROGRAM SECTION ONE
    10001 SEL INDEX
    20000 PROGRAM SECTION TWO
    20001 CALC COMPREPL = 0
    20002 CALC MINREPL = 999
    30000 PROGRAM SECTION THREE
    30001 SEL FHWSUMRY
    30002 REL INDEX 1 BY LOCATION
    40000 PROGRAM SECTION FOUR
    40001 IF NREPLICATE NE $1NREPLICATES
    40002 DISPLAY ' INCOMPLETE DATA ',LOCATION,ELEVATION,X-SECT-TYPE,N-FLAG,NREPLICAT
    40003 ENDIF
    40004 CALC $1COMPREPL = $1COMPREPL + 1
    40005 IF NREPLICATE NE $1NREPLICATES
    40006 CALC $1MINREPL = NREPLICATE
    40007 ENDIF
    50000 PROGRAM SECTION FIVE
    50001 SEL INDEX
    50002 LIST PRINT

     ENTER COMMAND >  QUIT
    ENTER USER NAME> STOP
 ===> $
 ===> $XT
0******CPU TIME=       0MINS    1.98SECS  ******
 ===> /DT
    6 FEB 86  8:39:52
```

E. Generating a Report For Regression Purposes

Once the error statistics have been entered into the INFO data base, the researcher may select results that meet certain desired criteria, generate an INFO "report", and exit the INFO system. The generated report is simply an ASCII file which contains the desired data which has been retrieved from the INFO data base. The INFORM program reformats that ASCII file into another formatted file which is compatible with either the Multiple Linear Regression Program or the STATGRAPHICS package. The original formulation of the regression model utilized the statistics from each individual run. The final formulation utilized the statistics of the statistics for a set of replicates. This data is stored in the INFO file "FHWSUMRY". To generate a report for use in the regression analysis, the following steps are performed:

(1) Execute INFO by entering "SYST*INFO" or simply "INFO".

(2) Enter the job name "FHWAJOB".

(3) Run the INFO program "GOMLRP". This program "SELECTS" the data file "FHWSUMRY" as the primary file, the data file "FHWMAS" as the first related file, and the data file "NCOEFF" as the second related file. This allows the researcher to access all of the necessary information used in the regression analysis. The INFO program "GOMLRP" is listed below:

```
PROGRAM NAME: GOMLRP                2/ 6/1986
10000  PROGRAM SECTION ONE
10001 SELECT FHWSUMRY
10002 RELATE FHWMAS 1 BY LOCATION
10004 RELATE NCOEFF 2 BY N-FLAG
```

(4) "RESELECT" the records which will be used in the regression analysis. Typically, the researcher requests results associated with only spot elevations or only topographic mapping. An example INFO input command to do this is:

RESELECT FOR X-SECT-TYPE EQ 'P'

This selects only those results associated with spot elevations.

(5) "RESELECT" for any additional criteria, such as results associated only with unadjusted Manning's coefficient. The example user command is:

RESELECT FOR SDN-VALUE EQ 'L'

or

RESELECT FOR $2ALPHA EQ 0

(6) Run an INFO report to generate an ASCII file for use in a regression model. For example, run report "MLRP2" to generate a file for use in the multiple regression program. The user may enter a specific output disk file which will contain the report. The following commands would generate the desired report in a disk file named "INFREP01":

```
OUTPUT INFREP01 INIT
REPORT MLRP2 Y 20000
```

The parameter "INIT" tells INFO to initialize the file --- in other words, do not append this report to the end of any existing reports. The "Y" parameter tells INFO to write the report to the spool file "INFREP01" rather than the users terminal. The parameter "20000" tells INFO that there are 20,000 lines per page --- this eliminates printer carriage control characters and associated report titles in the middle of the data. The report "MLRP2" is listed below:

```
 FORM NAME: MLRP2                              2/ 6/1986
 LINE>   1 COLUMN>   2 'DT ',,
    ,     ,
 LINE>   1 COLUMN>   5 LOCATION,5,,
 LOC   ,        ,
 LINE>   1 COLUMN>  11 $1HYDRAULIC-DEPTH,8,2,,
  HYD-DEP,         ,
 LINE>   1 COLUMN>  20 $1Q100MEAN,8,0,,
     Q100,         ,
 LINE>   1 COLUMN>  29 $1SLOPE,8,1,,
    SLOPE,         ,
 LINE>   1 COLUMN>  38 $2ALPHA,8,1,,
    ALPHA,         ,
 LINE>   1 COLUMN>  47 ELEVATION,8,0,,
     ELEV,         ,
 LINE>   1 COLUMN>  56 $1TOP-WIDTH,8,1,,
  TOP-WID,         ,
 LINE>   1 COLUMN>  65 $1REACH-N,8,4,,
  REACH-N,         ,
 LINE>   1 COLUMN>  74 MEMEANABS,9,3,,
    MEMEAB,          ,
 LINE>   1 COLUMN>  84 MESDABS,9,3,,
    MESDAB,          ,
 LINE>   1 COLUMN>  94 MEMAXABS,9,3,,
    MEMXAB,          ,
 LINE>   1 COLUMN> 104 MEMEAN,9,3,,
      MEME,          ,
 LINE>   1 COLUMN> 114 MESD,9,3,,
      MESD,          ,
'ERROR SUMMARY TO MLRP'
```

(7) Exit the INFO system by entering:

```
QUIT
STOP
```

(8) Proceed to reformatting the INFO generated report by using the program "INFORM".

The listing on the following page shows part of a report generated by the INFO program "MLRP2". It will then be converted into a format for use in the Multiple Regression Program. The first several lines are titling lines.

Table 10
Example Report Generated by INFO

Report Generated by INFO Program MLRP2

1
2/ 6/86 PAGE 1

ERROR SUMMARY TO MLRP

LOC	HYD-DEP	Q100	SLOPE	N_r	ELEV	TOP-WID	REACH-N	MEMEAB	MESDAB	MEMXAB	MEME	MESD
DT S05S1	3.00	5,010	36.9	1.0	0	338.4	0.0533	0.564	0.467	1.771	-0.004	0.730
DT S05S1	3.00	5,010	36.9	1.0	2	338.4	0.0533	0.569	0.449	1.637	-0.073	0.683
DT S05S1	3.00	5,010	36.9	1.0	5	338.4	0.0533	0.521	0.431	1.711	-0.025	0.650
DT S05S1	3.00	5,010	36.9	1.0	10	338.4	0.0533	0.606	0.482	1.757	0.075	0.735
DT S01S2	4.32	15,745	12.9	1.0	0	903.0	0.0523	0.663	0.455	1.744	-0.240	0.632
DT S01S2	4.32	15,745	12.9	1.0	2	903.0	0.0523	0.664	0.507	1.941	-0.336	0.767
DT S01S2	4.32	15,745	12.9	1.0	5	903.0	0.0523	0.800	0.616	2.148	-0.262	0.978
DT S01S2	4.32	15,745	12.9	1.0	10	903.0	0.0523	0.675	0.565	2.104	-0.179	0.806
DT S20S2	3.46	14,665	24.8	1.0	0	582.8	0.0301	0.452	0.342	1.268	-0.177	0.513
DT S20S2	3.46	14,665	24.8	1.0	2	582.8	0.0301	0.450	0.341	1.314	-0.005	0.549
DT S20S2	3.46	14,665	24.8	1.0	5	582.8	0.0301	0.382	0.273	1.091	-0.004	0.455
DT S20S2	3.46	14,665	24.8	1.0	10	582.8	0.0301	0.563	0.428	1.748	-0.025	0.705

Data Reformatted for MLRP

```
T1       FHWA JOB
T2
T3
J1     12
NM        HYD-DEP    Q100   SLOPE     Nr     ELEV TOP-WID REACH-N  MEMEAB  MESDAB
NM         MEMXAB    MEME    MESD
TR     12 1 1 1 1 1 1 1 1 1 1 1 1
DT S05S1    3.00    5010    36.9     1.0       0   338.4  0.0533   0.564   0.467
DT S05S1   1.771  -0.004   0.730
DT S05S1    3.00    5010    36.9     1.0       2   338.4  0.0533   0.569   0.449
DT S05S1   1.637  -0.073   0.683
DT S05S1    3.00    5010    36.9     1.0       5   338.4  0.0533   0.521   0.431
DT S05S1   1.711  -0.025   0.650
DT S05S1    3.00    5010    36.9     1.0      10   338.4  0.0533   0.606   0.482
DT S05S1   1.757   0.075   0.735
DT S01S2    4.32   15745    12.9     1.0       0   903.0  0.0523   0.663   0.455
DT S01S2   1.744  -0.240   0.632
DT S01S2    4.32   15745    12.9     1.0       2   903.0  0.0523   0.664   0.507
DT S01S2   1.941  -0.336   0.767
DT S01S2    4.32   15745    12.9     1.0       5   903.0  0.0523   0.800   0.616
DT S01S2   2.148  -0.262   0.978
DT S01S2    4.32   15745    12.9     1.0      10   903.0  0.0523   0.675   0.565
DT S01S2   2.104  -0.179   0.806
DT S20S2    3.46   14665    24.8     1.0       0   582.8  0.0301   0.452   0.342
DT S20S2   1.268  -0.177   0.513
DT S20S2    3.46   14665    24.8     1.0       2   582.8  0.0301   0.450   0.341
DT S20S2   1.314  -0.005   0.549
DT S20S2    3.46   14665    24.8     1.0       5   582.8  0.0301   0.382   0.273
DT S20S2   1.091  -0.004   0.455
DT S20S2    3.46   14665    24.8     1.0      10   582.8  0.0301   0.563   0.428
DT S20S2   1.748  -0.025   0.705
DT S02M1    3.96   10243     6.8     1.0       0  1100.0  0.0611   0.511   0.332
DT S02M1   1.491  -0.083   0.601
DT S02M1    3.96   10243     6.8     1.0       2  1100.0  0.0611   0.443   0.401
DT S02M1   1.802   0.015   0.601
DT S02M1    3.96   10243     6.8     1.0       5  1100.0  0.0611   0.532   0.457
```

Table 10
Example Report Generated by INFO

DT S02M1	1.908	-0.185	0.607						
DT S02M1	3.96	10243	6.8	1.0	10	1100.0	0.0611	0.562	0.379
DT S02M1	1.520	-0.159	0.659						
DT S06M1	5.49	7450	8.4	1.0	0	642.6	0.0693	0.766	0.625
DT S06M1	2.444	-0.244	0.894						

more data

DT S22S1	1.21	800	11.2	0.5	10	354.3	0.0368	0.478	0.341
DT S22S1	1.360	0.339	0.467						
DT S05S2	7.85	11979	25.4	0.5	0	390.2	0.0874	0.698	0.159
DT S05S2	0.942	-0.004	0.159						
DT S05S2	7.85	11979	25.4	0.5	2	390.2	0.0874	0.678	0.173
DT S05S2	0.973	-0.134	0.175						
DT S05S2	7.85	11979	25.4	0.5	5	390.2	0.0874	0.895	0.246
DT S05S2	1.332	-0.150	0.252						
DT S05S2	7.85	11979	25.4	0.5	10	390.2	0.0874	0.963	0.386
DT S05S2	1.789	0.095	0.427						
DT S06S2	5.06	16450	16.6	0.5	0	568.0	0.0552	0.621	0.079
DT S06S2	0.719	-0.101	0.079						
DT S06S2	5.06	16450	16.6	0.5	2	568.0	0.0552	0.579	0.094
DT S06S2	0.740	-0.110	0.094						
DT S06S2	5.06	16450	16.6	0.5	5	568.0	0.0552	0.562	0.128
DT S06S2	0.814	-0.035	0.131						
DT S06S2	5.06	16450	16.6	0.5	10	568.0	0.0552	0.728	0.253
DT S06S2	1.294	-0.215	0.281						
ED									
NJ									
T1									

VIII. Regression Analysis

At this point, the majority of the data management efforts are complete. After generating a report with the INFO data base, the researcher must reformat that report to be compatible with either the Multiple Regression Program or STATGRAPHICS. This is done by executing the program "INFORM" as follows:

```
P26P*INFORM INFODATA=INFREP01 MLRPDATA=MLRP01
```

where:

- INFREP01 — is any valid disk file name into which the INFO report was written.
- MLRP01 — is any valid disk file name into which INFORM will write the reformatted data.

The file "MLRP01" is now reformatted but is not quite ready for processing by the Multiple Linear Regression Program. Some of the input data records generated are simply skeleton records --- the researcher must edit the file to define the dependent variable and the independent variables which are used in the regression analysis. The previous page lists part of a reformatted report --- it would require additional editing before input to the Regression program.

If the reformatted file is input to STATGRAPHICS, the researcher must "download" it from the Harris to a personal computer. Harris supplies a software package called "VCS" that efficiently downloads (as well as uploads) data between the Harris 1000 and IBM personal computers. This package is used to transfer the formatted file to HEC's IBM Personal Computers.

As previously mentioned, a special version of the Multiple Linear Regression Program is used in the Profile Accuracy Study. It allows a maximum of 10,000 observations as compared to the standard 500. The program is executed by entering:

```
P26P*MLRPX INPUT=MLRP01
```

where:

- MLRP01 — is the data file generated using INFO and reformatted using INFORM.

IX. Miscellaneous Operations

A. Use of DSSUTL and DSPLAY

This section describes and illustrates some of the many miscellaneous operations that are performed in conjunction with the Profile Accuracy Study. Some of these operations have been previously described when they are critical elements of the data management system. However, some of them are useful as separate analysis tools at times when they are not required for the data management scheme. The HECDSS utility program "DSSUTL" is required to generate an abbreviated catalog listing which in turn is used by program COMPER to compute the profile errors. However, it can also be used to tabulate data, edit data, and purge data records. The catalog listing is also a useful reference for generating plots using the HECDSS utility program "DSPLAY". The data records may be accessed by a "reference number" rather than the full pathname. The pages following this show an example abbreviated catalog listing from DSSUTL and a profile plot using DSPLAY.

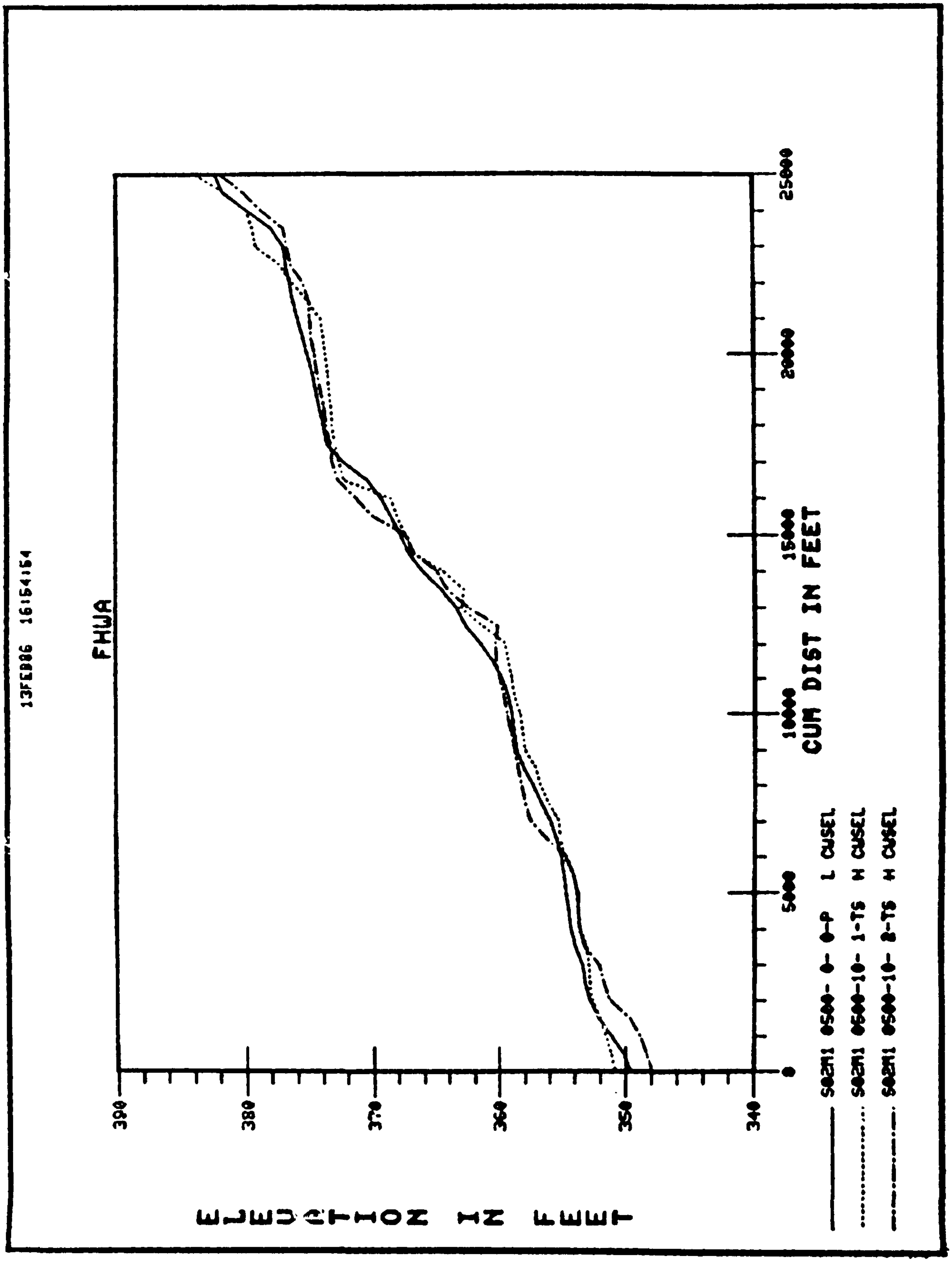
Table 11
Example Abbreviated DSSUTL Catalog Listing

```
1$JOB UTL002 P26D CARL P=4 TIME=3600 RQ OUT=P26M*UTL0002        6 FEB 86 16:09:44
 ===> $
 ===> $ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 ===> $     J.UTL002
 ===> $ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 ===> $
 ===> $MO QL=P26M PS=256 LP=60
 ===> $ ----------------------------------------------------------------------
 ===> SYS*DSSUTL
1*****************************************                                   ***************************************
 *                                       *                                   *                                     *
 *  DATA STORAGE SYSTEM UTILITY PROGRAM  *                                   *    U.S. ARMY CORPS OF ENGINEERS     *
 *            JANUARY 1985               *                                   *  THE HYDROLOGIC ENGINEERING CENTER  *
 *                                       *                                   *          609 SECOND STREET          *
 *                                       *                                   *       DAVIS, CALIFORNIA 95616       *
 *   RUN DATE 06FEB86     TIME 16:09:51  *                                   *  (916) 440-2105 OR (FTS) 448-2105   *
 *                                       *                                   *                                     *
 *****************************************                                   ***************************************


                                      DDDDDD    SSSSS    SSSSS   U     U  TTTTTTT  L
                                      D     D  S     S  S     S  U     U     T     L
                                      D     D  S        S        U     U     T     L
                                      D     D   SSSSS    SSSSS   U     U     T     L
                                      D     D        S        S  U     U     T     L
                                      D     D  S     S  S     S  U     U     T     L
                                      DDDDDD    SSSSS    SSSSS    UUUUU      T     LLLLLLL

1
 ENTER DSS FILE NAME
 U>P26M*S02M1Z
                  -----DSS---ZOPEN EXISTING FILE OPENED   71  0000P26M*S02M1Z
 U>CA.AN O=ABCDEF
 CATALOG FILE = 0000P26M*S02M1ZC
     1  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 0-P   L/
     2  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 0-P O L/
     3  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 1-PSO H/
     4  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 1-PSO M/
     5  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 2-PSO H/
     6  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 2-PSO M/
     7  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 3-PSO H/
     8  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 0- 3-PSO M/
     9  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-PSO H/
    10  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-PSO L/
    11  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-PSO M/
    12  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-TSO H/
    13  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-TSO L/
    14  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 1-TSO M/
    15  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-PSO H/
    16  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-PSO L/
    17  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-PSO M/
    18  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-TSO H/
    19  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-TSO L/
    20  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 2-TSO M/
    21  /FHWA/S02M1/CUM DIST-ELEVATION///0500- 2- 3-PSO H/
                           ...
                           ...
                           ...
```

Table 11 (continued)
Example Abbreviated DSSUTL Catalog Listing

```
                         ...
                         ...
    52  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 2-PSO L/
    53  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 2-PSO M/
    54  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 2-TSO H/
    55  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 2-TSO L/
    56  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 2-TSO M/
    57  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-PSO H/
    58  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-PSO L/
    59  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-PSO M/
    60  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-TSO H/
    61  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-TSO L/
    62  /FHWA/S02M1/CUM DIST-ELEVATION///0500-10- 3-TSO M/
 U>FINISH
                    -----DSS---ZCLOSE FILE   71
                               NO. RECORDS=      62
                               FILE SIZE=     18986 WORDS,     170 SECTORS
                               PERCENT INACTIVE=  0.00
 STOP
    6 FEB 86 16:10:03
0******CPU TIME=       0MINS    2.85SECS  ******
```

Figure 3: Example Profile Plot Using DSPLAY



B. HEC-2 Graphics (HGP and PLXSEC)

Two other software programs display HEC-2 data: (1) The Hydraulics Graphics Package (HGP, a limited availability graphics program), and (2) PLXSEC, a newly written graphics program. HGP generates cross-section plots, profile plots, or variable versus variable plots on a TEKTRONIX-4014 or a TEKTRONIX-4014 emulator, or on a pen plotter such as CALCOMP, ZETA, or HEWLET PACKARD. PLXSEC generates cross-section plots. It can overlay several plots on one graph allowing the researcher to compare, for example, the original cross-section as well as several adjustments of it or a topographic section.

The HGP package is primarily used to clean up data by viewing cross-section plots, and to compare profiles. It is well documented and will not be discussed here. The PLXSEC program is a quick and dirty way to view cross-section plots on a Tektronix 4014 or Tektronix 4014 emulator. It has been developed for this Study to provide the researcher with graphical information to help verify that elevations are correctly adjusted and that topographic cross-sections are properly generated. Since it has been specifically written for this study, it is not polished in user interaction. The following example demonstrates the input to and graphics output from PLXSEC. Several things should be noted:

(1) PLXSEC keys certain information to the T3 HEC-2 input data card --- see previous discussion of the T3 card as used in this study.

(2) The input specifications to PLXSEC use previously defined values if the user enters a carriage return or "enter" key.

(3) The user input must exactly agree with the values on the T3 card (for example, the section spacing must be entered as "0500" and not "500".

(4) A blank specification is defined by the lower case letter "b".

(5) The HEC-2 input used as the data file need not be ready for execution (only the T3, X1, and GR cards need be entered).

(6) The HEC-2 input data file may contain any number of HEC-2 jobs.

(7) The maximum length of the HEC-2 data file is 30,000 input records.

(8) Any combination of sections may be overplotted --- they do not have to be the same cross-section.

The example below demonstrates plotting the original section and the ten foot topographic cross-section for location S02M1 and cross-section 470.

```
 ===> $MO QL=P26C LP=60 EC=ON
 ===> $
 ===> $
 ===> LI S02M1M00 1 2
 ===> FIND X1
0 AREA:  "0000P26C*S02M1M00"
```

13	X1	470	23	1700	1815	0	0	0
21	X1	2.01	34	1199.	1324.	385.7	434.8	500.0
29	X1	2.02	34	697.	833.	385.7	434.8	500.0
37	X1	3.01	30	285.	425.	377.2	434.8	500.0
45	X1	3.02	30	389.	493.	328.2	434.8	500.0
52	X1	4.01	25	564.	649.	180.6	481.6	500.0
59	X1	5.01	38	792.	883.	23.3	518.4	500.0
69	X1	5.02	38	701.	856.	189.4	331.5	500.0
79	X1	6.01	54	600.	1039.	367.9	475.8	500.0
92	X1	7.01	36	484.	1057.	416.2	574.4	500.0
102	X1	7.02	36	356.	705.	335.3	582.4	500.0
111	X1	8.01	33	230.	359.	337.7	575.1	500.0
119	X1	8.02	33	211.	321.	455.2	218.5	500.0
127	X1	8.03	33	192.	283.	455.2	218.5	500.0
136	X1	9.01	30	165.	242.	400.5	245.6	500.0
144	X1	9.02	30	119.	193.	255.7	317.2	500.0
151	X1	10.01	20	151.	223.	307.4	326.7	500.0
157	X1	10.02	20	587.	655.	574.8	375.4	500.0
162	X1	11.01	23	984.	1050.	512.6	395.2	500.0
169	X1	11.02	23	1168.	1242.	176.0	502.5	500.0
176	X1	12.01	26	1245.	1325.	206.8	488.8	500.0
184	X1	12.02	26	709.	789.	381.7	411.2	500.0
192	X1	13.01	26	371.	449.	415.2	474.7	500.0
200	X1	13.02	26	265.	340.	454.5	549.2	500.0
207	X1	13.03	26	159.	230.	454.5	549.2	500.0
216	X1	14.01	26	182.	263.	513.0	388.9	500.0
223	X1	15.01	38	465.	556.	462.7	450.0	500.0
232	X1	15.02	38	869.	968.	429.8	500.0	500.0
241	X1	15.03	38	1272.	1380.	429.8	500.0	500.0
251	X1	15.04	38	1676.	1792.	429.8	500.0	500.0
260	X1	15.05	38	2079.	2204.	429.8	500.0	500.0
269	X1	15.06	38	2482.	2616.	429.8	500.0	500.0
278	X1	16.01	56	2295.	2410.	656.5	450.1	500.0
292	X1	16.02	56	2081.	2176.	666.9	447.8	500.0
305	X1	16.03	56	1867.	1941.	666.9	447.8	500.0
319	X1	17.01	48	1658.	1720.	589.6	444.2	500.0
330	X1	17.02	48	1464.	1535.	369.6	434.1	500.0
341	X1	17.03	48	1271.	1351.	369.6	434.1	500.0
353	X1	17.04	48	1078.	1166.	369.6	434.1	500.0
364	X1	17.05	48	885.	981.	369.6	434.1	500.0
376	X1	18.01	38	746.	834.	451.8	474.6	500.0
386	X1	18.02	38	643.	711.	503.5	500.0	500.0
395	X1	18.03	38	540.	587.	503.5	500.0	500.0
406	X1	19.01	40	621.	670.	428.8	530.9	500.0
415	X1	20.01	32	790.	843.	424.4	534.8	500.0
424	X1	20.02	32	1039.	1083.	472.9	520.3	500.0
432	X1	21.01	32	1015.	1066.	399.5	489.7	500.0
442	X1	22.01	40	963.	1024.	364.7	479.9	500.0
452	X1	22.02	40	1208.	1280.	233.1	461.5	500.0
462	X1	23.01	44	1446.	1529.	231.9	460.8	500.0
473	X1	23.02	44	1114.	1181.	134.2	402.7	500.0

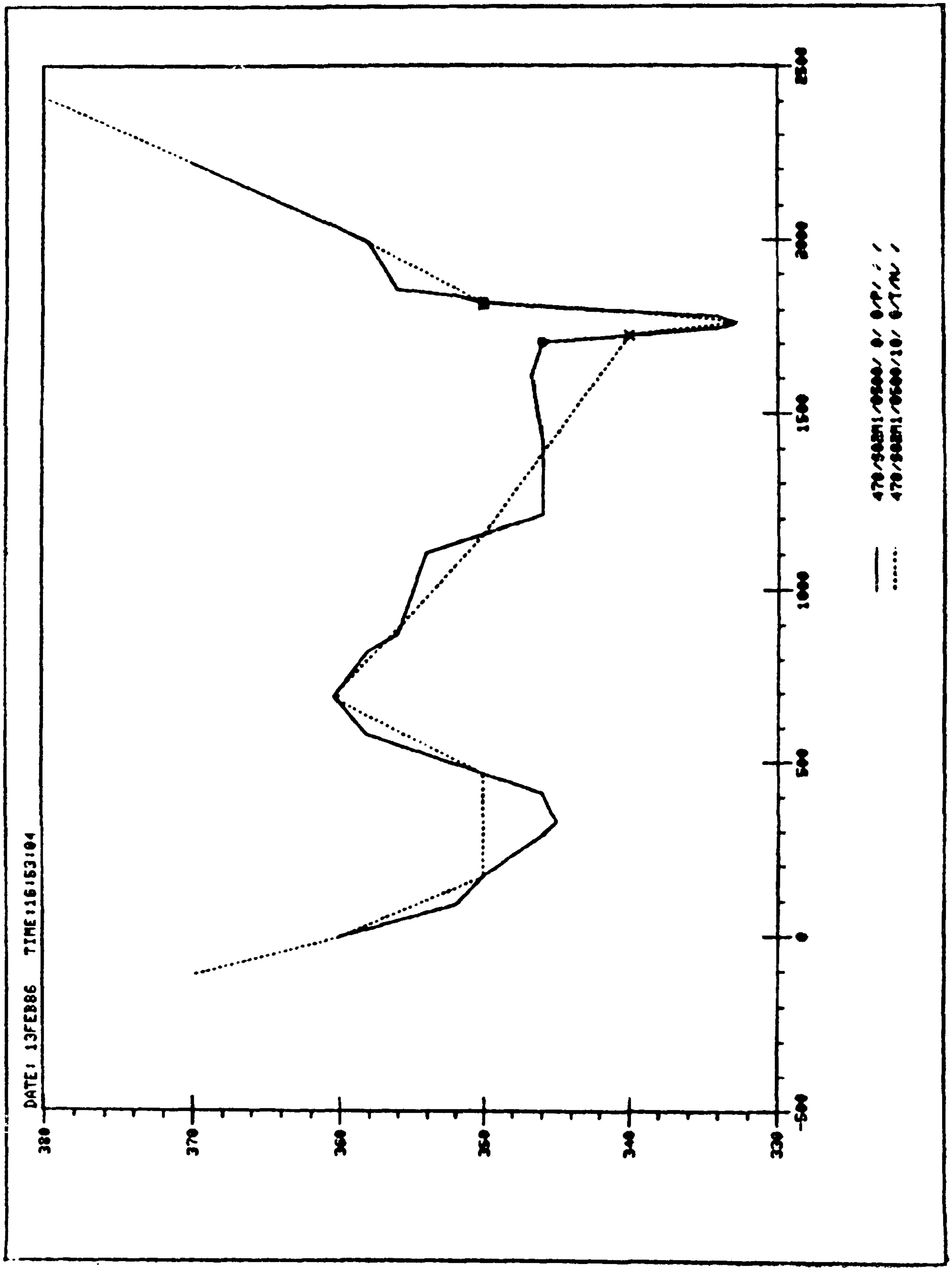
OFIND: 51 LINES FOUND

```
===> $
===> P26C*PLXSEC DATA=S02M1PL

READING HEC-2 INPUT DATA SET
PLEASE WAIT.


HEC-2 SPECIFICATIONS:

T3      S02M1  0500 0 0P
T3      S02M1  0500 2 1TS
T3      S02M1  0500 2 2TS
T3      S02M1  0500 2 1PS
T3      S02M1  0500 2 2PS
T3      S02M1  0500 2 3PS
T3      S02M1  050010 0TN
T3      S02M1  050010 0TE
T3      S02M1  050010 0PE

   3939 HEC-2 INPUT DATA RECORDS READ.

ENTER X-SECT ():
470

ENTER CLOC ():
S02M1

ENTER CSPACE ():
0500

ENTER CELEV ():
0

ENTER CNPERT ():
0

ENTER CTP ():
P

ENTER CMPERT ():
b

ENTER CTOPO ():
b
ENTER X-SECT (   470):


ENTER CLOC (S02M1):


ENTER CSPACE (0500):
```

```
ENTER CELEV ( 0):
10

ENTER CNPERT ( 0):


ENTER CTP (P):
T

ENTER CMPERT ( ):
N

ENTER CTOPO ( ):

ENTER X-SECT (    470):
PL
FI

USER HAS REQUESTED PLXSEC TO TERMINATE.
STOP
```

The following plot was generated by the above PLXSEC execution.

Figure 4: Example Plot Using PLXSEC



C. Generating JCL

Since many operations require a separate set of JCL for each location, it is convenient to use a program to generate and edit it. The program GENJCL allows the researcher to generate and edit JCL for DSSUTL, COMPER, and INFO. The program is again not real user friendly since it is considered to be disposable software --- very special purpose. The user may enter the following input:

Record	Field	Description
1	1	Columns 1-8, integer right justified. This identifies the particular operation which will be performed: If KASE = 1, generates files numbered "001" through "102" for program specified in field two. If KASE = 2, generates JCL to edit all 102 files ("001" - "102") --- must first have copied the base framework file "000" into each of the files. If KASE = 3, generates a listing of index numbers associated with each location.
1	2	Program for which JCL files will be generated. Must be either: "UTL", or "CMP", or "INF". Must be entered in columns 14 through 16.
2-n	1	For KASE = 2 or KASE = 3, must supply these cards. Columns 1-5 contain the 5 character location identifier in their numeric order. Suitable input exists in file P26M*SLIST1.

Below, the program GENJCL is listed.

```
      PROGRAM GENJCL
C
C     GENERATES JCL FOR VARIOUS PROGRAMS FOR FHW STUDY
C     ----------------------------------------------------------------
C
C
C     KASE=1      GENERATES JCL TO GENERATE JCL FILES, "$GE,J.CMP001 PR
C                 PW PD G=8"  FOR ANY USER INPUT 3 CHARACTER CODE.
C                 USER ENTERS ONE LINE OF INPUT, "     1  CMP"  WHERE CMP
C                 MAY BE ANY CODE (E.G. UTL).  DATA MUST BE RIGHT JUSTIFIED
C                 (I8,5X,A3)
C
C     KASE=2      GENERATES JCL TO "COED" JCL FILES FOR DSSUTL AND COMPER,
C                 ETC.  CHANGES # TO INDEX NUMBER (I.E.  # TO 002)  AND
C                 CHANGES @ TO LOCATION ID  (I.E. @ TO S02M1)
C
C     KASE=3      GENERATES AN INDEX LISTING OF LOCATION I.D. AND NUMERIC
C                 INDEX.  ALL 102 LOCATIONS MUST BE ENTERED AS INPUT, ONE
```

```
C               PER LINE.  MUST BE IN FIRST 5 COLUMNS.
C
C     -------------------------------------------------------------------
C
      CHARACTER CBUFF*30,CLOC*5,CTYPE*3
C
      KASE=2
C
      CALL ASGN(5,6HINPUT ,3H*0 ,+1)
C
      READ(5,'(I8,5X,A3)') KASE,CTYPE
      IF(KASE.LT.1) KASE=1
      IF(CTYPE.EQ.'   ') CTYPE='UTL'
C
      WRITE(1,'(''$JOB,FHWA,P26D,RDC,PRI=9,OUT=P26M*OUT'')')
      WRITE(1,'(''$MO QL=P26M LP=60 PS=256'')')
C
      FOR J=1,102
C
      IF(KASE.EQ.1) THEN
      CBUFF='$GE,J.UTL000 PR PW PD G=8'
      ELSE IF(KASE.EQ.2) THEN
      CBUFF='CED,J.UTL000'
      ENDIF
      WRITE(CBUFF(7:9),'(A3)') CTYPE
C
      WRITE(CBUFF(10:12),'(I3)') J
      IF(CBUFF(10:10).EQ.' ') CBUFF(10:10)='0'
      IF(CBUFF(11:11).EQ.' ') CBUFF(11:11)='0'
      IF(KASE.NE.3) WRITE(1,'(A)') CBUFF
C
      IF(KASE.EQ.2) THEN
C
      WRITE(1,'(''T'')')
      CBUFF='C ;#;000; * *'
      WRITE(CBUFF(6:8),'(I3)') J
      IF(CBUFF(6:6).EQ.' ') CBUFF(6:6)='0'
      IF(CBUFF(7:7).EQ.' ') CBUFF(7:7)='0'
      WRITE(1,'(A)') CBUFF
C
C
      READ(5,'(A5)') CLOC
      WRITE(1,'(''T'')')
      CBUFF='C ;@;S0000; * *'
      WRITE(CBUFF(6:10),'(A5)') CLOC
      WRITE(1,'(A)') CBUFF
C
      WRITE(1,'(''B'')')
      JP=J+1
      CBUFF='I IJ J.UTL000'
      WRITE(CBUFF(8:10),'(A3)') CTYPE
      WRITE(CBUFF(11:13),'(I3)') JP
      IF(CBUFF(11:11).EQ.' ') CBUFF(11:11)='0'
      IF(CBUFF(12:12).EQ.' ') CBUFF(12:12)='0'
```

```
      IF(CTYPE.EQ.'UTL' .OR. CTYPE.EQ.'INF') WRITE(1,'(A)') CBUFF
C
C
      WRITE(1,'(''FILE'')')
C
      ELSE IF(KASE.EQ.3) THEN
      READ(5,'(A5)') CLOC
      WRITE(1,'(A5,'','',I3)') CLOC,J
C
      ENDIF
C
      END FOR
C
      STOP
      END
```

Below is listed the output from GENJCL for KASE = 1 and for the DSSUTL program. The user enters the one input record shown below to generate this JCL:

```
                     1         2
Column      12345678901234567890
Input                1     UTL
```

JCL generated:

```
$JOB,FHWA,P26C,RDC,PRI=9,OUT=P26M*OUT
$MO QL=P26M LP=60 PS=256
$GE,J.UTL001 PR PW PD G=8
$GE,J.UTL002 PR PW PD G=8
$GE,J.UTL003 PR PW PD G=8
$GE,J.UTL004 PR PW PD G=8
$GE,J.UTL005 PR PW PD G=8
$GE,J.UTL006 PR PW PD G=8
$GE,J.UTL007 PR PW PD G=8
$GE,J.UTL008 PR PW PD G=8
$GE,J.UTL009 PR PW PD G=8
$GE,J.UTL010 PR PW PD G=8
$GE,J.UTL011 PR PW PD G=8
$GE,J.UTL012 PR PW PD G=8
$GE,J.UTL013 PR PW PD G=8
$GE,J.UTL014 PR PW PD G=8
$GE,J.UTL015 PR PW PD G=8
$GE,J.UTL016 PR PW PD G=8
$GE,J.UTL017 PR PW PD G=8
$GE,J.UTL018 PR PW PD G=8
$GE,J.UTL019 PR PW PD G=8
$GE,J.UTL020 PR PW PD G=8
$GE,J.UTL021 PR PW PD G=8
$GE,J.UTL022 PR PW PD G=8
$GE,J.UTL023 PR PW PD G=8
```

```
$GE,J.UTL024 PR PW PD G=8
$GE,J.UTL025 PR PW PD G=8
$GE,J.UTL026 PR PW PD G=8
$GE,J.UTL027 PR PW PD G=8
$GE,J.UTL028 PR PW PD G=8
$GE,J.UTL029 PR PW PD G=8
$GE,J.UTL030 PR PW PD G=8
$GE,J.UTL031 PR PW PD G=8
$GE,J.UTL032 PR PW PD G=8
$GE,J.UTL033 PR PW PD G=8
$GE,J.UTL034 PR PW PD G=8
             ...
             ...
             ...
             ...
             ...
             ...
             ...
$GE,J.UTL097 PR PW PD G=8
$GE,J.UTL098 PR PW PD G=8
$GE,J.UTL099 PR PW PD G=8
$GE,J.UTL100 PR PW PD G=8
$GE,J.UTL101 PR PW PD G=8
$GE,J.UTL102 PR PW PD G=8
```

The listing below demonstrates the JCL generated for KASE = 2. The required user input is similar to the example above for KASE = 1 except that the user must also enter the 5 character location identifier ("Sxxxx"), one location per record in columns 1 through 5 and in the same order as their numeric identifier "iii". For example, to edit DSSUTL file "J.UTL001" the corresponding location identifier is S20S2.

```
$JOB,FHWA,P26C,RDC,PRI=9,OUT=P26M*OUT
$MO QL=P26M LP=60 PS=256
CED,J.UTL001
T
C ;#;001; * *
T
C ;@;S20S2; * *
B
I IJ J.UTL002
FILE
CED,J.UTL002
T
C ;#;002; * *
T
C ;@;S02M1; * *
B
I IJ J.UTL003
FILE
CED,J.UTL003
T
```

```
C ;#;003; * *
T
C ;@;S06M1; * *
B
I IJ J.UTL004
FILE
CED,J.UTL004
T
C ;#;004; * *
          ...
          ...
          ...
          ...
          ...
          ...
          ...
          ...
```

Before executing this JCL, the user must copy the base JCL file J.UTL000 into every J.UTLiii file. The user may use the output from KASE = 1 and a editor such as COED to generate the JCL to copy the J.UTL000 file into every J.UTLiii file. The base JCL file for DSSUTL (identified as J.UTL000) is listed below:

```
$JOB,UTL#,P26D,RDC,P=4,TIME=3600,RQ,OUT=P26M*UTLO#
$
$ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
$     J.UTL#
$ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
$
$MO QL=P26M PS=256 LP=60
$
----------------------------------------------------------------------
SYS*DSSUTL
P26M*@Z
CA.ANS O=ABCDEF
FINISH
$
----------------------------------------------------------------------
/DT
$XT
MONEY
IJ J.CMP#
```

Similar files exist for the COMPER program and for entering data into the INFO data base.

D. Utilities Helpful In Managing Disk Space

Previous discussions have described the disk space limitations and the management of disk space. Two programs help manage the Profile Accuracy Study's disk space: SEARCH and RDSECT. SEARCH reads a Harris map command output and generates a series of JCL commands that map disk areas which meet the criteria of: DSS data and catalog files, and/or HEC-2 manipulated input data files, and/or HEC-2 manipulated data output files. RDSECT generates a consolidated listing of disk space usage by reading any Harris map command output (including that generated by SEARCH). SEARCH determines which files to map by a user specified, execution-time option. The program SEARCH is listed below:

```
      PROGRAM SEARCH
C
C     LOOKS AT MAP OF QUALIFIER AND GENERATES LIST OF FILE NAMES FOR
C     FHWA JOB.  FILES:  INPUT, OUTPUT, AND DSS
C     -----------------------------------------------------------------
      CHARACTER CINP*40
      LOGICAL POPT
C
      CALL ASGN(5,6HINPUT ,5HMAPM ,-1)
      CALL ASGN(1,7HOUTPUT ,9HFHWPURGE ,+1)
C
      WRITE(1,'(''$JOB,FHWA,P26D,RDC,PRI=14,OUT=P26M*FHWPURGO'',
     ./''$MO QL=P26M LP=60 PS=256'')')
C
5     READ(5,'(A)',END=90) CINP
C
C     CHECK FOR DSS FILE OR DSS CATALOG FILE
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      IF(POPT(1HD)) THEN
      IF(CINP(20:21).EQ.'*S' .AND. CINP(26:26).EQ.'Z' .AND.
     .CINP(28:28).EQ.' ') THEN
      WRITE(1,'(''$MA.L,'',A)') CINP(12:30)
      ENDIF
      ENDIF
C
C     CHECK FOR HEC-2 INPUT DATA FILES
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      IF(POPT(1HM)) THEN
      IF(CINP(20:21).EQ.'*S' .AND. CINP(26:26).EQ.'M') THEN
      WRITE(1,'(''$MA.L,'',A)') CINP(12:30)
      ENDIF
      ENDIF
C
C     CHECK FOR HEC-2 OUTPUT DATA FILES
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      IF(POPT(1HO)) THEN
      IF(CINP(20:21).EQ.'*S' .AND. CINP(26:26).EQ.'O') THEN
      WRITE(1,'(''$MA.L,'',A)') CINP(12:30)
      ENDIF
```

```
      ENDIF
C
C     CHECK FOR HEC-2 INPUT DATA FILES WITH "L" INSTEAD OF "M"
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      IF(POPT(1HL)) THEN
      IF(CINP(20:21).EQ.'*S' .AND. CINP(26:26).EQ.'L') THEN
      WRITE(1,'(''$MA.L,'',A)') CINP(12:30)
      ENDIF
      ENDIF
C
C     CHECK FOR HEC-2 INPUT DATA FILES (WIHT "N" INSTEAD OF "M")
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      IF(POPT(1HN)) THEN
      IF(CINP(20:21).EQ.'*S' .AND. CINP(26:26).EQ.'N') THEN
      WRITE(1,'(''$MA.L,'',A)') CINP(12:30)
      ENDIF
      ENDIF
      GO TO 5
90    STOP
      END
```

The program RDSECT is listed below:

```
      PROGRAM RDSECT
C     READS MAPSL AND COMPUTES THE NUMBER OF SECTORS
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      CHARACTER CINP*80,CSECT*8,CFMT*8
C
      CALL ASGN(1,5HMAP  ,3HW1 ,-1)
      CALL ASGN(6,7HOUTPUT ,3H*3 ,+1)
      NUSECT=0
      NUFILE=0
 5    READ(1,'(A80)',END=90) CINP
      IF(CINP(49:50).NE.'C=') GO TO 5
      CSECT=CINP(51:)
      MBL=INDEX(CSECT,' ')
      CFMT='(I7)'
      WRITE(CFMT(3:3),'(I1)') MBL
      READ(CSECT,CFMT) JSECT
C
      WRITE(6,'('' FILE: '',A17,2X,A9,10X,''CONTAINS: '',I7,'' SECTORS.'
     .')') CINP(12:28),CINP(48:56),JSECT
C
      NUSECT=NUSECT+JSECT
      NUFILE=NUFILE+1
      GO TO 5
C
```

```
90    WRITE(6,'(/'' IN'',I5,'' FILES THERE WERE'',I7,'' TOTAL SECTORS.''
     .)') NUFILE,NUSECT
      STOP
      END
```

Typical JCL to execute SEARCH is listed below. It is designed to generate the JCL to map all HECDSS data and catalog files.

```
$JOB,SEARCH,P26D,RDC,PRI=9,OUT=P26M*SEARCHO3
$MO QL=P26M LP=60 PS=256 ME=ON
$
$      IF OPTION D IS ENTERED, WRITES OUT DSS FILES AND ASSOCIATED CATALOG FILES
$      IF OPTION M IS ENTERED, WRITES OUT HEC-2 INPUT DATA FILES
$      IF OPTION O IS ENTERED, WRITES OUT HEC-2 OUTPUT DATA FILES
$      IF OPTION L IS ENTERED, WRITES OUT HEC-2 INPUT DATA FILES
$      IF OPTION N IS ENTERED, WRITES OUT HEC-2 INPUT DATA FILES
$
SEARCH.D
$XT
/DT
MONEY
```

The output from SEARCH is listed below:

```
$JOB,FHWA,P26D,RDC,PRI=14,OUT=P26M*FHWPURGO
$MO QL=P26M LP=60 PS=256
$MA.L,0000P26M*S01M2Z
$MA.L,0000P26M*S01M2ZC
$MA.L,0000P26M*S01M3Z
$MA.L,0000P26M*S01M3ZC
$MA.L,0000P26M*S01S1Z
$MA.L,0000P26M*S01S1ZC
$MA.L,0000P26M*S01S2Z
$MA.L,0000P26M*S01S2ZC
$MA.L,0000P26M*S01S3Z
$MA.L,0000P26M*S01S3ZC
$MA.L,0000P26M*S02M1Z
$MA.L,0000P26M*S02M1ZC
$MA.L,0000P26M*S02M2Z
$MA.L,0000P26M*S02M2ZC
$MA.L,0000P26M*S02S1Z
$MA.L,0000P26M*S02S1ZC
$MA.L,0000P26M*S02S2Z
$MA.L,0000P26M*S02S2ZC
$MA.L,0000P26M*S02S3Z
$MA.L,0000P26M*S02S3ZC
$MA.L,0000P26M*S03M1Z
```

```
$MA.L,0000P26M*S03M1ZC
$MA.L,0000P26M*S03M2Z
$MA.L,0000P26M*S03M2ZC
$MA.L,0000P26M*S03S1Z
          ...
          ...
          ...
          ...
          ...
          ...
          ...
```

Although the generated JCL maps the disk areas, the user may perform other operations (such as eliminating files) simply by invoking an editor (such as COED) to change the "$MA.L" command to something else (such as "$EL). Also, the HECDSS catalog file names may easily be eliminated by using the following COED commands:

```
X ?.L ;ZC    ;?.DE?.U?
X 300
```

If using the "map" option, the output would appear as shown below:

```
1$JOB FHWA P26D CARL PRI=14 OUT=P26M*FHWPURGO          7 FEB 86 17:11:15
 ===> $MO QL=P26M LP=60 PS=256
 ===> $MA.L,0000P26M*S01M2Z
  MAP:      0000P26M*S01M2Z    RO          P=3    C=1600
 ===> $MA.L,0000P26M*S01M2ZC
  MAP:      0000P26M*S01M2ZC   BO BF=8     P=3    C=80
 ===> $MA.L,0000P26M*S01M3Z
  MAP:      0000P26M*S01M3Z    RO          P=3    C=600
 ===> $MA.L,0000P26M*S01M3ZC
  MAP:      0000P26M*S01M3ZC   BO BF=8     P=3    C=40
 ===> $MA.L,0000P26M*S01S1Z
  MAP:      0000P26M*S01S1Z    RO          P=3    C=400
 ===> $MA.L,0000P26M*S01S1ZC
  MAP:      0000P26M*S01S1ZC   BO BF=8     P=3    C=40
 ===> $MA.L,0000P26M*S01S2Z
  MAP:      0000P26M*S01S2Z    RO          P=3    C=400
 ===> $MA.L,0000P26M*S01S2ZC
  MAP:      0000P26M*S01S2ZC   BO BF=8     P=3    C=40
 ===> $MA.L,0000P26M*S01S3Z
  MAP:      0000P26M*S01S3Z    RO          P=3    C=3000
 ===> $MA.L,0000P26M*S01S3ZC
  MAP:      0000P26M*S01S3ZC   BO BF=8     P=3    C=200
 ===> $MA.L,0000P26M*S02M1Z
  MAP:      0000P26M*S02M1Z    RO          P=3    C=200
 ===> $MA.L,0000P26M*S02M1ZC
  MAP:      0000P26M*S02M1ZC   BO BF=8     P=3    C=40
 ===> $MA.L,0000P26M*S02M2Z
```

```
 MAP:      0000P26M*S02M2Z    R0          P=3    C=400
===> $MA.L,0000P26M*S02M2ZC
 MAP:      0000P26M*S02M2ZC   B0 BF=8     P=3    C=40
===> $MA.L,0000P26M*S02S1Z
 MAP:      0000P26M*S02S1Z    R0          P=3    C=600
===> $MA.L,0000P26M*S02S1ZC
 MAP:      0000P26M*S02S1ZC   B0 BF=8     P=3    C=80
===> $MA.L,0000P26M*S02S2Z
 MAP:      0000P26M*S02S2Z    R0          P=3    C=400
===> $MA.L,0000P26M*S02S2ZC
 MAP:      0000P26M*S02S2ZC   B0 BF=8     P=3    C=40
===> $MA.L,0000P26M*S02S3Z
                         ...
                         ...
                         ...
                         ...
                         ...
                         ...
===> $MA.L,0000P26M*S55M2ZC
 MAP:      0000P26M*S55M2ZC   B0 BF=8     P=3    C=240
===> $MA.L,0000P26M*S56M2Z
 MAP:      0000P26M*S56M2Z    R0          P=3    C=3800
===> $MA.L,0000P26M*S56M2ZC
 MAP:      0000P26M*S56M2ZC   B0 BF=8     P=3    C=240
1$EOJ    (SUPPLIED BY COURTESY OF HARRIS)
0******JOB EXITED ON  7 FEB 86 17:12:59   ******
0******CPU TIME=       0MINS    3.98SECS  ******
0******CONNECT TIME=      1MINS   57SECS  ******
```

Then, by invoking the following JCL, the user may execute RDSECT to read the above map listing and generate a summary of disk space utilization. The file FHWPURGO is the file listed above.

```
$JOB,RDSECT,P26D,RDC,P=9,RQ,OUT=P26M*RDSECT02
$MO QL=P26M LP=60 PS=256
$          RDSECT MAP=M.RDSECT
RDSECT MAP=FHWPURGO
```

The output from RDSECT is shown below:

```
1$JOB RDSECT P26D CARL P=9 RQ OUT=P26M*RDSECT02           7 FEB 86 17:13:17
 ===> $MO QL=P26M LP=60 PS=256
 ===> $          RDSECT MAP=M.RDSECT
 ===> RDSECT MAP=FHWPURGO
 FILE: 0000P26M*S01M2Z     C=1600           CONTAINS:     1600 SECTORS.
 FILE: 0000P26M*S01M2ZC    C=80             CONTAINS:       80 SECTORS.
 FILE: 0000P26M*S01M3Z     C=600            CONTAINS:      600 SECTORS.
 FILE: 0000P26M*S01M3ZC    C=40             CONTAINS:       40 SECTORS.
```

```
FILE: 0000P26M*S01S1Z     C=400              CONTAINS:     400 SECTORS.
FILE: 0000P26M*S01S1ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S01S2Z     C=400              CONTAINS:     400 SECTORS.
FILE: 0000P26M*S01S2ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S01S3Z     C=3000             CONTAINS:    3000 SECTORS.
FILE: 0000P26M*S01S3ZC    C=200              CONTAINS:     200 SECTORS.
FILE: 0000P26M*S02M1Z     C=200              CONTAINS:     200 SECTORS.
FILE: 0000P26M*S02M1ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S02M2Z     C=400              CONTAINS:     400 SECTORS.
FILE: 0000P26M*S02M2ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S02S1Z     C=600              CONTAINS:     600 SECTORS.
FILE: 0000P26M*S02S1ZC    C=80               CONTAINS:      80 SECTORS.
FILE: 0000P26M*S02S2Z     C=400              CONTAINS:     400 SECTORS.
FILE: 0000P26M*S02S2ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S02S3Z     C=800              CONTAINS:     800 SECTORS.
FILE: 0000P26M*S02S3ZC    C=80               CONTAINS:      80 SECTORS.
FILE: 0000P26M*S03M1Z     C=1400             CONTAINS:    1400 SECTORS.
FILE: 0000P26M*S03M1ZC    C=120              CONTAINS:     120 SECTORS.
FILE: 0000P26M*S03M2Z     C=3800             CONTAINS:    3800 SECTORS.
FILE: 0000P26M*S03M2ZC    C=240              CONTAINS:     240 SECTORS.
FILE: 0000P26M*S03S1Z     C=3000             CONTAINS:    3000 SECTORS.
                              ...
                              ...
                              ...
                              ...
                              ...
                              ...
                              ...
FILE: 0000P26M*S49M2Z     C=1000             CONTAINS:    1000 SECTORS.
FILE: 0000P26M*S49M2ZC    C=80               CONTAINS:      80 SECTORS.
FILE: 0000P26M*S50M2Z     C=1400             CONTAINS:    1400 SECTORS.
FILE: 0000P26M*S50M2ZC    C=80               CONTAINS:      80 SECTORS.
FILE: 0000P26M*S51M2Z     C=1000             CONTAINS:    1000 SECTORS.
FILE: 0000P26M*S51M2ZC    C=80               CONTAINS:      80 SECTORS.
FILE: 0000P26M*S52M2Z     C=800              CONTAINS:     800 SECTORS.
FILE: 0000P26M*S52M2ZC    C=40               CONTAINS:      40 SECTORS.
FILE: 0000P26M*S53M2Z     C=1400             CONTAINS:    1400 SECTORS.
FILE: 0000P26M*S53M2ZC    C=120              CONTAINS:     120 SECTORS.
FILE: 0000P26M*S54M2Z     C=3600             CONTAINS:    3600 SECTORS.
FILE: 0000P26M*S54M2ZC    C=240              CONTAINS:     240 SECTORS.
FILE: 0000P26M*S55M2Z     C=4200             CONTAINS:    4200 SECTORS.
FILE: 0000P26M*S55M2ZC    C=240              CONTAINS:     240 SECTORS.
FILE: 0000P26M*S56M2Z     C=3800             CONTAINS:    3800 SECTORS.
FILE: 0000P26M*S56M2ZC    C=240              CONTAINS:     240 SECTORS.

IN  196 FILES THERE WERE 137800 TOTAL SECTORS.
STOP
1$EOJ    (SUPPLIED BY COURTESY OF HARRIS)
0******JOB EXITED ON  7 FEB 86 17:13:21   ******
0******CPU TIME=       0MINS    0.97SECS  ******
0******CONNECT TIME=      0MINS    6SECS  ******
```

By reviewing the output above, the researcher can determine that the HECDSS data and catalog files for the Study require 137,800 sectors of disk space. This means that there is on the order of 750,000 sectors of space available for HEC-2 input and output as well as the other miscellaneous files associated with utility programs.

E. Checking For Successful Executions

As mentioned earlier, the large number of data files required a high degree of automation in JCL and data handling. Several methods are utilized to determine if the various jobs successfully complete execution. These methods are summarized below.

To verify the SETUP and HEC-2 executions, the Harris commands "LIST" and "FIND" are used. "LIST" followed by a large number will list the last twenty or so lines of the file. By listing the end of the output, the user can determine if the job successfully completed. The inclusion of the "$XT" command at the end of the JCL files for SETUP and HEC-2 allows the user to invoke the "FIND" command to find the $XT command in the output. If the user cannot find the $XT command, then the job has aborted before reaching conclusion and the user must investigate further to determine the problem or problems. For the HEC-2 jobs, it is also helpful to search for the occurrence of "ERROR". HEC-2 may stop processing a current job due to a data error and proceed to the following job. The only indication of this is a HEC-2 generated error message and no abortion. For data files containing many HEC-2 job executions, the use of the "FIND" command quickly uncovers any of these errors. Since many files have to be searched, it is usually convenient to generate the JCL to do this by invoking an editor. The JCL below exemplifies that which is needed to search HEC-2 output data files:

```
LI S02M1M00 1000000
FIND $XT
FIND ERROR
LI S02M1M01 1000000
FIND $XT
FIND ERROR
LI S02M1M02 1000000
FIND $XT
FIND ERROR
LI S02M1M03 1000000
FIND $XT
FIND ERROR
LI S02M1M04 1000000
FIND $XT
FIND ERROR
LI S02M1M05 1000000
FIND $XT
FIND ERROR
LI S02M1M06 1000000
FIND $XT
FIND ERROR
    ...
    ...
    ...
```

F. Useful Macros Associated With Archiving Data

As mentioned earlier, all manipulated HEC-2 data sets are archived to 6250 BPI magnetic tape. The macro KEEP1 provides the structure for archiving data, the macro FETCH1 provides the structure for retrieving data, and the macro VERIFY provides the structure for verifying data on a tape. Each macro must be edited to reflect the correct data files and/or tapes. There exists one file containing the verified HEC-2 manipulated data file names for every archive tape (identified as: "VEFHWii", where "ii" goes from 01 to 16). To retrieve a HEC-2 manipulated data file from tape, the user may determine the proper tape by invoking Harris JCL to "LIST" and "FIND" the data file names in the verified listings. The tape backup process is made simpler by the use of automatic load tapes --- the user need not manually feed the tape into the tape drive but need only to place the tape on the tape drive. A list of the above macros appear below. As shown below, the macros are included with batch (or control point job) JCL.

```
$JOB KEEP1 P26D RDC PRI=4 OUT=P26M*KEEP1O
RS,4=FHW15,WA,WR,6250BPI
$
$     MACRO KEEP1
$
-------------------------------------------------------------------
$    MACRO TO RESOURCE MAGNETIC TAPE AND POSITION TO ADD FILES AT END OF
$     CURRENT FILES.
$
-------------------------------------------------------------------
RW,4
GE TAPEOUT1 PR PW PD
AS,6=TAPEOUT1
VE.EL
BF,4,1
$                NOW KEEP DESIRED FILES
```

```
$JOB,FETCH,P26D,RDC,PRI=4,OUT=P26M*FETCHO
RS,4=FHWZ1,WA,6250BPI
$
$     MACRO FETCH1
$
------------------------------------------------------------------
$     FETCH A FILE OR FILES FROM FHWA ARCHIVE TAPE
$
------------------------------------------------------------------
$
RW,4
$
FE,P26M*S02M1Z=P26M*S02M1ZB
$
RW,4
FR,4
```

```
$JOB,VERIFY,P26D,RDC,PRI=9,OUT=P26M*VERIFYO
RS,4=FHW16,WA,6250BPI
$
$     MACRO VERIFY
$
-------------------------------------------------------------------
$     VERIFY A TAPE USED IN FHWA STUDY
$
-------------------------------------------------------------------
$
RW,4
AS,6=P26M*VEFHW16
VE.EL
RW,4
```

X. Data Magnitude

The regression model, as finally formulated, requires nearly 41,000 HEC-2 jobs. These require about 2.3 trillion bytes of input data. The computed profiles stored in HECDSS data files require about 140,000 sectors (47 million bytes) of disk space. The sixteen magnetic tapes archive over 800 sets of manipulated HEC-2 input data and two tapes contain the HECDSS data files in which the computed profiles are stored. One tape serves as a backup for the other.

The programs SETUP and HEC-2 require the majority of the CPU (central processing units) used for this job. The HEC-2 runs have a fairly high ratio of elapsed to CPU time (on the order of five and as high as twenty). In other words, one HEC-2 file containing ten jobs might require one minute of execution time but require clock times of from five minutes to twenty minutes. This is due to several factors including: (1) At least two HEC-2 jobs are running simultaneously, each competing for computer system resources, (2) the HECDSS data storage system requires fairly significant clock time to write data to a data file, (3) there is a certain amount of time required to terminate HEC-2, initiate the post-processor, terminate the post-processor, and then restart HEC-2, and (4) HEC-2 jobs are run at very low priority and compete at a disadvantage with other work done on the system.

The following example execution and elapse clock times are rough indicators of the relative times required by each segment of the analysis.

Location: S02M1
No. of Replicates: 3
Number of Cross-sections: 51

Job	Priority	CPU time	Elapsed time
SETUP	4	298	814
HEC-2	1	241	3124
DSSUTL	1	3	33
COMPER	1	5	26
INFO	1	80	462
MLRP	4	5	21

All elapsed and CPU times are in seconds. The execution of INFO deleted all records associated with S02M1 in the INFO data base which contains data for all locations, and then adds all records associated with S02M1. If the data base were nearly empty, the required CPU time would be significantly less. The execution of the Multiple Linear Regression Program analyzed the 900 observations which were used in the final analysis for spot elevations. For locations requiring more cross-sections and more replicates, the execution times for SETUP and HEC-2 increase significantly.

XI. Alternative Schemes

As a wrap-up, it is interesting to consider alternative methods of managing the data. The scheme described above worked well with the available computer hardware, software, and manpower. However, a change in the availability of any of these three resources could significantly effect the study management. For example, a delay in the delivery of the Center's Harris 1000 would have prevented the archiving of the manipulated data sets and greatly reduced the amount of disk space available for the Study. Under those circumstances, all manipulated HEC-2 data sets would be deleted at the conclusion of HEC-2 jobs. This would reduce the problem of disk space management and eliminate the effort required to archive data. It also would require more computer CPU time to regenerate HEC-2 data sets that initially failed in execution. If disk space were very tight, the HECDSS data files would be archived and then eliminated from disk space. In fact, if disk space were extremely tight, the HECDSS data base could be eliminated and the error computation done directly at the time each HEC-2 data set were executed.

Another scheme for manipulating data includes performing the functions of H2POST within HEC-2. The adopted method eliminated the need to modify HEC-2 source code for error analysis --- a big advantage. However, there would be some savings in CPU and elapsed time if it were included as a subroutine to HEC-2.

SETUP requires a significant amount of time to generate and format data for HEC-2. The formatting of data can be greatly reduced if there were some mechanism within HEC-2 to input geometry in a binary fashion or provisions to easily make HEC-2 a subroutine to SETUP. This would allow direct transfer of geometry from SETUP to HEC-2.

Some savings could be realized if a fixed format is adopted for the output of geometry from SETUP to the HEC-2 input data file. Currently, a lot of CPU time is spent generating FORTRAN format statements. The adoption of a standard format could also make it easier for the user to "read" manipulated data sets. However, there would be some sacrifice in reliability and accuracy.

If the HECDSS software were not available, errors could be input to INFO directly from a modified HEC-2 program or from the postprocessor H2POST. However, it would be very difficult to duplicate all of the tools the user has available to catalog, plot, and manage data. In fact, some software would have to be developed to manage the data and prevent duplication of profiles and associated errors. This could probably be accomplished with the INFO data base management system. However, INFO does not have the plot capabilities of the HECDSS system.

If the INFO data base management system were not available, Harris system utilities could perform some of the same functions. However, some additional software development would be required to manage the data. Harris utilities could sort and merge files, but could not perform the basic data input and output functions. The large size of the data base prevents the usage of personal computer based data management systems. Therefore, if INFO were not available (or some similar system), the needs of the study would have required additional, significant software development.

ACCURACY OF COMPUTED WATER
SURFACE PROFILES

Appendix D

Exhibit 1. Description of Program SETUP

A. Program Updates

The following is a summary of updates made to SETUP during the development and testing procedures. The original program was dated August 12, 1985.

December 10, 1985 - January 3, 1986

Several changes were made during this time --- the exact dates are unknown. The jobcard generated for executing HEC-2 was changed: (1) The disk file name was inserted as the job name (e.g. S02M1M03 would be a job name instead of the previous "FHWA"), (2) The "RQ" option was added so that HEC-2 jobs in the input queue or in execution at the time the Harris system crashes are requed as input. If the NC records contain a zero "0", then it is treated the same as a blank entry (previously, SETUP would assume a Manning's coefficient of zero if a zero was input). SETUP always sets field 1 of the J2 record to "+1" to suppress printout. The number of GR points was increased from 200 to 300 ordinates.

December 10, 1985

If the user requests original sections be kept in the adjusted HEC-2 input data decks, SETUP will enter an "IN" record in front of every X1 record in the input deck which is processed by the interpolation routine. Previously, the "IN" record was entered only in front of the first X1 record. The result was that only the first original section was kept.

December 5, 1985

The granule size for HEC-2 output data files was changed from the system default to 120 sectors.

December 4, 1985

Two user input commands were added: "PAck" to define the disk pack on which the adjusted HEC-2 input will be written, and "GRanule" to define the granule size of the adjusted HEC-2 input disk file.

December 3, 1985

One user input command was added: "PRiority" to define the Harris control point job priority which will be used for the execution of the HEC-2 adjusted input data files. The "N-pert" command was altered to recognize a range of index numbers. For example, the user may define indexes of 20 numbers from one through 20 by entering the command: "N,1-20".

December 2, 1985

A monitor common and associated backup disk file was generated to save the seed number for the random number generator.

November 27, 1985

The number of columns of input data read by SETUP was increased from 80 to 132. The number of free-format fields of input was increased from 20 to 62, and the maximum number of Manning's coefficient indexes input at one time was increased from 20 to 60.

November 26, 1985

The execution time option of "C" was added to force SETUP to use one random number for all adjustments of Manning's coefficients. To utilize it, the user enters: "P26P*SETUP.C" at execution time.

November 8, 1985

When generating topographic cross-sections, SETUP now writes the generated input to disk rather than maintain it in memory. There was also an error in the topographic cross-section generation routine that was corrected --- previously, the program was actually adjusting the base condition input data. The option for computing the starting water surface elevation in adjusted data sets was changed from using the results of the base condition (as stored in the HECDSS data file) to normal depth. The user may still use the elevation computed for the base condition by using the option "S" with the "EXecute" command.

August 27, 1985

Several minor changes and two major changes were made to SETUP. The major changes were: (1) The command "SDN-value" was added to allow the user to define the "A" and "B" parameters in the equation which determines adjusted Manning's coefficients; (2) The "ALTernative" command was activated to allow the user to differentiate analyses that would otherwise be identical in pathname specifications. The minor changes included: (1) Changing the "MEthod" command so that if "T" and "P" were both specified, they could either be separated by a blank, comma, or slash, or contain no separator at all; (2) Changing the "PErturbation" command so that if both "I" and "S" were specified, they could either be separated by a blank, comma, or slash, or contain no separator at all; (3) The number of HEC-2 input records generated by either to topographic generation subroutine or the cross-section spacing subroutine was increased from 4,000 records to 10,000 records; (4) H2POST no longer stores the cross-section number in the DSS data file (only cumulative distance and calculated water surface elevation are now stored); (5) Between August 12 and August 27, SETUP was taught to determine whether the program user is either Bauer, Burnham, or Carl, and submit all HEC-2 jobs with the sign-on users identification --- if some other user executed SETUP, the HEC-2 jobs would be submitted with the signon qualifier "P26D,RDC".

B. Purpose of program SETUP

The SETUP program performs the following general tasks:

- reads an HEC-2 actual data set
- reads user input specifications
- interpolates cross-sections (if necessary)
- adjusts elevations entered on GR records (survey accuracy)
- adjusts Manning's coefficients entered on NC records
- generates new HEC-2 input data sets with associated Job Control Language (JCL)
- submits a control point job that runs HEC-2 and a post-processor which reads FORTRAN unit 95 containing results from HEC-2 and writes a paired function formatted record to a DSS data file.

C. Procedure to execute SETUP

To execute program SETUP, enter the following:

P26P*SETUP

SETUP will respond with:

ENTER COMMAND>

The user will then enter appropriate commands as described later. SETUP may be run either in the "batch" or "interactive" mode. It utilizes the "PREAD" command allowing the use of macros and function characters as described in the documentation for "HECLIB" and "PREAD". The HEC-2 post-processor "H2POST" as well as program SETUP are linked to the HEC'S Water Control Software libraries (HECLIB is accessed as library "1000SYSS*HECLIB" and the Tektronix library is accessed as "1000SYSS*AG2LIB"). The ramifications of this are that DSS manipulations (reading and writing data to a DSS data file) are much quicker both in CPU time and elapsed time and that the user should use the DSS utility programs maintained in the Water Control Software area (qualifier "SYS"). For example, the user would use the following programs:

SYS*DSSUTL
SYS*DSPLAY

D. General Analysis Procedure

The general procedure for analyzing a given location (river reach) is the following:

1. Sanitize the actual HEC-2 data set. This is done prior to utilizing the SETUP program.

2. Establish the calculated water surface profile for the actual data set. This corresponds to the sanitized data set obtained from step 1 above. Commands for program SETUP are described in a later section of this document. However, for reference, an example SETUP execution is shown below.

   Location file name for actual data set: P26C*S01F3

   To establish profile for actual data set:

   ```
   P26P*SETUP
   SP,0          Spacing 0', actual input
   EL,0          Elevation 0', no elevation adjustment.
   N,0           N-value index 0, no Manning's coefficient
                 adjustment.
   ME,P          Use spot elevations (not contour).
   PE,S          Adjustment (Perturbation) method (moot
                 point here).
   SDN L         Parameters for Manning's coefficient
                 adjustment equation.
   EX.I S01F3    Submit control point job.
   FI            Terminate processing of SETUP.
   ```

3. Evaluate different adjustments --- cross-section spacing, elevations for survey accuracy, and Manning's coefficient adjustments. In general, the following commands should be entered first before the first "EXecute" command to explicitly establish all parameters:

   ```
   MEthod
   SPacing,.....
   ELevation,.....
   N-value,.....
   PErturbation,.....
   SDN-value,.....
   ```

Subsequently, all parameters remain the same until changed. For example, if the following input is supplied to SETUP:

```
ME,P
SP,4000
EL,10
N,0
PE I
SDN LMH
EX.I S01F3
ME,T
EX.I
SP.O-E
EX.I
N 1
FI
```

The result would be six HEC-2 jobs. All jobs would evaluate cross-section spacing at 4,000 feet, a survey accuracy of ten feet, and Manning's coefficients would not be adjusted except in the fourth through the sixth runs. The first job would use spot elevations (and adjust elevations based on that criteria), the second job would use topographic or contour elevations based on the "even" method of determining contour elevations, and the third job would use topographic or contour elevations based on the "non-even" method of determining contour elevations (option "-E"). The "even" and "non-even" method of determining contour elevations is discussed in conjunction with the "SPacing" command. Notice that once the location-i.d. is specified with the "EXecute" command, it need not be reentered unless it changes. The fourth through sixth runs are the same except that the Manning's coefficients are adjusted using different parameters in the adjustment equation.

4. Perform error analysis. This part of the analysis is currently not well defined. However, a HEC-2 postprocessor called "H2POST" stores computed results in a DSS file from which an error analysis will be made. The errors are then stored in one file for statistical analysis.

E. Description of DSS Pathname Part E for HEC-2 Results

The results from HEC-2 are written to a DSS data file. One DSS data file exists for each "location-i.d.". For a given location, parts A through C are the same. Part E is usually left blank. However, the user may differentiate results that would otherwise be identical by defining the "ALTernative" name. This would allow the user to compare results dependent only upon the random numbers used for adjusting elevations and Manning's coefficients.

F. Description of DSS Pathname Part D for HEC-2 Results

Part D would normally be blank. However, if the user specifies numeric parameters for the Manning's coefficient adjustment equation and if those parameters do not correspond with recognized parameters stored internally within SETUP, SETUP will store the parameters in part D of the DSS pathname. It is written as FORTRAN format (F6.4,1H-,F6.4) where the first parameter is "A" and the second parameter is "B" in the following equation:

$$SD=A+B*\ln(n)$$

where:

SD is the standard deviation for Manning's coefficient
A is the user defined parameter
B is the user defined parameter
ln(n) is the natural logarithm of the Manning's coefficient entered on an "NC" record in the HEC-2 input data.

The adjusted Manning's coefficient would then be calculated using the following equations:

$$ERRORN=K*SD$$

$$N\ ADJUSTED = e^{(\ln(n)+ERRORN)}$$

where:

ERRORN is the incremental adjustment.
SD is the standard deviation as computed above.
K is a normalized, random deviate.
ln(n) is the natural logarithm of the original Manning's coefficient value entered on an "NC" record.

SETUP contains (as of August 27, 1985) three sets of default parameters. These were subsequently changed. The correspond to an average error, a lower than average error, and a higher than average error. These parameters are entered using the "SDN-value" command and may be accessed by explicitly entering the parameters or by entering a character code as follows:

Case	Code	Parameter A	Parameter B
Low	L	.0000	.0000
Average	M	.2909	.0493
High	H	.5818	.0986

To adjust Manning's coefficients using all three sets of parameters, the user would enter:

SDN LMH

However, if the user wishes to explicitly define the parameters (.5 and .09 for example) the following would be entered:

SDN .05 .09

G. Description of DSS Pathname Part F for HEC-2 Results

The results from HEC-2 are written to a DSS data file. One DSS data file exists for each "location-i.d.". For a given location, parts A through C are the same. Part F contains the descriptors to differentiate between the user supplied options and parameters as described below. The column location refers to that within part F only and not the whole pathname.

Column(s)	Description
1-4	Indicates the cross-section spacing in feet, zero filled. For example, if the actual data were used, these columns would be filled with "0000".
5	The character "-".
6-7	The elevation (or survey accuracy) in feet. For topographic sections, indicates the contour interval. For example, if the survey accuracy is two feet, these columns would contain " 2".
8	The character "-".
9-10	The Manning's coefficient adjustment index. This is strictly an index except that a value of "0" (zero) indicates that the Manning's coefficients were not adjusted. It allows a comparison between Manning's coefficient adjustments due solely to the random component.
11	The character "-".
12	Cross-section indicator to identify the type of cross-section used: P For spot elevations. T For topographic or contour elevations.

Column(s)	Description
13	Indicator of the type of adjustment used:

- S — For simultaneous adjustments. The elevations and the Manning's coefficients will be adjusted simultaneously (both will be adjusted in one run of HEC-2).
- N — The Manning's coefficients only are adjusted (user specified "PE,I". If the Manning's coefficient index is set to "0" (zero), the Manning's coefficients are not adjusted although this character implies that they are.
- E — The elevation values only (not Manning's coefficients) are adjusted (user specified "PE,I". If the elevation value is set to "0" (zero), the elevations are not adjusted although this character implies that they are.
- blank — If this column is blank (or not included), it indicates that both the elevation adjustment and the Manning's coefficient index have been set to zero --- neither parameter is adjusted.

Column(s)	Description
14	Indicates if the original cross-sections have been retained in the HEC-2 input data deck.

- O — Original sections are retained.
- blank — If this column is blank (or not included), only the interpolated sections are retained in the HEC-2 input data.

Column(s)	Description
15	Indicates the method that was used to develop the cross-section from topographic (or contour mapping) information.

- X — Indicates that the "non-even" method of determining contour elevations was used.
- blank — If left blank (or not included in part F), indicates that the "even" method of determining contour elevations was used.

Column(s)	Description
16	Indicates the parameters used in the equation for adjusting Manning's coefficient.

- L   The parameters for the "lower" Manning's coefficient standard deviation were used. These parameters are stored internally within SETUP. See the discussion for Part D of the DSS pathname for more information.

- M   The parameters for the "average" Manning's coefficient standard deviation were used.

- H   The parameters for the "higher" Manning's coefficient standard deviation were used.

- U   The user input parameters that were not within the range of "lower", "average", or "higher" as internally defined by SETUP. SETUP will use the parameters as entered by the user and will store them in Part D of the DSS pathname.

H. Important file names

There will be many important files associated with these analyses. They include program files, input data files, output results, and DSS data files. The list below uses an example location identifier file named "S01F3" to describe the file names. The location-i.d. must be limited to a maximum of 5 characters. SETUP generates files in the same qualifier as the input data file.

Filename	Description
P26P*SETUP	Program that reads an actual HEC-2 data set and generates new data sets based on different adjustments and data manipulations.
P26P*H2POST	Program that reads FORTRAN unit 95 containing results from the HEC-2 runs and writes the results to a DSS data file in a "paired function" format; curve 1 is the cumulative river distance, curve 2 is the calculated water surface elevation, and curve 3 is the section number. H2POST writes this data to a DSS data file having the same name as the HEC-2 input data file with the addition of a "Z" appended to it. For example, if the HEC-2 actual data input file is named "P26C*S01F3", the DSS data file will be named "P26C*S01F3Z". H2POST is automatically executed by the JCL (job control language) that executes HEC-2.
P26C*S01F3	Actual HEC-2 input data deck for location "S01F3". The qualifier need not be "P26C" but may be any qualifier. The location-i.d. must be limited to a maximum of 5 characters.
P26C*S01F3I	The HEC-2 input data file for program INTSEC (actually subroutine XSINTP). This data file contains the actual HEC-2 input data set including the DF record for specifying the maximum allowable distance between cross-sections for interpolation purposes and the optional "IN" record which indicates that the original cross-sections must also be included with the interpolated sections. This file is re-written every time the HEC-2 spacing is changed.
P26C*S01F3B	The HEC-2 input data file containing interpolated cross-sections as inserted by program INTSEC. This file is re-written every time the HEC-2 spacing is changed.

Filename	Description
P26C*S01F3Mnn	The data file containing the HEC-2 input data set for a given "execute" command entered to program SETUP. The index "nn" is incremented every time the "EXecute" command is entered for this location. This file contains the JCL (job control language) required to execute HEC-2 and the HEC-2 post-processor H2POST, as well as all of the HEC-2 input data. These files can grow very large and the user must manually archive and then eliminate them or else the users disk limit will be exceeded. The job card entered in these files uses the sign-on qualifier "P26D,RDC" unless it recognizes the user as Burnham or Bauer, in which case, it will use the corresponding user signon.
P26C*S01F3Onn	The output file for the data contained in file "P26C*S01F3Mnn". It contains the HEC-2 output and the DSS messages from H2POST.
P26C*S01F3Z	The DSS data file containing all of the HEC-2 results for this location. It is stored as paired function formatted data; curve 1 is the cumulative river distance, curve 2 is the calculated water surface elevation. Previously, curve 3 was the cross-section number (field X1.1 of the HEC-2 input data file).

I. Use of FORTRAN input/output units by SETUP

SETUP requires many FORTRAN input/output units. Some are assigned using the HECLIB routine called "ASGN", others are temporarily assigned (if needed) using the Harris FORTRAN callable routine called "ASSIGN", and the DSS data file is assigned using the HECLIB routine called "ASSIGS". Below is a summary of the FORTRAN units used by SETUP.

Assignments for the entire duration of a SETUP run (assigned using ASGN):

Unit	Description
5	User input from terminal or in batch input stream.
6	Normal SETUP printout. Contains the file names of HEC-2 input and output files and the DSS data file. Also includes any error messages that might be generated.
9	Contains trace printout (currently very minimal).
30	Scratch disk unit; It is used if PREAD is invoked and in the subroutine XSINTP (program INTSEC, the cross-section interpolation program). PREAD may be disabled by setting the internal variable "LPREAD" to false, and recompiling and vulcanizing the program.
31	Function file for PREAD.
32	Macro file for PREAD.
34	Log file for PREAD. By default, no logging is performed.

Temporary assignments invoked only if needed and only as needed during the SETUP run (assigned using the Harris ASSIGN routine.

10 Actual HEC-2 input data set is read on this unit in subroutine RDACTU (unit is assigned and then closed). The actual HEC-2 data set is also written to this unit with the addition of the DF and optional IN records for processing by XSINTP (program INTSEC) in subroutine XINTSC. The input data for the interpolation program is written (unit 10 is assigned) to a permanent disk file named the same as the HEC-2 input data file with an "I" appended to it. For example:

HEC-2 input data file:	P26C*S01F3
Unit 10 is assigned to:	P26C*S01F3I

11 The new HEC-2 input data set containing interpolated cross-sections is written to this unit. It as assigned in subroutine XINTSC, written to in subroutine XSINTP which is called by XINTSC, and then that data is stored into memory in XINTSC and unit 11 is closed.

14 Scratch unit used in subroutine XSINTP (program INTSEC).

15 Scratch unit used in subroutine XSINTP (program INTSEC).

71 DSS data file containing results for the current location. It is assigned in subroutine GTWS1. Subroutine GTWS1 retrieves the calculated water surface elevation for the following condition:

Method: Point or Spot elevations	(ME P)
Spacing: Actual data cross-section spacing	(SP 0)
Elevation: Actual elevations	(EL 0)
N-VALUE adjustment index	(N 0)
Adjustment method: individual	(PE I)
Standard Deviation coeff.: average	(SDN M)

This elevation is used as the starting water surface elevation for all HEC-2 runs. Accordingly, the first execution of HEC-2 must be made for these specifications by itself before proceeding with additional adjustments.

95 Scratch unit used in subroutine XSINTP (program INTSEC).

J. List of SETUP input commands

The following text describes the available input commands.

1. FInish / QUit / STop / ENd

Terminate the execution of SETUP. This command will not automatically generate HEC-2 adjusted data sets if spacing / elevation / Manning's coefficient specifications have been entered. You must enter the EXecute command to generate the HEC-2 input.

2. ALternative, alternative

Specifies the alternative name to be used with the current data set. It is used in part E of the DSS pathname which identifies the paired function record containing results from the HEC-2 execution. This was implemented with the August 27, 1985 version of the program. The option would normally not be entered. It allows the user to differentiate results from HEC-2 runs that would otherwise be identified exactly the same (for instance, comparing results from adjusting elevations where only the random numbers changed).

3. BAtch

Tells SETUP that the user is executing in a "batch" (or control point job) environment or is currently running a macro. This is the default.

4. INteractive

Tells SETUP that the user is sitting at a terminal and entering data interactively. The "BAtch" command should be entered before invoking a macro.

5. DEfer mildate time

Define the date and time at which this HEC-2 job will be executed. Must specify the "D" option on the EXECUTE command. The date is entered as the military date and the time as a 24 hour clock time. For example, valid military dates are:

02AUG1985	Full military date.
2AUG85	Abbreviated date.
T	Special code, today's date.
2AUG	The 2nd of August of the current year.

Examples of valid times are:

1900	Submit job at 7 p.m.
19	Submit job at 7 p.m. The macro DEFER accepts times in this format.
2300	Submit job at 11 p.m.

6. ELevation, $i_1, i_2, i_3, \ldots\ldots i_n$

Define the elevation adjustment values (survey accuracy) for cross-sectional data. If topographic cross-sections are requested (MEthod,T), the values entered here will be used for the contour interval. If a value of "0" (zero) is entered, the elevations will not be adjusted and the topographic sections will simply be the actual cross-sections. The following elevations are currently considered valid.

Elevation	Standard Deviation Spot Elevations	Standard Deviation Contour Mapping
0	0.	.0
1	.15	.30
2	.30	.60
5	.60	1.5
10	1.5	3.0

An example user input is:

EL,0 1 2 5

SETUP would then generate at least four HEC-2 data sets (and probably more depending upon the other options entered). The first data set would be the actual input as supplied by a District or Division office. The second through fourth sets would contain adjusted elevation data. The amount of error added is a function of the elevation adjustment value (2 feet) and the resulting standard deviation (.30 for spot elevations).

7. EXecute.ICDWS, location-i.d.

Tells SETUP to generate an adjusted HEC-2 input data set. The user must have previously specified the appropriate conditions by entering the following commands and appropriate data:

SPacing	To generate interpolated cross-sections and/or use the actual data set.
ELevation	To indicate if elevations are to be adjusted and the survey accuracy (and contour interval for topographic mapping analysis).
N-value	To indicate the number of Manning's coefficient adjustments.
MEthod	To indicate the survey method (topo or spot elevations).
PErturbation	To indicate if elevations and Manning's coefficients are to be adjusted simultaneously or independently.

The parameter "location-i.d." indicates which data file (location) will be used. It must be limited to five characters or less. An example location-i.d. is "S01F3". It is separated from the command and options by a blank or comma.

The options tell SETUP when to execute the HEC-2 data set. Currently there are problems with using the "C" or "D" options. The allowable options are:

Option	Description
I	SETUP will generate the HEC-2 input data set and then immediately submit it as a control point job at priority 4 using the sign-on qualifier/user: "P26D,RDC".
W	SETUP will generate the HEC-2 input data set but will not submit it. The printout will indicate the file name in which the data set is stored (along with JCL) so that the user may later submit it as a control point job, cheap job, or defer job. It allows the user to edit the input file (so that JCL or input data may be changed). If a large number of adjustments are asked for, it may be unwieldy to edit the input file for it may contain in excess of 100,000 lines.
D	SETUP will generate the HEC-2 input data set and then submit it as a "deferred" control point (batch) execution. This currently does not properly work. The user must have entered the date and time using the "DEfer" command before invoking the "D" option on the "EXecute" command.
C	SETUP will generate the HEC-2 input data set and then submit it as a "cheap" control point (batch) execution. This currently does not properly work.
S	SETUP will set the parameters on the J1 record for HEC-2 to use the starting water surface calculated in the base condition as the starting elevation for all adjusted data sets. The results for the base condition are retrieved from the HECDSS data file, profile part F of: "0500- 0- 0-P L"

8. GEnerate,location-i.d.

Obsolete command. Used to generate the "base" data set (500 foot spacing of cross-sections). The base data set is now generated every time an EXecute command is entered, and is generated once for each cross-section spacing. The "base" data file is overwritten each time it is generated. For example, if the user enters: "SPACING,500,1000", SETUP will generate a "base" data set for 500 foot spacing, adjust the data and write it to unit 1, generated a "base" data set for 1000 foot spacing which will overwrite the 500 foot spacing data set, adjust the data and write it to unit 1.

Upon receiving the GEnerate command, SETUP reads the actual HEC-2 input data set for "location-i.d." (the five character file identifier such as "S01F3"), swaps the first set of T1-J1 records with the second set of T1-J1 records (second set of records is entered after the EJ record; the first set is for the 10 year frequency event, the second set is for the 100 year frequency event), writes the actual data set to unit 10 including the "DF" record which specifies the maximum allowable cross-section spacing for the interpolation routine, calls the interpolation subroutine (program INTSEC has been converted to a subroutine), and then reads the new HEC-2 data set from unit 11 (data set contains interpolated sections). The user must have previously entered the SPacing command to specify the maximum allowable spacing between cross-sections.

9. GRanule, size

Specifies the granule size with which to generate the disk files which will contain the adjusted HEC-2 input data. For many files, this is set from 500 to 2,000 sectors depending upon the size of the data. The default granule size on HEC's system is 40.

10. HElp (or ?)

Currently, SETUP will list all available commands. It is envisioned that sometime descriptive text for each command will be available. For example, the command "HELP,EXECUTE" would give a description of the "EXECUTE" command.

11. MEthod, TP

Tells SETUP which survey method to utilize. A "T" and/or a "P" may be entered. If both T and P are entered, they may either be concatenated or separated by either a blank, comma, or slash.

Character	Description
T	The topographic (or contour mapping) method of surveying will be used. SETUP will take all cross-sections and generate new ones based on the contour interval entered with the ELevation command. For an ELevation of "0" (zero), SETUP will use the actual data set elevation values. The minimum cross-section elevation will be taken as the first contour interval (even though it will not be an integral elevation). Subsequent contour elevations will either be the integral elevation adjustment distance from the minimum elevation (termed "non-even" contour interval) or at even, integral elevation adjustment distances (termed "even" contour spacing). For example, if 10 foot contour intervals are used and the minimum section elevation is 426.5, a new section using the "non-even" method will be generated with coordinates at elevations 426.5, 436.5, 446.5, 456.5, ... etc. up to the maximum section elevation. If using the "even" method, the contour elevations would be: 426.5, 430, 440, 450, ... etc. up to the maximum section elevation. The method is chosen with an option on the "SPacing" command. The option "E" selects the "even" method whereas the option "-E" selects the "non-even" method. When the elevations are adjusted, the standard deviations associated with the elevations entered with the ELevation command and topographic mapping will be used to determine the elevation error.
P	The spot elevation (such as aerial mapping) method of surveying will be used. SETUP will take the cross-sections and adjust elevations using the standard deviations associated with the elevations entered with the ELevation command and the spot elevation mapping.

12. N-pert,i_1,i_2,i_3,......i_n

May be entered as: "N 0 1 2 3 ....". Specifies the Manning's coefficient adjustment index. If "0" is entered, then the Manning's coefficients are not adjusted. Any non-zero entry is used as an index in part "F" of the DSS pathname part used in identifying the HEC-2 results.

13. PAck, number

Specifies the disk pack on which the adjusted HEC-2 input data files will be generated. HEC's system has four disk packs. At the time of the study, disk pack one usually had the most unused space. Only one number is entered for each "EXecute" command.

14. PErturbation,SI

Specifies how the adjustment of elevations and Manning's coefficients are performed.

Parameter	Description
S	Adjust the elevation and Manning's coefficients simultaneously. The HEC-2 input data set will contain both adjusted elevations as well as adjusted Manning's coefficients.
I	Adjust both the elevation and Manning's coefficients but do them independently. SETUP will generate two input data decks, one containing adjusted elevations and the other containing adjusted Manning's coefficients.

Both the parameters "S" and "I" may be input---at least one must be input. If both parameters are input, they may either be concatenated or separated by either a blank, comma, or slash. For example:

```
PE,SI
PE S I
```

15. PRiority, number

Specifies the priority at which adjusted HEC-2 input data sets are run. On the Harris, this number may be from zero to fifteen. The higher the number, the higher the priority and the more expensive the run. It is recommended that either a zero or a one should normally be used except for small jobs. Example entry is:

```
PR,1
```

16. SDN-value,LMH or A_i,B_i,A_{i+1},B_{i+1},.....

This allows the user to define the parameters used to adjust the Manning's coefficients. By default, SETUP will only adjust Manning's coefficients using the "average" or "mean" parameters. The user may specify the parameters either by entering character(s) corresponding to three sets of parameters ("L" for lower, "M" for mean, or "H" for higher), or by explicitly entering the parameters. Parameters must be entered in pairs --- both "A" and "B" must be entered. SETUP generates one run for each pair of parameters. The results are identified in the DSS file by column 16 of Part F and possibly Part E for non-standard parameters. SETUP adjusts Manning's coefficients by processing the following equations:

$$SD=A+B*\ln(n)$$

where:

SD is the standard deviation for "n"
A is the user defined parameter
B is the user defined parameter
ln(n) is the natural logarithm of the Manning's coefficient entered on an "NC" record in the HEC-2 input data.

The adjusted Manning's coefficient would then be calculated using the following equations:

$$ERRORN=K*SD$$

$$N\ ADJUSTED = e^{(\ln(n)+ERRORN)}$$

where:

ERRORN is the incremental adjustment.
SD is the standard deviation as computed above.
K is a normalized, random deviate.
ln(n) is the natural logarithm of the original Manning's coefficient value entered on an "NC" record.

SETUP contains (as of August 27, 1985) three sets of default parameters. These were subsequently changed. They correspond to an average error, a lower than average error, and a higher than average error. These parameters are entered using the "SDN-value" command and may be accessed by explicitly entering the parameters or by entering a character code as follows:

Case	Code	Parameter A	Parameter B
Low	L	.0000	.0000
Average	M	.2909	.0493
High	H	.5818	.0986

To adjust Manning's coefficients using all three sets of internally defined parameters, the user would enter:

SDN LMH

However, if the user wishes to explicitly define the parameters (.5 and .09 for example) the following would be entered:

SDN .05 .09

Multiple parameters may be entered as follows:

SDN .5 .09 .4 .07 .6 .11

Three runs would be made as follows:

Run	Parameter A	Parameter B
1	.50	.09
2	.40	.07
3	.60	.11

17. SPacing.OTGE, $i_1, i_2, i_3, \ldots . i_n$

Define the cross-section spacing to generate HEC-2 input data sets containing interpolated cross-sections. The entries "i_n" may be any integer. If "0" (zero) is entered, the HEC-2 actual data spacing is used (no interpolated cross-sections are inserted). An example entry is:

SP.OE 0,500 1000 2000 4000

SETUP would generate data sets containing cross-sections spaced a maximum of 500, 1000, 2000, and 4000 feet apart as well as one with the actual data set spacing. All data sets will include the original cross-sections (option"O"). If topographic sections will be developed (MEthod,T), the "even" method of determining contour elevations is used (see the MEthod command description).

The following options apply:

Option	Description
O	Include the original cross-sections with the interpolated cross-sections. If only the interpolated sections are to be included, enter the option: "-O".
T	Tabulate the cross-sections both before and after determining a new topographic cross-section (ME,T must be entered).
G	Plot the cross-sections both before and after determining a new topographic cross-section (ME,T must be entered). The user must have a Tektronix 4014 emulation terminal).
E	If generating topographic cross-sections, use the "even" method of determining contour intervals (see the MEthod command description). If the "non-even" method of determining contour elevations is used, enter the option: "-E".