SEDIMENTATION IN STREAM NETWORKS (HEC-6T)

Flume Problem Workbook

January 3, 2002

A Generalized Computer Program
of
MBH Software, Inc.

Copyright

Disclaimer

Distribution Policy

MBH Software, Inc.
465 East Northside Drive
P.O. Box 264
Clinton, MS 39060-0264

(601)925-4092
FAX: (601)925-4093
mbh2o@aol.com

TABLE OF CONTENTS

WORKSHOP PROBLEM

CHAPTER 1. GETTING STARTED

Introduction

HEC-6T is a one dimensional sedimentation model which includes the hydrologic processes of erosion, entrainment, compaction, transportation, and deposition of sediment. Computational modeling of sedimentation is the technology of using the computer to simulate these physical processes. HEC-6T can provide sufficient detail to assist engineers in making decisions about the impact of sedimentation and stream system morphology.

A model such as HEC-6T is not an expert system. It is to aid a person who is trained in river mechanics. It takes the drudgery out of computational details and allows the engineer to focus on understanding the project and the river system.

Certain data requirements must be filled so that HEC-6T will run efficiently and effectively. These data requirements are grouped into three types: geometric data, sedimentary data and hydrologic data. They are always placed in that sequence in the input file.

The input file contains the following data:

Geometric data set:

1. model network structure
2. the initial cross sections of the model
3. the hydraulic roughness value
4. the size of the bed sediment reservoir

Sedimentary data set:

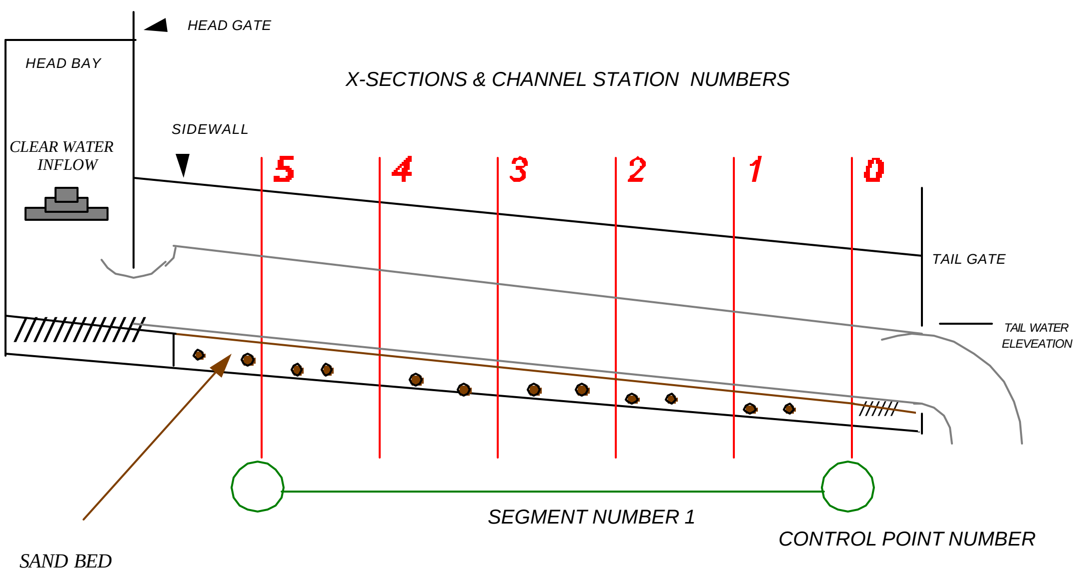
1. the number of size classes of sediment in the model
2. the specific weight of the sediment deposit
3. the gradation of the bed sediment reservoir
4. the selection of the transport function
5. the water sediment discharge rating curves for all inflow points around the model

Hydrologic data set:

1. the water discharge histogram
2. the tailwater elevation (Base Level)
3. the water temperature
4. the computation time step
5. program commands

Problem

The following example is a data set that represents a model of a simple flume. Below is a sketch of what the physical model of this flume would look like from a side view. Notice the 6 vertical lines. These are the cross sections and station numbers of the flume. The flume has a single inflow at Control Point 2 and a single outflow at Control Point 1. The flume sketch shows these control points as circles. Notice that the circles are connected by a line that runs the length of the flume. This is called a "Segment." A segment is comprised of a group of cross sections. In this example, a sand mixture has been placed in the bed of this flume. The sketch shows clean water coming from the head bay. This flume will have a single gate across its entire width to insure that the inflowing water is distributed uniformly from one wall to the other. The tailwater elevation will be at normal depth. Since there is no bed material in the inflowing water, one expects erosion to take place as water flows along this flume.



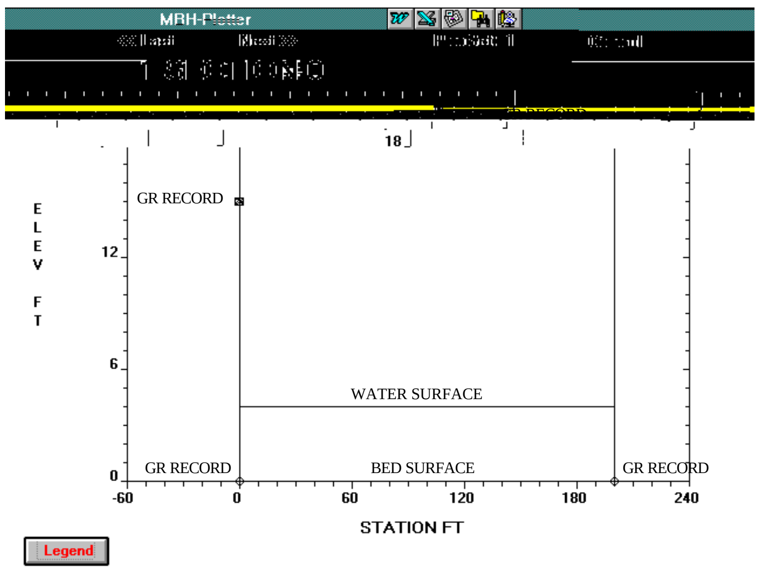
FLUME

Developing the HEC-6T Data File

Now that the physical parameters of our flume have been explained, we can construct what is called a .T5 file for HEC-6T to execute. The .T5 file is all the raw data collected and put in a format the computer can read. The .T5 file looks like this:

```
T1      FLUME TEST
T2      HEC-6T  VERSION 4.00.   4 MARCH 1994,   WA THOMAS
T3
NC  .150    .150    .025
X1     0       6     -.1   200.1       0       0       0
X3    10
GR    10      -1      10     -.1       0       0       0     200      10   200.1
GR    10     201
H      0
X1   100                             100     100     100             .1
X3    10
H    100
X1   200                             100     100     100             .1
X3    10
H    200
PX           100                                   3    .001     100     100     100
EJ
T4      SEDIMENT DATA FOR FLUME TEST
T5      BED GRADATION ARE HYPOTHETICAL
T6      NO SEDIMENT INFLOW
T7
T8
I1            10
I4             4       1      11
LQ     Q      10  30000.
LTLTOTAL
LF   VFS
LF    FS
LF    MS
LF    CS
LF   VCS
LF   VFG
LF    FG
LF    MG
LF    CG
LF   VCG
LF    SC
PF                   1.0   128.0    64.0    36.0    32.0    31.0    16.0    28.0
PFC  8.0    27.0     4.0    25.0     2.0    24.0     1.0    19.0     .50    16.0
PFC .250    15.0    .125    13.0
$HYD
*   AB  RUN 1
Q   2000
R      4
T    45.
W    .1
$PLOTP  TITLE="EXAMPLE 1"  8,9,16
$$END
```

The following graph is a digital representation of Cross Section 0 of the flume as it is encoded in the .T5 file. Certain parts have been labeled for easier identification.



The following table groups records by purpose and annotates the different elements of the input data file.

Table 1-1. Description of Input Records

Input Records	Description
T1 FLUME TEST T2 HEC-6T VERSION 4.00. 4 MARCH 1994, WA THOMAS T3	Title records that describe the contents of this .T5 file.
NC .150 .150 .025	Friction Coefficient
X1 0 6 -.1 200.1 0 0 0 X3 10 GR 10 -1 10 -.1 0 0 0 200 10 200.1 GR 10 201 H 0	The first cross section in the model. This is at channel station 0 - coded on X1. The cross sectio is on GR-Records. X3 requests ineffective area. The bed sediment reservoir i coded on H-Record.
X1 100 100 100 100 X3 10 H 100	Reuse GR-Records fro previous cross section.
X1 200 100 100 100 .1 X3 10 H 200	ditto
PX 100 3 .001 100 100 100	Template for extending the model in the upstream direction.
EJ	End of Geometric dat
T4 SEDIMENT DATA FOR FLUME TEST T5 BED GRADATION ARE HYPOTHETICAL T6 NO SEDIMENT INFLOW T7 T8	Title records for th sedimentary data set
I1 10 I4 4 1 11	Sediment and model parameters
LQ Q 10 30000. LTLTOTAL LF VFS LF FS LF MS LF CS LF VCS LF VFG LF FG LF MG LF CG LF VCG LF SC	Inflowing water sediment mixture in the water column. (Zero in this case) The LF-Records partition the inflow into fractions by size class.
PF 1.0 128.0 64.0 36.0 32.0 31.0 16.0 28.0	Sediment gradation i the bed sediment reservoir
PFC 8.0 27.0 4.0 25.0 2.0 24.0 1.0 19.0 .50 16.0	
PFC .250 15.0 .125 13.0	

Input Records	Description
$HYD	Hydrologic data set begins.
* AB RUN 1 Q 2000 R 4 T 45. W .1	These records describe the Hydrologic Boundary Conditions. Q - the water discharge in cfs. R - tailwater elevation T - water temperature. W - computation time step in days.
* Q W	After the first event code only *,Q,W until the water temperature or downstream elevation changes.
$PLOTP TITLE="EXAMPLE 1" 8,9,16	Plot parameters: Bed, Water Surface and Cross Section in this Example.
$$END	END OF RUN

Execution

To execute the program, type H6. The program will scroll through information about geometry and water discharges. The bottom of the screen shows 0 fatal data errors detected and 2 information errors detected, followed by END OF JOB and the RUN labels. This shows that the execution has come to a normal termination. The screen will look similar to this.

```
READING INPUT DATA FROM file_name                = VIDEO.T5
END OF GEOMETRIC DATA FOR SEGMENT NO.   1
EVENT     1 WSP#     1 RUN 1

WRITE THE FOLLOWING VALUES TO DSS.
  8.  WATER SURFACE ELEVATION
  9.  BED SURFACE ELEVATION
 16.  X-SECTION WITH WS ELEV
PRINTOUT WRITTEN TO file_name                   = VIDEO.T6
END OF RUN GEOMETRY WRITTEN TO file_name  = VIDEO.T12
PLOT FILE WRITTEN TO file_name                  = VIDEO.T98

    0 FATAL DATA ERRORS DETECTED.
    2 INFORMATION MESSAGES DETECTED.

END OF JOB
END OF RUN
```

Printout

Printout is written as the data file is read. This makes it possible to locate errors in the data by searching to the end of the printout file. Printout can be inspected with LIST.

To enter the printout file type LIST and VIDEO.T6.

Use the arrow keys to navigate through the printout file if there are long lines. If additional help is needed, turn the Help screen on by using the QUESTION MARK key on the computer keyboard. Press the QUESTION MARK key again to turn the Help screen off.

The first image of the printout file is the time and date followed by the HEC-6T banner. The banner shows the program name, version number and dates. Just below the banner is a description of the program dimensions. This is to verify that the problem has fit in terms of the number of cross sections and control points.

```
23:15:12.49     06/28/95
*************************************************************
*          SEDIMENTATION IN STREAM NETWORKS (HEC-6T)
*                             BY
*                     William A. Thomas
*
*
*
* VERSION 4.00                                JUNE 15, 1994
*     MOD  .32                                JUNE 25, 1995
*
* MOBILE BOUNDARY HYDRAULICS       William A. Thomas, Owner
* 425 RIDGEWOOD DRIVE                TELEPHONE 601-634-9543
* VICKSBURG, MISSISSIPPI 39180             FAX 601-634-8004
*
*
* COPYRIGHT PENDING,  ALL RIGHTS RESERVED.
************************************************************



************************************************************
* Disclaimer:
* This computer program was written for use by engineers
* and scientist who are competent in the field of Sedimen-
* tation Engineering.  It provides a framework for perform-
* ing Sedimentation Studies.
*
*
* This Program and Documentation are provided "AS IS," with-
* out warranty of any kind, either express or implied.  All
* warranties of any type respecting this program and/or the
* documentation are hereby disclaimed by the author.
*
*                                          William A. Thomas
************************************************************
```

```
THIS PROGRAM IS DIMENSIONED FOR:
 MAXIMUM NUMBER OF CROSS SECTIONS                      =   250
 MAXIMUM NUMBER OF CONTROL POINTS                      =    31
 MAXIMUM NUMBER OF SEGMENTS                            =    30
 MAXIMUM NUMBER OF SEGMENTS JOINING A CONTROL POINT    =     3
 MAXIMUM NUMBER OF LOCAL INFLOW POINTS PER SEGMENT     =    10
 MAXIMUM NUMBER OF CROSS SECTION (STA,ELEV) POINTS     =   100
 MAXIMUM NUMBER OF GRAIN SIZES                         =    20


 TABLE GEO-1.  GEOMETRIC MODEL.
 T1      FLUME TEST
 T2      HEC-6T  VERSION 4.00.   4 MARCH 1994,   WA THOMAS
 T3
```

After entering the output file go immediately to the end by pressing the END key on the keyboard. It shows the normal termination labels.

```
0 FATAL DATA ERRORS DETECTED.
1 INFORMATION MESSAGES DETECTED.


 TOTAL NO. OF EVENTS READ=       1
 TOTAL NO. OF WS PROFILES=       1
 ITERATIONS IN EXNER EQ  =      60


 END OF JOB
 23:15:12.98     06/28/95
```

These are signs of normal termination. If there is other type of information at the bottom of the printout file, it is a sign the program has not come to a normal termination.

Press the PAGE UP key and view the table referred to as table SB-2 (See copy below). This table is entitled

"SEGMENT 1 STATUS OF THE BED PROFILE AT TIME = 0.100 days."

The SB-2 Table presents the result of the sedimentation calculation. It shows the cross sections and how much deposition has been calculated at that cross section. The negative sign indicates erosion and the positive sign indicates deposition. It shows the water surface profile elevation, the thalweg elevation, the water discharge, and the calculated sand discharge passing each cross section.

For example, this SB-2 table shows that during this event 75 tons of sediment has passed across section number 500.

TABLE SB-2: SEGMENT 1 STATUS OF THE BED PROFILE AT TIME = 0.100 DAYS

SECTION ID NO	BED CHANGE	WS ELEV FEET	THALWEG FEET	Q CFS	SEDIMENT LOAD IN TONS/DAY SAND
500.000	-0.02	4.15	0.48	2000.	76.
400.000	0.00	4.12	0.40	2000.	103.
300.000	0.00	4.09	0.30	2000.	107.
200.000	0.00	4.05	0.20	2000.	106.
100.000	0.00	4.03	0.10	2000.	102.
0.000	0.00	4.00	0.00	2000.	97.

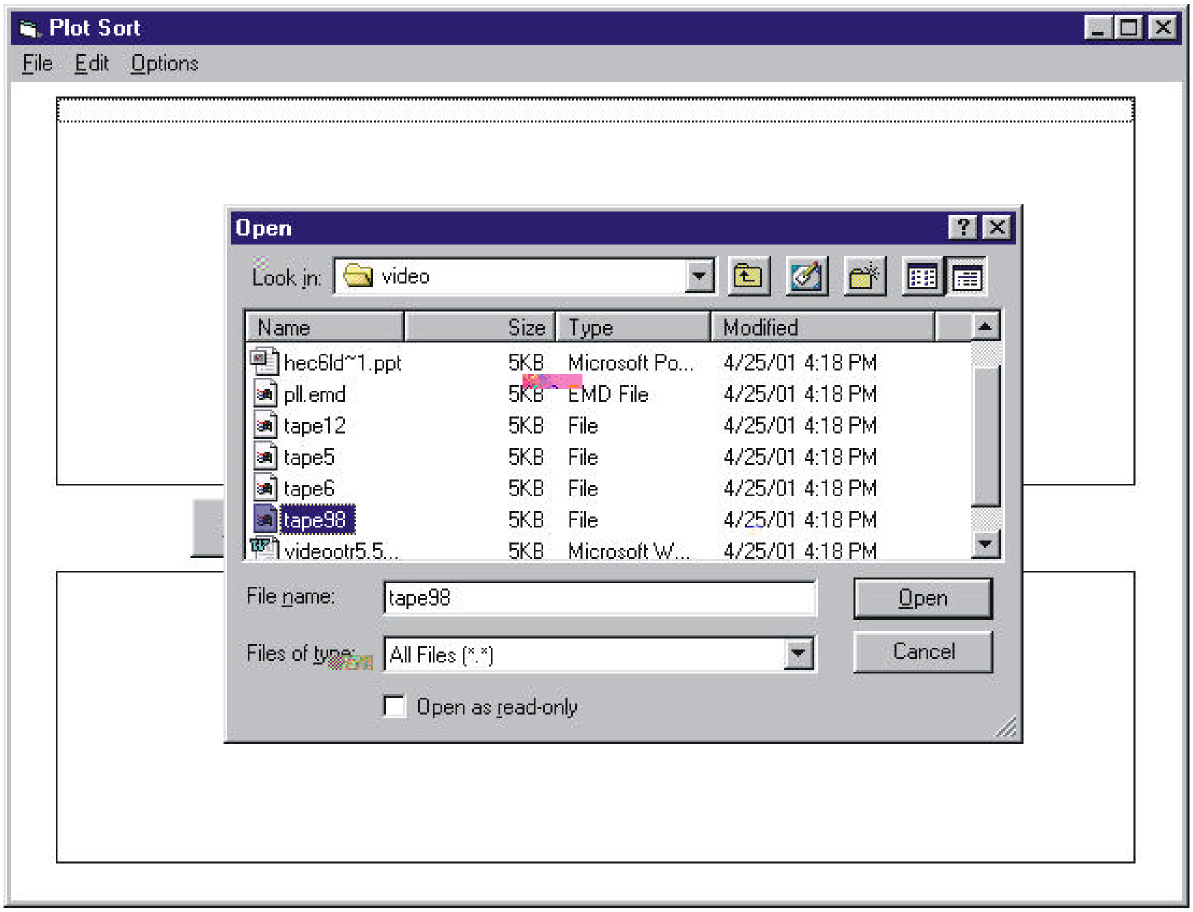
TABLE SC-1. NETWORK SEGMENT NO 1
FLUME TEST
ACCUMULATED WATER DISCHARGE FROM DAY ZERO (ACRE FEET)

There are 0 tons per day of sand coming into this numerical model of the flume, and at cross section 500 there are 75 t/d of sand being transported. This means that sediment comes from the stream bed and shows -0.02 feet of change. The negative sign means the bed has eroded. The SB-2 table is the result of all the hydraulic and sedimentation computations for one event in the histogram.

MBH Plotter

To plot, leave DOS and activate the WINDOWS program. Double click on the MBH GRAPHICS icon and the MBH PLOTTER program will be activated.

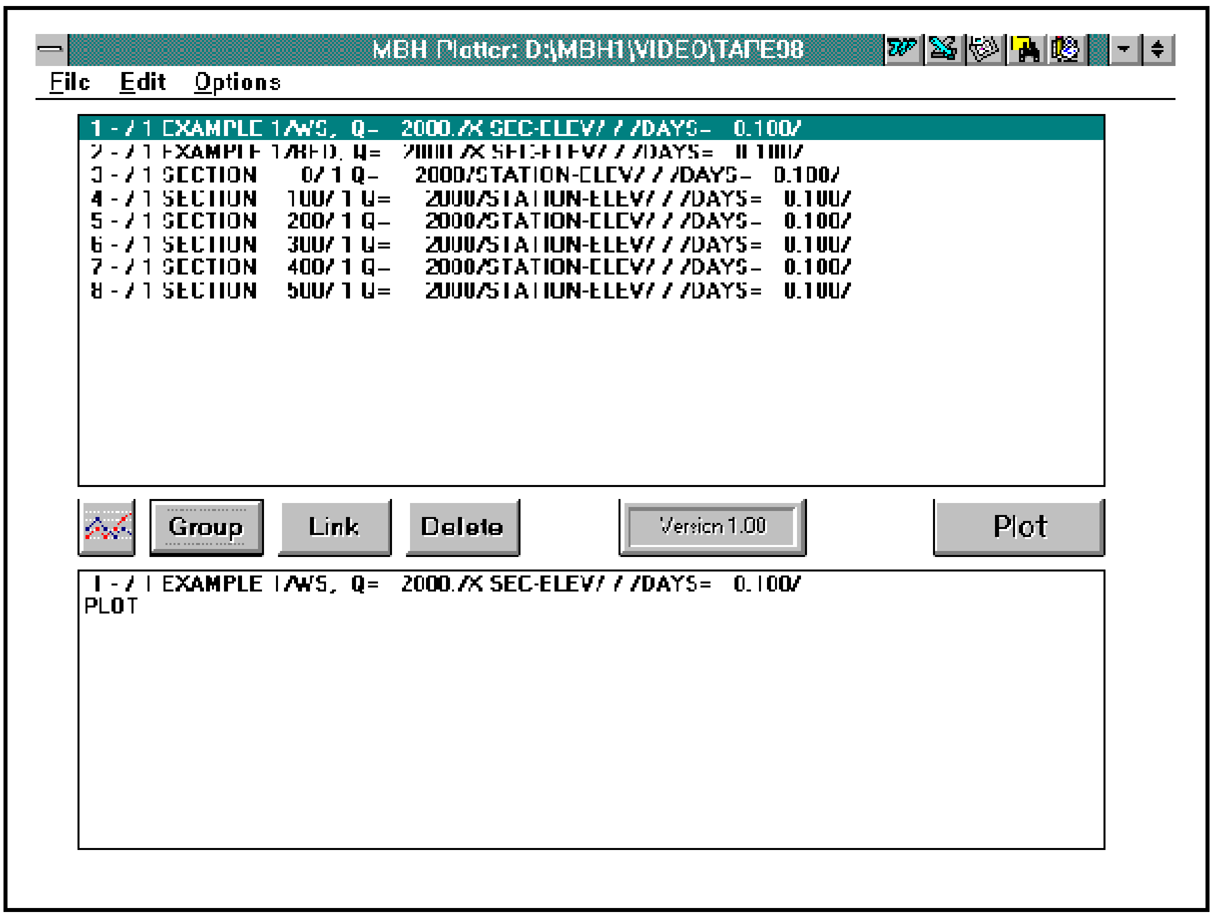
The first screen to appear is **Plot Sort**. It shows three options, FILE, Edit, and Options. To attach the plot file, click on FILE followed by menu item, OPEN. The plot file in this example is entitled **"tape98"** and is located in the video directory. It can be attached by clicking OK .



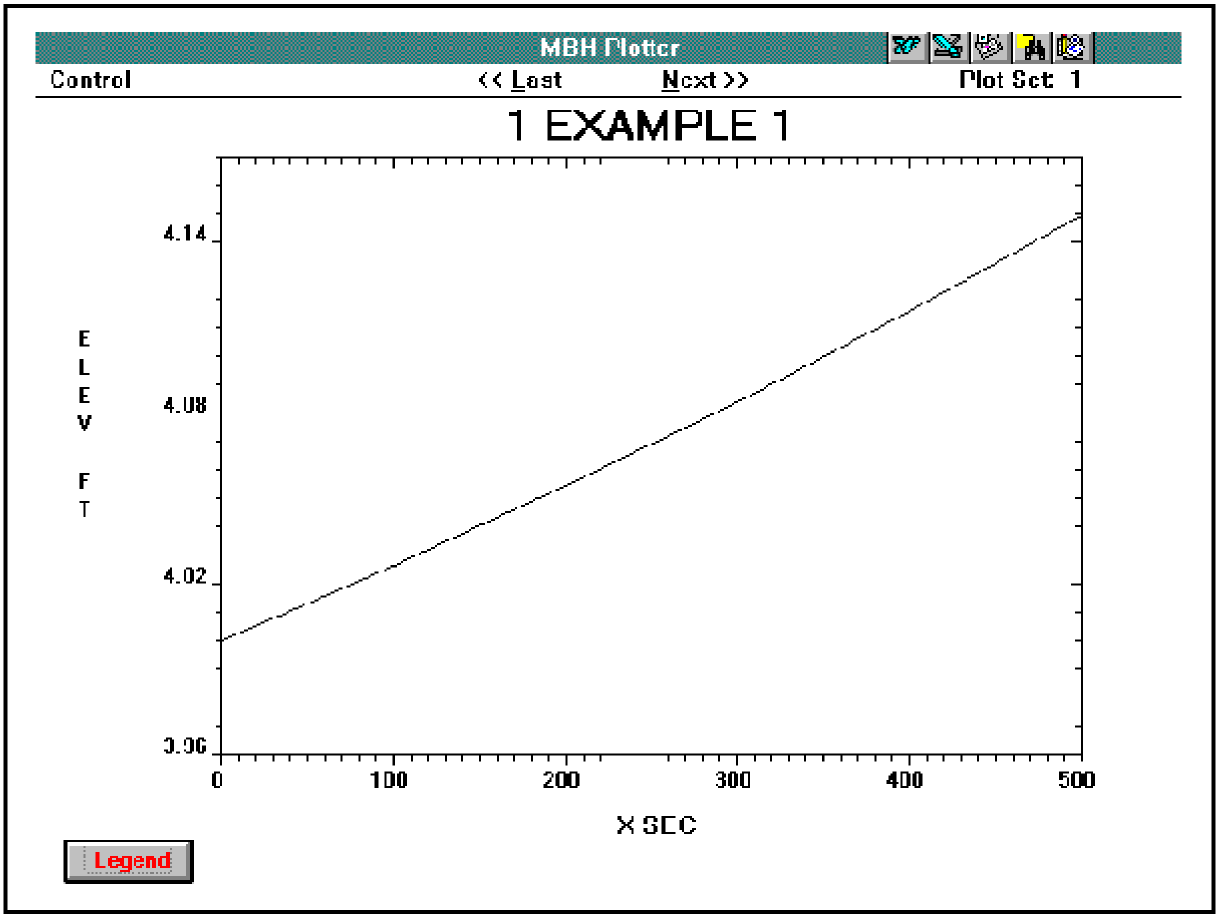
The MBH graphics program will display, in a list box at the top of the screen, the DSS header records for the plots in this file. It is illustrated in the following figure. Each header record is a plot frame. These are numbered 1 - 8 in this example. To view all graphs, click on the PLOT button. Plot number 1 will appear.

At the top of the Plotter screen there are two options, Last and Next. Click on NEXT and the next plot frame will appear, etc.

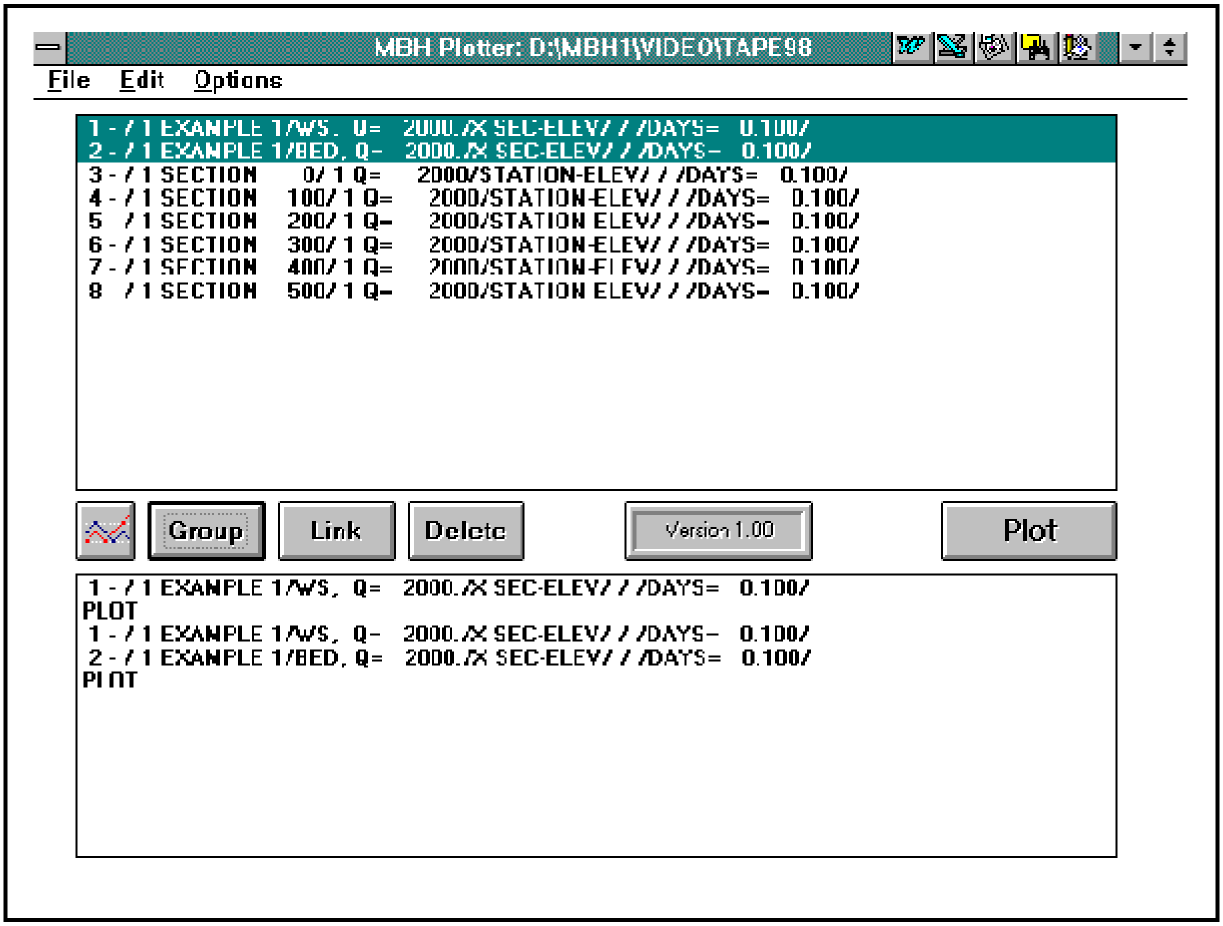
To select certain plots, delete all plots in the bottom window. Then click on the record in the top window for the desired plot followed by the GROUP button. For example, a graph of the water surface can be plotted by highlighting the DSS header and then clicking the GROUP command button. The 1 EXAMPLE 1/WS, Q header record will be written into plot list box at the bottom of the window. Click on the PLOT button to view the water surface profile.



The plot of Flume Test is the following water surface profile. It has cross sections along the abscissa and elevation on the ordinate. To select other graphs, click on Control and then Close. The DSS plot frames will appear again.

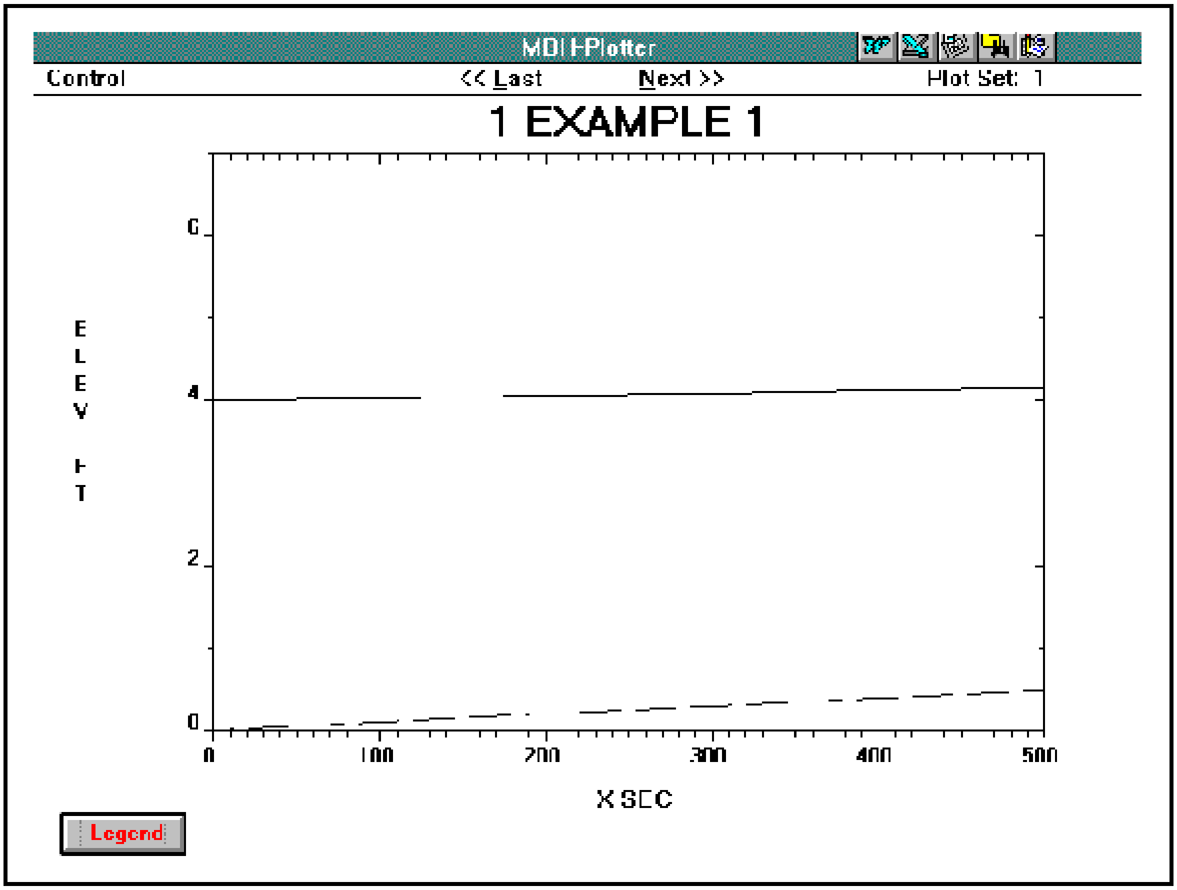


The Bed Surface can be included in this plot. Leave the Water Surface frame highlighted. Hold down the CTRL key and click on the BED header record. While both header records are highlighted, click the GROUP command button. Both records will be added to the plot list box at the bottom of the window. Click the PLOT button and the first plot, the water surface profile, will appear once again.

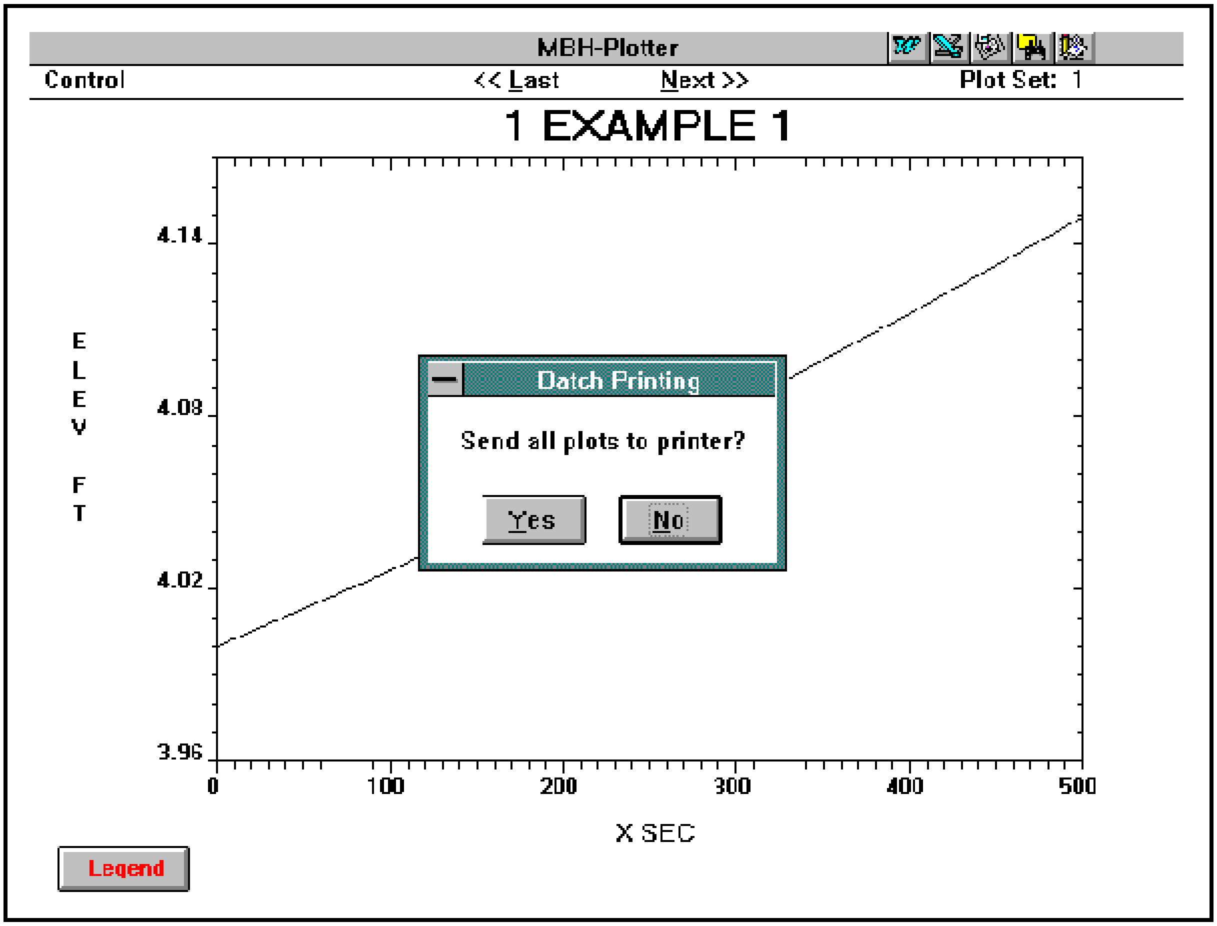


Click the NEXT button and the Water Surface - Bed Surface graph will appear. The water surface is a solid line and the bed surface is a dashed line. Click the LEGEND button to display the legend on the screen.

Up to five graphs, one base and four overplots, can be plotted per plot frame.



To obtain a hard copy of the graphs click on the PRINT menu button at the top of the screen. To print all of the frames click on BATCH. The program will ask, Send All Plots to the Printer? Click YES and all frames will be plotted. To plot a single frame click on THIS FRAME.



CHAPTER 2. MODELING A BRIDGE SITE WITH HEC-6T[1]

Introduction

The segment of river selected for this problem is the West Fork of the San Juan River (UPPER). It is also called the Bridge Site. This site has a drainage area of 50.5 square miles and a bank full discharge of 650 cfs. The channel slope is about 2 percent. Sediment size varies from sand to boulders.

Making a Sediment Study

Summary of Tasks. The problem is organized according to the following Summary of Tasks for making a sediment study.

1. Assemble available data from office files *(maps, cross sections, suspended sediment measurements, bed load data, bed material measurements, soil types/sediment yield, hydrographs, water temperature, observed water surface profiles, reservoirs in the basin, construction activities)*

2. Develop geometric data set and run a steady state water discharge *(using a 2-year peak discharge to identify trouble spots)*

3. Make a reconnaissance trip through the study area *(to identify locations of bank instability, bed instability, features that will aid in establishing n-values of the bed, banks and overbanks, giving particular attention to locations appearing to be trouble spots);* Document the observations with photographs and prepare a report of the findings

4. Calibrate n-values

5. Develop the sedimentary data set

6. Calibrate the model

7. Run Base Test *(The No Action Condition)*

8. Run Plan Test

9. Analyze Results *(Compare the results of the Plan Test with those from the Base Test to evaluate the impact of sedimentation on the plan, the impact of the plan on stream system morphology, the cost effectiveness of the plan, and the reliability of the plan during extreme events)* Continue running plans until all have been tested

10. Select the Recommended Plan and perform a sensitivity analysis by changing boundary condition values

General Concepts. Computational modeling is the formal process of assembling data which provides the geometry of a study reach at two points in time and which provides the inflowing water discharge, the inflowing sediment load and the downstream stages between those two points in time. The model is "calibrated" by running the

---

[1] Data furnished by Dave Rosgen, Wildland Hydrology, Pagosa Springs, CO 81147, 970-264-7100.

hydrologic/sediment boundary conditions between two sets of measured cross sections. Sediment inflow, the sediment transport function, and n-values are adjusted, within reason, until calculated changes match those in the prototype. Important parameters to observe are cross sectional areas, water surface elevations, water velocities, and sediment delivery. **Calibration** is the process of adjusting model parameters until the calculated values agree with the measured data.

An alternative to computational modeling is **Computational analysis.** Computational analysis is the application of, perhaps, the same computer program to a problem in which model calibration is not possible. Perhaps there is only one survey of the river. Perhaps boundary condition data are not available. Perhaps the river is so highly disturbed that computational modeling is not possible. Whatever the case, computational analysis allows the engineer to use the latest technology in mobile boundary computations as an aid for decision making. The list of tasks is the same for both studies.

Step 1

This chapter presents Step 1 from the Summary of Tasks: "Assemble available data from office files (maps, cross sections, suspended sediment measurements, bed load data, bed material measurements, soil types/sediment yield, hydrographs, water temperature, observed water surface profiles, reservoirs in the basin, construction activities.)"

Study Area

Figure 2-1 shows Plan and Profile views of the study area. Four cross sections were measured. These are plotted on **Figures 2-2A** through **2D**.

> The circles on these figures mark subsection boundaries. There are five subsections: left overbank, left bank of the channel, channel bed, right bank of the channel, and right overbank.
>
> The asterisks mark left and right sides of the bed sediment reservoir, and the squares mark erosion limits. Note that sediment can deposit over the entire cross section, but erosion is limited to the channel bed.
>
> The triangles mark the left and right conveyance limits. There was no reason to set a conveyance limit in this model.
>
> The water surface on these cross sections is the calculated value for a discharge of 650 cfs - which is the bank full discharge.

Discharge Rating Curve

The measured stage-discharge rating curve is shown in **Figure 2-3**. It is for USGS Gage Number 9340800 which is located about 30 feet upstream from the bridge. Sixteen water-sediment discharge measurements have been made. The water discharges ranged from 295 cfs to 957 cfs. The measured stage, water discharge and bedload values are shown in Table 1.

Sedimentary Data

The gradation of sediment in the bed sediment reservoir was measured at each surveyed cross section, **Figure 2-4**. The D_{50} ranged from 75 to 110mm (0.25 ft to 0.36 ft) and D_{max} from 1000 to 2000 mm (3.28 ft to 6.56 ft).

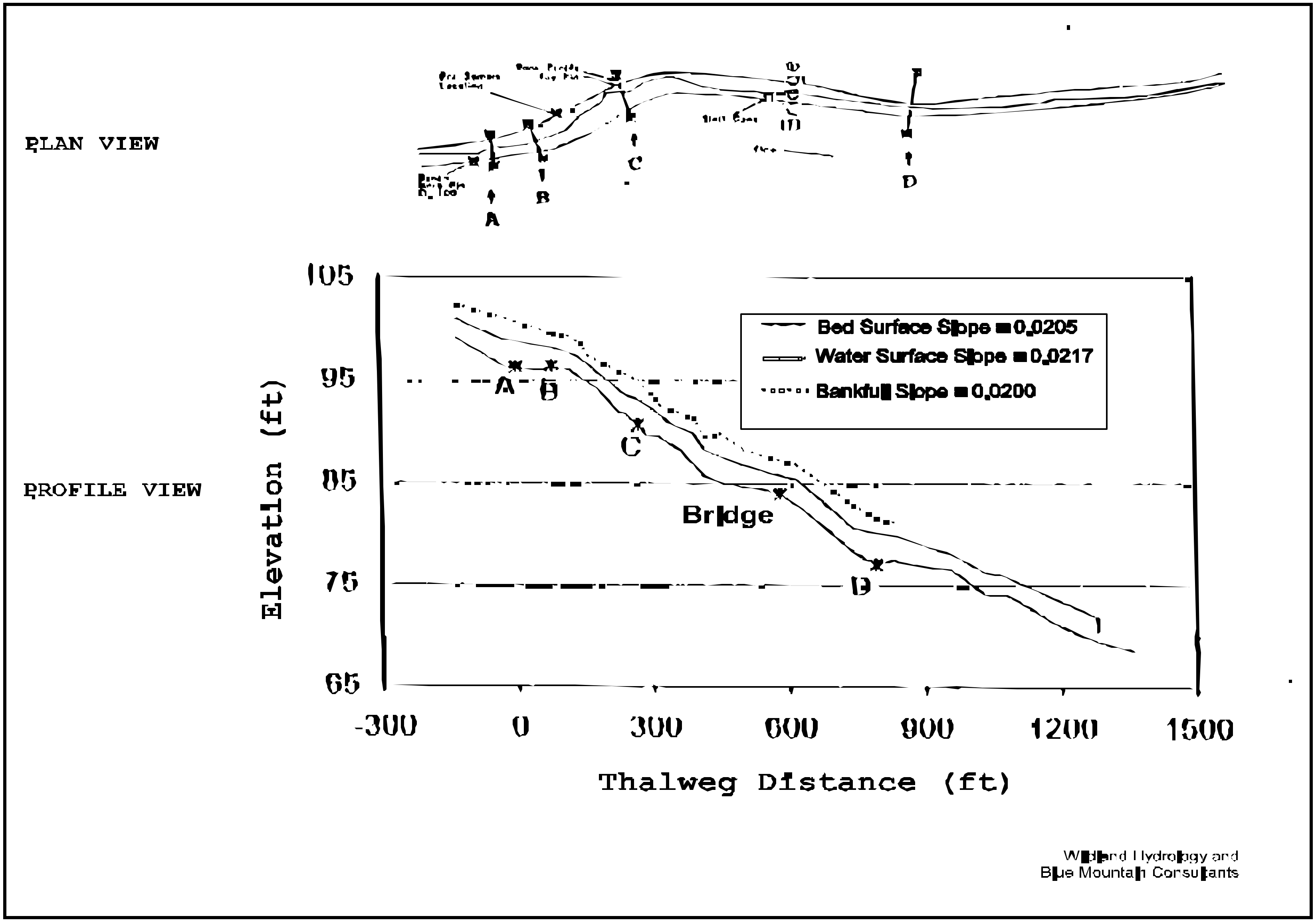


Figure 2-1. Plan and Profile of West Fork, San Juan River (Upper)

Figure 2-2A. 1 SECTION 0

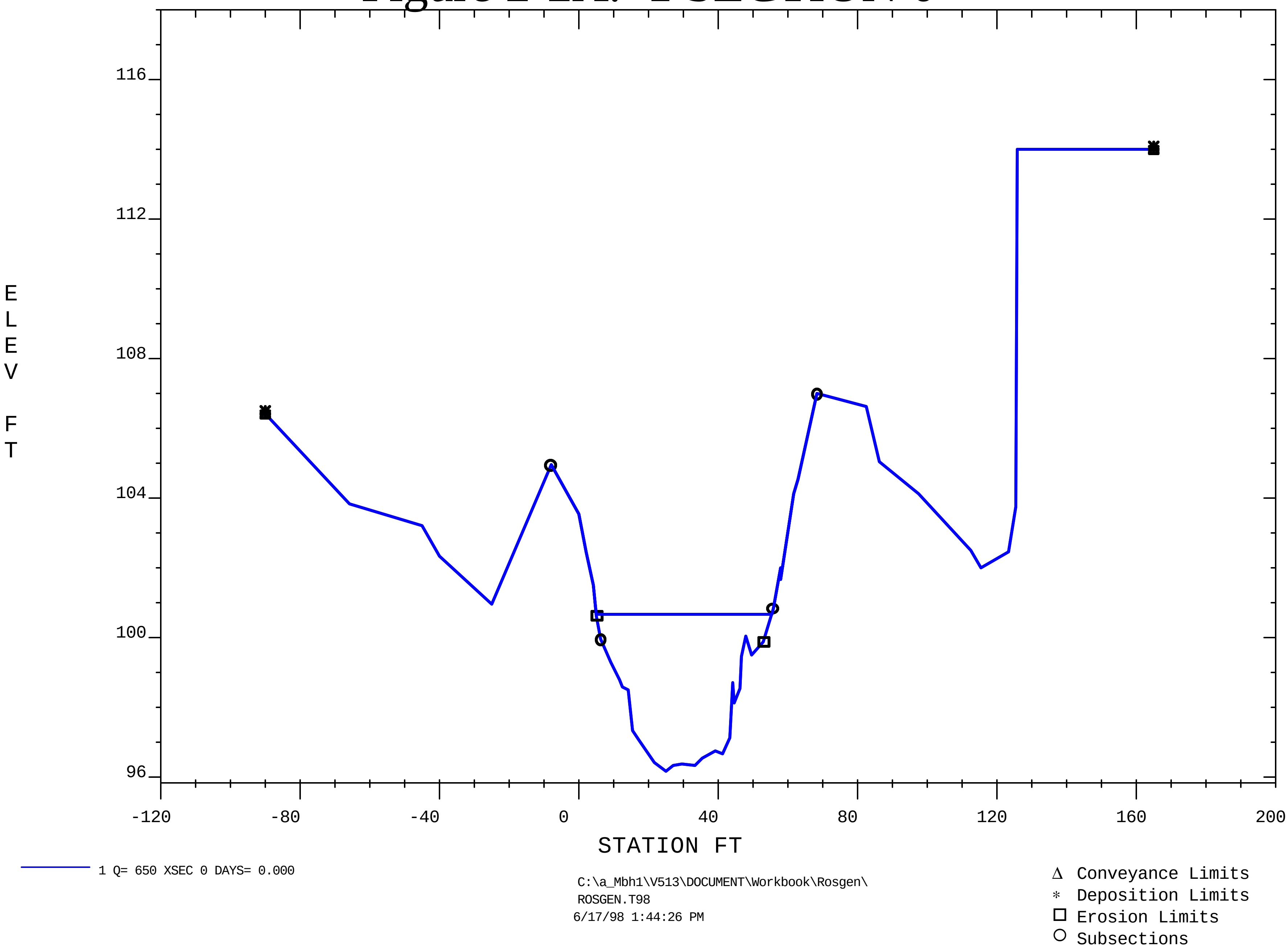


Figure 2-2B. 1 SECTION 75

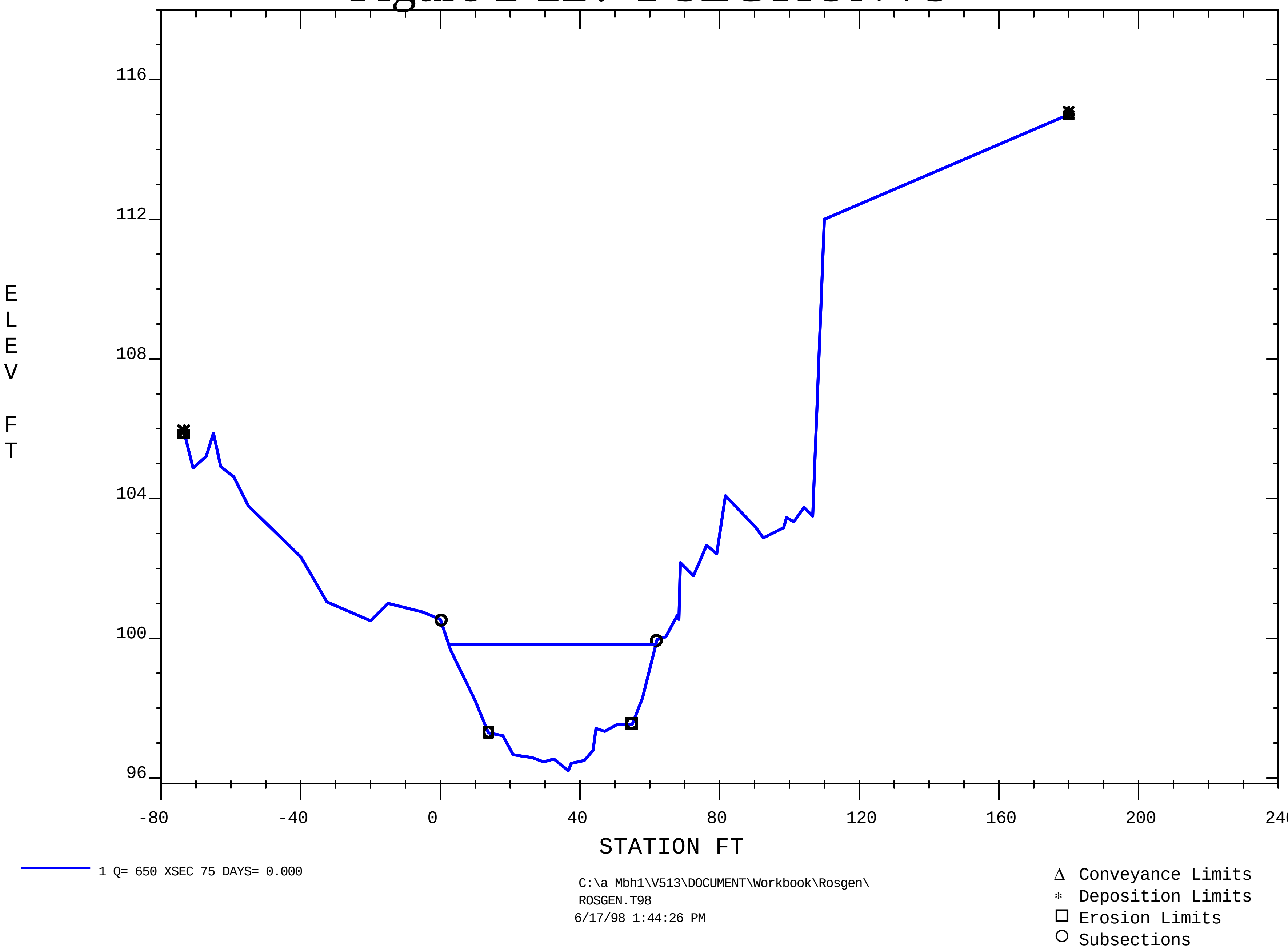


Figure 2-2C. 1 SECTION 269

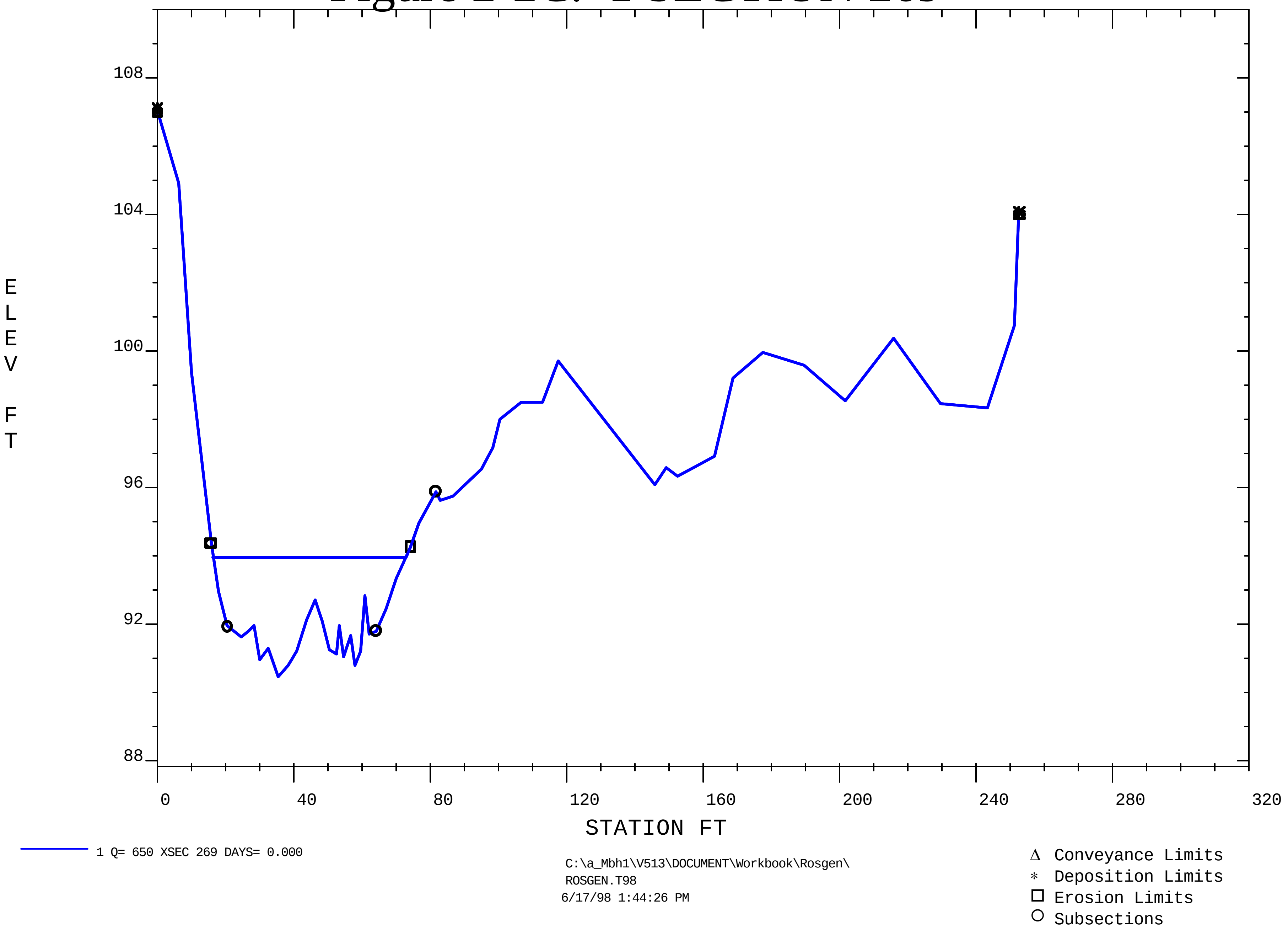


Figure 2-2D. 1 SECTION 791

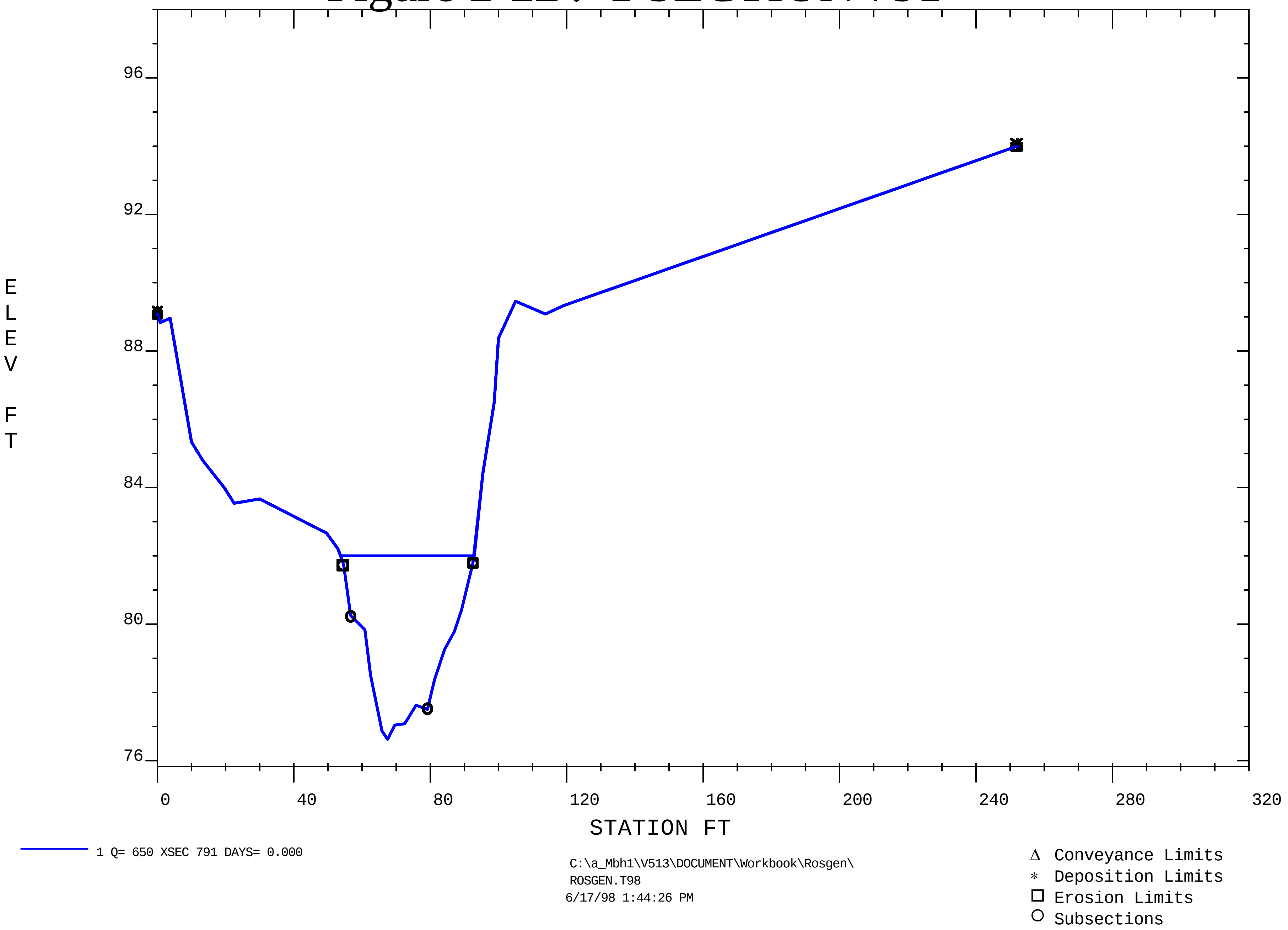


Figure 2-3. Discharge Rating Curve at Gage, West Fork of San Juan River(Upper)

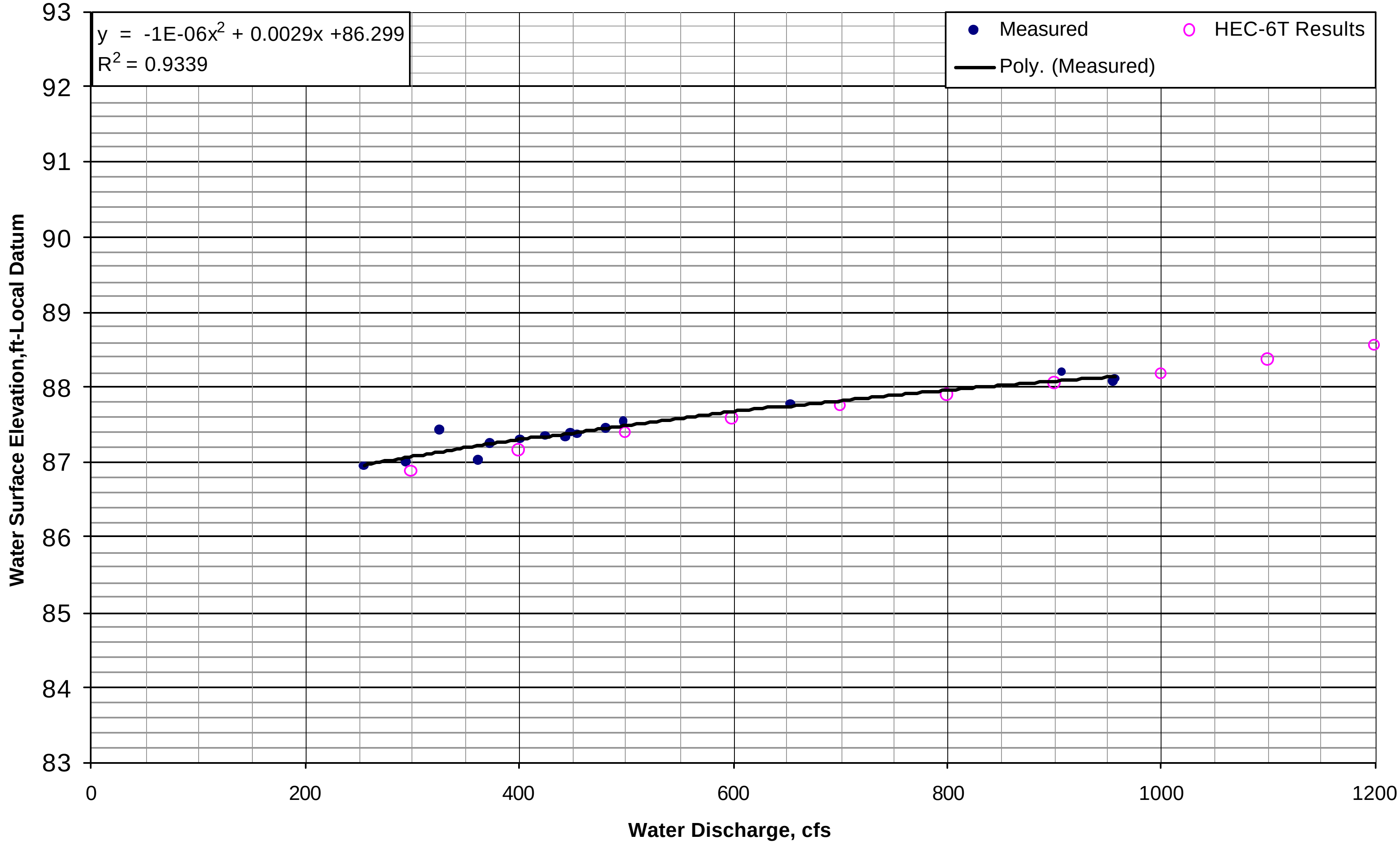
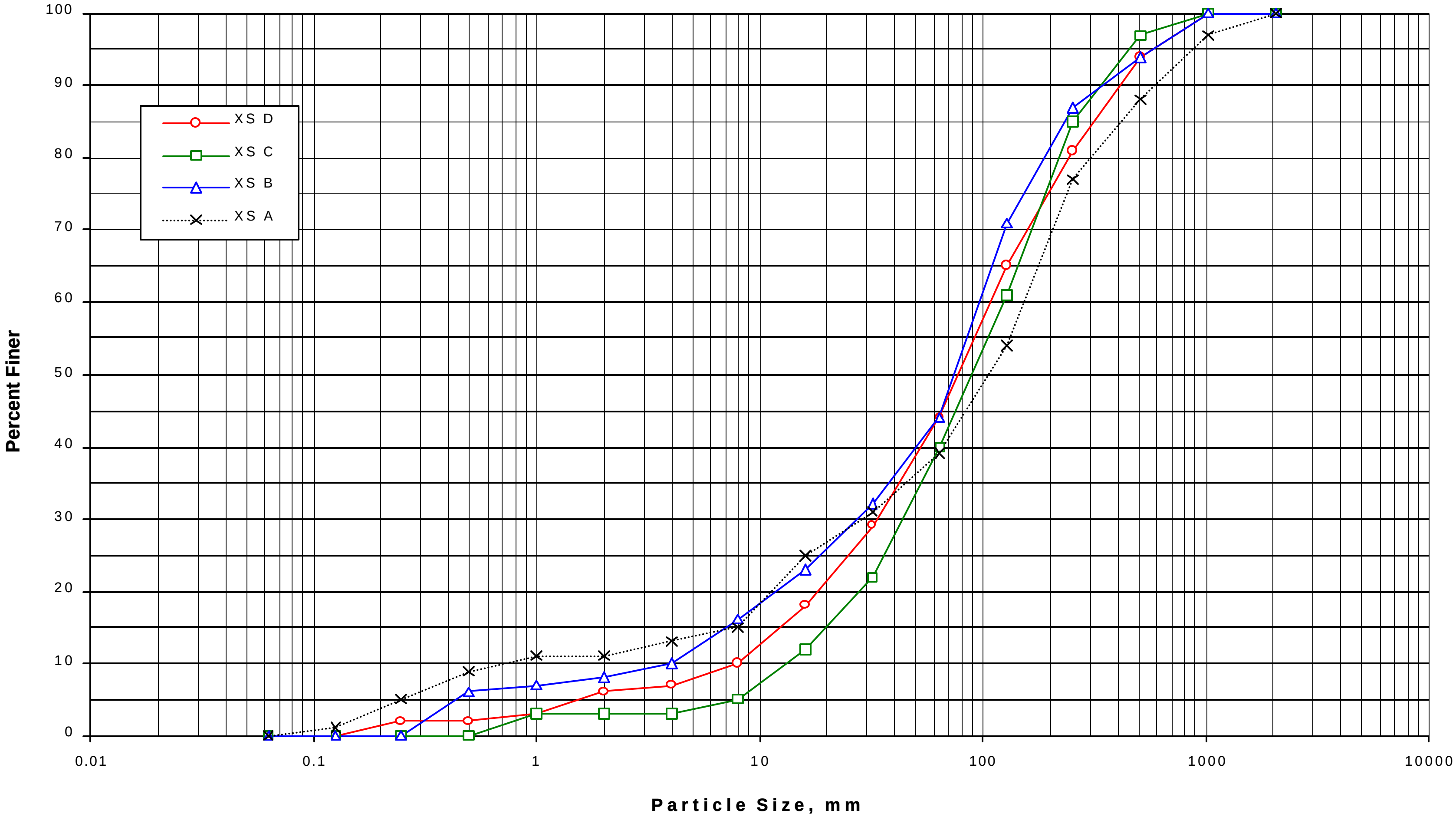


Table 1. Measured Water Discharge and Bedload

WSNAME	DATE	Width (ft)	Mean Depth (ft)	Mean Velocity (ft/s)	DRY WEIGHT captured on sieves in grams <2mm (g)	2mm (g)	4mm (g)	8mm (g)	16mm (g)	32mm (g)	64mm (g)	Largest particle (mm)	total discharge (cfs)	bedload tons/day	bedload mg/l
WFORK	51497	48	1.87	3.29	123	29	21	6	13			18	295.71	1.467	1.84
WFORK	51597	48	2.23	4.19	348	133	164	102	13			17	448.08	5.791	4.79
WFORK	51697	48	2.24	4.13	362	109	222	358	180	111		45	444.77	10.22	8.51
WFORK	51797	48	2.5	4.40	664	948	856	655	165	278		48	527.11	27.173	19.09
WFORK	51897	48	2.28	4.15	584	207	185	155	67			30	455.00	9.121	7.42
WFORK	52097	48	2.17	3.58	106	32	30	12				10	372.47	1.373	1.37
WFORK	52197	48	2.18	4.06	733	546	531	465	195	329		63	424.89	21.327	18.59
WFORK	52297	48	2.17	3.85	193	186	319	222	169	145		40	400.80	9.395	8.68
WFORK	52797	48	1.75	3.02	41	14	18	8	6			20	254.55	0.666	0.97
WFORK	52997	48	1.92	3.92	68	20	34	12				14	361.69	1.022	1.05
WFORK	53097	48	2.4	4.32	546	133	140	76	51			37	498.26	7.208	5.36
WFORK	53197	48	2.59	5.27	2289	1328	1489	1793	960	716		52	655.03	65.335	36.94
WFORK	60197	48	2.73	7.29	2184	1594	3234	5707	5278	3440	1390	86	955.77	173.924	67.40
WFORK	60297	48	2.88	6.92	3549	1616	1954	3106	3990	4321		75	957.27	141.23	54.64
WFORK	60497	48	3.02	6.27	2098	819	1094	1187	556	1184	880	85	908.43	59.567	24.29
WFORK	61097	48	2.22	4.51	483	199	326	25	51			21	480.94	8.259	6.36

Figure 2-4. Gradation of Bed Surface



The bed load measurements were converted from tons/day to milligrams/liter, using the following equation, and plotted in **Figure 2-5.**

$$Qs = 0.0027 * C * Qw$$

where

Qs	=	Sediment Discharge, Tons/Day
Qw	=	Water Discharge, cfs
C	=	Sediment Concentration, milligrams/liter
0.0027	=	Units Conversion factor, i.e. $\frac{Tons}{Day} = 0.0027 \cdot \frac{Milligrams}{Liter} \cdot \frac{CF}{Sec}$

The suspended sediment measurements are shown in Table 2 and plotted in **Figure 2-6**. Both the bed load and suspended load concentrations were fitted with trend lines and plotted in **Figure 2-7**.

Table 2. Measured Suspended Sediment Concentrations

DATE	Q,cfs	Conc,mg/l	DATE	Q,cfs	Conc,mg/l
5/9/97	99.96	10.93	6/10/97	480.94	17.55
5/12/97	87.86	11.92	6/11/97	544.6	19.49
5/14/97	295.71	30.37	6/12/97	574.85	20.45
5/15/97	448.08	106.67	6/15/97	481.08	10.44
5/16/97	444.77	48.73	6/16/97	589.98	14.87
5/17/97	527.11	65.24	6/17/97	550.65	13.96
5/18/97	455	34.74	6/19/97	586.95	25.61
5/19/97	417.56	20.81	6/21/97	656.52	40.09
5/20/97	372.47	25.71	6/23/97	638.37	51.02
5/21/97	424.89	62.03	6/24/97	614.18	17.97
5/22/97	400.8	15.11	6/26/97	472.01	31.71
5/23/97	357.07	14.44	6/27/97	426.64	5.85
5/27/97	254.55	7.22	6/29/97	360.09	11.2
5/30/97	498.26	88.5	6/30/97	320.77	4.21
5/31/97	655.03	293.17	7/1/97	332.87	8.29
6/1/97	955.77	390	7/2/97	223.98	11.49
6/2/97	957.27	161.89	7/3/97	181.63	7.21
6/4/97	908.43	322.91	7/5/97	124.16	3.49
6/5/97	862.21	84.68	7/6/97	72.74	9.54
6/6/97	701.89	49.49	7/9/97	102.98	7.91

Particle size fractions for the bed load were calculated from data in Table 1 and a few measurements were plotted in **Figure 2-8**.

Hydrologic Data

The water discharge hydrograph at the gage is shown in **Figure 2-9.**

Figure 2-6. Measured Suspended Concentrations

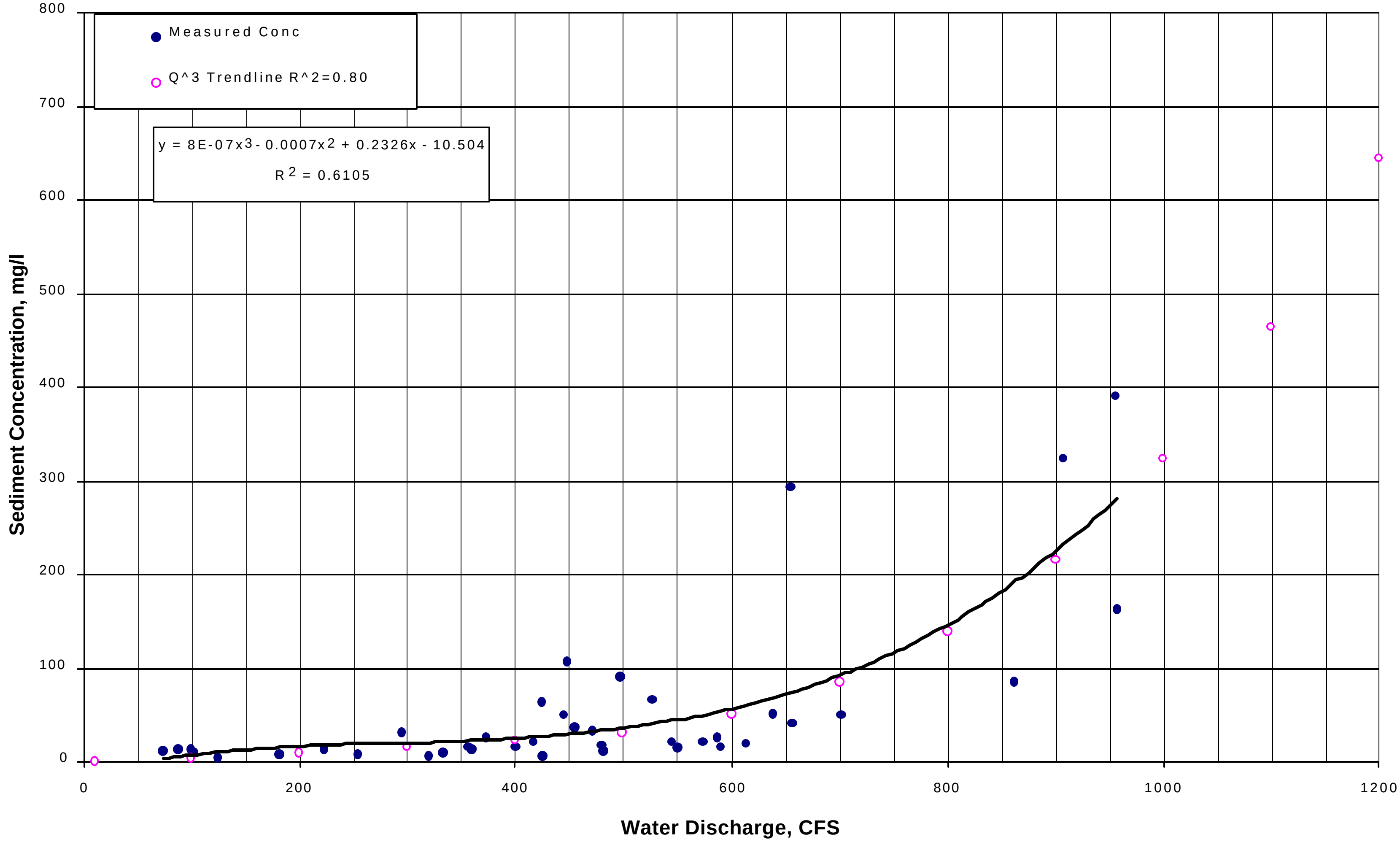


Figure 2-7. Total Measured Concentration

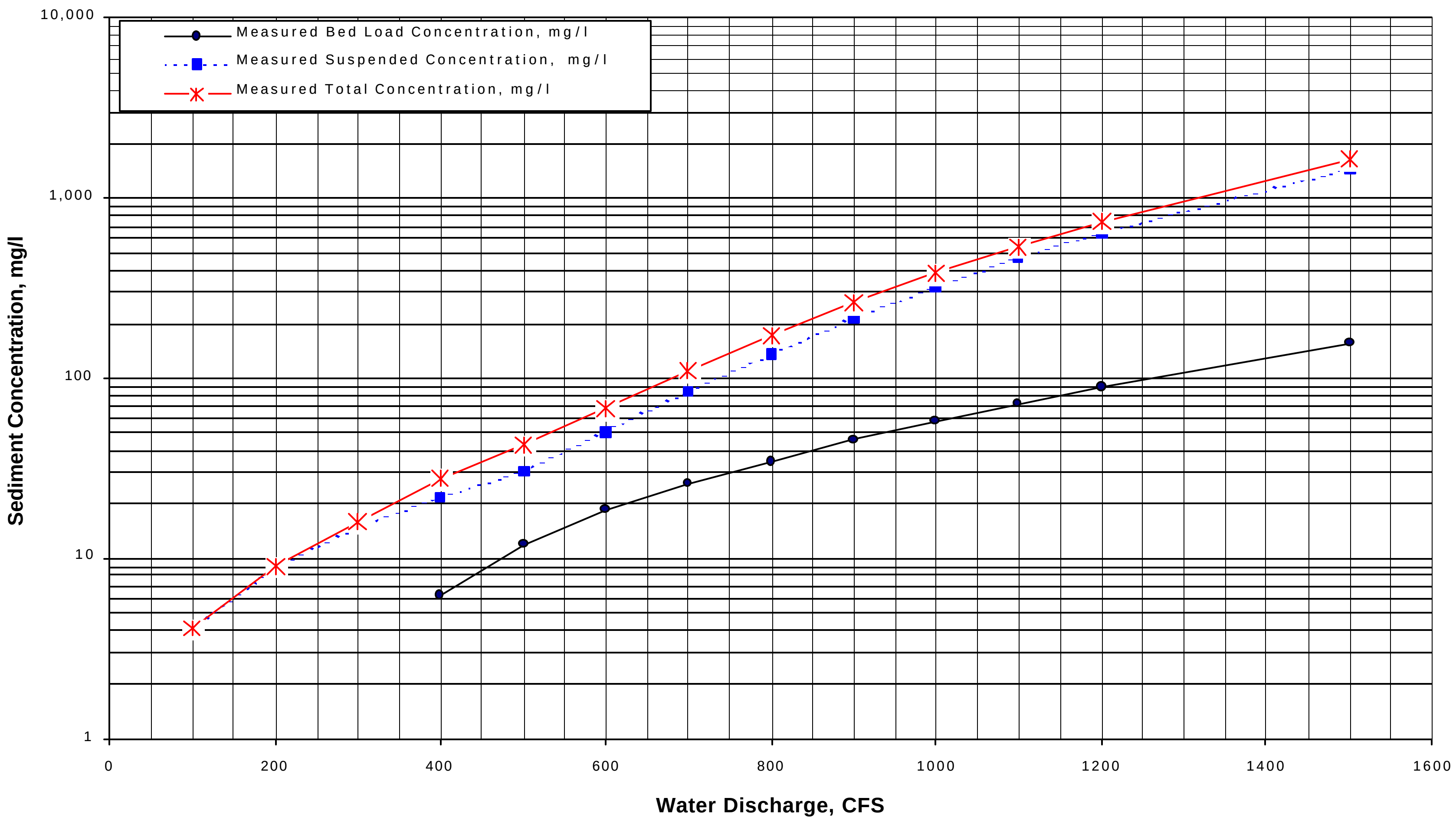
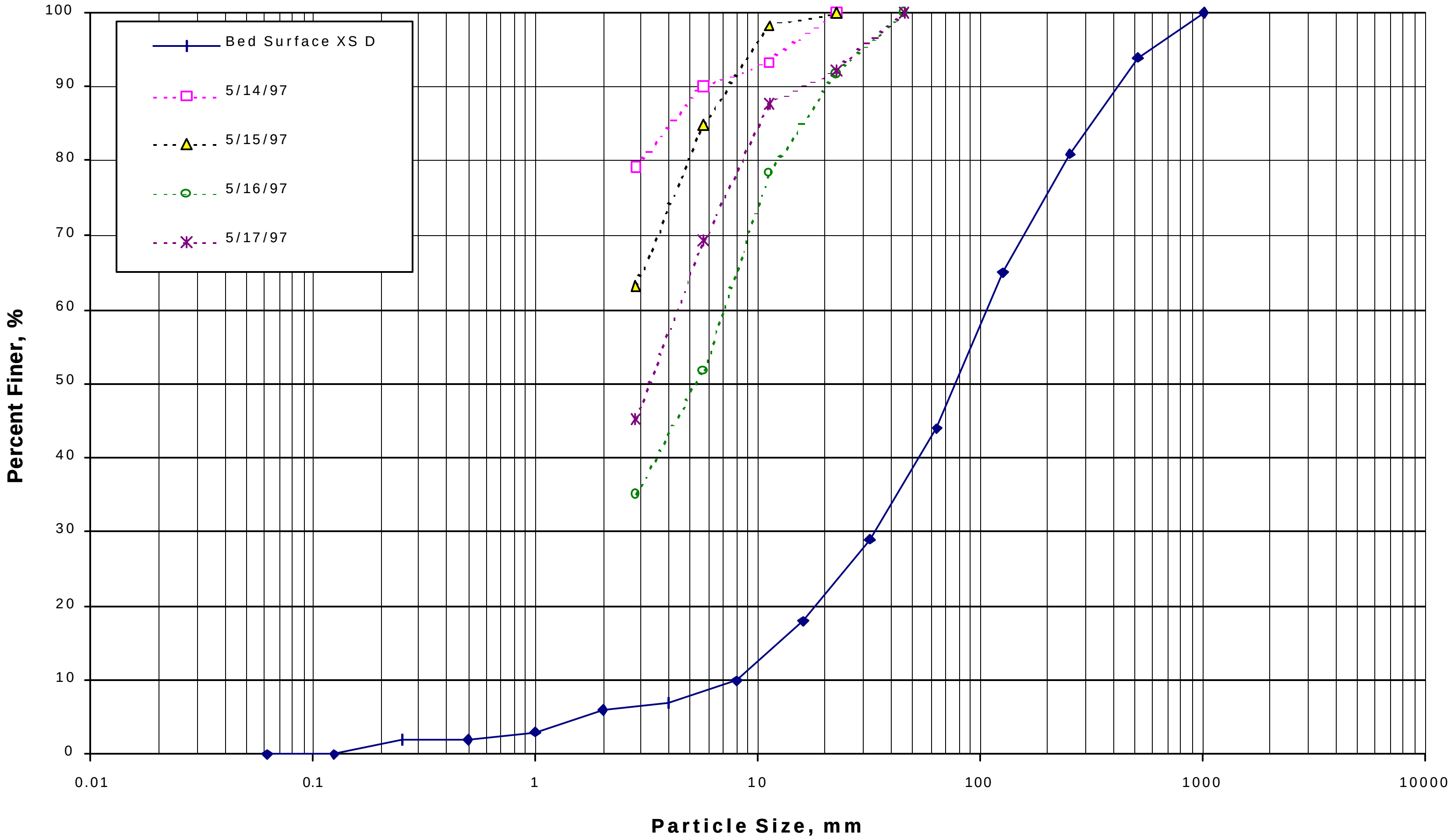


Figure 2-8. Gradation of Bed and of Bed Load



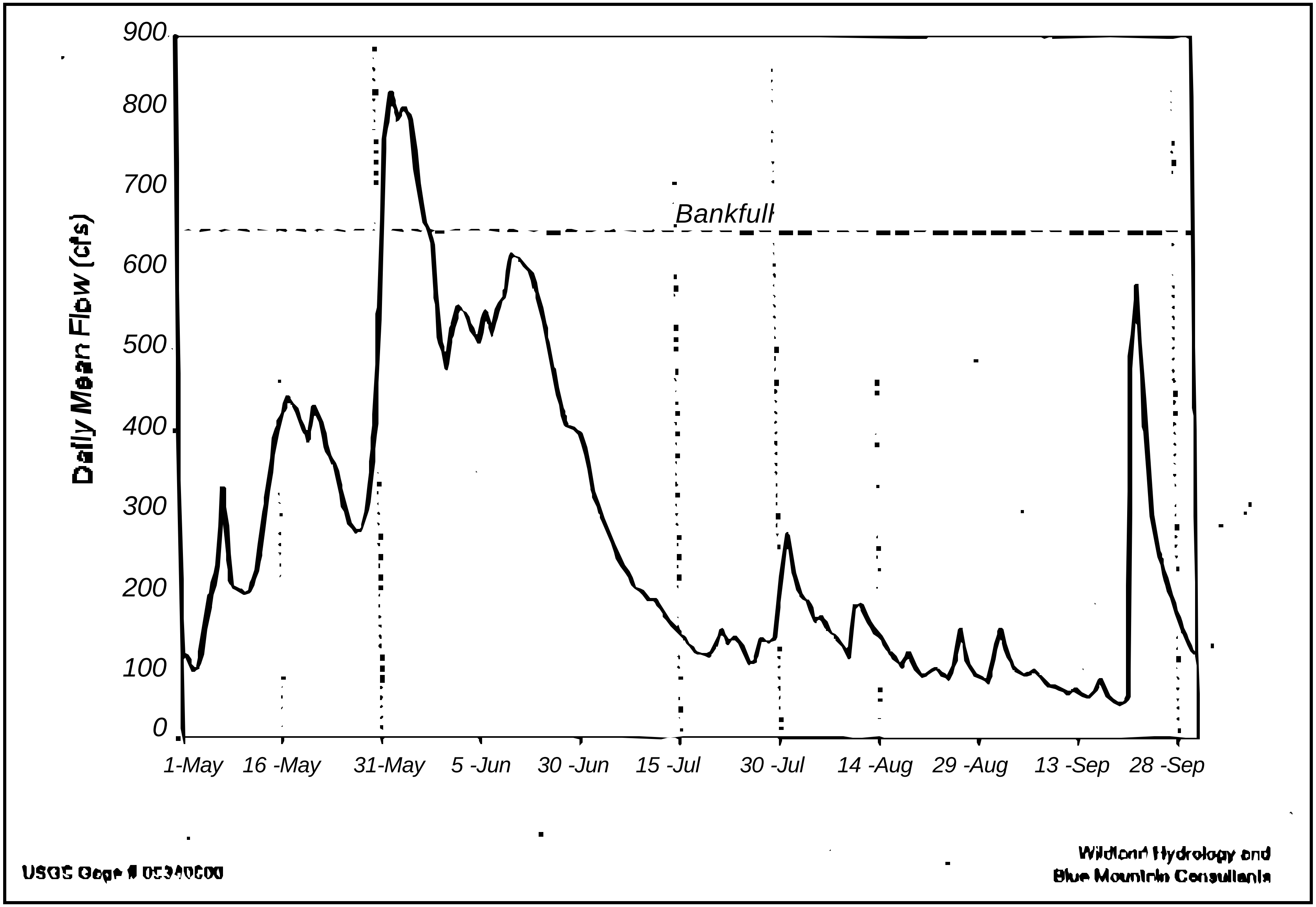


Figure 2-9. Water Discharge Hydrograph

```
$SEG   1       2       1
$TAPE12  OFF
T1      CALCULATE INFLOWING SEDIMENT DISCHARGE. FUNCTION= EINSTEIN, TRIAL =2
T2      West Fork San Jaun River (UPPER) Wildland Hydrology Class June
T3      HEC-6T Version 5. April 2, 1998 WA THOMAS
NC  .150    .150    .079
ND    11    .200
ND    22    .175       2    .040       4
ND    34    .175      .5    .175       2    .100     3.0    .040     4.0
ND    42    .175       2    .040       4
ND    51    .200

X1   791      32    54.4    92.5       0       0       0
XB  54.4    56.6    79.2    92.5     252
X3    10
GR  89.1       0   88.84       1   88.97     3.6   85.32    10.2    84.8    13.5
GR 84.01    19.6   83.53    22.7   83.67    30.1   82.65    49.6   82.21      53
GR 81.73    54.4   80.23    56.6   79.83    60.8   78.48    62.4   76.88      66
GR 76.61    67.5   77.03    69.5   77.07    72.6   77.60    75.9   77.50    79.2
GR 78.37    81.3   79.26    84.3   79.80    86.9   80.41      89   81.78    92.5
GR 84.42    95.6   86.51    98.8   88.36   100.2   89.44     105    89.1   113.8
GR 89.32   119.2      94     252
HL   791      10
HE   791            54.4    92.5  0.0000

X1   740      32    54.4    92.5      51      51      51     1.2     0.8
XB  54.4    56.6    79.2    92.5     252
X3    10
GR  89.1       0   88.84       1   88.97     3.6   85.32    10.2    84.8    13.5
GR 84.01    19.6   83.53    22.7   83.67    30.1   82.65    49.6   82.21      53
GR 81.73    54.4   80.23    56.6   79.83    60.8   78.48    62.4   76.88      66
GR 76.61    67.5   77.03    69.5   77.07    72.6   77.60    75.9   77.50    79.2
GR 78.37    81.3   79.26    84.3   79.80    86.9   80.41      89   81.78    92.5
GR 84.42    95.6   86.51    98.8   88.36   100.2   89.44     105    89.1   113.8
GR 89.32   119.2      92     252
HL   740      10
HE   740            54.4    92.5  0.0000

X1   660      32    54.4    92.5      80      80      80     1.6     4.3
XB  54.4    56.6    79.2    92.5     252
X3    10
GR  89.1       0   88.84       1   88.97     3.6   85.32    10.2    84.8    13.5
GR 84.01    19.6   83.53    22.7   83.67    30.1   82.65    49.6   82.21      53
GR 81.73    54.4   80.23    56.6   79.83    60.8   78.48    62.4   76.88      66
GR 76.61    67.5   77.03    69.5   77.07    72.6   77.60    75.9   77.50    79.2
GR 78.37    81.3   79.26    84.3   79.80    86.9   80.41      89   81.78    92.5
GR 84.42    95.6   86.51    98.8   88.36   100.2   89.44     105    89.1   113.8
GR 89.32   119.2      92     252
HL   660      10
HE   660            54.4    92.5

X1   583       9     -.1    48.1      77      77      77
XB   -.1      .1    47.9    48.1     252
X3    10
GR  98.2      -1    98.2     -.1   83.85      .1   83.85      23   83.85    47.9
```

```
GR  98.2    48.1    98.2      49      98     240      99     252
HL   583      10
HE   583            -0.1    48.1  0.0000

X1   553       9     -.1    45.5      30      30      30             0.4
XB   -.1      .1    45.4    45.5     240
X3    10
GR  98.2      -1    98.2     -.1   83.85      .1   83.85      23   83.85    45.4
GR  98.2    45.5    98.2      49      98     235      99     240
HL   553      .1
HE   553             0.1    45.4

X1   500      57    15.7    81.5      53      53      53            -5.9
XB  15.7    20.4      64    81.5   252.6
X3    10
GR107.03       0   104.9     6.2   99.37      10   94.38    15.7   92.98    18.1
GR 91.94    20.4   91.79    22.7   91.64    24.7   91.78    26.6   91.95    28.3
GR 90.97    30.1   91.29    32.4   90.46    35.4   90.78    38.3   91.02   39.69
GR 91.19    40.7   92.12    43.9   92.72    46.3   92.07    48.3   91.24    50.6
GR 91.13    52.3   91.98    53.2   91.05    54.7   91.68    56.6   90.80    57.8
GR 91.19    59.7   92.85      61   91.69    62.1   91.81      64   92.47    66.9
GR 93.34    70.2   94.26    74.2   94.96    76.6   94.96    76.6   95.89    81.5
GR 95.63    83.1   95.76    86.8   96.55    94.8   97.16    98.4   97.99   100.4
GR 98.48   106.8    98.5   112.8   99.69   117.3   98.73   124.8   96.07   145.8
GR 96.57   149.3   96.35   152.6   96.91   163.2   99.22   168.8   99.97   177.5
GR 99.57   189.5   98.54   201.8  100.38   215.7   98.47   229.4   98.32   243.5
GR100.77   251.2     104   252.6
HL   500      10
HE   500            15.7    74.2  0.0000

X1   400      57    15.7    81.5     100     100     100            -4.1
XB  15.7    20.4      64    81.5   252.6
X3    10
GR107.03       0   104.9     6.2   99.37      10   94.38    15.7   92.98    18.1
GR 91.94    20.4   91.79    22.7   91.64    24.7   91.78    26.6   91.95    28.3
GR 90.97    30.1   91.29    32.4   90.46    35.4   90.78    38.3   91.02   39.69
GR 91.19    40.7   92.12    43.9   92.72    46.3   92.07    48.3   91.24    50.6
GR 91.13    52.3   91.98    53.2   91.05    54.7   91.68    56.6   90.80    57.8
GR 91.19    59.7   92.85      61   91.69    62.1   91.81      64   92.47    66.9
GR 93.34    70.2   94.26    74.2   94.96    76.6   94.96    76.6   95.89    81.5
GR 95.63    83.1   95.76    86.8   96.55    94.8   97.16    98.4   97.99   100.4
GR 98.48   106.8    98.5   112.8   99.69   117.3   98.73   124.8   96.07   145.8
GR 96.57   149.3   96.35   152.6   96.91   163.2   99.22   168.8   99.97   177.5
GR 99.57   189.5   98.54   201.8  100.38   215.7   98.47   229.4   98.32   243.5
GR100.77   251.2     104   252.6
HL   400      10
HE   400            15.7    74.2  0.0000

X1   269      57    15.7    81.5     131     131     131
XB  15.7    20.4      64    81.5   252.6
X3    10
GR107.03       0   104.9     6.2   99.37      10   94.38    15.7   92.98    18.1
GR 91.94    20.4   91.79    22.7   91.64    24.7   91.78    26.6   91.95    28.3
GR 90.97    30.1   91.29    32.4   90.46    35.4   90.78    38.3   91.02   39.69
GR 91.19    40.7   92.12    43.9   92.72    46.3   92.07    48.3   91.24    50.6
```

```
GR 91.13    52.3   91.98    53.2   91.05    54.7   91.68    56.6   90.80    57.8
GR 91.19    59.7   92.85      61   91.69    62.1   91.81      64   92.47    66.9
GR 93.34    70.2   94.26    74.2   94.96    76.6   94.96    76.6   95.89    81.5
GR 95.63    83.1   95.76    86.8   96.55    94.8   97.16    98.4   97.99   100.4
GR 98.48   106.8    98.5   112.8   99.69   117.3   98.73   124.8   96.07   145.8
GR 96.57   149.3   96.35   152.6   96.91   163.2   99.22   168.8   99.97   177.5
GR 99.57   189.5   98.54   201.8  100.38   215.7   98.47   229.4   98.32   243.5
GR100.77   251.2     104   252.6
HL   269      10
HE   269              15.7    74.2  0.0000

X1    75      52       0    61.9     194     194    194
XB   0.1    13.7    54.9    61.9     180
X3    10
GR105.87   -73.5  104.87     -71   105.2     -67  105.87     -65  104.93     -63
GR104.62     -59  103.79     -55  102.35     -40  101.04   -32.3  100.51     -20
GR101.02     -15  100.77      -5  100.55       0   99.65     3.1   98.19     9.8
GR 97.30    13.7   97.21    17.8   96.66      21   96.62    23.2   96.59    26.3
GR 96.47    29.5   96.55    32.3   96.38    34.5   96.20    36.6   96.41    37.5
GR 96.51    41.3   96.81    43.6   97.43    44.7   97.32    47.1   97.54    50.9
GR 97.55    54.9   98.31    58.1   99.30    60.5   99.94    61.9  100.06    64.7
GR100.67    68.1  100.54    68.4  102.15    68.9  101.81    72.3  102.17    74.2
GR102.67    76.3  102.43    79.3  104.07    81.5  103.15    90.3  102.88    92.3
GR103.15    98.3  103.46    99.3  103.32   101.3  103.73   104.3  103.48   106.8
GR   112     110     115     180
HL    75      10
HE    75                10      55  0.0000

X1     0      48      -8    68.3     75       75      75
XB    -8     6.3    55.7    68.3     165
X3    10
GR106.42     -90  103.82     -66  103.22     -45  102.32     -40  100.97     -25
GR104.94      -8  103.55       0  102.46     1.9  101.49     4.1  100.63     5.2
GR 99.95     6.3   99.30     9.3   98.81    11.7   98.58    12.5   98.51    14.3
GR 97.32    15.3   97.08      17   96.41    21.8   96.16      25   96.35    27.1
GR 96.39    29.5   96.35    33.3   96.56    35.5   96.73    39.3   96.65    41.3
GR 97.14    43.3   98.72    44.1   98.13    44.7   98.53    46.4   99.47    46.8
GR100.06      48   99.50    49.6   99.87    53.1  100.83    55.7  102.01    57.9
GR101.65    58.1  104.12    61.7  104.55    62.9  106.98    68.3  106.62    82.3
GR105.03    86.3  104.11    97.3   102.5   112.3  102.01   115.3  102.45   123.3
GR103.73   125.3     114     126     114     165
HL     0      10
HE     0                 5      55  0.0000
EJ

T4      SEDIMENT DATA FROM MEASUREMENTS  EINSTEIN METHOD  PF = A
T5      BED GRADATION ARE
T6      SEDIMENT INFLOW IS 0.0
T7
T8
I1            -1
I4             6       1      15
I5             0       1       0       1       0       0       1       2
LQ     Q     100     200     400     800    1000
LC  MG/L       4       9      28     180     380
```

```
LF 1 VFS      .2      .2    0.30    0.30    0.30
LF 2  FS      .2      .2    0.20    0.20    0.20
LF 3  MS      .2      .2    0.10    0.10    0.10
LF 4  CS      .2      .2    0.08    0.08    0.09
LF 5 VCS      .2      .2    0.05    0.05    0.08
LF 6 VFG       0       0     .02     .02    0.07
LF 7  FG       0       0    .002    .002   .0013
LF 8  MG       0       0    .022    .022   .0139
LF 9  CG       0       0    .078    .078   .0491
LF10 VCG       0       0    .144    .144   .0917
LF 1  SC       0       0    .002    .002   .0015
LF 2  LC       0       0 .000001 .000001 .000003
LF 3  SB       0       0       0       0       0
LF 4  MB       0       0       0       0       0
LF 5  LB       0       0       0       0       0
PF    D      791            2048    1024  100.00 512.000   94.00 256.000   81.00
PFC 128.   65.00  64.000   44.00  32.000   29.00  16.000   18.00   8.000   10.00
PFC4.000    7.00   2.000    6.00   1.000    3.00   0.500    2.00   0.250    2.00
PFC0.125    0.00   0.063    0.00
PF    D      553            2048    1024  100.00 512.000   94.00 256.000   81.00
PFC 128.   65.00  64.000   44.00  32.000   29.00  16.000   18.00   8.000   10.00
PFC4.000    7.00   2.000    6.00   1.000    3.00   0.500    2.00   0.250    2.00
PFC0.125    0.00   0.063    0.00
PF    C      269            2048    1024  100.00 512.000   97.00 256.000   85.00
PFC 128.   61.00  64.000   40.00  32.000   22.00  16.000   12.00   8.000    5.00
PFC4.000    3.00   2.000    3.00   1.000    3.00   0.500    0.00   0.250    0.00
PFC0.125    0.00   0.063    0.00
PF    B       75            2048    1024  100.00 512.000   94.00 256.000   87.00
PFC 128.   71.00  64.000   44.00  32.000   32.00  16.000   23.00   8.000   16.00
PFC4.000   10.00   2.000    8.00   1.000    7.00   0.500    6.00   0.250    0.00
PFC0.125    0.00   0.063    0.00
PF    A        0            2048    1024   97.00 512.000   88.00 256.000   77.00
PFC 128.   54.00  64.000   39.00  32.000   31.00  16.000   25.00   8.000   15.00
PFC4.000   13.00   2.000   11.00   1.000   11.00   0.500    9.00   0.250    5.00
PFC0.125    1.00   0.063    0.00

$HYD
$RATING        1
RC             9     200       0       0      77    79.5    80.5    81.5    82.6
RC          83.6    84.6    85.7    86.7
 $RE      9
$KI      2
*   AB   RUN 1
Q   1000
T     40
W 0.0025
$PLOTP  TITLE="CALIB, EINSTEIN FUNC" 8,9,15
*    B   RUN 2
Q    650
W 0.0025
*    B   RUN 3
Q    650
W 0.0025
*    B   RUN 4
Q    650
```

```
W 0.0025
*    B   RUN 5
Q    650
W 0.0025
*   AB   RUN 1B
Q    650
W 0.0025
*    B   RUN 2B
Q    650
W 0.0025
*    B   RUN 3B
Q    650
W 0.0025
*    B   RUN 4B
Q    650
W 0.0025
*   AB   RUN 1C
Q    650
W 0.0025
*    B   RUN 2C
Q    650
W 0.0025
*    B   RUN 3C
Q    650
W 0.0025
*    B   RUN 4C
Q    650
W 0.0025
*   AB   RUN 1D
Q    650
T     40
W 0.0025
*    B   RUN 2D
Q    650
W 0.0025
*    B   RUN 3D
Q    650
W 0.0025
*    B   RUN 4D
Q    650
W 0.0025
$$END
```

INPUT DESCRIPTION FOR GEOMETRY DATA

E-1 $SEG-Record - Segment Record (Required)

The Segment record tells the program how to assemble the Network Geometry, and it tells the program that this data set is coded in **HEC-6T syntax**. Place one $SEG-Record before each T1-T4 set on each segment of the network. To run historical data sets, do not include $SEG-Records.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
$SEG   1       2       1
T1      THE $SEG RECORD GOES PRIOR TO THE T1 - T3-RecordS
T2
T3
```

Field	Variable	Value	Description
0		$SEG	RECORD Identifier goes in Columns 1-2.
1	NCPD	+	The control point number at the downstream end of this branch
2	NCPU	+	The control point number at the upstream end of this branch
3	NGDS	+	Segment number

E-2 Title Records (T1 - T3)

Three title records are required to precede the geometry data for each stream segment in the network. The program expects a T in Column 1. Additional printout of geometric data can be requested by specifying a B or C in Column 3 on the T1-Record.

Field	Variable	Value	Description
0	ICG, IDT	T1	Record identification in Columns 1 and 2. **T1, T2** and **T3** for the first, second and third title records, respectively.
Column 3 of **T1**-record only		Blank (zero not allowed)	Normal printout lists data from title records and the **NC**-Record. Only the cross section identification number is listed for records **X1** through **EJ**.
	KSW(5)	B	This printout option prints the left and right bank assignments for the channel.
	KSW(5, 6, 10, 17)	C	This printout option activates a trace printout through subroutine GMOD.
	KSW(4)	O	This option turns off all printout in the geometric data set except for cross section numbers-river miles.
2-10		Comments	Fields 2 through 10 (Columns 9-80) may be used for identification purposes such as labeling the data set, noting the date of the run, or other relevant information.

E-4 Manning's n-Value Options (Required Data)

Hydraulic roughness is prescribed by Manning n-values. There are four options for each subsection plus a multiplier for the entire cross section: constant n-value for the subsection, n vs Elevation for the subsection, n vs Water Discharge for the subsection and n vs Water Depth in the subsection. The multiplier for the cross section is Cowan's coefficient for meander (Chow, 1959). In Version 4.60 and above these options can be used in any combination. However, it remembers the last option read.

E-4.1 NC-Record - Constant N-Values Plus Expansion/Contraction Coefficients

The NC-Record prescribes Manning's n-values and expansion/contraction coefficients. The NC-Record values are constant with depth and will be used until changed by the next NC-Record. The n-values apply over the reach. New n-values or Expansion and/or contraction coefficients will be used starting in the reach in which the record appears in the data set. **NC**-Records may be inserted before any **X1**-Record. However, when using more than one n value option, insert the NC-Record first.

Note: HEC-6 applies n-values starting in the reach where the NC-Record appears; whereas HEC-2 applies them halfway to the cross section on either side of the one for which they appear in the data set. However, results using either method are usually in close agreement without changing the n-values.

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
NC   .15     .15    .025      .1       .3
ND    22     .08     .01    .025      .10
X1    ...
```

Field	Variable	Value	Description
0	ICG, IDT	NC	Record identification
1	XNVR(1)	+	Manning's n-value for the **left overbank**
		0	No change from previous n-value for the **left overbank**
2	XNVR(3)	+	Manning's n-value for the **right overbank**
		0	No change from previous n-value for the **right overbank**
3	XNVR(2)	+	Manning's n-value for the **channel**
		0	No change from previous n-value for the **channel**
4	CC	+	**Contraction coefficient** used in computing transition losses
		0	No change in contraction coefficient
5	CE	+	**Expansion coefficient** used in computing transition losses
		0	No change in expansion coefficient
6-10			Leave blank

E-4.2 ND-Record - Vary N-Values by Depth (Optional)

A table of Manning's n-values versus depth is entered on the ND-Record. The program linearly interpolates when the EFFECTIVE DEPTH is between values specified in the table. Otherwise, this record functions like the NV-Record.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
T3
ND    11     .10
ND    25     0.5     0.5    .023       1    .019       5    .020      12    .021
ND    15
ND    31     .15
X1    ...
```

Field	Variable	Value	Description
0	ICG, IDT	ND	Record identification
1	NPAR,NCH	++	Enter subsection number in Column 7 and number of n-values in Column 8. Subsection numbers:

In a 3-Strip Model In a 5-Strip Model

E-4.3 NK-Record - Calculate N-Values (Optional)

Manning's n-values can be calculated with the Brownlie Bed Roughness equations or with the Limerinos Equation. There is a global command, $K, in Appendix H, "Special Commands and Program Options" which will over-ride the channel n-values prescribed on any N*-Record. However, there are cases when it is desirable to prescribe n-values for some cross sections and use the bed roughness predictors for others. The NK-Record offers that flexibility.

Note: Even when these NK-Record(s) are selected, a $K-Record must be added to the Hydrologic Data Set to prescribe the method for compositing hydraulic parameters. This is particularly important when the model has only 3 Strips (i.e. left overbank, channel and right overbank).

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
T3
NC     .1       .1     .025
NKB     2
X1     ...
```

Field	Variable	Value	Description
COL 1&2	CLINE	NK	Record identification
COL 3	NPARTY()	B	Calculate bed roughness using Brownlie Equations (Sand Bed Channels)
		L	Calculate bed roughness using Limerinos Equation (Gravel Bed Channels)
1	NCH	2,3	The Number of the Channel Strip
		2	For a 3-Strip Model
		3	For a 5-Strip Model

E-6 X1-Record - Cross Section Location (Required)

The X*-Record Types contain data for cross section controls. The first record is always the **X1**-Record. It identifies the cross section and prescribes it's distance from the downstream cross section.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
NC   .15     .20    .025      .1      .3
X1  1660      10    2582    3020     500     500     500
X3    10
```

Field	Variable	Value	Description
0	ICG, IDT	X1	Record identification
1	SECID	-,0,+	Cross section identification number
2	NXY	+	Total number of coordinate points used to describe the cross section's geometry on the **GR**-Records which follow (5 ≤ NXY ≤ 100.)
		0	**Repeat Cross Section Option.** The geometry of the previous (downstream) cross section (**GR**-Records) will be repeated for the present cross section. Therefore, no **GP**-Records will be entered for this section. Do not code a zero for the first cross section.
3	STCHL	-,+	Station of the **left** bank of the channel, use top-bank when the bank roughness is included in channel n-values. Toe of bank is recommended when channel bank roughness is included in overbank n-values. STCHL does not need to equal one of the station values entered on the **GR**-Records for this cross-section.
		0	For a repeat cross section, enter blank or zero (i.e., when NXY (**X1**.2) is zero).
4	STCHR	-,0,+	Station of the **right** bank of the channel. Same rules as for STCHL above.
5	RLL	+	**Reach length** of the **left** overbank between current cross section and the (previous) downstream cross section.
		0	Enter zero or leave blank for the first cross section or when there is no left overbank subsection.
6	RLR	0,+	**Reach length** of the **right** overbank. Same rules apply as for RLL above.

X1-Record (continued)

Field	Variable	Value	Description
7	RLC	0,+	**Channel Reach Length**. The same rules apply as for overbank reach lengths above.
8	RX		**Cross Section Width Adjustment Factor**. Each GR station will be **multiplied** by RX. For a repeat cross section, GR stations from the previous cross section will be changed before they are reused.
		b, 0	No change to cross section stations.
		0<RX<1	The cross section width is reduced.
		RX > 1	The cross section width is increased.
9	DH		**Cross Section Elevation Adjustment Factor**. The constant DH will be **added** to each elevation on the GR-Records for this cross section. For a repeat cross section, elevation values from the previous cross section will be changed before they are reused.
		b,0	No change to cross section elevations.
		+	Constant will be added to all elevations.
		-	Constant will be subtracted from elevations.

E-7 XB-Record - Separate Channel Bed from Banks (Optional)

The **XB-**Record allows the top of bank station and the toe of bank station to be prescribed for the left and right channel banks. The bed roughness can then be computed separately from bank roughness, and a composite channel n-value can be calculated. The program uses the Einstein-Horton (i.e. Equal Velocity) method of compositing.

The **XB**-Record partitions the model into 5 strips. N-values and reach lengths are needed for each strip. Code reach lengths on an **XC-**Record. Code n-values on NV- or ND-Records, one record for each strip. See **COMMANDS** for selecting Limerinos or Brownlie bed roughness predictors for the channel n-values.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
X1    20      18    1500    2250    1320    1320    1320
XB  1500    1540    2200    2250    7500
XC    ...
X3    ...
XL    ...
GR    ...
```

Field	Variable	Value	Description
0	ICG, IDT	XB	Record identification
1	STA(1)	+	Top of left bank (Old STCHL)
2	STA(2)	+	Toe of left bank
3	STA(3)	+	Toe of right bank. The program assigns the channel to this strip (i.e. strip 3).
4	STA(4)	+	Top of right bank (Old STCHR)
5	STA(5)	+	End of cross section station
	...	...	
9	BKSLO	b,+	Program uses BKSLO to test cross section for Toe of Banks. Default is 0.2 (i.e. 1:5) It sweeps down from Top Bank to locate the Toe
10	CHST	+	Channel station if not STA(3)

E-8 XC-Record - Reach Lengths for XB-Record

The **XC-**Record allows reach lengths to be assigned to each subsection on the XB-Record. Do not use a XC-Record without a XB.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
X1    20      18    1500    2250    1320    1320    1320
XB  1500    1540    2200    2250    7500
XC  1000    1100    1200    1300    1500
X3    10
XL    ...
GR    ...
```

Field	Variable	Value	Description
0	ICG, IDT	XC	Record identification
1	RL(1)	+	Reach length of left overbank
2	RL(2)	+	Reach length of left bank of channel
3	RL(3)	+	Reach length of channel
4	RL(4)	+	Reach length of right bank of channel
5	RL(5)	+	Reach length of right overbank

E-9 X3-Record - Ineffective Flow and Encroachments (Optional)

The **X3**-Record provides three methods for defining encroachments to a cross section. These methods are: (1) ineffective flow area, defined using Field 1; (2) effective width, defined using Field 3; and (3) encroachment stations, defined using Fields 4-7. The HEC-6 **X3-**Record is different from the HEC-2 **X3-**Record.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
X1    20      18    1500    2250    1320    1320    1320
XB  1500    1540    2200    2250    7500
XC  1000    1100    1200    1300    1500
X3    10
XL    ...
GR    ...
```

Field	Variable	Value	Description
0	ICG, IDT	X3	Record identification
1	MEID		**Method 1.** Inefffective flow area option
		10	All water is confined to the channel, as defined by variables STCHL and STCHR on the **X1-**Record, until the calculated water surface elevation exceeds the channel bank elevation (the elevations corresponding to STCHL and STCHR on the **X1**-Record). The rest of this record may be left blank.
		0	Method 1 is not used. See other methods below.
2			Leave blank
3	ENCFP		**Method 2.** Effective width for all flow
		+	The program confines all flow to the width specified by ENCFP. It will be centered using the left and right bank stations of the channel (STCHL and STCHR on **X1**-Record). Side boundaries will be vertical and frictionless. Method 2 may be used in conjunction with Method 1.
		0	The width option is not being used or is not changed from previous value.
4	STENCL		**Method 3**. Station of Encroachment, left side of cross section **Method 3 may not be used in conjunction with Methods 1 and/or 2**.

X3-Record - (continued)

Field	Variable	Value	Description
		-,+	STENCL sets a limit for flow on the **left** side of the cross section. The side will be vertical and frictionless unless ELENCL is also used (see Field 5 below). **Note:** Do not enter a station value of zero since it will be treated as if no value was entered. Enter a small positive number like 0.01 instead.
5	ELENCL		**Method 3.** Elevation of encroachment, left side of cross section. All cross section elevations for stations to the left of STENCL are raised to this elevation.
		-,+	Enter the elevation at the top of encroachment. **Note:** Do not enter a value of zero since it will be treated as if no value was entered as cautioned above.
6	STENCR		**Method 3.** Encroachment station right. (SEE STENCL AND ELENCL above.)
		-,+	Same rules and purpose as STENCL-- but for use on the **right** side of the channel.
7	ELENCR		**Method 3.** Elevation of Encroachment, right side of cross section.
		-,+	Same rules and purpose as ELENCL but for use on the **right** side of the channel.
8	ELLEA	-,+	**Method 4.** Elevation of ineffective flow area, Left Overbank. This option works with MEID=10 when the elevation of the channel station is not a satisfactory measure of ineffective flow area. If this option is selected, then ELREA SHOULD BE USED, also.
9	ELREA	-,+	**Method 4.** Elevation of ineffective flow area, Right Overbank. SEE ELLEA above; if this option is selected, then ELLEA SHOULD BE USED, also.

E-13 GR-Record - Cross Section Coordinates (Required)

The data entered on the **GR-**Records are used to specify the cross section. These coordinate points correspond to the elevation (Y) and station (X) along the cross section's ground profile. A set of GR-Records is required to each cross section unless NXY (**X1**.2) is zero (or blank) indicating a repeat cross section. Code stations in increasing order. Enter five elevation/station pairs per **GR**-Record. A maximum of 100 points (or twenty **GR**-Records) per cross section is permitted.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
NC  .125    .125     .03
X1 20.07      90 10418.8 10493.6    1500    2200    3390            -0.5
X3    10
XL                                                 11000
GR   290    6550     285    8350     285    8500     280    8650     275    8800
GR    ...
```

Field	Variable	Value	Description
0	ICG, IDT	GR	Record identification
1	EL(1)	-,0,+	Elevation of first coordinate point
2	STA(1)	-,0,+	Station of first coordinate point
3	EL(2)	-,0,+	Elevation of second coordinate point
4	STA(2)	-,0,+	Station of second coordinate point
5 - 10			Continue for up to 100 coordinate point pairs. Each continuation record is identified with **GR** in Field 0, and the format is identical for all records.

E-14.4 HL-Record - Multiple Dredging Sites

This record prescribes the width and depth of the bed sediment reservoir and the dredging template at a cross section. It replaces the HD-Record and allows different dredging sites (HL-9). All other fields of the HL-Record are the same as those on the HD-Record and either record is acceptable to the program. Use only one H-HD- HI- or HL-Record at the same cross section, but it is appropriate to include an HE-Record with any of these H-Records.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
NC  .125    .125     .03
X1   4.1      90 10418.8 10493.6    1500    2200    3390            -0.5
X3    10
XL                                                11000
GR   290    6550     285    8350     285    8500     280    8650     275    8800
GR    ...
HD   4.1      10   10120   10490
HE
```

Field	Variable	Value	Description
0	ICG, IDT	HL	Record identification
1	SECID	-,+	Cross Section Identification Number. Use the same value as previously entered in **X1**-record for this cross section.
2	DLY	0,+	Depth of the Bed Sediment Reservoir at this cross section. Negative values are not permitted. There is no default. Blank is the same as zero.
3	XSM		Movable Bed Limit, Left; counterpart to XFM (**HD**.4).
		-,+	Enter the station, left side of channel, where the fixed bed stops. The next **GR** station will be in the bed sediment reservoir.
		0	Program will automatically set XSM equal to the first GR-Station.
4	XFM		Movable Bed Limit, Right; counterpart to XSM.
		-,+	Enter the station of the first fixed point on the right side of channel.
		0	Program will automatically set XFM equal to the last GR-Station.

HL-Record - Multiple Dredging Sites (continued)

Field	Variable	Value	Description
5	DLYR		Elevation correction for movable bed. It is sometimes desirable to modify bed elevations and restart a run. If so:
		-,+	Enter a value for DLYR and the program will add this value to the Y-coordinates within the movable bed.
		0,b	In most cases, leave this field blank.
6	EDC	-,+	Elevation of Bottom of Dredged Channel. This value should always be above the model bottom.
		0	Dredging is not desired at this cross section. If the desired elevation of the dredged channel bottom is zero, enter a small positive value (e.g. 0.001).
7	XSD		Dredged Channel Boundary, Left. The cross section station where dredging will begin if this value equals a station coded on the **GR**-Records. If it does not coincide with a **GR** station, dredging will begin at the next **GR** station after the value coded here. This value should be equal to or greater than XSM. No new cross section station is interpolated.
		-,+	Enter the station of the cross section coordinate point on the left side of the dredged channel, so that the elevation of coordinate points within the dredge channel (from XSD to XFD, **HD**.8) can be corrected for dredging. XSD should always be greater than or equal to XSM.
		b,0	XSD is set equal to XSM (**HD**.3).
8	XFD		Dredged Channel Boundary, Right. Cross section station beyond which no dredging is performed, counterpart to XSD.
		-.+	Dredging will stop at the **GR** station equal to, or to the left of this station. This value should be less than or equal to XFM.
		b,0	XFD is set equal to XFM (**HD**.4).
9	NDRR()		The dredging site number. Enter a value from 1 to 10.
		0	The default is NO DREDGING at this cross section.
10	DOD		Depth of Over dredging. Used to establish some extra depth below required bottom elevation.

HL-Record - Multiple Dredging Sites (continued)

Field	Variable	Value	Description
		+	Enter the amount of overdredging desired at this cross section. Do not enter over depth dredging below the bottom of the bed-sediment reservoir, (i.e. EMB).
		0,b	The default is zero over depth dredging.

E-14.5 HE-Record - Erosion Limits (Optional)

Erosion Limits restrict bed erosion while allowing deposition to extend to the limits of the movable bed.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
NC  .125    .125     .03
X1   4.1      90 10418.8 10493.6    1500    2200    3390            -0.5
X3    10
XL                                                 11000
GR   290    6550     285    8350     285    8500     280    8650     275    8800
GR    ...
HD   4.1      10
HE   4.1           10420   10490
X1   ...
```

Field	Variable	Value	Description
0	ICG, IDT	HE	Record identification
1	ISI()		Cross Section Identification
2			Leave blank
3	EROL	-,+	Enter the cross section station at the left side of the limit of erosion. It does not have to coincide with a **GR** station, but if it does not, the erosion will begin at the first GR station after EROL. Note: Do not enter a value of zero since it will be interpreted as if no value were entered. Enter a small number (e.g., +,- 0.001) when a value of zero is desired.
4	EROR	-,+	Enter the cross section station at the right side of the limit of erosion. It does not have to coincide with a coordinate point, but if it does not, erosion will cease at the last GR station prior to EROR.
5	SIDER()	-	Subsidence Rate in Feet/Year
		+	Rebound Rate in Feet/Year
6 - 10			Leave blank

E-15 EJ-Record (Required)

End of geometric model data is established by an EJ-Record. This record must be the last geometry record entered for each stream segment described in the geometry section.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
X1   4.1      90 10418.8 10493.6    1500    2200    3390            -0.5
X3    10
XL                                                11000
GR   290    6550     285    8350     285    8500     280    8650     275    8800
GR    ...
HD   4.1      10   10117   10449
HE
EJ
$SEG ...
```

Field	Variable	Value	Description
0	ICG, IDT	EJ	Record identification
1-10			Leave blank

INPUT DESCRIPTION FOR SEDIMENTARY DATA

F-1 Title Records - Comments (Five Required: T4-Record through T8-Record)

Five Title Records are required to precede the sediment data for **each segment** in the network. They each have a T in Column 1 and the sequence number in Column 2. The number four is suggested for the first sequence number. A Data Echo print option is available; see below for details.

Note: Column 4 of **T4**-Record is reserved for program use.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
EJ
T4      THE TITLE RECORDS MAY CONTAIN ANY ALPHA-NUMERIC DATA  AFTER COLUMN 4.
T5      SUGGEST SUCH AS DATE AND SOURCE OF SED SAMPLES.  PLAN-MODEL-RUN NO
T6      ETC
T7      PERSON PERFORMING STUDY AND DATE ARE USEFUL INFORMATION
T8      AND COMPUTER FILE NAME.  THIS EXAMPLE IS NOT COMPLETE.  IT SHOWS RECORDS DOWN TO
LQ-LT
I1            20       0             1       0       0       0
I2 CLAY        2       1       1    2.80    0.02              69     30.     16.
I2 CLAY        1     .02     .02     .02     100       0
I2 CLAY        2     .02     .02     .02     100       0
I3 SILT        2       1       4    2.80    0.02              69     65.     5.7
I4 Yang        4       1      15
I5             0       1       0       1       0       0       1       2
I6 MAXC        1 .301886 .301886 .150943
LQ DISCH       1     100   20000  100000
LT TOTAL  137786  137786  137786  137786
LF  CLAY     .06     .06     .06     .06
LF  SILT     .06     .06     .06     .06
```

Field	Variable	Value	Description
0	ICG, IDT	T4	Record identification in Columns 1 and 2. **T4, T5, T6, T7,** and **T8** for the first through fifth title records, respectively.
Column 4 of **T4**-Record only	ISI(2)	B	**Data Echo.** Each input record is echoed in the output file as it is read. This is available to help the user verify the initial conditions of the model and is not recommended for normal use. To exercise this option, enter B in Column 4 of the **T4**-Record.
		O	Turn off input data printout from sedimentary model.
1-10			Fields 1 through 10 (Columns 5-80) may be used for identifying the stream segment, project date, or any other relevant information.

F-2 I1-Record - Sediment Properties (Required)

This record contains sediment properties for the job. See the T4-Record for a larger set of example records.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
T8      AND COMPUTER FILE NAME.  THIS EXAMPLE IS NOT COMPLETE.  IT SHOWS RECORDS DOWN TO
LQ-LT
I1             20       0               1       0       0       0
I2 CLAY         2       1       1    2.80    0.02              69     30.     16.
```

Field	Variable	Value	Description
0	ICG, IDT	Il	Record identification
1	ISI	Comment	Any alphanumeric characters or comments
2	SPI		**Specify iterations** of the Exner computations.
		b,0	The program assigns 20.
		+	Assign the desired number of iterations.
		-1	Program calculates the value.
			Note: The value of SPI computed by the program can become very large resulting in excessive computer time.
3	IBG		Bed Gradation Option. Instructs program to calculate gradation in surface layer based upon transport capacity. Not recommended in normal application.
		0	Program uses gradation on N-Records to calculate transport capacity.
		+3	Program calculates gradation of surface layer based on inflowing load and sediment transport theory. Iterative process performed in three iterations (i.e., IBG iterations).
4	MNQ		Number of Parallel Discharges. This option is **no longer permitted**.
		0	Program assigns one.
5	SPGF	+	Specific Gravity of Fluid. It is used with density and acceleration of gravity to calculate unit weight.

I1-Record - Sediment Properties (continued)

Field	Variable	Value	Description
		0	Program assigns 1.0000 (fresh water at 39.2 degrees F).
6	ACGR	+	Acceleration Due to Gravity.
		0	Program assigns 32.174 ft/sec (standard at 45 degrees latitude, sea level).
7	NFALL		Fall Velocity Computation Method. Refer to Chapter 2, Section 2.3.6, in HEC-6 User's Manual for a discussion of the available methods.
		0	Program defaults to Method 2
		1	Original Toffaleti fall velocities
		2	Federal Interagency Sedimentation Project (FISP) method for computing fall velocities.
8	IBSHER		Bed Shear Stress Computation Method
		0,1	Program calculates bed shear stress as ãDS for clay/silt erosion and deposition.
		2	Program uses U_* from smooth wall law velocity distribution to calculate bed shear stress for clay/silt erosion and deposition.

F-7 I4-Record - Parameters Required for Sand Transport (Optional)

The presence of an **I4**-Record instructs the program that sand sizes are present. The following table of grain sizes is built into HEC-6. IASA and LASA must be selected from this table. All sizes between and including IASA and LASA will be transported.

Table A-3
Grain Size Classes for Sands and Larger

ID Number	Classification	Grain Size (mm)	Geometric Mean (mm)
1	Very Fine Sand	.062 - .125	0.088
2	Fine Sand	.125 - .250	0.177
3	Medium Sand	.250 - .500	0.354
4	Coarse Sand	.500 - 1.0	0.707
5	Very Coarse Sand	1.0 - 2.0	1.414
6	Very Fine Gravel	2.0 - 4.0	2.828
7	Fine Gravel	4.0 - 8.0	5.657
8	Medium Gravel	8.0 - 16.0	11.314
9	Coarse Gravel	16.0 - 32.0	22.627
10	Very Coarse Gravel	32.0 - 64.0	45.255
11	Small Cobbles	64.0 - 128	90.50
12	Large Cobbles	128 -256	181.02
13	Small Boulders	256 - 512	362.04
14	Medium Boulders	512 - 1024	724.08
15	Large Boulders	1024 - 2048	1448.15

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
I3 SILT        2       1       4    2.80    0.02              69     65.     5.7
I4 Yang        4       1      15
I5             0       1       0       1       0       0       1       2
```

I4-Record - Parameters Required for Sand Transport (continued)

Field	Variable	Value	Description
0	ICG, IDT	I4	Record identification
1	ISI	Comment	Any alphanumeric characters or comments
2	MTC		Transport capacity relationship to be used by program to compute sediment load for a given water discharge.
		0,1	Toffaleti Method (1969)
		2	User Specified Transport Function. User must supply his own transport relationship in the form of DS versus transport coefficients (**J**-record and **K**-record), where DS is depth times slope. See instructions for the **J** and **K**-Records for a more complete description.
		3	Madden's (1963) modification of Laursen's (1958) relationship
		4	Yang's stream power (1973)
		5	Duboy's (Brown, 1950)
		6	Einstein
		7	Ackers-White (1973)
		8	Colby (1964)
		9	Toffaleti and Schoklitsch combination
		10	Meyer-Peter and Muller (1948)
		11	Schoklitsch
		12	Toffaleti (1969) - Meyer-Peter and Muller (1948) combination
		13	Madden's (1985) modification of Laursen's (1958) relationship
		14	Laursen-Copeland
		15	~~Engelund-Hansen~~ ...Not availriab yetre

I4-Record - Parameters Required for Sand Transport (continued)

Field	Variable	Value	Description
		21	Yang-High Concentration Formula, 1996
3	IASA	+	ID number of the smallest grain size classification of sand to be transported in the calculations (see Table A-3). IASA must always be less than LASA.
		0	Default IASA = 1
4	LASA	+	ID number of the largest grain size classification of sand to be transported in the calculations (see Table A-3)
		0	Default LASA = 10
5	SPGS	+	Specific gravity of sand particles. (Not the unit weight of deposited material.)
		0	Default = 2.65
6	GSF	+	Grain shape factor
		0	Default = 0.667
7	BSAE	+	B coefficient in surface area exposed function. Equation is as follows: $FSAE = (1. - CSAE)*SAE^{BSAE} + CSAE$
		0	Default = 0.5
8	PSI	+	The parameter ø from Einstein's method [29], used to approximate **ø *** for calculating equilibrium bed elevation.
		0	Default = 30
9	UWD	+	Unit weight of deposited sediment. Specify in lb/cu ft.
		0	Default UWD = 93 lb/cu ft, a reasonable value for sand Program does not change this value with time.

F-8 I5-Record - Coefficients for Numerical Integration Method (Optional)

Use this record to enter the user selected hydraulic parameter integration coefficients. Chapter 2 , Section 2.24 of the HEC-6 User's Manual presents two sets or schemes of weighing factors for the numerical integration method used by the program. If the I5-Record is omitted, the program defaults to the Scheme 2.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
I4 Yang        4       1      15
I5             0       1       0       1       0       0       1       2
I6 MAXC        1 .301886 .301886 .150943
```

Field	Variable	Value	Description
0	ICG, IDT	I5	Record identification
1	ISI	Comment	Any alphanumeric characters or comments
2	DBI	+	Coefficient assigned to hydraulic properties at second cross section when calculating at downstream boundary.
3	DBN	+	Coefficient assigned to hydraulic properties at downstream boundary for downstream boundary calculations. **Note:** If values are entered for DBI and DBN; then DBI + DBN must equal 1.0.
4	XID	+	Coefficient assigned to hydraulic properties at cross section downstream of section of interest - interior point calculations.
5	XIN	+	Coefficient assigned to hydraulic properties at cross section of interest - interior point calculations.
6	XIU	+	Coefficient assigned to hydraulic properties at cross section upstream of section of interest - interior point calculations. **Note:** If values are entered for XID, XIN and XIU; then XID + XIN + XIU must equal 1.0
7	UBI	+	Coefficient assigned to hydraulic properties at next to last cross section for calculation at upstream boundary.
8	UBN	+	Coefficient assigned to hydraulic properties at upstream boundary. **Note:** If values are entered for UBI and UBN; then UBI + UBN must equal 1.0.
9	JSL	b,1,2	Numerical Options for Calculating Slope.
		b,1	The original HEC-6 option. The energy slopes on each side of the cross section are averaged.
		2	The $(Q/K)^2$ Slope at each cross section is weighted by the coefficients on this record.

F-11 LQ-[LT, LC]-LF-Records - Sediment Inflow Boundary Condition (Required)

The inflowing sediment load is a boundary condition. A sediment load is needed for every water discharge in the inflowing hydrograph. However, it is related to water discharge by a sediment discharge rating curve and that rating curve is then coded as a table having:

(1) water discharge on the **LQ**-Record,
(2) total sediment load in tons per day on the **LT**-Record, and
(3) the fraction of the sediment load in each grain size class on **LF**-Records.

An alternative to the LT-Record is the LC in which total sediment inflow is prescribed in units of mg/l, and the sediment discharge is calculated with the following equation

QSED (tons/day) = 0.0027*QW(cfs)*CSED(mal)

```
Example:             FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
LQ            1     100    1000   10000  100000  840000
LT  T/D   .0027    0.81    48.6   10800  270000 6804000
LF  VFS     .80     .55     .40     .35     .40     .40
LF   FS     .15     .30     .40     .30     .30     .30
LF   MS     .04     .10     .10     .15     .15     .15
LF   CS     .01     .04     .06     .12     .10     .09
LF  VCS     .00     .01     .04     .08     .05     .06
```

or

```
Example:             FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
LQ            1     100    1000   10000  100000  840000
LC  mal     1       3      18     400    1000    3000
LF  VFS     .80     .55     .40     .35     .40     .40
LF   FS     .15     .30     .40     .30     .30     .30
LF   MS     .04     .10     .10     .15     .15     .15
LF   CS     .01     .04     .06     .12     .10     .09
0LF  VCS     .00     .01     .04     .08     .05     .06
```

The Inflowing Sediment Load Relationship (continued)

F-11.1 LQ-Record - Water Discharge for Inflowing Sediment Load (Required)

Field	Variable	Value	Description
0	ICG, IDT	LQ	Record identification
1	ISI	Comment	Any alphanumeric characters or comments
2	QW(1)	+	Water discharge in cfs. Enter the first discharge value for the water discharge versus sediment load table. If the range of water discharges in the inflow hydrograph is beyond that specified in this table, the extreme values of sediment load from the table will be used (i.e. the program will not extrapolate beyond the ends of the table).
3	QW(2)	+	The second water discharge for the sediment load table. Each consecutive water discharge must be greater in value than the previous one.
4-10	QW(3) - QW(9)	+	Continue to enter increasing water discharge values in Fields 4 through 10. A maximum of nine water discharge values is permitted.

The Inflowing Sediment Load Relationship (continued)

F-11.2 [LT, LC] Record - Total Sediment Inflow (Required)

The inflowing sediment discharge, QSED, in tons/day corresponding to the water discharges coded on the **LQ-**Record which was described on the previous page. These QSED values are partitioned into sediment load by grain size class using the fractions coded on the following **LF**-Records. **An alternative to the LT-Record is the LC. Using the LC-Record, the total sediment inflow can be coded in CONCENTRATION units, mal, rather than tons/day**. Do not use both LT and LC in the same Table.

Field	Variable	Value	Description
0	ICG, IDT		Record identification
		LT	Values are coded in tons/day
		LC	Values are coded in mal (same as ppm up to 16000 mal).
1	ISI	Comment	Any alphanumeric characters or comments
2	QSED(1)	+,0	Total sediment load in tons per day. This value corresponds to the water discharge entered in Field 2 of the **LQ**-Record.
3	QSED(2)	+,0	Total sediment load in tons per day. This value corresponds to the water discharge entered in Field 3 of the **LQ**-Record.
4-10	QSED(3)-QSED(9)	+,0	Continue to enter the total sediment load values for each subsequent water discharge entered on the **LQ**-Record. A maximum of nine values is permitted.

The Inflowing Sediment Load Relationship (continued)

F-11.3 LF-Record -Fraction of Inflowing Sediment Discharge by size class (Required)

Each **LF**-Record will describe the sediment load of one grain size fraction. There must be one **LF**-Record for each grain size classification selected on records **I2** through **I4** even if the fraction of the load for any grain size equals zero. **LF**-Records should be entered from fine to coarse.

Field	Variable	Value	Description
0	ICG, IDT	LF	Record identification
1	ISI	Comment	Any alphanumeric characters or comments. (It is recommended that the grain size class be entered in the comment field, i.e. CLAY, SILT1, SILT2, VFS, FS,...VCG.)
2	QSF	0. to 1.0	The fraction for this grain size of the total sediment load corresponding to the water discharge in Field 2 of the **LQ**-Record.
3	QSF	0. to 1.0	The fraction for this grain size of the total sediment load corresponding to the water discharge in Field 3 of the **LQ**-Record.
4-10	QSF	0. to 1.0	Continue to enter the fraction of the total sediment load corresponding to each subsequent water discharge entered on the **LQ**-Record. A maximum of nine values if permitted.

F-14 PF-Record - Bed Material Gradation

The **PF**-Record is an alternative to N-Records for prescribing the gradation of the bed sediment reservoir. They utilize the percent finer curve. The sediment computations require the bed material gradation at each cross section; however, it is not necessary to enter a **PF**-Record set for every cross section in the network. The program uses the following rules to fill in for missing PF-Records. An example is shown on the next page.

a. There must be at least one **PF**-Record for each stream segment in the network. If only one **PF**-Record is present, that gradation is used for all cross sections on that stream segment.

b. The cross section ID number (i.e. river mile) is coded in Field 2 and read by the program. That ID number should correspond to one used previously on an **X1-R**ecord. If more that one **PF**-Record is present, but not one for each cross section on the stream segment, linear interpolation is used to fill in the missing data.

c. If the cross section ID number is omitted from a **PF**-Record, it will be assigned to the last cross section (i.e. the one most upstream), and values to the previous **PF-**Record will be interpolated.

d. The gradation for any cross sections before the first or after the final **PF**-Records are assigned the values on those records.

e. Do not skip grain sizes on the I2, I3, and I4-Records {i.e. When clay and silt are present, set IASL and LASL for 1 and 4, (**I3-3 and I3-4**) and set IGS = 1, (**I4-3**).} It is not necessary to calculate all 20 size classes.

f. It is not necessary for a PF-Coordinate to correspond to a grain size class interval boundary, but it can. Semi-log interpolation is used to calculate the percent finer at each class interval boundary, and these are subtracted to calculate the fraction of sediment in each size class. Therefore, use DAXIS = .001 for the smallest size -- not DAXIS = 0.

```
Example:             FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
PF         15.08                2       1      90      .5      45      .1       1
PFC .001       0
```

Field	Variable	Value	Description
0	ICG, IDT	PF	Record identification
		PFC	Record identification, continuation records
1	ISI	Comment	Comment on **PF**-Record; data on **PFC**-Records
2	SECID	-,0,+	Cross section ID number (i.e. river mile). There is not default. Do not leave this field blank.

F-14 PF-Record - Bed Material Gradation (continued)

Field	Variable	Value	Description
3	SAE	b,0	The fraction of the bed surface that is exposed to erosion. That is, a portion of the bed may be armored or partially covered with bedrock. Usually SAE is left blank in which case the program will default to 1.0.
		.001-1.0	The normal range
4	DMAX	+	The diameter of the maximum particle size. Code all diameters in millimeters. Always code a value. The program assigns a percent finer (PFXIS(1)=100) to correspond with DMAX. DMAX should be equal to the largest size being transported (I4-4). DMAX is also known as DAXIS(1).
5	DAXIS(2)	+	The grain size diameter at the first coordinate point down the percent finer curve from DMAX. If this particle size is larger than 64 mm, choose a point that will approximate the PF-Curve with two straight line segments from DMAX to 64 mm.
6	PFAXIS(2)	0,+	The percent finer corresponding to DAXIS(2). Code as a percent (e.g., enter 10 for 10 percent, 20 for 20 percent, etc.).
7-10	DAXIS-PFAXIS	0,+	Continue to code points from the percent finer curve in (grain size diameter, percent finer) pairs. Use up to three continuation **PFC**-Records to code a maximum of twenty points. Begin coding data in Field 1 on continuation records.

INPUT DESCRIPTION FOR HYDROLOGIC DATA

G-1 $HYD-Record - Hydrologic Model (Required)

The **$HYD**-Record marks the beginning of the hydrologic data. This record is required to precede discharge data records described on the following pages.

Field	Variable	Value	Description
0	ICG , IDT	$HYD	Record identification (Columns 1 through 3)

G-2   *-Record - Comment and Print Control (Required)

One comment record is required for each **Q**-Record in the hydrologic data. This record provides title information for each time step defined in the hydrologic data. It also allows the user to specify various output printing options.

```
Example:             FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q     -1      -2      -3  350000
R     .6
T                              40
W     .1
```

Field	Variable	Value	Description
0	ICG	*	Record identification (Column 1)
Column 5	CLINE		Select printout from the hydraulic computations (water surface profiles) is obtained by specifying one of the following codes in Column 5 on the *-Record.
		blank	Discharge, starting water surface elevation, water temperature and flow duration in days is printed. For this option, leave Column 5 blank, not zero. This is the standard hydraulic output option.
		A	Water surface and energy line elevations, velocity head, alpha, top width, average bed elevation, and velocity in each subsection are printed for each discharge at each cross section.
		B	Cross section coordinates at the current time and distribution of hydraulic data across the section for the final calculated water surface are printed.
		D	Trace information. (Not recommended for normal applications.) See Note on next page.
		E	Detailed Trace Information. All of the above information plus coordinates, area and wetted perimeter for each trapezoidal area in each cross section and for each trial elevation at each cross section. (Not recommended for normal applications.)

Note: Printout levels D and E produce a very large amount of output. This output was designed primarily for debugging purposes. Execution time will increase if any of these options are used.

***-Record (continued)**

Field	Variable	Value	Description
Column 6	CLINE		Select printout from sediment transport computations.
		blank	No printout except summary at end of job. For this option leave Column 6 blank, not zero.
		A	A table showing the volume of sediment entering and leaving each segment and the computed trap efficiency for each segment.
		B	In addition to A, the bed change from the initial elevation in feet, water surface elevation in feet, bed thalweg elevation in feet, sediment load passing in tons/day for clay, silt and sand. This and all higher level selections cause a "solution file" to be written at this time step for post-processing purposes.
		C	A detailed printout of calculations (in addition to the above)
		D	In addition to the above values from Toffaleti's procedure showing the detailed distribution by grain size fraction for the bed surface material at each cross section before the values are corrected by percentage present in the bed. (Not recommended for normal applications.)
		E	Detailed trace for debugging purposes in addition to the above. (Not recommended for normal applications.)
2-10	Comment		Comment data for discharge-elevation-duration data that follows. Use the remainder of this record to provide title/comment information for this time step. This data will appear in the output

Note: Printout levels D and E produce a very large amount of output. This output was designed primarily for debugging purposes. Execution time will increase if any of these options are used.

***-Record (continued)**

Field	Variable	Value	Description
Column 8	CLINE		Select printout from Hardy Cross Calculations
		blank	No printout
		A	A-Level printout from Hardy-Cross Method provides a table of Final Flows for this event.
		B	Flows in each segment and discharge error at convergence
		C	Conveyance data and detailed Hardy-Cross Flow Distribution Calculations. (Excessive printout - use only for Program Debugging)

G-3 Q-Record - Water Discharge Entering the Model(Required)

The water discharge entering the model is prescribed on the Q-Record, but **IT IS DIFFERENT FROM PREVIOUS VERSIONS OF HEC-6**. This Q-Record contains water discharges entering each segment of the network at the **UPSTREAM** end rather than leaving at the downstream end. When there is only 1 segment and no local inflow points, the record is the same as old versions of HEC-6. However, when local inflows are present or when there are several segments, new Q-Records must be coded.

The program associates Discharge with location in the network by the position of that discharge on the Q-Record. Field 1 is always the Downstream most inflow point. The program expects the discharges to be coded in sequence by segment. See the printout table entitled NETWORK STRUCTURE.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q      -1      -2      -3  350000
R      .6
T                              40
W      .1
```

Field	Variable	Value	Description
0		Q	RECORD Identifier goes in Columns 1-2
1	Q(1)	+	The First Water discharge entering the network. This is assigned to the first segment to have a water inflow boundary condition. It could be a Local inflow or it could be the upstream boundary condition inflow.
		-	Code as negative if flow is in the upstream direction or if it is a local outflow.
2	Q(2)	+	The second water discharge entering the network. Continue coding the inflows in the sequence of the segments until all inflow points have been satisfied.
		-	Etc.
10	Q(I)	+,-	If more than 10 values are required, continue coding in FIELD 1 of the next Q-Record.

G-4 R-Record - Downstream Water Surface Elevation Boundary Condition (Required)

A starting water surface elevation is required at the downstream boundary of the model for every time step. HEC-6 provides three methods for prescribing this downstream boundary value: (1) a rating curve, (2) **R-**Records, or (3) a combination of a rating curve and **R-**Records.

The first method involves the use of a rating curve which can be specified using a **$RATING-**Record followed by a set of **RC-**Records containing the water surface elevation data as a function of discharge. The rating curve need only be specified once at the start of the hydrologic data (immediately following the **$HYD-**Record) and a water surface elevation will be determined by interpolation using the discharge given on the **Q-**Record for each time step. The rating curve may be temporarily modified using the **S**-Record or replaced by entering a new set of **$RATING** and **RC-**Records before and *****-Record in the hydrologic data.

In Method 2, **R-**Records are used **instead** of a rating curve to define the water surface elevation. To use this method, and **R**-Record is required for the first time step. The elevation entered in Field 1 of this record will be used for each succeeding time step until another **R**-Record is found with a non-zero value in Field 1 to change it. In this way, you need only inset **R**-Records to change the water surface elevation to a new value.

Method 3 is a combination of the first two methods. This method makes it possible to use the rating curve most of the time to determine the downstream water surface elevation while still allowing the user to specify the elevation exactly at given time steps. In this method, the **R-**Record's non-zero Field 1 value for the downstream water surface elevation will override the rating curve for that time step. On the next time step, the program will go back to using the rating curve unless another **R**-Record is found with a non-zero value in Field 1.

R-Records have a secondary purpose. They are used to define the water surface elevation at certain internal control points in the geometry. The location of internal control points is defined using **X5**-Records. **R-**Records are necessary to define the water surface at those internal control points where the UPE option on the **X5**-Record has not been set (**X5.2**) and
the active field value is prescribed. The water surface elevation (UPE) for that time step will be read from the **R-**Record at the field prescribed on the **X5**-Record (**X5.4**). Note that if a value is given for HLOS (head loss) on the **X5**-Record, that value **will** be used in conjunction with the water surface elevation (UPE) value found on the **R**-Record.

R-Record (continued)

In the case of a distributary, code the elevations across the R-Record in the sequence of the Segments: i.e. Code the Elevation for Segment 1 in field 1, the Elevation for Segment 2 in field 2, etc. The program will retain these elevations. Enter new values when the elevations need to be changed.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q      -1      -2      -3  350000
R      .6
T                               40
W      .1
```

Field	Variable	Value	Description
0		R	Record Identifier goes in Column 1
1	R()	+	The Water Surface Elevation for Segment 1
2	R()	+	In the case of a distributary, enter the Water Surface Elevation for segment in Field 2.
	.		
	.		
	.		
10	Q()	+	If more than 10 values are required, continue coding in FIELD 1 of the next Q-Record.

G-6 T-Record - Water Temperature (Optional)

The **T**-Record provides water temperature data (refer to Chapter 3, Section 3.4.2 in the HEC-6 User's Manual). This record is required only in the first time step. Include subsequent **T-**Records only if the water temperature changes. The water temperature(s) entered on this record will remain in effect until another **T-**Record is entered to change it. Water temperature is important for computing sediment settling velocity. It becomes more importance as particle size becomes smaller.

The water temperature is still prescribed on the T-Record, but **IT IS DIFFERENT FROM PREVIOUS VERSIONS OF HEC-6**. The T-Record in HEC-6T contains water temperature for discharges entering each segment of the network at the **UPSTREAM** end rather than the values leaving at the downstream end.

Code a water temperature for each inflowing water discharge on the Q-Record as shown in the following example. The 350,000 cfs value is the main-stem inflow, and the water temperature is 40 degrees Fahrenheit. The negative Q's are local outflows, and the program uses the ambient water temperature for outflows. Any inflow, be it main-stem or local, must have a water temperature value.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q     -1      -2      -3  350000
R     .6
T                             40
W     .1
```

Field	Variable	Value	Description
0		T	Record Identifier goes in Column 1
1	WT(1)	$33 < WT < 211$	Temperature for the Water Discharge in Q.1
2	WT(2)	"	Temperature for the Water Discharge in Q.2
	.		
	.		
	.		
10	WT(I)	"	If more than 10 values are required, continue coding in FIELD 1 of the next T-Record.

G-7 W-Record - Computation Time Step (Required)

The **W-**Record contains the computation time step. The water discharge hydrograph is partitioned into short intervals for calculating the sedimentation processes. Each interval is called an EVENT. The water discharge is constant during each event, and the length of the event becomes the computation time step for the numerical integration. Each time step can be different (refer to Chapter 3, Section 3.4 and Figure 3.7 of the HEC-6 User's Manual).

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q     -1      -2      -3   350000
R     .6
T                               40
W      1
```

Field	Variable	Value	Description
0	ICG	W	Record identification (Column 1)
	DD(1)	+	**The computation time step**. Code this time in days or fractions of a day.
2-10	DD(2)..DD(10)	+	**Obsolete - The parallel discharge option should not be used.**

G-8 X-Record - Alternate Format for Coding Computational Time Step

The **X**-Record may be used to define the computation time step, in place of the **W**-Record. The purpose, of the X-Record is to partition the time of a single event, the time on a **W**-Record, into shorter intervals for the numerical computations. For example, this need arises when unstable computation steps are not detected until after the hydrologic data has been assembled using the traditional **W**-Record approach. The **X-R**ecord allows the computation time interval to be shortened without requiring additional event data sets (***, Q, W**-Record sets) to be inserted into the hydrologic data. To use X-Records, replace the **W-Record** with an **X-Record** coded with one of the following options.

Note: When printing with X-Records, only the final computation step is printed. This is appropriate for displaying results, but it is misleading when debugging. Always convert X-Records to W-Records when debugging.

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q     -1      -2      -3  350000
R     .6
T                             40
X             .1       1
```

Coding Option #1

Field	Variable	Value	Description
0	ICG	X	Record identification (Column 1)
1			Leave blank
2	DT	+	**Computation Time** in days. Should be the exact multiple of the duration of this event.
3	DD	+	**The Duration** of this event in days. This is the value coded in a **W-**record: i.e. DD ÷ DT is the number of computational time steps that will be used.
4-10			Leave blank

X Record - (Continued)

Coding Option #2

This coding option is useful for prescribing the exact time for the event. It must be the total accumulated time since the start of the run.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q      -1      -2      -3  350000
R      .6
T                              40
X       1      .1
```

Field	Variable	Value	Description
0	ICG	X	Record identification (Column 1)
1	TCH	+	The Total Accumulated Time in days at the end of this event. This value must be greater than the accumulated time at the end of the previous event. The duration of this event equals TCH minus the accumulated time at the end of the previous event.
2	DT	+	Computation time step in days. Should be the exact multiple of the duration of this event. Event duration divided by DT equals the number of computational time steps that will be used.
3-10			Leave blank

X Record - (Continued)

Coding Option #3

This coding option is useful for partitioning a computation time step into ***n***-sub intervals.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*    B A EVENT 0 .. CONDITION THE NETWORK
Q     -1      -2      -3  350000
R     .6
T                             40
X             1                4
```

Field	Variable	Value	Description
0	ICG	X	Record identification (Column 1)
1			Leave blank
2	DT	+	Computation time step in days
3			Leave blank
4	INT		The number of computational sub-intervals that will be used
5-10			Leave blank

G-9 $$END-Record - Required

Last record in the data file.

Field	Variable	Value	Description
0	ICG, IDT	$$END	Record identification (Columns 1 through 5)

INPUT DESCRIPTION FOR SPECIAL COMMANDS AND PROGRAM OPTIONS

H-7 $K-Records - Channel n-values by Relative Roughness (Optional)

The model ignores the prescribed Manning's n-values for the channel (**NC** or **NV**-Records) when a **$KL**-Record is encountered and calculates bed roughness as a function of the bed material gradation via Limerinos' (1970) relative roughness method (see Chapter 3 in the HEC-6 User's Manual). To return to standard n-values insert a **$KI**-Record.

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
$KB             2
```

Field	Variable	Value	Description
0	ICG, IDT	$K	Record identification (Columns 1 and 2)
COL=3		I	Use n-values from Input NC or NV-Records
		B	Calculate bed roughness using Brownlie Equations
		L	Calculate bed roughness using Limerinos Equation
COL=2&3		IG	Must tell program to Ignore the error test for bank roughness values when using a B or L option to calculate bed roughness in a 3-strip model.
1	MCHRUF		Methods for Compositing Channel n-values when bed and banks are prescribed separately. Overbank n–values are not included in the compositing.
		0	No Compositing. Use this for a 3 strip model.
		1	Alpha Method. Only recommended for very wide channels.
		2	Equal Velocity Method.

H-10 $PLOT-Record - Plot Option

The Plot command instructs the program to write output files in DSS form. To plot with MBH Graphics, attach a P to the plot command as follows: $PLOTP. The available plots are explained in Chapter 10 and summarized in the table below. The $PLOT-Record is inserted in the HYDROLOGIC DATA SET after the event for which the plot(s) is(are) desired.

```
      VPLOT(1)  = TOTAL WATER DISCHARGE
      VPLOT(2)  = CHANNEL DISCHARGE
      VPLOT(3)  = TOP WIDTH
      VPLOT(4)  = AVERAGE BED ELEVATION
      VPLOT(5)  = SLOPE
      VPLOT(6)  = CHANNEL VELOCITY
      VPLOT(7)  = CHANNEL N-VALUE
      VPLOT(8)  = WATER SURFACE ELEVATION
      VPLOT(9)  = BED SURFACE ELEVATION
      VPLOT(10) = EFFECTIVE WIDTH
      VPLOT(11) = EFFECTIVE DEPTH
      VPLOT(12) = SAND DISCHARGE RATE
      VPLOT(13) = SILT DISCHARGE RATE
      VPLOT(14) = CLAY DISCHARGE RATE
      VPLOT(15) = X-SECTION COORDINATES
      VPLOT(16) = X-SECTION WITH WS ELEV
      VPLOT(17) = TOP BANK PROFILES
      VPLOT(18) = ACCUM VOLUME PROFILES
      VPLOT(19) = ACCUM SURF AREA PROFS
      VPLOT(20) = TOTAL CLAY INFLOW, TONS
      VPLOT(21) = ACCUM CLAY DELIVERY,TONS
      VPLOT(22) = TOTAL SILT INFLOW, TONS
      VPLOT(23) = ACCUM SILT DELIVERY,TONS
      VPLOT(24) = TOTAL SAND INFLOW, TONS
      VPLOT(25) = ACCUM SAND DELIVERY,TONS
      VPLOT(26) = ACCUMULATED DEP/ER, CY
      VPLOT(27) = CHANGE IN AVG BED ELEV.
      VPLOT(28) = MAX/MIN Q PROFILES
      VPLOT(29) = MAX/MIN WS ELEVATIONS
      VPLOT(30) = MAX/MIN BED ELEVATIONS
      VPLOT(31) = MAX/MIN SED DISCHARGE
      VPLOT(32) = MAX/MIN SED CONC
      VPLOT(33) = SHEAR STRESS & THRESHOL
```

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
$HYD
$PLOTP TITLE = "HOTOPHIA CREEK, 1977"  9,15
*
Q
```

$PLOT-Record - Plot Option (continued)

The PLOTP-Record is read with a free field format. It must contain the word TITLE (ALL CAPS) for the code to expect a titling string. Put the titling string in " ". The title can be up to 20 Characters. Separate the plot numbers with a comma or a blank. Both Title and Plot numbers can be changed within the run. VPLOT numbers 9 and 15 are the initial bed profile and the cross sections in the model. No hydraulic or sediment output are available for plotting because this position in the data file comes before the first event.

H-11 $PRT-Record - Selective Printout Option

This data set does not request output. It restricts print and cross section plot output to selected cross sections. (SEE description of columns 5 and 6 on the *-Record, Hydrologic Data Set.)

The selective output will remain in effect until it is turned off by a subsequent $PRT-Record.

Normally, selective printout will control all cross section output except the B-Level Table for Sedimentation output. It is possible to also include that table in the selective printout by requesting the B Option on the $PRT-Record.

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

*    B  RUN 4
Q  90000   10000
W      1
$PR
CP      2       2
PS  0.78
CP      2       3
PN      1       2
*    C  RUN 5
Q  90000   10000
W      1
```

Field	Variable	Value	Description
0	ICG, IDT	$PRT	Record identification (Columns 1 through 4)
Column 8	ISI(6)	N	Turn Printout OFF at all sections.
		A	Turn Printout ON at all sections.
"	PRINTBL		Option to apply Selective Printout to SB-2 Tables
		B	Only those Cross Sections Selected on the following PN or PS-Records will be printed in the SB-2 Table.
		blank	The SB-2 Sediment Table is not affected by selective printout.

H-11.1 CP-Record - Control Point for Selective Printout

The **CP-**Record prescribes the stream segment for which the cross sections on the following **PN** or **PS-**Record(s) apply.

Field	Variable	Value	Description
0	ICG, IDT	CP	Record identification
1	NCP	+	Control Point Number
		b	In this case, the program only uses the Stream Segment Number so NCP can be left blank.
2	NGDS	+	Stream segment number

H-11.2 PN-Record - Cross Section Sequence Number for Selective Printout

Use the **PN**-Record to prescribe the cross section sequence number where output is desired. The limit is 10 cross sections. Note that each PN-Record must follow a CP-Record to prescribe the segment of the network for which print out is being requested.

Field	Variable	Value	Description
0	ICG, IDT	PN	Record identification
1-10	IPXS	+	Enter the index numbers of the desired cross sections. No. 1 is the downstream most cross section on the segment. Count in the upstream direction. Restart the count at 1 for each new segment in the network. The program prints output for the IPXSth cross section on segment NGDS (**CP**.2).

H-11.3 PS-Record - Cross Section Identification(River Mile) for Selective Printout

Use the **PS**-Record to prescribe the cross section identification (channel station or river mile) number where output is desired. The limit is 10 cross sections.

Field	Variable	Value	Description
0	ICG, IDT	PN	Record identification

1-10	SECID	+	This record works exactly like the PN-Record. Sometimes it is more convenient to prescribe cross section identification rather than sequence number. Enter up to 10 cross section identification (X1-1) values. The program will location those cross sections in the cross section array and determine the proper sequence number for printout.

H-12 $RATING Tailwater Rating Curve Boundary Condition (Optional)

H-12.1 $RATING-Record

HEC-6 provides two methods for prescribing the downstream boundary condition (i.e. the tailwater). One is the R-Record and the other is a tailwater rating curve.

The **$RATING-**Record tells the program that a set of **RC**-Records, containing the rating curve points, will follow. A new **$RATING** can be input, or an existing one changed, between EVENT DATA SETS in the hydrologic data. The following example shows one, along with some other Command Records, before the first event data set.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

$HYD
$KI     2
$RATING 1
RC           31    1000       0      -6   198.0   198.3   200.1   202.1   204.0
RC        206.0   206.8   207.4   208.0   208.8   209.5   210.0   210.5   211.0
RC        211.5   212.0   212.6   213.0   213.5   214.0   214.5   214.9   215.3
RC        215.7   216.2   216.6   216.9   217.3   217.7   218.1   218.6
$SED
LR NONAM             .1       3       1
*   AB    Event 1
Q   2000
T     55
W     .1
...
```

Field	Variable	Value	Description
0	ICG, IDT	$RATING	Record identification (Columns 1 through 7)
2	NCPDB	1,3	Control point number where this Rating Curve applies (Note: Program uses a Free Field Read to extract this numeric data.)

H-12.2 RC-Record - Tailwater Rating Curve Data

Field	Variable	Value	Description
0	ICG, IDT	RC	Record identification
1			Leave blank
2	MNI	+	The number of water surface values that will be read. (May not exceed forty).
3	TINT	+	The discharge interval between water surface values in cfs. Use as small as interval as desired, but it must be a constant for the full range of water surface elevations that follow.
4	QBASE	+	If the first discharge in the table is not zero enter its value here in cfs.
5	GZRO	+	If the rating table is a stage-discharge curve rather than elevation-discharge, enter gage zero here.
6	RAT(1)	+	Lowest **water surface elevation or stage** goes here.
7-10	RAT(2)... RAT(MNI)		Continue entering **water surface elevation or stage values** defining the rating curve using Fields 7-10 on this record and Fields 2-10 on continuation **RC**-Records. A maximum of forty points can be entered to define the curve.

H-13 $SED-Record - Water Discharge-Sediment Load Table (Optional)

This program command option allows the user to change a sediment load table during a simulation. A change to a sediment load table can be made by either entering a new sediment load table definition on **LP, LQ, LT** and **LF-**Records or by altering the existing table with a ratio defined on **LP** and **LR-R**ecords. However, the new table must have **the same number of columns and rows as the original table.**

A **$SED** command precedes a **LP, LQ, LT, LF-**Record combination that defines the discharge-sediment load rating curve. It can also precede a **LP, LR**-Record combination (see **LR**-Record). The **LP**-Record is used to specify the location where the modified sediment load table applies. It is required with either the **LQ, LT** and **LF**-Records or with the **LR**-Record. An **END-**Record is required as the last record to close the **$SED** option.

If the sediment load table for the main stem or a tributary is to be replaced, see the input descriptions for the **LQ, LT** and **LF-**Records for the Sediment data set. However, if the sediment load table for a local inflow or outflow is to be replaced, refer to the input description for the **LQL, LTL,** and **LFL**-Records in the Sediment data set instead (i.e. **LQ, LT, LF**-Records are used for the main channel and tributaries. The **LQL, LTL** and **LFL**-Records are used for local inflows and outflows).

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

$SED
$LOCAL
LP MAIN        1
LQ cfs         1  100000
LT t/d     .0002  500000
LF vfs       .20     .10
LF  fs       .35     .30
LF  ms       .20     .25
LF  cs       .20     .20
LF vcs       .05     .15
END
```

Field	Variable	Value	Description
0	ICG, IDT	$SED	Record identification (Columns 1 through 4)

H-13.1 LP-Record - Inflow Point Identification for Changing the Inflowing Load Table (Optional)

The **LP-**Record defines the stream segment and/or inflow point whose sediment load table will be modified by the succeeding **LQ, LT, LF,** or **LR-**Records.

NOTE: This version of HEC-6T REQUIRES A DIFFERENT LP-RECORD THAN WES VERSIONS OF HEC-6. ALSO, THE LPOINT-RECORD IS NOT AVAILABLE FOR HEC-6T AT THIS TIME.

Field	Variable	Value	Description
0	ICG, IDT	LP	Record identification
1	ISI	Comment	Any alphanumeric character comment
2	NGDS	+	Segment number
3	NLIP	b,0,+	Local inflow/outflow point number. Blank is the same as 0 = no local inflow/outflow points
4	NCP	b,0,+	Control point number
5	IDSD	b	Identifier. Leave blank for LQ-LT-LF-Records
		1	Enter 1 for LQ-SD-Records
6-10			Leave blank

H-13.2 LR-Record - Ratio for Changing the Sediment Load Table (Optional)

When changing the sediment discharge with the **$SED** option, the existing sediment-discharge load table can be modified by entering an **LR**-Record with a multiplier constant, rather than by entering a whole new table. The following set of records are required to enter a change in the sediment discharge table using a load ratio.

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

$SED
LR             2      .9       1
LR                    .9       1       1
```

Field	Variable	Value	Description
0	ICG, IDT	LR	Record identification
1	ISI	Comment	Any alphanumeric character comment
2	NCP	+	The Control Point number of sediment rating table to modify. (Usually the upstream end of the segment.) Required for main stem tables.
		0	Not needed for local inflows. (See Fields 4 and 5)
3	RATIO	+	The existing sediment-discharges in the rating table will be multiplied by RATIO.
4	NGDS	+	Enter the segment number
		0	Not required for main stem inflows, but it helps interpret some printout tables. (See Field 2)
5	NLIP	+	Local inflow point Number on this segment. The numbering starts over with 1 at the downstream end of each new segment. Numbers increase in the upstream direction.
		0	Not needed for main stem inflows. (See Field 2)

H-13.3 LRATIO-Record - Ratio for Changing Sediment Load Table (Optional)

When changing the sediment discharge with the **$SED** option, the existing sediment-discharge load table can be modified by entering a **LRATIO-**Record with a multiplier constant, rather than by entering a new sediment load table.

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567
*
Q
W
$SED
LRATIO         2       1      .8
*    B ...
```

Field	Variable	Value	Description
0	ICG, IDT	LR	Record identification
1	ISI	Comment	Any alphanumeric character comment
2	NGDS	+	The Segment Number for the sediment rating table
3	NLOC	+	Enter the Local Inflow Point number. It starts at 1 for each new segment.
		b,0	Not a local inflow load table
4	RATIO	+	The existing sediment-discharges in the rating table will be multiplied by RATIO.

H-13.4 END-Record - Termination Record for the $SED Option

An **END-**Record is used to indicate the end of the changes made to the sediment load table(s). This record should be inserted after the last **LR** or **LF**-Record. If changes are to be made to more than one sediment load table sets of **LR** or LP-Record**, LQ, LT, LF**-Records may be stacked one after another. Insert the **END** -Record only after the last set of change records.

Field	Variable	Value	Description
0	Icg, IDT	END	Record identification (Columns 1 through 3)

H-14 $SUBSID-Record - Subsidence Option

This option allows areas to be modeled which are either settling or rebounding due to subsidence or uplift. It requires that each cross section be assigned a subsidence rate. (SEE HE-Records in the Geometric Data Set.)

```
Example:           FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

$HYD
$SUBSID       ON      ON      ON      ON       0      10
*    B  RUN 1
Q  90000   10000
W      1
```

Field	Variable	Value	Description
0	CLINE	$SUBSID	Record identification (Columns 1 through 7)
2	ISIDEX	ON,OFF	Command tells code whether or not to include cross section elevations in the Subsidence. (Note: SEE HE-Record for Rate of Subsidence)
3	ISIDEB	ON,OFF	Command tells code whether or not to include Tailwater Elevation in the Subsidence. (I.e. R or $Rating Curve)
4	ISIDED	ON,OFF	Command tells code whether or not to include Dredged Channel Template in the Subsidence. (H_-Records)
5	ISIDEV	ON,OFF	Command tells code whether or not to include $VOL Elevations in the Subsidence. (See VJ- & VR-Records)
6	SIDETI	0,+	Enter the Time-in-Days between Subsidence calculations. In some cases it is not necessary to correct for subsidence every event and some computer time can be saved using this option.
7	SIDETS	0,+	Scaling Factor = Calendar Time/Model Hydrograph Time. The Subsidence rate is coded as feet/year. (This ratio is provided for those cases when low-low days are omitted from the model hydrograph. Fewer than 365 days will make a year.)

H-15 $TAPE12-Record - END OF RUN Data Set (Optional)

This command record controls writing the END OF JOB data file. Make this the first Record in the Data File. It has the general form:

$TAPE12 KT12=[ON,OFF], HE=[OLD,NEW,OFF], HL=[OLD,NEW,OFF], SED [ON,OFF], PF=[OLD,NEW,OFF], OF=[OLD,NEW,OFF], HYD[OLD,NEW,OFF]

Options:

1. If the $TAPE12-Record is omitted, the program defaults to the historical option. (i.e. The geometric data file is written.) However, that file is now a complete geometric data set for HEC-6T whereas the historical option provided only the X1-GR-Records.

2. There is not an option to write a HEC-2 compatible TAPE12 file; however, the following command will write the X1-X3-GR and NC-NV-NH-Records into a file which can be edited for HEC-2.

```
 Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

$TAPE12 X3=ON, HE=OFF, HL=OFF, SED=OFF, HYD=OFF
$SEG   1       2       1
```

3. To write a $TAPE12 file that will save the updated cross sections and the updated sediment gradations from the end of a run and then copy any hydrology data below the $$END-Record from the original *.T5 file, use the following command:

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

 $TAPE12 HE=OLD, HL=NEW, PF=NEW, OF=NEW, HYD=NEW
$SEG    1      2       1
```

4. To write a $TAPE12 file that will save the updated cross sections and the updated sediment gradations from the end of a run and then copy all hydrology data below the $HYD-Record from the original *.T5 file, use the following command:

```
Example:            FIELDS
1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567 1234567

 $TAPE12 HE=OLD, HL=NEW, PF=NEW, OF=NEW, HYD=OLD
$SEG   1       2       1
```

$TAPE12-Record - (continued)

Field	Variable	Value	Description
(0)		$TAPE12	Record Identification. **Use Upper Case Letters** for all Data on this Record.
	KT12		Write a TAPE12 at the END OF RUN
		b, ON	The default option is ON I.e. A *.T12 File will be written at the END OF JOB if no $TAPE12-Record is supplied.
		OFF	Prevents the program from writing a .T12 file
	HE		Options for writing HE-Record (Erosion Limits) into the *.T12 File
		OLD	Copy the HE-Records from the .T5 file
		NEW	Write HE-Records using Erosion Limits at the END OF RUN
		OFF	No HE-record will be written into the .T12 File
	HL		Options for writing HL-Record (Limits of Bed Sediment Reservoir) into the *.T12 File
		OLD	Copy the HL-Records from the .T5 file
		NEW	Write HL-Records using values from END OF RUN
		OFF	No HL-record will be written into the .T12 File
	HYD12		Options for writing HYDROLOGIC DATA into the *.T12 file
		OLD	Copy the HYDROLOGIC DATA from the *.T5 File Beginning with $HYD
		NEW	Copy the HYDROLOGIC DATA from the *.T5 File Beginning after $$END
	PF		Options for writing PF-Records (Gradation of Bed Sediment Reservoir) into the *.T12 File
		OLD	Copy the PF-Records from the .T5 file
		NEW	Write PF-Records using values from END OF RUN
		OFF	No PF-records will be written into the .T12 File

$TAPE12-Record - (continued)

Field	Variable	Value	Description
	OF		Options for writing OF-Records (Gradation of Bed Surface) into the *.T12 File
		OLD	Copy the OF-Records from the .T5 file
		NEW	Write OF-Records using values from END OF RUN
		OFF	No OF-records will be written into the .T12 File
	NEWX3		Options for writing X3-Records (Ineffective Flow Area) into the *.T12 File
		OLD	Copy the X3-Records from the .T5 file.
		NEW	Write X3-Records using values from END OF RUN
		OFF	No X3-Records will be written into the .T12 File
	NEWXB		Options for writing XB-Records (Separate Bed & Bank) into the *.T12 File
		OLD	Copy the XB-Records from the .T5 file
		NEW	Write XB-Records using values from END OF RUN
		OFF	No XB-records will be written into the .T12 File
	NEWXC		Options for writing XC-Records (Separate Bed & Bank) into the *.T12 File
		OLD	Copy the XC-Records from the .T5 file
		NEW	Write XC-Records using values from END OF RUN
		OFF	No XC-Records will be written into the .T12 File
	NEWXD		Options for writing XD-Records (Separate Bed & Bank) into the *.T12 File
		OLD	Copy the XD-Records from the .T5 file
		NEW	Write XD-Records using values from END OF RUN
		OFF	No XD-records will be written into the .T12 File

$TAPE12-Record - (continued)

Field	Variable	Value	Description
	NEWXL		Options for writing XL-Records (Conveyance Limits) into the *.T12 File
		OLD	Copy the XL-Records from the .T5 file
		NEW	Write XL-Records using values from END OF RUN
		OFF	No XL-records will be written into the .T12 File
	SED12	b, OFF	The default option is OFF No Sediment Data will be written. (I.e. Sediment Data begins with the T4-Record and ends with LOCAL Inflow/Outflow Load Records.)
		ON	Write sediment data as requested by PF and OF options

INDEX