6.5 Example Problem 5 - Reservoirs

HEC-6 simulates reservoirs by allowing the water surface elevation at the reservoir location to be a function of time, as defined by input data. The hydraulic computations are still steady state; therefore, there is no routing of the water (i.e outflow equals inflow at all times).

6.5.1 Reservoir Data

Example Problem 5 input is shown in Table 6-5a and illustrates the data for a problem with two reservoirs; one at the downstream boundary (Section No. 1.0) and one at Silver Lake - which begins at Section No. 35.0 and extends upstream to Section No. 53.0 (much farther upstream than is illustrated in Figure 6-1). Section No. 33.3 is at the approximate upstream extent of the pool for the downstream reservoir and Section No. 53.0 is at the upstream end of Silver Lake. The operation of the downstream reservoir is simulated by the time history of pool elevations entered in field 1 of the R records in the flow data. Similarly, the X5 record at Section No. 35.0 that defines the downstream boundary of the Silver Lake reservoir indicates that the time history of pool elevations will be in Field 2 of the R record. The X5 record at Section No. 53.1 marks the upstream limit of Silver Lake. The two X5 records divide the model into 3 subreaches; the first, which represents the downstream reservoir, is bounded by Sections 1.0 and 33.9, the second subreach, Silver Lake, is bounded by Sections 35.0 and 53.0, and the third, the contributing upstream reach, is bounded by Sections 53.1 and 58.0. Thus the information produced for each subreach can be used to analyze the behavior of the two reservoirs and the contributing upstream reach.

Table 6-5a
Example Problem 5 - Input
Reservoir Model

```
T1      EXAMPLE PROBLEM NO 5.  RESERVOIRS.
T2      2 RESERVOIRS, 3 LOCAL INFLOWS.
T3      SOUTH FORK, ZUMBRO RIVER     ** Example Problem 5 **
NC    .1      .1     .04      .1      .3
X1   1.0      31  10077.  10275.      0.      0.      0.
GR 1004.   9915.   978.4  10002.   956.0  10060.   959.2  10077.   959.3  10081.
GR 950.0  10092.  948.48  10108.   946.6  10138.   944.7  10158.   955.2  10225.
GR 956.2  10243.   958.9  10250.   959.8  10275.   959.8  10300.   959.9  10325.
GR 958.8  10350.   957.4  10400.   970.0  10700.   966.0  10960.   970.0  11060.
GR 968.0  11085.   968.0  11240.   970.0  11365.   970.0  11500.   970.0  11615.
GR 962.0  11665.   962.0  12400.   976.0  12550.   980.0  12670.   982.0  12730.
GR 984.0  12735.
HD   1.0     10.  10081.  10250.
NV    22    .045   965.6    .064   988.8
NV    12     .08   965.6     .13   988.8
NV    33      .1   965.6     .11   982.0     .12   988.8
X1  15.0      27  10665.  10850.   3560.   3030.   3280.
X3                        10700.   961.0  11000.   970.0
GR 992.0   9570.   982.0  10110.   976.0  10300.   976.0  10490.   966.0  10610.
GR 964.7  10665.   956.0  10673.   953.0   10693   954.0  10703.   955.6  10723.
GR 958.6  10750.   959.3  10800.   957.0  10822.   957.3  10825.   961.5  10850.
GR 962.0  10852.   964.0  10970.   966.0  11015.   961.0  11090.   962.0  11150.
GR 970.0  11190.   972.0  11310.   980.0  11410.   984.0  11570.   990.0  11770.
GR 990.0  11865.  1000.0  12150.
HD  15.0     10.  10673.  10852.
  CASCADE CREEK - LOCAL INFLOW
QT
NC    .1      .1     .05
X1  32.0      29  10057.  10271.   3630.   3060.   4240.
GR 998.0   9080.   982.0   9250.   982.0   9510.   980.0   9600.  980.01   9925.
GR979.48  10000.   978.5  10057.   968.6  10075.  959.82  10087.   956.5  10097.
GR 956.8  10117.   957.8  10137.   959.4  10157.   959.6  10177.  959.82  10196.
GR 966.5  10225.   971.2  10250.   978.5  10271.   978.5  10300.   978.6  10350.
GR978.91  10370.  978.96  10387.   980.0  10610.   982.0  10745.   982.0  11145.
GR 984.0  11150.   992.0  11240.  1000.0  11330.   1008.  11425.
HD  32.0     10.  10075.  10275.
X1  33.0      21   1850.   2150.   3130.   3250.   3320.
XL                  250.
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
```

```
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.
HD  33.0      0.   1851.   2149.
   NOTE:      Section 33.3 is a duplicate of Section  33.0.
X1  33.3      21  1850.0  2150.0   1550.   1750.   1750.     .95    1.49
XL                  250.
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.
HD  33.3      0.   1851.   2149.                                 .95    1.65
  Section 33.9 is a duplicate of Sec 33.3, needed to model IBC at Sec 35.0
X1  33.9      21  1850.0  2150.0   1050.   1050.   1050.
X3    10
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.
HD  33.9      0.   1851.   2149.
X1  35.0      22   9894.  10245.       0       0       0
X3    10
X5                             2
GR 984.0   9035.   980.0   9070.   978.0   9135.   980.0   9185.   982.0   9270.
GR 980.0   9465.   981.7   9595.   983.7   9745.   984.7   9894.   963.4  9894.1
GR 963.3   9954.   967.1   9974.   967.4  10004.   968.2  10044.   967.6  10054.
GR 973.4  10115.   977.4  10120.   983.7  10155.   984.0  10245.   982.0  10695.
GR 982.0  10895.  1004.0  11085.
HD  35.0      0.   9954.  10155.
  - - -  SILVER LAKE  - - -
NC   .06     .06    .045
X1  42.0      32   9880.  10130.   5370.   5000.   5210.
GR 996.0   7130.   998.0   7310.   998.0   7930.   992.0   8205.   990.0   8495.
GR 988.0   8780.   986.0   8990.   985.7   9570.   986.4   9707.   989.4   9857.
GR 990.0   9880.   969.8   9881.   969.8   9941.   985.8   9941.   985.8   9943.
GR 969.8   9943.   969.8  10001.   986.7  10001.   986.7  10003.   969.8  10003.
GR 969.8  10067.   985.8  10067.   985.8  10069.   969.8  10069.   969.8  10129.
GR 989.9  10130.   989.5  10180.   988.6  10230.   987.6  10280.   985.2  10430.
GR 986.8  11720.   989.9  12310.
HD  42.0      0.   9881.  10021.
  SILVER CREEK - LOCAL INFLOW
QT
X1  44.0      28   9845.  10127.   3200.   3800.   3500.
XL                         9850.0 10200.0
GR 1002.   8035.   992.0   8150.   990.0   8305.   990.0   8735.   988.0   8835.
GR 996.0   9285.  1017.6   9425.   990.0   9505.   986.0   9650.   984.1   9788.
GR 980.6   9845.   970.9   9868.   972.2   9898.   970.5   9968.   967.5   9998.
GR 968.9  10028.   967.4  10058.   967.1  10078.   971.9  10118.   976.8  10127.
GR 977.8  10150.   976.9  10193.   982.0  10206.   981.2  10300.   979.2  10325.
GR 983.1  10400.   999.8  10450.  1002.4  10464.
HD  44.0     10.   9868.  10193.
X1  53.0      22  10000.  10136.   3366.   2832.   2942.
GR 1004.   7550.  1000.0   7760.   998.0   8440.   996.0   8640.   996.0   8780.
GR 994.0   8940.   986.0   9245.   986.3   9555.   986.3   9825.   983.8   9900.
GR 982.8  10000.   978.2  10011.   974.0  10041.   972.2  10071.   972.6  10101.
GR 978.2  10121.   988.7  10136.   989.3  10154.   999.2  10200.   1000.  10320.
GR 1002.  10470.  1004.0  10700.
HD  53.0     10.  10000.  10136.
  Section 53.1 is a REPEAT of Sec 53.0, needed to model an IBC at THIS location.
  NOTE: no water surface is defined at this IBC, i.e. No Hydraulic Cntrl Strctr
X1  53.1       0  10000.  10136.       0       0       0
X5
HD  53.1     10.  10000.  10136.
  BEAR CREEK - LOCAL INFLOW
QT
X1  55.0      18   9931.  10062.   2275.   3430.   2770.
GR 1004.   7592.  1000.0   7947.   996.0   8627.   990.0   9052.   986.0   9337.
GR 984.3   9737.   984.7   9837.   985.5   9910.   987.2   9931.   978.1   9955.
GR 974.8   9975.   974.2  10005.   972.9  10035.   973.2  10045.   983.8  10062.
GR 985.8  10187.   986.0  10307.   990.0  10497.
HD  55.0     10.   9931.  10062.
X1  58.0      22   9912.  10015.   1098.   1012.   1462.
GR 1006.   8542.  1004.0   8952.  1000.0   9702.   997.2   9812.   996.3   9912.
GR 976.2   9944.   975.4   9974.   978.2   9991.   990.4  10015.   988.3  10062.
GR 988.8  10065.   988.3  10065.   989.3  10169.   990.0  10172.   992.0  10242.
GR 992.0  10492.   988.0  10642.   986.7  10852.   988.0  11022.   986.0  11097.
GR 986.0  11137.   988.0  11192.
HD  58.0     3.4   9912.  10015.
EJ
T4      South Fork, Zumbro River - Stream Segment 1     ** Example Problem 5 **
T5      LOAD CURVE FROM GAGE DATA.
```

```
T6      BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of Sands and Gravels
T8      SEDIMENT TRANSPORT BY Yang's STREAM POWER [ref ASCE JOURNAL (YANG 1971)]
I1             5
I4  SAND       4       1      10
I5            .5      .5     .25      .5     .25       0     1.0
LQ             1      50    1000    5800   90000
LT TOTAL   .0110     1.5     320   4500.  400000
LF   VFS    .119    .119    .498    .511    .582
LF    FS    .328    .328    .331    .306    .280
LF    MS    .553    .553    .156    .154    .110
LF    CS    .000    .000    .011    .016    .020
LF   VCS    .000    .000    .004    .008    .005
LF   VFG    .000    .000    .000    .004    .002
LF    FG    .000    .000    .000    .001    .001
LF    MG    .000    .000    .000    .000    .000
LF    CG    .000    .000    .000    .000    .000
LF   VCG      .0      .0    .000    .000    .000
PF EXAMP     1.0     1.0    32.0    16.0    96.5     8.0    95.0     4.0    91.0
PFC  2.0    85.0     1.0    73.0      .5    37.0     .25     8.0    .125     1.0
PFC.0625     0.0
PF EXAMP    32.0     1.0    64.0    32.0    99.5    16.0    99.0     8.0    98.5
PFC  4.0    96.0     2.0    93.5     1.0    83.0     .50    45.5    .250     8.0
PFC .125     1.0   .0625     0.0
PF EXAMP    58.0     1.0    64.0    32.0    97.0    16.0    94.0     8.0    94.0
PFC  4.0    90.0     2.0    79.0     1.0    56.0     .50     4.0    .125     0.0
$LOCAL
  LOAD TABLE - CASCADE CREEK - A LOCAL INFLOW
LQL            1     100    1000   10000
LTLTOTAL   .0040      10     500   30000
LFL  VFS    .664    .664    .015    .198
LFL   FS    .207    .207    .245    .181
LFL   MS    .086    .086    .605    .107
LFL   CS    .031    .031    .052    .098
LFL  VCS    .008    .008    .039    .127
LFL  VFG   .0030   .0030   .0200   .1160
LFL   FG   .0010   .0010   .0110   .0910
LFL   MG   .0000   .0000   .0110   .0530
LFL   CG   .0000   .0000   .0000   .0220
LFL  VCG   .0000   .0000   .0000   .0060
  LOAD TABLE - SILVER CREEK - A LOCAL INFLOW
LQL            1     100    1000   10000
LTLTOTAL   .0040      10     500   30000
LFL  VFS    .664    .664    .015    .198
LFL   FS    .207    .207    .245    .181
LFL   MS    .086    .086    .605    .107
LFL   CS    .031    .031    .052    .098
LFL  VCS    .008    .008    .039    .127
LFL  VFG   .0030   .0030   .0200   .1160
LFL   FG   .0010   .0010   .0110   .0910
LFL   MG   .0000   .0000   .0110   .0530
LFL   CG   .0000   .0000   .0000   .0220
LFL  VCG   .0000   .0000   .0000   .0060
  LOAD TABLE - BEAR CREEK - A LOCAL INFLOW
LQL           1.    100.    500.   1000.  30000.
LTLTOTAL   .0020    30.0    500.    1200   22500
LFL  VFS    .201    .201    .078    .078    .137
LFL   FS    .342    .342    .172    .175    .218
LFL   MS    .451    .451    .454    .601    .476
LFL   CS    .001    .001    .197    .142    .158
LFL  VCS    .000    .000    .000    .003    .008
LFL  VFG   .0000   .0000   .0000   .0000   .0020
LFL   FG   .0000    .000   .0000   .0000   .0010
LFL   MG   .0000    .000   .0000   .0000   .0000
LFL   CG   .0000    .000   .0000   .0000   .0000
LFL  VCG   .0000    .000   .0000   .0000   .0000
$HYD
$PRT
CP             1
PS           1.0    35.0    53.1
END
$VOL  X        0
VJ    16
VR   944     946     948     950     952     954     956     958     960     962
VR   964     966     968     970     972     974
$PRT   A
Q    A     FLOW 1 = BASE FLOW 0F 750 CFS
Q    750      61      29     128
R   960.   973.5
T     65      72      70      67
W    10.
Q    A     FLOW 2 = 50 DAYS AT BANK FULL DISCHARGE
Q 2500.0    300.    150.    650.
R   965.     975
```

```
X           2.5     50.
Q    A     FLOW 3 = NEAR BANK FULL DISCHARGE
Q  1250.    150.     78.    340.
R   963.   974.5
W     1.
Q    B     FLOW 4 = BASE FLOW OF 750 CFS
Q   750.     61      29     128
R   960.    973
W     1.
$PRT
CP            1
PS          1.0    35.0    53.1
END
$VOL  X
VJ    16      0
VR   944     946     948     950     952     954     956     958     960     962
VR   964     966     968     970     972     974
$$END
```

6.5.2 Elevation-Surface Area and Elevation-Storage Tables

Tables of elevation *vs*. surface area and storage can be obtained by use of the $VOL, VJ, and VR records in the flow data. In this example, these records were used to request that these tables be produced for a series of horizontal planes extending from elevation 944 ft (the approximate thalweg of Section No. 1.0) to elevation 974 ft (the approximate thalweg of section No. 53.0) in 2 ft increments. Care should be taken to ensure that the endpoints of each cross section are higher than these elevations; otherwise, HEC-6 will extend the ends of the sections vertically and the surface areas and volumes will be too small.

The output for Example Problem 5 is shown in Table 6-5b. Prior to time step 1 and after time step 4, tables containing the surface areas and storage volumes for Sections 1.0, 35.0, and 53.1 at each elevation specified on the VR records. (The $PRT option was used to limit the $VOL output to these cross sections.) For example, at Section No. 35.0, the initial storage volume at elevation 968 ft is 859.78 acre-ft; and after the last time step, the storage volume is 855.45 acre-ft. This indicates that approximately 4.3 acre-ft of sediment was deposited between Sections 35.0 and 58.0 below elevation 968 ft, reducing the storage capability of Silver Lake. One only needs to use information in the table for elevations above the thalweg of the cross section at the dam of interest. These tables can be used to construct elevation-deposition and deposition-distance relations.

6.5.3 Trap Efficiency

The computation of trap efficiency and the interpretation of "TABLE SA-1" were presented in Section 6.3.8 for Example Problem 3. In this example, the X5 records were used to delineate the upstream and downstream extent of the reservoirs causing trap efficiency to be computed for each. For example, looking at TABLE SA-1 of time step 4 for the middle reach which represents Silver Lake, 42.71 acre-ft has entered the reservoir from the upstream reach, 0.37 acre-ft from Silver Creek and 3.55 acre-ft have passed through Silver Lake, giving it a trap efficiency of 91% for this simulation. The downstream reservoir has a trap efficiency of 99%. Negative trap efficiencies indicate scour.

Table 6-5b
Example Problem 5 - Output
Reservoir Model

```
****************************************************     ***********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS   *
*       Version: 4.1.00 -  AUGUST 1993            *     *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  EXAMPLE5.DAT                      *     *  609 SECOND STREET              *
*  OUTPUT FILE: EXAMPLE5.OUT                      *     *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 31 AUG 93    RUN TIME: 15:53:06      *     *  (916) 756-1104                 *
****************************************************     ***********************************

                       X     X  XXXXXXX   XXXXX          XXXXX
                       X     X  X        X     X        X     X
                       X     X  X        X              X
                       XXXXXXX  XXXX     X       XXXXX  XXXXXX
                       X     X  X        X              X     X
                       X     X  X        X     X        X     X
                       X     X  XXXXXXX   XXXXX          XXXXX

         **********************************************************************
         *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
         *       10  Stream Segments (Main Stem + Tributaries)                *
         *      150  Cross Sections                                           *
         *      100  Elevation/Station Points per Cross Section               *
         *       20  Grain Sizes                                              *
         *       10  Control Points                                           *
         **********************************************************************

T1      EXAMPLE PROBLEM NO 5.  RESERVOIRS.
T2      2 RESERVOIRS, 3 LOCAL INFLOWS.
T3      SOUTH FORK, ZUMBRO RIVER     ** Example Problem 5 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0400   0.1000       1.1000     0.7000

SECTION NO.     1.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

N-Values vs. Elevation Table
       Channel           Left Overbank        Right Overbank
  0.0450     966.       0.0800     966.       0.1000     966.
  0.0640     989.       0.1300     989.       0.1100     982.
  0.0000       0.       0.0000       0.       0.1200     989.

SECTION NO.    15.000
...Left Encroachment defined at station 10700.000 at elevation   961.000
...Right Encroachment defined at station 11000.000 at elevation   970.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

LOCAL INFLOW POINT  1 occurs upstream from Section No.      15.000

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0500   0.1000       1.1000     0.7000

SECTION NO.    32.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    33.000
...Limit CONVEYANCE to  250.000 ft. centered about midpoint of channel.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    33.300
...Adjust Section WIDTH to  95.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...Limit CONVEYANCE to  250.000 ft. centered about midpoint of channel.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    33.900
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station       1850.000       2150.000
              Ineffective Elevation        984.410        984.500
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    35.000
...Internal Boundary Condition
   Water Surface Elevation will be read from R-RECORD, Field  2
   Head Loss =    0.000
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station       9894.000      10245.000
              Ineffective Elevation        984.700        984.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.0600   0.0450   0.0600       1.1000     0.7000

SECTION NO.    42.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.
```

```
LOCAL INFLOW POINT  2 occurs upstream from Section No.      42.000

SECTION NO.    44.000
...Limit CONVEYANCE between stations    9850.000 and   10200.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    53.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    53.100
...Internal Boundary Condition
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

LOCAL INFLOW POINT  3 occurs upstream from Section No.      53.100

SECTION NO.    55.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    58.000
...DEPTH of the Bed Sediment Control Volume =    3.40 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 13
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  13
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

==========================================================================================
```

The output produced during processing of the sediment data does not differ from that produced for Example Problem 3. It has therefore, been omitted from this table. Refer to Table 6-3b.

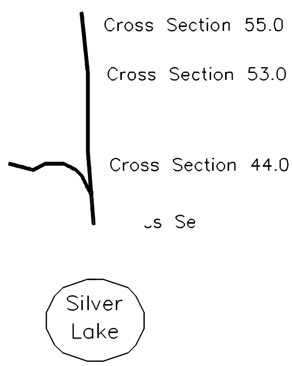
```
==========================================================================================

$HYD
BEGIN COMPUTATIONS.

------------------------------------------------------------------------------------------
$PRT
...Selective Printout Option
     - Print at the following cross sections
CP              1
PS            1.0    35.0    53.1
END

------------------------------------------------------------------------------------------
$VOL  X

STREAM SEGMENT #  1: EXAMPLE PROBLEM NO 5.  RESERVOIRS.

                   SUMMARY TABLE:  MASS AND VOLUME OF SEDIMENT
----------------------------------------------------------------------------------------------------------------
   SECTION      SEDIMENT THROUGH SECTION (tons)         SEDIMENT DEPOSITED IN REACH in cu. yds
             TOTAL      SAND      SILT      CLAY     TOTAL   CUMULATIVE   SAND      SILT      CLAY

    INFLOW        0.        0.        0.        0.        0.

    58.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    55.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    53.100        0.        0.        0.        0.        0.        0.        0.        0.        0.
    53.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    44.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    42.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    35.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    33.900        0.        0.        0.        0.        0.        0.        0.        0.        0.
    33.300        0.        0.        0.        0.        0.        0.        0.        0.        0.
    33.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    32.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
    15.000        0.        0.        0.        0.        0.        0.        0.        0.        0.
     1.000        0.        0.        0.        0.        0.        0.        0.        0.        0.

             ELEV     SURFACE     VOLUME      VOLUME
                       AREA       AC-FT         CY
SECTION NO.     1.000
             974.00        0.00        0.00        0.00

SECTION NO.    35.000
             944.00        0.00        0.00        0.00
             946.00        0.83        0.54      867.78
             948.00        2.39        3.67     5915.09
             950.00        3.76        9.89    15949.33
             952.00        4.33       17.97    28994.35
             954.00        5.16       27.24    43939.75
             956.00        8.11       40.39    65164.13
```

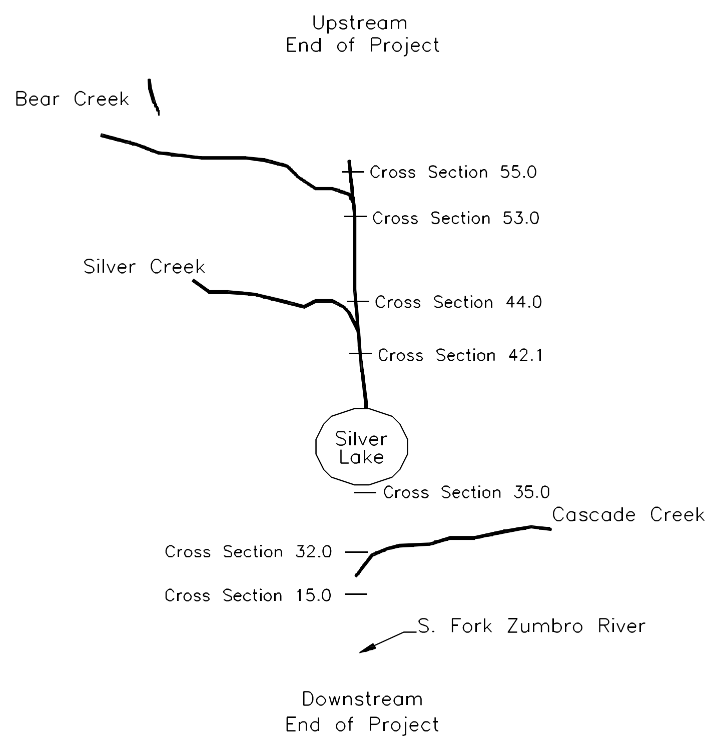
```
           958.00      17.48      64.33  103778.95
           960.00      36.80     116.56  188053.68
           962.00      83.01     210.59  339749.19
           964.00     102.86     399.48  644489.52
           966.00     114.88     616.41  994482.30
           968.00     133.90     859.78 1387110.86
           970.00     174.82    1146.51 1849704.72
           972.00     188.44    1509.87 2435927.43
           974.00     195.16    1893.47 3054796.73

SECTION NO.    53.100
           944.00       0.00       0.00       0.00
           946.00       0.83       0.54     867.78
           948.00       2.39       3.67    5915.09
           950.00       3.76       9.89   15949.33
           952.00       4.33      17.97   28994.35
           954.00       5.16      27.24   43939.75
           956.00       8.11      40.39   65164.13
           958.00      17.48      64.33  103778.95
           960.00      36.80     116.56  188053.68
           962.00      83.01     210.59  339749.19
           964.00     106.66     401.88  648370.52
           966.00     119.32     627.06 1011649.74
           968.00     147.00     883.72 1425731.27
           970.00     219.64    1211.25 1954147.00
           972.00     242.73    1671.97 2697446.67
           974.00     254.16    2170.41 3501589.08


------------------------------------------------------------------------------------------

$PRT   A
...Selective Printout Option
   A - Print at all cross sections

==========================================================================================
TIME STEP #       1
Q    A     FLOW 1 = BASE FLOW 0F 750 CFS

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 5.  RESERVOIRS.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   10.00      58.000 *     0.46                     *
              53.100 *     0.21                     *
   TOTAL=     53.100 *     0.67      5.24     -6.78 *
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   10.00      53.100 *     5.24                     *
              42.000 *     0.01                     *
   TOTAL=     35.000 *     5.25      0.00      1.00 *
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   10.00      35.000 *     0.00                     *
              15.000 *     0.02                     *
   TOTAL=      1.000 *     0.02      0.00      0.98 *
******************************************************


==========================================================================================
TIME STEP #       2
Q    A     FLOW 2 = 50 DAYS AT BANK FULL DISCHARGE
COMPUTING FROM TIME=     10.0000 DAYS TO TIME=     60.0000 DAYS IN    20 COMPUTATION STEPS

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 5.  RESERVOIRS.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   60.00      58.000 *    13.54                     *
              53.100 *    16.20                     *
   TOTAL=     53.100 *    29.74     40.95     -0.38 *
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   60.00      53.100 *    40.95                     *
              42.000 *     0.36                     *
   TOTAL=     35.000 *    41.31      3.55      0.91 *
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *   INFLOW  OUTFLOW  TRAP EFF *
   60.00      35.000 *     3.55                     *
              15.000 *     1.01                     *
   TOTAL=      1.000 *     4.56      0.06      0.99 *
******************************************************
```

```
==========================================================================================
TIME STEP #       3
Q    A     FLOW 3 = NEAR BANK FULL DISCHARGE

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 5.  RESERVOIRS.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   61.00      58.000 *     13.62                     *
              53.100 *     16.30                     *
   TOTAL=     53.100 *     29.92     41.19     -0.38 *
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   61.00      53.100 *     41.19                     *
              42.000 *      0.37                     *
   TOTAL=     35.000 *     41.56      3.55      0.91 *
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   61.00      35.000 *      3.55                     *
              15.000 *      1.02                     *
   TOTAL=      1.000 *      4.57      0.06      0.99 *
******************************************************


==========================================================================================
TIME STEP #       4
Q    B     FLOW 4 = BASE FLOW OF 750 CFS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 5.  RESERVOIRS.
       ACCUMULATED TIME (yrs)....      0.170
       FLOW DURATION (days)......      1.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        532.00 |         93.30 |        63.44

Upstream of SECTION NO.     53.100 is...
LOCAL INFLOW POINT # 3 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        532.00 |         93.30 |        63.44
      LOCAL     INFLOW |        128.00 |         43.20 |        67.00
----------------------------------------------------------------------
                 TOTAL |        660.00 |        136.50 |        64.13

Upstream of SECTION NO.     42.000 is...
LOCAL INFLOW POINT # 2 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        660.00 |        136.50 |        64.13
      LOCAL     INFLOW |         29.00 |          1.22 |        70.00
----------------------------------------------------------------------
                 TOTAL |        689.00 |        137.72 |        64.38

Upstream of SECTION NO.     15.000 is...
LOCAL INFLOW POINT # 1 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        689.00 |        137.72 |        64.38
      LOCAL     INFLOW |         61.00 |          4.32 |        72.00
----------------------------------------------------------------------
                 TOTAL |        750.00 |        142.04 |        65.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 5.  RESERVOIRS.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   62.00      58.000 *     13.66                     *
              53.100 *     16.32                     *
   TOTAL=     53.100 *     29.99     41.34     -0.38 *
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   62.00      53.100 *     41.34                     *
              42.000 *      0.37                     *
   TOTAL=     35.000 *     41.71      3.55      0.91 *
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   62.00      35.000 *      3.55                     *
              15.000 *      1.02                     *
   TOTAL=      1.000 *      4.57      0.06      0.99 *
******************************************************
```

```
TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....         38.08  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         34.16  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         21.06  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.00  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                    -------------
                                             TOTAL =         93.30
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          0.06  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          0.05  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          0.11  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.08  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.02  |  VERY COARSE GRAVEL          0.00
                       -------------                    -------------
                                             TOTAL =          0.32

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    62.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)        SAND
     58.000      -2.12    978.00    973.28       532.        196.
     55.000      -0.97    977.02    971.93       532.        237.
     53.100      -1.18    975.27    971.02       660.        303.
     53.000      -2.09    975.27    970.11       660.        243.
     44.000       1.98    974.14    969.08       660.         85.
     42.000       0.68    973.32    970.48       689.         17.
     35.000       0.23    973.00    963.53       689.          1.
     33.900       0.00    965.13    961.00       689.          1.
     33.300       0.00    964.81    962.49       689.          7.
     33.000       0.00    963.72    961.00       689.         11.
     32.000      -0.55    962.68    955.95       689.        159.
     15.000       0.25    960.18    953.95       750.        175.
      1.000       0.93    960.00    945.63       750.          0.

------------------------------------------------------------------------------------------
$PRT
...Selective Printout Option
    - Print at the following cross sections
CP             1
PS           1.0    35.0    53.1
END
------------------------------------------------------------------------------------------
$VOL  X

STREAM SEGMENT #  1: EXAMPLE PROBLEM NO 5.  RESERVOIRS.

                   SUMMARY TABLE:  MASS AND VOLUME OF SEDIMENT
--------------------------------------------------------------------------------------------------------------
   SECTION      SEDIMENT THROUGH SECTION (tons)          SEDIMENT DEPOSITED IN REACH in cu. yds
               TOTAL      SAND      SILT      CLAY     TOTAL   CUMULATIVE   SAND      SILT      CLAY

    INFLOW     27675.    27675.        0.        0.    22043.

    58.000     33913.    33913.        0.        0.    -4968.    -4968.    -4968.        0.        0.
    55.000     43560.    43560.        0.        0.    -7684.   -12652.    -7684.        0.        0.

     LOCAL     33067.    33067.        0.        0.    26338.

    53.100     83742.    83742.        0.        0.    -5667.   -18319.    -5667.        0.        0.
    53.000    104383.   104383.        0.        0.   -16441.   -34760.   -16441.        0.        0.
    44.000     38587.    38587.        0.        0.    52407.    17646.    52407.        0.        0.

     LOCAL       742.      742.        0.        0.      591.

    42.000     12452.    12452.        0.        0.    21408.    39054.    21408.        0.        0.
    35.000      7197.     7197.        0.        0.     4185.    43240.     4185.        0.        0.
    33.900      7193.     7193.        0.        0.        3.    43243.        3.        0.        0.
    33.300      7192.     7192.        0.        0.        0.    43243.        0.        0.        0.
    33.000      7186.     7186.        0.        0.        5.    43248.        5.        0.        0.
    32.000     25290.    25290.        0.        0.   -14420.    28828.   -14420.        0.        0.

     LOCAL      2062.     2062.        0.        0.     1642.

    15.000     16144.    16144.        0.        0.     8927.    37755.     8927.        0.        0.
     1.000       119.      119.        0.        0.    12764.    50519.    12764.        0.        0.


             ELEV     SURFACE     VOLUME      VOLUME
                       AREA       AC-FT         CY
SECTION NO.     1.000
             974.00        0.00        0.00        0.00

SECTION NO.    35.000
             944.00        0.00        0.00        0.00
             946.00        0.23        0.04       68.42
             948.00        1.60        1.80     2907.75
```

```
             950.00        3.16        6.65    10729.40
             952.00        4.06       14.05    22667.32
             954.00        4.67       22.74    36692.89
             956.00        7.60       34.72    56007.76
             958.00       17.55       59.75    96392.34
             960.00       36.89      112.36   181277.81
             962.00       83.15      206.06   332439.56
             964.00      103.07      394.36   636234.41
             966.00      115.08      611.72   986900.29
             968.00      134.04      855.45  1380128.58
             970.00      174.87     1142.37  1843028.68
             972.00      188.44     1505.77  2429301.12
             974.00      195.16     1889.36  3048170.38

SECTION NO.    53.100
             944.00        0.00        0.00        0.00
             946.00        0.23        0.04       68.42
             948.00        1.60        1.80     2907.75
             950.00        3.16        6.65    10729.40
             952.00        4.06       14.05    22667.32
             954.00        4.67       22.74    36692.89
             956.00        7.60       34.72    56007.76
             958.00       17.55       59.75    96392.34
             960.00       36.89      112.36   181277.81
             962.00       83.15      206.06   332439.56
             964.00      106.80      396.31   639386.72
             966.00      119.44      621.76  1003106.83
             968.00      142.01      875.94  1413188.12
             970.00      197.85     1186.47  1914179.58
             972.00      236.59     1632.71  2634112.44
             974.00      253.24     2120.94  3421777.07

------------------------------------------------------------------------------------------
$$END

       0   DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ =         4
TOTAL NO. OF WS PROFILES =            23
ITERATIONS IN EXNER EQ =            1495

COMPUTATIONS COMPLETED
RUN TIME =  0 HOURS,  0 MINUTES &  6.00 SECONDS
```


Cross Section 55.0
Cross Section 53.0
Cross Section 44.0
Silver
Lake


Upstream
End of Project
Bear Creek
Cross Section 55.0
Cross Section 53.0
Silver Creek
Cross Section 44.0
Cross Section 42.1
Silver
Lake
Cross Section 35.0
Cascade Creek
Cross Section 32.0
Cross Section 15.0
S. Fork Zumbro River
Downstream
End of Project

```
NV    33      .1   965.6     .11   982.0     .12   988.8
X1  15.0      27  10665.  10850.   3560.   3030.   3280.
X3                        10700.   961.0  11000.   970.0
GR 992.0   9570.   982.0  10110.   976.0  10300.   976.0  10490.   966.0  10610.
GR 964.7  10665.   956.0  10673.   953.0  10693.   954.0  10703.   955.6  10723.
GR 958.6  10750.   959.3  10800.   957.0  10822.   957.3  10825.   961.5  10850.
GR 962.0  10852.   964.0  10970.   966.0  11015.   961.0  11090.   962.0  11150.
GR 970.0  11190.   972.0  11310.   980.0  11410.   984.0  11570.   990.0  11770.
GR 990.0  11865.  1000.0  12150.
HD  15.0     10.  10673.  10852.
  CASCADE CREEK - TRIBUTARY
QT     2
NC   .10     .10     .05
X1  32.0      29  10057.  10271.   3630.   3060.   4240.
GR 998.0   9080.   982.0   9250.   982.0   9510.   980.0   9600.  980.01   9925.
GR979.48  10000.   978.5  10057.   968.6  10075.  959.82  10087.   956.5  10097.
GR 956.8  10117.   957.8  10137.   959.4  10157.   959.6  10177.  959.82  10196.
GR 966.5  10225.   971.2  10250.   978.5  10271.   978.5  10300.   978.6  10350.
GR978.91  10370.  978.96  10387.   980.0  10610.   982.0  10745.   982.0  11145.
GR 984.0  11150.   992.0  11240.  1000.0  11330.   1008.  11425.
HD  32.0     10.  10075.  10275.
X1  33.0      21   1850.   2150.   3130.   3250.   3320.
XL                   250
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.     0.0      0.     0.0      0.     0.0      0.     0.0      0.
HD  33.0     0.0   1851.   2149.
  Section 33.3 is a duplicate of Section  33.0.
X1  33.3      21   1850.   2150.   1550.   1750.   1750.     .95    1.49
XL                   250
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.     0.0      0.     0.0      0.     0.0      0.     0.0      0.
HD  33.3     0.0   1851.   2149.
  Section 33.9 is a duplicate of Sec 33.3, needed to model IBC at Sec 35.0
X1  33.9      21   1850.   2150.   1050.   1050.   1050.     .95    1.65
X3    10
GR 1000.    980.   990.0   1060.   980.0   1150.   982.0   1180.   982.0   1215.
GR 980.0   1260.   982.0   1300.   982.0   1350.   980.0   1420.   980.0   1540.
GR 982.0   1730.   982.0   1830.  984.41   1850.  979.19   1851.   961.0  1900.8
GR 961.0  2099.2   976.0   2149.   984.5   2150.   982.0   2800.   990.0   3100.
GR 1000.   3170.     0.0      0.     0.0      0.     0.0      0.     0.0      0.
HD  33.9     0.0   1851.   2149.
X1  35.0      22   9894.  10245.       0       0       0
X3    10
X5                              2
GR 984.0   9035.   980.0   9070.   978.0   9135.   980.0   9185.   982.0   9270.
GR 980.0   9465.   981.7   9595.   983.7   9745.   984.7   9894.   963.4  9894.1
GR 963.3   9954.   967.1   9974.   967.4  10004.   968.2  10044.   967.6  10054.
GR 973.4  10115.   977.4  10120.   983.7  10155.   984.0  10245.   982.0  10695.
GR 982.0  10895.  1004.0  11085.
HD  35.0       0   9954.  10155.
  - - -  SILVER LAKE  - - -
NC   .06     .06    .045
X1  42.0      32   9880.  10130.   5370.   5000.   5210.
GR 996.0   7130.   998.0   7310.   998.0   7930.   992.0   8205.   990.0   8495.
GR 988.0   8780.   986.0   8990.   985.7   9570.  986.45   9707.  989.44   9857.
GR 990.0   9880.   969.8   9881.   969.8   9941.   985.8   9941.   985.8   9943.
GR 969.8   9943.   969.8  10001.   986.7  10001.   986.7  10003.   969.8  10003.
GR 969.8  10067.   985.8  10067.   985.8  10069.   969.8  10069.   969.8  10129.
GR 989.9  10130.   989.5  10180.   988.6  10230.   987.6  10280.   985.2  10430.
GR 986.8   11720   989.9  12310.
HD  42.0       0   9881.  10021.
  SILVER CREEK - LOCAL INFLOW
QT
X1  44.0      28   9845.  10127.   3200.   3800.   3500.
XL                          9850   10200
GR 1002.   8035.   992.0   8150.   990.0   8305.   990.0   8735.   988.0   8835.
GR 996.0   9285.   1017.   9425.   990.0   9505.   986.0   9650.   984.1   9788.
GR 980.6   9845.   970.9   9868.   972.2   9898.   970.5   9968.   967.5   9998.
GR 968.9  10028.   967.4  10058.   967.1  10078.   971.9  10118.   976.8  10127.
GR 977.8  10150.   976.9  10193.   982.0  10206.   981.2  10300.   979.2  10325.
GR 983.1  10400.   999.8  10450.  1002.4  10464.
HD  44.0     10.   9868.  10193.
X1  53.0      22  10000.  10136.   3366.   2832.   2942.
GR 1004.   7550.  1000.0   7760.   998.0   8440.   996.0   8640.   996.0   8780.
GR 994.0   8940.   986.0   9245.   986.3   9555.   986.3   9825.   983.8   9900.
GR 982.8  10000.   978.2  10011.   974.0  10041.   972.2  10071.   972.6  10101.
GR 978.2  10121.   988.7  10136.   989.3  10154.   999.2  10200.  1000.1  10320.
GR 1002.  10470.  1004.0  10700.
```

```
HD  53.0     10.  10000.  10136.
  BEAR CREEK - TRIBUTARY
QT     3
X1  55.0      18   9931.  10062.   2275.   3430.   2770.
GR 1004.   7592.  1000.0   7947.   996.0   8627.   990.0   9052.   986.0   9337.
GR 984.3   9737.   984.7   9837.   985.5   9910.   987.2   9931.   978.1   9955.
GR 974.8   9975.   974.2  10005.   972.9  10035.   973.2  10045.   983.8  10062.
GR 985.8  10187.   986.0  10307.   990.0  10497.
HD  55.0     10.   9931.  10062.
X1  58.0      22   9912.  10015.   1098.   1012.   1462.
GR 1006.   8542.  1004.0   8952.  1000.0   9702.   997.2   9812.   996.3   9912.
GR 976.2   9944.   975.4   9974.   978.2   9991.   990.4  10015.   988.3  10062.
GR 988.8  10065.   988.3  10065.   989.3  10169.   990.0  10172.   992.0  10242.
GR 992.0  10492.   988.0  10642.   986.7  10852.   988.0  11022.   986.0  11097.
GR 986.0  11137.   988.0  11192.
HD  58.0     3.4   9912.  10015.
EJ
$TRIB               CASCADE GEOMETRY, SEGMENT 2, CONTROL POINT 2
CP     2
T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
T2      CASCADE IS A TRIBUTARY OF THE ZUMBRO RIVER DOWNSTREAM OF SILVER LAKE
T3      CASCADE CREEK GEOMETRY - STREAM SEGMENT 2     ** Example Problem 6 **
NC  .120    .120    .045      .1      .3
X1   1.0      25   5000.   5100.      0.      0.      0.
GR 995.0   4570.   980.0   4600.   970.0   4690.   968.0   4740.   968.0   4850.
GR965.24   4900.   964.6   4950.   964.0   4975.   963.7   5000.   961.5   5003.
GR 959.8   5014.   960.2   5025.   959.9   5038.   960.1   5068.   960.4   5073.
GR 962.5   5075.   963.1   5083.   968.9   5094.   969.6   5100.   970.3   5150.
GR 970.0   5260.   972.0   5280.   972.0   5400.   980.0   5460.    982.   5780.
H    1.0           4925.   5121.
X1   3.0      24   4942.   5050.    460.    280.    537.
GR 1000.   4715.   983.9   4897.   982.9   4942.   973.2   4959.   973.0   4967.
GR 970.2   5000.  964.78   5007.   964.3   5017.   965.1   5027.  965.17   5027.
GR 968.7   5042.   969.9   5050.   969.4   5067.   971.1   5092.   970.3   5103.
GR 972.7   5180.     970   5207.   972.8   5217.   971.1   5242.   970.7   5267.
GR 975.2   5277.  976.56   5300.   980.0   5360.   982.0   5690.
H    3.0   964.3   4942.   5103.
X1   4.0      18   4950.   5045.    300.    280.    240.
GR 1000.   4775.   991.3   4875.   988.1   4931.   981.6   4941.   981.7   4950.
GR 975.4   4961.   972.9   4975.   970.6   5004.   968.3   5015.   969.2   5025.
GR 969.4   5040.   981.2   5045.   981.2   5075.   985.7   5082.   985.9   5100.
GR 980.0   5270.   982.0   5330.   982.0   5700.
H    4.0   968.3   4950.   5047.
X1   6.2      17   5000.   5130.    405.    350.    474.
X3    10
GR 994.0   4700.   990.0   4720.   986.0   4750.   986.0   4940.   987.4   5000.
GR 983.1   5000.   979.0   5016.   972.0   5032.   972.0   5092.   974.0   5100.
GR 976.0   5109.   982.7   5126.   987.5   5130.   986.0   5210.   980.0   5420.
GR 980.0   5830.   982.0   5900.
H    6.2   972.0   5000.   5130.
EJ
$TRIB              BEAR CREEK GEOMETRY,  SEGMENT 3 CONTROL POINT 3
CP     3
T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
T2      BEAR IS A TRIBUTARY OF THE ZUMBRO RIVER UPSTREAM OF SILVER CREEK
T3      BEAR CREEK GEOMETRY - STREAM SEGMENT 3     ** Example Problem 6 **
NC  .090    .090    .046      .3      .5
X1   1.0      19  10115.  10250.      0.      0.      0.
GR 996.0   9020.   990.0   9420.   988.0   9550.   994.0   9780.   985.3  10055.
GR 985.0  10115.  978.18  10137.   977.2  10147.   977.0  10157.   977.1  10200.
GR 978.2  10209.   981.6  10216.   982.8  10225.   984.7  10250.   985.9  10275.
GR 987.1  10300.   988.0  10380.   990.0  10560.  1000.0  10890.
H    1.0          10115.  10275.
X1   2.1      21   1511.   1629.    210.    310.    260.
GR 995.2    600.   992.0    790.   990.0    970.   990.0    971.   990.0    972.
GR 989.0   1000.   988.0   1080.   988.0   1290.   990.0   1450.   990.8   1490.
GR 989.8   1493.   986.7   1511.   977.3   1516.   977.3   1629.   986.7   1629.
GR 990.7   1650.   988.0   1840.   992.0   2000.   994.0   2100.   998.0   2450.
GR 1002.   2580.
H    2.1           1511.   1629.
  TAKEO CREEK - TRIBUTARY
QT     4
X1   4.0      30  10537.  10660.   1053.    533.    708.
GR 998.0   8370.   997.0   8860.   998.3   9100.   994.5   9350.   996.0   9480.
GR 999.0   9560.   996.0   9640.   994.0   9900.   992.0   9980.   993.9  10400.
GR 994.0  10425.   995.2  10506.   993.1  10523.   986.3  10537.   986.0  10550.
GR 985.8  10561.   980.9  10570.   978.7  10585.   978.3  10595.   978.4  10600.
GR 980.5  10625.   980.8  10636.  991.77  10657.   992.3  10660.   991.3  10675.
GR 991.4  10700.   998.0  10970.   998.0  11120.  1000.0  11290.  1006.0  11400.
H    4.0   978.3  10537.  10660.
X1   6.0      29  10100.  10222.    330.    570.    665.
X3    10
GR 998.0   8500.   997.1   8650.  1000.0   8900.  1002.0   9110.  1001.0   9400.
GR 999.8   9525.  1002.0   9610.  1002.0   9730.  1000.0   9840.  995.16  10000.
```

```
GR 995.6  10100.   994.2  10109.   990.8  10125.   987.3  10140.   985.8  10150.
GR 986.2  10161.  985.24  10162.   983.3  10172.   983.3  10182.   982.8  10202.
GR985.24  10210.   992.0  10222.   992.2  10250.   993.5  10300.   994.2  10325.
GR 1000.  10470.   997.8  10640.   998.0  10770.  1004.6  10910.
H    6.0    982.7 10100.0 10325.0
EJ
$TRIB              TAKEO CREEK GEOMETRY, SEGMENT 4, CONTROL POINT 4
CP     4
T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
T2      TAKEO CREEK IS A TRIBUTARY OF BEAR CREEK UPSTREAM OF SECTION 2.1
T3      TAKEO CREEK GEOMETRY - STREAM SEGMENT 4     ** Example Problem 6 **
NC  .090    .090    .046      .3      .5
X1   1.0      19  10115.  10250.      0.      0.      0.              2.
GR 996.0   9020.   990.0   9420.   988.0   9550.   994.0   9780.   985.3  10055.
GR 985.0  10115.  978.18  10137.   977.2  10147.   977.0  10157.   977.1  10200.
GR 978.2  10209.   981.6  10216.   982.8  10225.   984.7  10250.   985.9  10275.
GR 987.1  10300.   988.0  10380.   990.0  10560.  1000.0  10890.
H    1.0          10115.  10275.
X1   2.1      21   1511.   1629.    210.    310.    260.              2.
GR 995.2    600.   992.0    790.   990.0    970.   990.0    971.   990.0    972.
GR 989.0   1000.   988.0   1080.   988.0   1290.   990.0   1450.   990.8   1490.
GR 989.8   1493.   986.7   1511.   977.3   1516.   977.3   1629.   986.7   1629.
GR 990.7   1650.   988.0   1840.   992.0   2000.   994.0   2100.   998.0   2450.
GR1002.0   2580.
H    2.1          1511.0  1629.0
X1   4.0      30  10537.  10660.   1053.    533.    708.              2.
GR 998.0   8370.   997.0   8860.   998.3   9100.   994.5   9350.   996.0   9480.
GR 999.0   9560.   996.0   9640.   994.0   9900.   992.0   9980.   993.9  10400.
GR 994.0  10425.   995.2  10506.   993.1  10523.   986.3  10537.   986.0  10550.
GR 985.8  10561.    980.  10570.   978.7  10585.   978.3  10595.   978.4  10600.
GR 980.5  10625.   980.8  10636.  991.77  10657.   992.3  10660.   991.3  10675.
GR 991.4  10700.   998.0  10970.   998.0  11120.  1000.0  11290.  1006.0 11400.0
H    4.0   978.3  10537.  10660.
X1   6.0      29  10100.  10222.    330.    570.    665.              2.
X3    10
GR 998.0   8500.   997.1   8650.  1000.0   8900.  1002.0   9110.  1001.0   9400.
GR 999.8   9525.  1002.0   9610.  1002.0   9730.  1000.0   9840.  995.16  10000.
GR 995.6  10100.   994.2  10109.   990.8  10125.   987.3  10140.   985.8  10150.
GR 986.2  10161.  985.24  10162.   983.3  10172.   983.3  10182.   982.8  10202.
GR985.24  10210.   992.0  10222.   992.2  10250.   993.5  10300.   994.2  10325.
GR 1000.  10470.   997.8  10640.   998.0  10770.  1004.6  10910.
H    6.0   982.7  10100.  10325.
EJ
T4      South Fork, Zumbro River - Stream Segment 1     ** Example Problem 6 **
T5      LOAD CURVE FROM GAGE DATA.
T6      BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels
T8      SEDIMENT TRANSPORT BY Yang's STREAM POWER [ref ASCE JOURNAL (YANG 1971)]
I1     0       5
I4  SAND       4       1      10
I5            .5      .5     .25      .5     .25       0     1.0
LQ             1      50    1000    5800   90000
LT TOTAL   .0110     1.5     320   4500.  400000
LF   VFS    .119    .119    .498    .511    .582
LF    FS    .328    .328    .331    .306    .280
LF    MS    .553    .553    .156    .154    .110
LF    CS    .000    .000    .011    .016    .020
LF   VCS    .000    .000    .004    .008    .005
LF   VFG    .000    .000    .000    .004    .002
LF    FG    .000    .000    .000    .001    .001
LF    MG    .000    .000    .000    .000    .000
LF    CG    .000    .000    .000    .000    .000
LF   VCG      .0      .0    .000    .000    .000
PF EXAMP     1.0     1.0    32.0    16.0    96.5     8.0    95.0     4.0    91.0
PFC  2.0    85.0     1.0    73.0      .5    37.0     .25     8.0    .125     1.0
PFC.0625     0.0
PF EXAMP    32.0     1.0    64.0    32.0    99.5    16.0    99.0     8.0    98.5
PFC  4.0    96.0     2.0    93.5     1.0    83.0     .50    45.5    .250     8.0
PFC .125     1.0   .0625     0.0
PF EXAMP    58.0     1.0    64.0    32.0    97.0    16.0    94.0     8.0    94.0
PFC  4.0    90.0     2.0    79.0     1.0    56.0     .50     4.0    .125     0.0
$LOCAL
LQ             1     100    1000   10000
LT TOTAL   .0040      10     500   30000
LF   VFS    .664    .664    .015    .198
LF    FS    .207    .207    .245    .181
LF    MS    .086    .086    .605    .107
LF    CS    .031    .031    .052    .098
```

```
LF   VCS    .008    .008    .039    .127
LF   VFG   .0030   .0030   .0200   .1160
LF    FG   .0010   .0010   .0110   .0910
LF    MG   .0000   .0000   .0110   .0530
LF    CG   .0000   .0000   .0000   .0220
LF   VCG   .0000   .0000   .0000   .0060
$TRIB
T4      CASCADE CREEK - STREAM SEGMENT 2      ** Example Problem 6 **
T5      FIRST TRIB ON Zumbro River.
T6      LOAD CURVE FROM GAGE DATA.  BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels - Yang's Stream Power.
T8      Zumbro River Project
LQL            1     100    1000   10000
LTLTOTAL   .0040      10     500   30000
LFL  VFS    .664    .664    .015    .198
LFL   FS    .207    .207    .245    .181
LFL   MS    .086    .086    .605    .107
LFL   CS    .031    .031    .052    .098
LFL  VCS    .008    .008    .039    .127
LFL  VFG   .0030   .0030   .0200   .1160
LFL   FG   .0010   .0010   .0110   .0910
LFL   MG   .0000   .0000   .0110   .0530
LFL   CG   .0000   .0000   .0000   .0220
LFL  VCG   .0000   .0000   .0000   .0060
PF  CASC     1.0     1.0     64.     32.     94.     16.     85.      8.     70.
PFC   4.     50.      2.     32.      1.     18.      .5      9.     .25      5.
PFC .125     2.5   .0625      0.
$TRIB
T4      BEAR CREEK - Stream Segment 3      ** Example Problem 6 **
T5      SECOND UPSTREAM TRIB ON Zumbro River.
T6      LOAD CURVE FROM GAGE DATA.  BED GRADATIONS FROM FIELD SAMPLES
T7      Use full range of sands and gravels.  Yang's Stream Power.
T8      Zumbro River Project
LQL            1     100     500    1000   30000
LTLTOTAL   .0020    30.0    500.    1200   22500
LFL  VFS    .201    .201    .078    .078    .137
LFL   FS    .342    .342    .172    .175    .218
LFL   MS    .451    .451    .454    .601    .476
LFL   CS    .001    .001    .197    .142    .158
LFL  VCS    .000    .000   .000    .003    .008
LFL  VFG   .0000   .0000  .0000   .0000   .0020
LFL   FG   .0000    .000  .0000   .0000   .0010
LFL   MG   .0000    .000  .0000   .0000   .0000
LFL   CG   .0000    .000  .0000   .0000   .0000
LFL  VCG   .0000    .000  .0000   .0000   .0000
PF  BEAR      1.      1.      4.      2.    99.5      1.     99.      .5     93.
PFC  .25      27    .125      3.   .0625      0.
PF  BEAR      6.      1.      4.      2.    99.5      1.     99.      .5    89.5
PFC  .25    22.5    .125     2.5   .0625      0.
$TRIB
T4      TAKEO CREEK - Stream Segment 4      ** Example Problem 6 **
T5      FIRST TRIBUTARY ON Bear Creek.
T6      LOAD CURVE IS FROM GAGE DATA. BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels.  Yang's Stream Power.
T8      Zumbro River Project
LQL            1     100     500    1000   30000
LTLTOTAL   .0020    30.0    500.    1200   22500
LFL  VFS    .201    .201    .078    .078    .137
LFL   FS    .342    .342    .172    .175    .218
LFL   MS    .451    .451    .454    .601    .476
LFL   CS    .001    .001    .197    .142    .158
LFL  VCS    .000    .000   .000    .003    .008
LFL  VFG   .0000   .0000  .0000   .0000   .0020
LFL   FG   .0000    .000  .0000   .0000   .0010
LFL   MG   .0000    .000  .0000   .0000   .0000
LFL   CG   .0000    .000  .0000   .0000   .0000
LFL  VCG   .0000    .000  .0000   .0000   .0000
PF TAKEO      1.      1.      4.      2.    99.5      1.     99.      .5     93.
PFC  .25     27.    .125      3.   .0625      0.
PF TAKEO      6.      1.      4.      2.    99.5      1.     99.      .5    89.5
PFC  .25    22.5    .125     2.5   .0625      0.
$HYD
Q   AB     FLOW 1 = BASE FLOW 0F 750 CFS
Q    750      29      61     128      90
R   956.    970.
T     65      70      72      67      73
W      2
$PRT
  Zumbro River, Sections 35.1 and 55.0
CP             1
PS  35.1    55.0
```

```
  Takeo Creek, Section 6.0
CP             4
PS   6.0
END
Q   AC     FLOW 2 = 50 DAYS AT BANK FULL DISCHARGE
Q 2500.0     150     300     650     450
R   965.    978.
X              5      50
Q    A     FLOW 3 = NEAR BANK FULL DISCHARGE
Q  1250.      78     150    340.     250
R   960.    975.
W     1.
Q    B     FLOW 4 = BASE FLOW 0F 500 CFS
Q    500      29      61     128      90
R   955.    973.
W      2
$$END
```

6.6.5 Network Output

The output produced for a network system is very similar to that of a single stream problem. The output for Example Problem 6 is shown in Table 6-6b. The geometric data is output (as entered) in increasing segment order. Sediment data are then given for the main stem, the local inflow (Silver Creek), and the tributaries. The user is advised to take advantage of the title (and comment) records to annotate the output file. The information from the T1 records is used throughout the output so they should contain the name of each stream segment.

The A-level hydrologic data are output in the sequence in which the backwater computation is performed. Segment 1 is calculated first, from downstream to upstream and the water surface elevation at each control point is printed. When segment 1 is complete, the backwater computations start at the downstream boundary of segment 2 using the water surface computed at control point 2 as the starting water surface. This process continues though the remainder of the tributaries in order.

The temperature in each stream segment changes as differing water temperatures enter from the tributaries and local inflows. For example, in time step 1, the inflow from Cascade Creek is 61 cfs at 72€F and the flow in the main stem below that confluence is 750 cfs at 65€F. Therefore, the flow in the main stem above the confluence is 689 cfs at 64.38€F (689 € 64.38 + 61 € 72 = 750 € 65).

In previous examples it was noted that the sedimentation computations proceed from upstream to downstream, in reverse order from the hydraulic computations. In this example network system, this means that the sedimentation computations begin at the upstream boundary of segment 4, work downstream to the confluence with segment 3, then proceed to the upstream boundary of segment 3 and so on. Sediment output contains the same information previously discussed; identified primarily by cross section and segment.

Output can be limited to specified cross sections on any stream segment. As seen in the previous example problems, this is done via the $PRT, CP, and PN records. The output level is governed by the output options on the Q record. For example, prior to time step 2, the $PRT option was used to limit output to Sections 35.1 and 55.0 on the main river segment and Section No. 6.0 on segment 4, Takeo Creek; A-level hydraulic and C-level sediment output was requested for time step 2 on the Q record.

Table 6-6b
Example Problem 6 - Output
Network System

```
****************************************************     **********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS   *
*       Version: 4.1.00 -  AUGUST 1993            *     *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  example6.DAT                      *     *  609 SECOND STREET              *
*  OUTPUT FILE: example6.OUT                      *     *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 31 AUG 93    RUN TIME: 18:54:00      *     *  (916) 756-1104                 *
****************************************************     **********************************

                       X     X  XXXXXXX   XXXXX           XXXXX
                       X     X  X        X     X         X     X
                       X     X  X        X               X
                       XXXXXXX  XXXX     X        XXXXX  XXXXXX
                       X     X  X        X               X     X
                       X     X  X        X     X         X     X
                       X     X  XXXXXXX   XXXXX           XXXXX

         **********************************************************************
         *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
         *       10  Stream Segments (Main Stem + Tributaries)                *
         *      150  Cross Sections                                           *
         *      100  Elevation/Station Points per Cross Section               *
         *       20  Grain Sizes                                              *
         *       10  Control Points                                           *
         **********************************************************************

T1      EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
T2      CASCADE & BEAR: TRIBS OF ZUMBRO;  TAKEO: TRIB OF BEAR;  SILVER: LOCAL
T3      ZUMBRO RIVER PROJECT - Dendritic System     ** Example Problem 6 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0400   0.1000       1.1000     0.7000

SECTION NO.     1.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

N-Values vs. Elevation Table
    Left Overbank           Channel           Right Overbank
  0.0800     966.       0.0450     966.       0.1000     966.
  0.1300     989.       0.0640     989.       0.1100     982.
  0.0000       0.       0.0000       0.       0.1200     989.

SECTION NO.    15.000
...Left Encroachment defined at station 10700.000 at elevation   961.000
...Right Encroachment defined at station 11000.000 at elevation   970.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

TRIBUTARY ENTRY POINT  1 occurs upstream from Section No.     15.000  at Control Point #  2

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0500   0.1000       1.1000     0.7000

SECTION NO.    32.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    33.000
...Limit CONVEYANCE to  250.000 ft. centered about midpoint of channel.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    33.300
...Adjust Section WIDTH to  95.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...Limit CONVEYANCE to  250.000 ft. centered about midpoint of channel.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    33.900
...Adjust Section WIDTH to  95.00% of original.
...Adjust Section ELEVATIONS by    1.650 ft.
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station       1757.500       2042.500
              Ineffective Elevation        986.060        986.150
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    35.000
...Internal Boundary Condition
   Water Surface Elevation will be read from R-RECORD, Field  2
   Head Loss =    0.000
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station       9894.000      10245.000
              Ineffective Elevation        984.700        984.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.0600   0.0450   0.0600       1.1000     0.7000

SECTION NO.    42.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.
```

```
LOCAL INFLOW POINT  1 occurs upstream from Section No.      42.000

SECTION NO.    44.000
...Limit CONVEYANCE between stations    9850.000 and   10200.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    53.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

TRIBUTARY ENTRY POINT  2 occurs upstream from Section No.     53.000  at Control Point #  3

SECTION NO.    55.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    58.000
...DEPTH of the Bed Sediment Control Volume =    3.40 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 12
NO. OF INPUT DATA MESSAGES =   0
--------------------------------------------------------------------------------------------------------------

T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
T2      CASCADE IS A TRIBUTARY OF THE ZUMBRO RIVER DOWNSTREAM OF SILVER LAKE
T3      CASCADE CREEK GEOMETRY - STREAM SEGMENT 2     ** Example Problem 6 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.1200   0.0450   0.1200       1.1000     0.7000

SECTION NO.     1.000
...ELEVATION of Model Bottom =    949.800 ft.

SECTION NO.     3.000
...ELEVATION of Model Bottom =    964.300 ft.

SECTION NO.     4.000
...ELEVATION of Model Bottom =    968.300 ft.

SECTION NO.     6.200
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station       5000.000       5130.000
              Ineffective Elevation        987.400        987.500
...ELEVATION of Model Bottom =    972.000 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT=  4
NO. OF INPUT DATA MESSAGES =   0
--------------------------------------------------------------------------------------------------------------

T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
T2      BEAR IS A TRIBUTARY OF THE ZUMBRO RIVER UPSTREAM OF SILVER CREEK
T3      BEAR CREEK GEOMETRY - STREAM SEGMENT 3     ** Example Problem 6 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.0900   0.0460   0.0900       1.3000     0.5000

SECTION NO.     1.000
...ELEVATION of Model Bottom =    967.000 ft.

SECTION NO.     2.100
...ELEVATION of Model Bottom =    967.300 ft.

TRIBUTARY ENTRY POINT  1 occurs upstream from Section No.      2.100  at Control Point #  4

SECTION NO.     4.000
...ELEVATION of Model Bottom =    978.300 ft.

SECTION NO.     6.000
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station      10100.000      10222.000
              Ineffective Elevation        995.600        992.000
...ELEVATION of Model Bottom =    982.700 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT=  4
NO. OF INPUT DATA MESSAGES =   0
--------------------------------------------------------------------------------------------------------------

T1      EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
T2      TAKEO CREEK IS A TRIBUTARY OF BEAR CREEK UPSTREAM OF SECTION 2.1
T3      TAKEO CREEK GEOMETRY - STREAM SEGMENT 4     ** Example Problem 6 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.0900   0.0460   0.0900       1.3000     0.5000

SECTION NO.     1.000
...Adjust Section ELEVATIONS by    2.000 ft.
...ELEVATION of Model Bottom =    969.000 ft.

SECTION NO.     2.100
...Adjust Section ELEVATIONS by    2.000 ft.
...ELEVATION of Model Bottom =    969.300 ft.

SECTION NO.     4.000
...Adjust Section ELEVATIONS by    2.000 ft.
```

```
...ELEVATION of Model Bottom =    980.300 ft.

SECTION NO.     6.000
...Adjust Section ELEVATIONS by    2.000 ft.
...Ineffective Flow Area - Method 1 - Left Overbank  Right Overbank
          Natural Levees at Station      10100.000      10222.000
              Ineffective Elevation        997.600        994.000
...ELEVATION of Model Bottom =    984.700 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT=  4
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  24
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   4
END OF GEOMETRIC DATA

==============================================================================================================

T4      South Fork, Zumbro River - Stream Segment 1     ** Example Problem 6 **
T5      LOAD CURVE FROM GAGE DATA.
T6      BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels
T8      SEDIMENT TRANSPORT BY Yang's STREAM POWER [ref ASCE JOURNAL (YANG 1971)]

        EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
        CASCADE & BEAR: TRIBS OF ZUMBRO;  TAKEO: TRIB OF BEAR;  SILVER: LOCAL
        ZUMBRO RIVER PROJECT - Dendritic System     ** Example Problem 6 **

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SEDIMENT PROPERTIES AND PARAMETERS

       SPI     IBG    MNQ      SPGF      ACGR     NFALL    IBSHER
I1      5.       0      1     1.000    32.174         2         1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SANDS - BOULDERS ARE PRESENT

       MTC     IASA    LASA     SPGS       GSF      BSAE       PSI     UWDLB
I4      4       1      10     2.650     0.667     0.500    30.000    93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG
GRAIN SIZES UTILIZED (mean diameter - mm)
----------------------------------------------------------------------
    VERY FINE SAND....    0.088  |  VERY FINE GRAVEL..    2.828
    FINE SAND.........    0.177  |  FINE GRAVEL.......    5.657
    MEDIUM SAND.......    0.354  |  MEDIUM GRAVEL.....   11.314
    COARSE SAND.......    0.707  |  COARSE GRAVEL.....   22.627
    VERY COARSE SAND..    1.414  |  VERY COARSE GRAVEL   45.255
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
COEFFICIENTS FOR COMPUTATION SCHEME WERE SPECIFIED
        DBI      DBN      XID      XIN      XIU      UBI      UBN      JSL
I5    0.500    0.500    0.250    0.500    0.250    0.000    1.000        1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   1
          LOAD BY GRAIN SIZE CLASS (tons/day)
---------------------------------------------------------------------------
LQ       | 1.00000    | 50.0000    | 1000.00    | 5800.00    | 90000.0    |
           ------------ ------------ ------------ ------------ ------------
LF   VFS |0.130900E-02|0.178500    | 159.360    | 2299.50    | 232800.    |
LF    FS |0.360800E-02|0.492000    | 105.920    | 1377.00    | 112000.    |
LF    MS |0.608300E-02|0.829500    | 49.9200    | 693.000    | 44000.0    |
LF    CS |0.100000E-19|0.100000E-19| 3.52000    | 72.0000    | 8000.00    |
LF   VCS |0.100000E-19|0.100000E-19| 1.28000    | 36.0000    | 2000.00    |
LF   VFG |0.100000E-19|0.100000E-19|0.100000E-19| 18.0000    | 800.000    |
LF    FG |0.100000E-19|0.100000E-19|0.100000E-19| 4.50000    | 400.000    |
LF    MG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LF    CG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LF   VCG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
           ------------ ------------ ------------ ------------ ------------
   TOTAL |0.110000E-01| 1.50000    | 320.000    | 4500.00    | 400000.    |
---------------------------------------------------------------------------

REACH GEOMETRY FOR STREAM SEGMENT  1
-------------------------------------
  CROSS        REACH    MOVABLE      INITIAL BED-ELEVATIONS       ACCUMULATED CHANNEL DISTANCE
  SECTION      LENGTH     BED    LEFT SIDE  THALWEG  RIGHT SIDE        FROM DOWNSTREAM
    NO.         (ft)     WIDTH      (ft)      (ft)      (ft)          (ft)       (miles)
-----------------------------------------------------------------------------------------------
                0.000
    1.000               183.500   959.300   944.700   958.900        0.000        0.000
             3280.000
   15.000               242.000   961.000   953.700   962.000     3280.000        0.621
             4240.000
   32.000               219.500   968.600   956.500   978.500     7520.000        1.424
             3320.000
   33.000               299.000   979.190   961.000   976.000    10840.000        2.053
             1750.000
   33.300               284.050   980.680   962.490   977.490    12590.000        2.384
             1050.000
   33.900               284.050   980.840   962.650   977.650    13640.000        2.583
                0.000
   35.000               275.950   963.300   963.300   983.700    13640.000        2.583
             5210.000
   42.000               154.500   969.800   969.800   969.800    18850.000        3.570
             3500.000
   44.000               337.500   970.900   967.100   976.900    22350.000        4.233
```

```
              2942.000
   53.000                195.000   982.800   972.200   988.700    25292.000        4.790
              2770.000
   55.000                204.000   987.200   972.900   983.800    28062.000        5.315
              1462.000
   58.000                176.500   996.300   975.400   990.400    29524.000        5.592
```

```
BED MATERIAL GRADATION
----------------------
     SECNO    SAE   DMAX   DXPI    XPI  TOTAL       BED MATERIAL FRACTIONS
                    (ft)   (ft)          BED           per grain size
---------------------------------------------------------------------------------------------------
     1.000  1.000  0.105  0.105  1.000  1.000 | VF SAND  0.010 | VC SAND  0.120 | M  GRVL  0.015 |
                                              | F  SAND  0.070 | VF GRVL  0.060 | C  GRVL  0.035 |
                                              | M  SAND  0.290 | F  GRVL  0.040 | VC GRVL  0.000 |
                                              | C  SAND  0.360 |

    15.000  1.000  0.151  0.151  1.000  1.000 | VF SAND  0.010 | VC SAND  0.113 | M  GRVL  0.011 |
                                              | F  SAND  0.070 | VF GRVL  0.045 | C  GRVL  0.022 |
                                              | M  SAND  0.327 | F  GRVL  0.033 | VC GRVL  0.002 |
                                              | C  SAND  0.367 |

    32.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.010 | VC SAND  0.105 | M  GRVL  0.005 |
                                              | F  SAND  0.070 | VF GRVL  0.025 | C  GRVL  0.005 |
                                              | M  SAND  0.375 | F  GRVL  0.025 | VC GRVL  0.005 |
                                              | C  SAND  0.375 |

    33.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.008 | VC SAND  0.124 | M  GRVL  0.004 |
                                              | F  SAND  0.062 | VF GRVL  0.038 | C  GRVL  0.009 |
                                              | M  SAND  0.321 | F  GRVL  0.027 | VC GRVL  0.009 |
                                              | C  SAND  0.397 |

    33.300  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.008 | VC SAND  0.134 | M  GRVL  0.004 |
                                              | F  SAND  0.058 | VF GRVL  0.045 | C  GRVL  0.011 |
                                              | M  SAND  0.293 | F  GRVL  0.028 | VC GRVL  0.011 |
                                              | C  SAND  0.408 |

    33.900  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.007 | VC SAND  0.140 | M  GRVL  0.004 |
                                              | F  SAND  0.056 | VF GRVL  0.049 | C  GRVL  0.012 |
                                              | M  SAND  0.276 | F  GRVL  0.029 | VC GRVL  0.012 |
                                              | C  SAND  0.415 |

    35.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.007 | VC SAND  0.140 | M  GRVL  0.004 |
                                              | F  SAND  0.056 | VF GRVL  0.049 | C  GRVL  0.012 |
                                              | M  SAND  0.276 | F  GRVL  0.029 | VC GRVL  0.012 |
                                              | C  SAND  0.415 |

    42.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.005 | VC SAND  0.169 | M  GRVL  0.002 |
                                              | F  SAND  0.044 | VF GRVL  0.069 | C  GRVL  0.018 |
                                              | M  SAND  0.192 | F  GRVL  0.033 | VC GRVL  0.018 |
                                              | C  SAND  0.450 |

    44.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.003 | VC SAND  0.189 | M  GRVL  0.002 |
                                              | F  SAND  0.036 | VF GRVL  0.082 | C  GRVL  0.022 |
                                              | M  SAND  0.136 | F  GRVL  0.035 | VC GRVL  0.022 |
                                              | C  SAND  0.473 |

    53.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.002 | VC SAND  0.206 | M  GRVL  0.001 |
                                              | F  SAND  0.030 | VF GRVL  0.094 | C  GRVL  0.025 |
                                              | M  SAND  0.088 | F  GRVL  0.037 | VC GRVL  0.025 |
                                              | C  SAND  0.492 |

    55.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.001 | VC SAND  0.222 | M  GRVL  0.000 |
                                              | F  SAND  0.023 | VF GRVL  0.104 | C  GRVL  0.028 |
                                              | M  SAND  0.044 | F  GRVL  0.039 | VC GRVL  0.028 |
                                              | C  SAND  0.510 |

    58.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.000 | VC SAND  0.230 | M  GRVL  0.000 |
                                              | F  SAND  0.020 | VF GRVL  0.110 | C  GRVL  0.030 |
                                              | M  SAND  0.020 | F  GRVL  0.040 | VC GRVL  0.030 |
                                              | C  SAND  0.520 |
```

```
..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   1
                 AT LOCAL INFLOW POINT #   1
          LOAD BY GRAIN SIZE CLASS (tons/day)
--------------------------------------------------------------
LQ       | 1.00000    | 100.000    | 1000.00    | 10000.0    |
           ------------ ------------ ------------ ------------
LF   VFS |0.265600E-02| 6.64000    | 7.50000    | 5940.00    |
LF    FS |0.828000E-03| 2.07000    | 122.500    | 5430.00    |
LF    MS |0.344000E-03|0.860000    | 302.500    | 3210.00    |
LF    CS |0.124000E-03|0.310000    | 26.0000    | 2940.00    |
LF   VCS |0.320000E-04|0.800000E-01| 19.5000    | 3810.00    |
LF   VFG |0.120000E-04|0.300000E-01| 10.0000    | 3480.00    |
LF    FG |0.400000E-05|0.100000E-01| 5.50000    | 2730.00    |
LF    MG |0.100000E-19|0.100000E-19| 5.50000    | 1590.00    |
LF    CG |0.100000E-19|0.100000E-19|0.100000E-19| 660.000    |
LF   VCG |0.100000E-19|0.100000E-19|0.100000E-19| 180.000    |
           ------------ ------------ ------------ ------------
   TOTAL |0.400000E-02| 10.0000    | 499.000    | 29970.0    |
--------------------------------------------------------------

----------------------------------------------------------------------------------------------------------------
```

```
T4      CASCADE CREEK - STREAM SEGMENT 2      ** Example Problem 6 **
T5      FIRST TRIB ON Zumbro River.
T6      LOAD CURVE FROM GAGE DATA.  BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels - Yang's Stream Power.
T8      Zumbro River Project

        EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
        CASCADE IS A TRIBUTARY OF THE ZUMBRO RIVER DOWNSTREAM OF SILVER LAKE
        CASCADE CREEK GEOMETRY - STREAM SEGMENT 2     ** Example Problem 6 **
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   2
          LOAD BY GRAIN SIZE CLASS (tons/day)
--------------------------------------------------------------
LQL      | 1.00000    | 100.000    | 1000.00    | 10000.0    |
          ------------ ------------ ------------ ------------
LFL  VFS |0.265600E-02| 6.64000    | 7.50000    | 5940.00    |
LFL   FS |0.828000E-03| 2.07000    | 122.500    | 5430.00    |
LFL   MS |0.344000E-03|0.860000    | 302.500    | 3210.00    |
LFL   CS |0.124000E-03|0.310000    | 26.0000    | 2940.00    |
LFL  VCS |0.320000E-04|0.800000E-01| 19.5000    | 3810.00    |
LFL  VFG |0.120000E-04|0.300000E-01| 10.0000    | 3480.00    |
LFL   FG |0.400000E-05|0.100000E-01| 5.50000    | 2730.00    |
LFL   MG |0.100000E-19|0.100000E-19| 5.50000    | 1590.00    |
LFL   CG |0.100000E-19|0.100000E-19|0.100000E-19| 660.000    |
LFL  VCG |0.100000E-19|0.100000E-19|0.100000E-19| 180.000    |
          ------------ ------------ ------------ ------------
   TOTAL |0.400000E-02| 10.0000    | 499.000    | 29970.0    |
--------------------------------------------------------------

REACH GEOMETRY FOR STREAM SEGMENT  2
------------------------------------
  CROSS        REACH    MOVABLE      INITIAL BED-ELEVATIONS       ACCUMULATED CHANNEL DISTANCE
 SECTION      LENGTH      BED    LEFT SIDE  THALWEG  RIGHT SIDE        FROM DOWNSTREAM
   NO.         (ft)     WIDTH      (ft)       (ft)      (ft)          (ft)       (miles)
-----------------------------------------------------------------------------------------------
               0.000
   1.000                200.000   964.600   959.800   969.600        0.000        0.000
             537.000
   3.000                222.000   982.900   964.300   970.300      537.000        0.102
             240.000
   4.000                114.500   981.700   968.300   981.200      777.000        0.147
             474.000
   6.200                200.000   987.400   972.000   987.500     1251.000        0.237

BED MATERIAL GRADATION
----------------------
     SECNO    SAE   DMAX   DXPI    XPI  TOTAL       BED MATERIAL FRACTIONS
                    (ft)   (ft)          BED            per grain size
----------------------------------------------------------------------------------------------------
     1.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.025 | VC SAND  0.140 | M  GRVL  0.150 |
                                              | F  SAND  0.025 | VF GRVL  0.180 | C  GRVL  0.090 |
                                              | M  SAND  0.040 | F  GRVL  0.200 | VC GRVL  0.060 |
                                              | C  SAND  0.090 |

     3.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.025 | VC SAND  0.140 | M  GRVL  0.150 |
                                              | F  SAND  0.025 | VF GRVL  0.180 | C  GRVL  0.090 |
                                              | M  SAND  0.040 | F  GRVL  0.200 | VC GRVL  0.060 |
                                              | C  SAND  0.090 |

     4.000  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.025 | VC SAND  0.140 | M  GRVL  0.150 |
                                              | F  SAND  0.025 | VF GRVL  0.180 | C  GRVL  0.090 |
                                              | M  SAND  0.040 | F  GRVL  0.200 | VC GRVL  0.060 |
                                              | C  SAND  0.090 |

     6.200  1.000  0.210  0.210  1.000  1.000 | VF SAND  0.025 | VC SAND  0.140 | M  GRVL  0.150 |
                                              | F  SAND  0.025 | VF GRVL  0.180 | C  GRVL  0.090 |
                                              | M  SAND  0.040 | F  GRVL  0.200 | VC GRVL  0.060 |
                                              | C  SAND  0.090 |

--------------------------------------------------------------------------------------------------------------

T4      BEAR CREEK - Stream Segment 3      ** Example Problem 6 **
T5      SECOND UPSTREAM TRIB ON Zumbro River.
T6      LOAD CURVE FROM GAGE DATA.  BED GRADATIONS FROM FIELD SAMPLES
T7      Use full range of sands and gravels.  Yang's Stream Power.
T8      Zumbro River Project

        EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
        BEAR IS A TRIBUTARY OF THE ZUMBRO RIVER UPSTREAM OF SILVER CREEK
        BEAR CREEK GEOMETRY - STREAM SEGMENT 3     ** Example Problem 6 **
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   3
          LOAD BY GRAIN SIZE CLASS (tons/day)
---------------------------------------------------------------------------
LQL      | 1.00000    | 100.000    | 500.000    | 1000.00    | 30000.0    |
          ------------ ------------ ------------ ------------ ------------
LFL  VFS |0.402000E-03| 6.03000    | 39.0000    | 93.6000    | 3082.50    |
LFL   FS |0.684000E-03| 10.2600    | 86.0000    | 210.000    | 4905.00    |
LFL   MS |0.902000E-03| 13.5300    | 227.000    | 721.200    | 10710.0    |
LFL   CS |0.200000E-05|0.300000E-01| 98.5000    | 170.400    | 3555.00    |
LFL  VCS |0.100000E-19|0.100000E-19|0.100000E-19| 3.60000    | 180.000    |
LFL  VFG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19| 45.0000    |
LFL   FG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19| 22.5000    |
LFL   MG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
```

```
LFL   CG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LFL  VCG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
          ------------ ------------ ------------ ------------ ------------
   TOTAL |0.199000E-02| 29.8500    | 450.500    | 1198.80    | 22500.0    |
---------------------------------------------------------------------------

REACH GEOMETRY FOR STREAM SEGMENT  3
------------------------------------
  CROSS        REACH    MOVABLE      INITIAL BED-ELEVATIONS       ACCUMULATED CHANNEL DISTANCE
  SECTION      LENGTH     BED    LEFT SIDE  THALWEG  RIGHT SIDE        FROM DOWNSTREAM
    NO.         (ft)     WIDTH      (ft)       (ft)      (ft)           (ft)       (miles)
----------------------------------------------------------------------------------------------
                0.000
    1.000                202.500   985.000   977.000   985.900        0.000        0.000
              260.000
    2.100                137.500   986.700   977.300   986.700      260.000        0.049
              708.000
    4.000                137.500   986.300   978.300   992.300      968.000        0.183
              665.000
    6.000                347.500   995.600   982.800   994.200     1633.000        0.309

BED MATERIAL GRADATION
----------------------
     SECNO    SAE   DMAX   DXPI    XPI  TOTAL       BED MATERIAL FRACTIONS
                    (ft)   (ft)          BED            per grain size
---------------------------------------------------------------------------------------------------
     1.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.030 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.240 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.660 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.060 |

     2.100  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.029 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.234 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.662 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.066 |

     4.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.027 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.216 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.666 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.081 |

     6.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.025 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.200 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.670 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.095 |

---------------------------------------------------------------------------------------------------------------

T4      TAKEO CREEK - Stream Segment 4      ** Example Problem 6 **
T5      FIRST TRIBUTARY ON Bear Creek.
T6      LOAD CURVE IS FROM GAGE DATA. BED GRADATIONS FROM FIELD SAMPLES.
T7      Use full range of sands and gravels.  Yang's Stream Power.
T8      Zumbro River Project

        EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
        TAKEO CREEK IS A TRIBUTARY OF BEAR CREEK UPSTREAM OF SECTION 2.1
        TAKEO CREEK GEOMETRY - STREAM SEGMENT 4     ** Example Problem 6 **
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   4
          LOAD BY GRAIN SIZE CLASS (tons/day)
---------------------------------------------------------------------------
LQL      | 1.00000    | 100.000    | 500.000    | 1000.00    | 30000.0    |
          ------------ ------------ ------------ ------------ ------------
LFL  VFS |0.402000E-03| 6.03000    | 39.0000    | 93.6000    | 3082.50    |
LFL   FS |0.684000E-03| 10.2600    | 86.0000    | 210.000    | 4905.00    |
LFL   MS |0.902000E-03| 13.5300    | 227.000    | 721.200    | 10710.0    |
LFL   CS |0.200000E-05|0.300000E-01| 98.5000    | 170.400    | 3555.00    |
LFL  VCS |0.100000E-19|0.100000E-19|0.100000E-19| 3.60000    | 180.000    |
LFL  VFG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19| 45.0000    |
LFL   FG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19| 22.5000    |
LFL   MG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LFL   CG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LFL  VCG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
          ------------ ------------ ------------ ------------ ------------
   TOTAL |0.199000E-02| 29.8500    | 450.500    | 1198.80    | 22500.0    |
---------------------------------------------------------------------------

REACH GEOMETRY FOR STREAM SEGMENT  4
------------------------------------
  CROSS        REACH    MOVABLE      INITIAL BED-ELEVATIONS       ACCUMULATED CHANNEL DISTANCE
  SECTION      LENGTH     BED    LEFT SIDE  THALWEG  RIGHT SIDE        FROM DOWNSTREAM
    NO.         (ft)     WIDTH      (ft)       (ft)      (ft)           (ft)       (miles)
----------------------------------------------------------------------------------------------
                0.000
    1.000                202.500   987.000   979.000   987.900        0.000        0.000
              260.000
    2.100                137.500   988.700   979.300   988.700      260.000        0.049
              708.000
    4.000                137.500   988.300   980.300   994.300      968.000        0.183
              665.000
    6.000                347.500   997.600   984.800   996.200     1633.000        0.309

BED MATERIAL GRADATION
----------------------
```

```
     SECNO    SAE   DMAX   DXPI    XPI  TOTAL       BED MATERIAL FRACTIONS
                    (ft)   (ft)          BED            per grain size
-----------------------------------------------------------------------------------------------------
     1.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.030 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.240 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.660 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.060 |

     2.100  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.029 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.234 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.662 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.066 |

     4.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.027 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.216 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.666 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.081 |

     6.000  1.000  0.013  0.013  1.000  1.000 | VF SAND  0.025 | VC SAND  0.005 | M  GRVL  0.000 |
                                              | F  SAND  0.200 | VF GRVL  0.005 | C  GRVL  0.000 |
                                              | M  SAND  0.670 | F  GRVL  0.000 | VC GRVL  0.000 |
                                              | C  SAND  0.095 |

BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT #  1: EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
|  SECTION  |   LENGTH   |   WIDTH    |  DEPTH    |          V O L U M E          |
|  NUMBER   |    (ft)    |    (ft)    |   (ft)    |    (cu.ft)    |    (cu.yd)    |
---------------------------------------------------------------------------------
|     1.000 |   1640.000 |    203.000 |   10.000 |0.332920E+07 | 123304.      |
|    15.000 |   3760.000 |    229.266 |   10.000 |0.862040E+07 | 319274.      |
|    32.000 |   3780.000 |    235.344 |   10.000 |0.889600E+07 | 329481.      |
|    33.000 |   2535.000 |    279.927 |    0.000 |0.000000     |0.000000      |
|    33.300 |   1400.000 |    287.165 |    0.000 |0.000000     |0.000000      |
|    33.900 |    525.000 |    284.050 |    0.000 |0.000000     |0.000000      |
|    35.000 |   2605.000 |    235.467 |    0.000 |0.000000     |0.000000      |
|    42.000 |   4355.000 |    203.228 |    0.000 |0.000000     |0.000000      |
|    44.000 |   3221.000 |    282.665 |   10.000 |0.910465E+07 | 337209.      |
|    53.000 |   2856.000 |    220.920 |   10.000 |0.630947E+07 | 233684.      |
|    55.000 |   2116.000 |    198.870 |   10.000 |0.420808E+07 | 155855.      |
|    58.000 |    731.000 |    185.667 |    3.400 | 461456.     | 17091.0      |

BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT #  2: EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
|  SECTION  |   LENGTH   |   WIDTH    |  DEPTH    |          V O L U M E          |
|  NUMBER   |    (ft)    |    (ft)    |   (ft)    |    (cu.ft)    |    (cu.yd)    |
---------------------------------------------------------------------------------
|     1.000 |    268.500 |    207.333 |   10.000 | 556690.     | 20618.1      |
|     3.000 |    388.500 |    205.864 |    0.000 |0.000000     |0.000000      |
|     4.000 |    357.000 |    145.465 |    0.000 |0.000000     |0.000000      |
|     6.200 |    237.000 |    171.500 |    0.000 |0.000000     |0.000000      |

BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT #  3: EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
|  SECTION  |   LENGTH   |   WIDTH    |  DEPTH    |          V O L U M E          |
|  NUMBER   |    (ft)    |    (ft)    |   (ft)    |    (cu.ft)    |    (cu.yd)    |
---------------------------------------------------------------------------------
|     1.000 |    130.000 |    180.833 |   10.000 | 235083.     | 8706.79      |
|     2.100 |    484.000 |    143.320 |   10.000 | 693667.     | 25691.4      |
|     4.000 |    686.500 |    171.404 |    0.000 |0.000000     |0.000000      |
|     6.000 |    332.500 |    277.500 |    0.100 | 9226.87     | 341.736      |

BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT #  4: EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
|  SECTION  |   LENGTH   |   WIDTH    |  DEPTH    |          V O L U M E          |
|  NUMBER   |    (ft)    |    (ft)    |   (ft)    |    (cu.ft)    |    (cu.yd)    |
---------------------------------------------------------------------------------
|     1.000 |    130.000 |    180.833 |   10.000 | 235083.     | 8706.79      |
|     2.100 |    484.000 |    143.320 |   10.000 | 693667.     | 25691.4      |
|     4.000 |    686.500 |    171.404 |    0.000 |0.000000     |0.000000      |
|     6.000 |    332.500 |    277.500 |    0.100 | 9226.87     | 341.736      |

NO. OF INPUT DATA MESSAGES=    0
END OF SEDIMENT DATA

==========================================================================================
$HYD
BEGIN COMPUTATIONS.

==========================================================================================
TIME STEP #       1
Q   AB     FLOW 1 = BASE FLOW 0F 750 CFS

EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
ACCUMULATED TIME (yrs)..........      0.000

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  1 at Control Point #  1 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)       (deg F)       (ft)
```

```
                              750.000      65.00       956.000

****  DISCHARGE     WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.      1.000
****     750.000   956.000   956.009   0.009    1.000   154.497   949.519   0.000   0.749   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     15.000
** SUPERCRITICAL **  Using Critical Water Surface +
SECTION NO.     15.000 TIME =     2.000 DAYS.
TRIAL    TRIAL      COMPUTED     CRITICAL
 NO.      WS          WS           WS
  0.    957.779     956.256
  1.    957.873     956.309     957.823
****     750.000   957.873   958.688   0.815    1.000    58.210   956.094   0.000   7.243   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

--- TRIBUTARY JUNCTION - CONTROL POINT #  2 is upstream of Section No.      15.000 ---
                            DISCHARGE   TEMPERATURE
                              (cfs)      (deg F)
        Tributary Inflow:       61.000       72.00
                   Total:      689.000       64.38

SECTION NO.     32.000
****     689.000   963.275   963.297   0.022    1.000   128.771   958.809   0.000   1.198   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     33.000
****     689.000   964.126   964.144   0.018    1.000   217.196   961.158   0.000   1.069   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     33.300
****     689.000   964.929   964.962   0.032    1.000   202.548   962.570   0.000   1.442   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     33.900
****     689.000   965.528   965.551   0.023    1.000   205.131   962.752   0.000   1.210   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     35.000
...Internal Boundary Condition - Water Surface =    970.000
                                     Head Loss =      0.000
****     689.000   970.000   970.014   0.014    1.000   185.172   966.132   0.000   0.962   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     42.000
****     689.000   971.707   971.743   0.036    1.000   242.186   969.833   0.000   1.517   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

--- LOCAL INFLOW POINT #  1 is upstream of Section No.      42.000 ---
                            DISCHARGE   TEMPERATURE
                              (cfs)      (deg F)
            Local Inflow:       29.000       70.00
                   Total:      660.000       64.13

SECTION NO.     44.000
****     660.000   972.831   972.842   0.011    1.000   256.448   969.726   0.000   0.829   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     53.000
****     660.000   974.325   975.010   0.685    1.000    68.355   972.871   0.000   6.641   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

--- TRIBUTARY JUNCTION - CONTROL POINT #  3 is upstream of Section No.      53.000 ---
                            DISCHARGE   TEMPERATURE
                              (cfs)      (deg F)
        Tributary Inflow:      128.000       67.00
                   Total:      532.000       63.44

SECTION NO.     55.000
****     532.000   978.436   978.466   0.030    1.000    99.479   974.567   0.000   1.382   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.     58.000
****     532.000   979.363   979.535   0.172    1.000    54.345   976.417   0.000   3.323   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  2 at Control Point #  2 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)      (deg F)       (ft)
                                61.000       72.00       957.873

****  DISCHARGE     WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.      1.000
** CRITICAL WATER SURFACE USED AT SECTION NO.      1.000 AT TIME =      2.000 DAYS.**                **ELOEQ**
****      61.000   960.360   960.545   0.186    1.000    60.932   960.070   0.000   3.457   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      3.000
****      61.000   965.937   966.008   0.071    1.000    24.774   964.785   0.000   2.137   0.000
                                                 FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      4.000
** SUPERCRITICAL **  Using Critical Water Surface +
SECTION NO.      4.000 TIME =     2.000 DAYS.
```

```
TRIAL    TRIAL       COMPUTED     CRITICAL
 NO.       WS           WS           WS
  0.    969.500      968.272
  1.    969.594      967.882      969.544
****     61.000   969.594   969.797   0.203    1.000    31.272   969.055   0.000   3.616   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      6.200
****     61.000   972.744   972.771   0.026    1.000    64.729   972.019   0.000   1.300   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  3 at Control Point #  3 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)      (deg F)       (ft)
                               128.000      67.00       974.325

****  DISCHARGE    WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.      1.000
** CRITICAL WATER SURFACE USED AT SECTION NO.      1.000 AT TIME =      2.000 DAYS.**                **ELOEQ**
****    128.000   977.612   977.924   0.312    1.000    60.598   977.140   0.000   4.478   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      2.100
****    128.000   978.595   978.607   0.011    1.000   113.709   977.267   0.000   0.847   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

--- TRIBUTARY JUNCTION - CONTROL POINT #  4 is upstream of Section No.      2.100 ---
                            DISCHARGE   TEMPERATURE
                              (cfs)      (deg F)
        Tributary Inflow:       90.000      73.00
                   Total:       38.000      52.79

SECTION NO.      4.000
** SUPERCRITICAL **  Using Critical Water Surface +
SECTION NO.      4.000 TIME =     2.000 DAYS.
TRIAL    TRIAL       COMPUTED     CRITICAL
 NO.       WS           WS           WS
  2.    978.920      978.649
  3.    979.014      978.687      978.964
****     38.000   979.014   979.198   0.184    1.000    24.453   978.563   0.000   3.441   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      6.000
****     38.000   983.945   983.973   0.028    1.000    37.207   983.189   0.000   1.351   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  4 at Control Point #  4 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)      (deg F)       (ft)
                                90.000      73.00       978.595

****  DISCHARGE    WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.      1.000
** CRITICAL WATER SURFACE USED AT SECTION NO.      1.000 AT TIME =      2.000 DAYS.**                **ELOEQ**
****     90.000   979.501   979.688   0.188    1.000    59.777   979.067   0.000   3.475   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      2.100
****     90.000   980.319   980.328   0.009    1.000   113.557   979.275   0.000   0.759   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      4.000
****     90.000   981.486   981.662   0.176    1.000    37.369   980.771   0.000   3.369   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000
SECTION NO.      6.000
****     90.000   986.358   986.422   0.064    1.000    40.719   985.269   0.000   2.029   0.000
                                                FLOW DISTRIBUTION (%) =   0.000 100.000   0.000

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EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
       ACCUMULATED TIME (yrs)....      0.005
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 4      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |         90.00 |         23.96 |       73.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  4
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND              *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
    2.00       6.000 *      0.02                   *
   TOTAL=      1.000 *      0.02      0.93    -38.26 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  4
```

```
-------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....          4.84  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          8.23  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         10.86  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.02  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =         23.96
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....         31.85  |  VERY FINE GRAVEL..          1.42
    FINE SAND.........        231.57  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......        615.85  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         55.40  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          4.42  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =        940.52

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =     2.000 DAYS
-------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)       (ft)      (ft)        (cfs)       SAND
      6.000      -0.10   986.36    984.70         90.         53.
      4.000       0.01   981.49    980.31         90.         42.
      2.100      -0.20   980.32    979.10         90.        250.
      1.000      -2.85   979.50    976.15         90.        941.

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EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
       ACCUMULATED TIME (yrs)....      0.005
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
---------------------------------------------------------------------
Stream Segment # 3      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)     |  (tons/day)   |   (deg F)
---------------------------------------------------------------------
                INFLOW |         38.00 |          3.96 |       52.79

Upstream of SECTION NO.      2.100 is...
TRIBUTARY JUNCTION # 4 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
---------------------------------------------------------------------
      MAIN STEM INFLOW |         38.00 |          3.96 |       52.79
      TRIBUTARY INFLOW |         90.00 |        940.52 |       73.00
---------------------------------------------------------------------
                 TOTAL |        128.00 |        944.48 |       67.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  3
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND              *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
    2.00       6.000 *     0.00                     *
               2.100 *     0.93                     *
   TOTAL=      1.000 *     0.93      1.31     -0.41 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  3
-------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....          0.80  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          1.36  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          1.79  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.00  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =          3.96
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....         51.95  |  VERY FINE GRAVEL..          1.95
    FINE SAND.........        363.17  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......        838.78  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         69.59  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          5.54  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =       1330.97

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =     2.000 DAYS
-------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)       (ft)      (ft)        (cfs)       SAND
      6.000      -0.10   983.95    982.70         38.         32.
      4.000       0.01   979.01    978.31         38.         26.
      2.100       0.51   978.60    977.81        128.        447.
      1.000      -3.65   977.61    973.35        128.       1331.

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```

```
EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
       ACCUMULATED TIME (yrs)....      0.005
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 2     |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.200 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |         61.00 |          4.32 |       72.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  2
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *   INFLOW   OUTFLOW  TRAP EFF *
    2.00       6.200 *     0.00                      *
   TOTAL=      1.000 *     0.00      0.02     -3.99 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  2
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          2.87  |  VERY FINE GRAVEL..          0.01
    FINE SAND.........          0.89  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          0.37  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.13  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.03  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                 TOTAL =          4.32
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          2.57  |  VERY FINE GRAVEL..          3.14
    FINE SAND.........          1.56  |  FINE GRAVEL.......          2.08
    MEDIUM SAND.......          1.96  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          4.05  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          6.21  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                 TOTAL =         21.57

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =     2.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.200       0.00    972.74    972.00         61.         3.
      4.000       0.00    969.59    968.30         61.         3.
      3.000       0.00    965.94    964.30         61.         2.
      1.000      -0.06    960.36    959.74         61.        22.

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EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
       ACCUMULATED TIME (yrs)....      0.005
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1     |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        532.00 |         93.30 |       63.44

Upstream of SECTION NO.     53.000 is...
TRIBUTARY JUNCTION # 3 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        532.00 |         93.30 |       63.44
      TRIBUTARY INFLOW |        128.00 |       1330.97 |       67.00
----------------------------------------------------------------------
                 TOTAL |        660.00 |       1424.27 |       64.13

Upstream of SECTION NO.     42.000 is...
LOCAL INFLOW POINT # 1 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        660.00 |       1424.27 |       64.13
      LOCAL     INFLOW |         29.00 |          1.22 |       70.00
----------------------------------------------------------------------
                 TOTAL |        689.00 |       1425.49 |       64.38

Upstream of SECTION NO.     15.000 is...
TRIBUTARY JUNCTION # 2 |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
                       |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
      MAIN STEM INFLOW |        689.00 |       1425.49 |       64.38
      TRIBUTARY INFLOW |         61.00 |         21.57 |       72.00
----------------------------------------------------------------------
                 TOTAL |        750.00 |       1447.06 |       65.00
```

```
TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
    2.00      58.000 *      0.09                     *
              53.000 *      1.31                     *
              42.000 *      0.00                     *
   TOTAL=     35.000 *      1.41      0.03      0.98 *
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
    2.00      35.000 *      0.03                     *
              15.000 *      0.02                     *
   TOTAL=      1.000 *      0.05      0.02      0.62 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....         38.08  |  VERY FINE GRAVEL..         0.00
    FINE SAND.........         34.16  |  FINE GRAVEL.......         0.00
    MEDIUM SAND.......         21.06  |  MEDIUM GRAVEL.....         0.00
    COARSE SAND.......          0.00  |  COARSE GRAVEL.....         0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL         0.00
                       -------------                   -------------
                                              TOTAL =          93.30
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          0.99  |  VERY FINE GRAVEL..         0.60
    FINE SAND.........          2.37  |  FINE GRAVEL.......         0.72
    MEDIUM SAND.......          5.74  |  MEDIUM GRAVEL.....         0.25
    COARSE SAND.......          5.70  |  COARSE GRAVEL.....         0.00
    VERY COARSE SAND..          2.49  |  VERY COARSE GRAVEL         0.00
                       -------------                   -------------
                                              TOTAL =          18.86

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =     2.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)       (ft)      (ft)        (cfs)       SAND
     58.000      -0.13    979.36    975.27        532.        284.
     55.000      -0.07    978.44    972.83        532.        616.
     53.000       0.07    974.32    972.27        660.       1413.
     44.000       0.07    972.83    967.17        660.        326.
     42.000       0.01    971.71    969.81        689.         56.
     35.000       0.00    970.00    963.30        689.         28.
     33.900       0.00    965.53    962.65        689.         22.
     33.300       0.00    964.93    962.49        689.         18.
     33.000       0.00    964.13    961.00        689.         13.
     32.000      -0.05    963.28    956.45        689.        602.
     15.000      -0.14    957.87    953.56        750.       1724.
      1.000       0.37    956.00    945.07        750.         19.

------------------------------------------------------------------------------------------
$PRT
...Selective Printout Option
    - Print at the following cross sections
CP            1
PS  35.1    55.0
CP            4
PS   6.0
END

==========================================================================================
TIME STEP #       2
Q   AC     FLOW 2 = 50 DAYS AT BANK FULL DISCHARGE
COMPUTING FROM TIME=      2.0000 DAYS TO TIME=     52.0000 DAYS IN    10 COMPUTATION STEPS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
ACCUMULATED TIME (yrs)..........     0.005

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  1 at Control Point #  1 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)       (deg F)        (ft)
                              2500.000       65.00        965.000

****  DISCHARGE    WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3


--- TRIBUTARY JUNCTION - CONTROL POINT #  3 is upstream of Section No.      53.000 ---
                            DISCHARGE   TEMPERATURE
                              (cfs)       (deg F)
        Tributary Inflow:      650.000       67.00
                   Total:     1400.000       62.04

SECTION NO.     55.000
****   1400.000   980.829   980.903   0.074    1.000   109.662   974.980   0.000   2.182   0.000
                                                FLOW DISTRIBUTION (%) =    0.000 100.000   0.000
```

```
EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  4 at Control Point #  4 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)       (deg F)        (ft)
                             450.000       73.00       979.221

****  DISCHARGE    WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG      AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.      6.000
****    450.000   988.475   988.626   0.151    1.000    67.244   986.328   0.000   3.117   0.000
                                                 FLOW DISTRIBUTION (%) =    0.000 100.000   0.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
       ACCUMULATED TIME (yrs)....      0.142
       FLOW DURATION (days)......      5.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 4      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)      |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        450.00 |        356.05 |       73.00

  SEDIMENT INFLOW at SECTION NO.      6.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------
    VERY FINE SAND....         34.51  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         74.83  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......        188.73  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         57.98  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                        -------------
                                           TOTAL =        356.05

    FALL VELOCITIES - Method 2
              DIAMETER   VELOCITY       REY. NO.          CD
    -----------------------------------------------------------
    VF SAND   0.000290  0.2115882E-01  0.6021239       45.84847
    F  SAND   0.000580  0.6288557E-01   3.579113       10.38092
    M  SAND   0.001160  0.1423402       16.20246       4.052398
    C  SAND   0.002320  0.2905100       66.13704       1.945695
    VC SAND   0.004640  0.4865262       221.5240       1.387444
    VF GRVL   0.009280  0.7223283       657.7777       1.258893
    F  GRVL   0.018559   1.041785       1897.368       1.210406
    M  GRVL   0.037118   1.472894       5365.081       1.211086
    C  GRVL   0.074237   2.082985       15174.71       1.211086
    VC GRVL   0.148474   2.945788       42920.64       1.211086

*****************************************************************************************
                  TRACE OUTPUT FOR SECTION NO.      6.000
           -------------------------------------------------------

HYDRAULIC PARAMETERS:
      VEL      SLO        EFD        EFW     N-VALUE     TAU      USTARM    FROUDE NO.
     3.117  0.008268      2.838     50.874    0.0460   1.46520   0.86883     0.326

BED SEDIMENT CONTROL VOLUME COMPUTATIONS:
NEW SURFACE AREA (SQ FT):     TOTAL        K-PORTION      S-PORTION
                            22942.50      22942.50           0.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER              BED FRACTION  PERCENT FINER
                       VF SAND      0.080074      8.007434      VF GRVL      0.000000     99.999999
                       F  SAND      0.214080     29.415438      F  GRVL      0.000000     99.999999
                       M  SAND      0.539976     83.413004      M  GRVL      0.000000     99.999999
                       C  SAND      0.165870     99.999999      C  GRVL      0.000000     99.999999
                       VC SAND      0.000000     99.999999      VC GRVL      0.000000     99.999999

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=     0.04195
MIN.GRAIN DIAM       =    0.013194
BED SURFACE EXPOSED  =     0.00000

        INACTIVE LAYER      ACTIVE LAYER
         %       DEPTH      %      DEPTH
 CLAY   0.0000    0.00     0.0000   0.00
 SILT   0.0000    0.00     0.0000   0.00
 SAND   1.0000    0.00     1.0000   0.36
TOTAL   1.0000    0.00     1.0000   0.36

       AVG. UNIT              AVG. UNIT
         WEIGHT                 WEIGHT
        0.046500               0.046500
-- CAUTION --
SECTION NO.      6.000 AT TIME =    52.00 DAYS.
ACTIVE LAYER THICKNESS EXCEEDS DEPTH OF SEDIMENT RESERVOIR.
...LOWER THE MODEL BOTTOM BY MORE THAN     1.35 FT.
```

```
    COMPOSITE UNIT WT OF ACTIVE LAYER   (t/cf)=       0.046500
    COMPOSITE UNIT WT OF INACTIVE LAYER (t/cf)=       0.046500
    DEPTH OF SURFACE LAYER (ft)           DSL=             0.1
    WEIGHT IN SURFACE LAYER (tons)       WTSL=            88.9
    DEPTH OF NEW ACTIVE LAYER (ft)        DSE=          0.3588
    WEIGHT IN NEW ACTIVE LAYER(tons)   WTMXAL=           382.8
    WEIGHT IN OLD ACTIVE LAYER(tons)      WAL=           382.8
    USEABLE WEIGHT, OLD INACTIVE LAYER    WIL=             0.0
    SURFACE AREA OF DEPOSIT (sq ft)      SABK= 0.22942500E+05

** INACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER              BED FRACTION  PERCENT FINER
                       VF SAND      0.000000      0.000000      VF GRVL      0.000000      0.000000
                       F  SAND      0.000000      0.000000      F  GRVL      0.000000      0.000000
                       M  SAND      0.000000      0.000000      M  GRVL      0.000000      0.000000
                       C  SAND      0.000000      0.000000      C  GRVL      0.000000      0.000000
                       VC SAND      0.000000      0.000000      VC GRVL      0.000000      0.000000
** ACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER              BED FRACTION  PERCENT FINER
                       VF SAND      0.080074      8.007434      VF GRVL      0.000000    100.000000
                       F  SAND      0.214080     29.415438      F  GRVL      0.000000    100.000000
                       M  SAND      0.539976     83.413004      M  GRVL      0.000000    100.000000
                       C  SAND      0.165870    100.000000      C  GRVL      0.000000    100.000000
                       VC SAND      0.000000    100.000000      VC GRVL      0.000000    100.000000

C FINES, COEF(CFFML), MX POTENTIAL= 0.000000E+00 0.100000E+01 0.972000E+06
POTENTIAL TRANSPORT (tons/day):  VF SAND 0.897832E+05  VF GRVL 0.204164E+02
                                 F  SAND 0.221666E+05  F  GRVL 0.182502E+02
                                 M  SAND 0.964949E+04  M  GRVL 0.846757E+00
                                 C  SAND 0.557199E+04  C  GRVL 0.100000E-06
                                 VC SAND 0.432242E+04  VC GRVL 0.100000E-06

  SEDIMENT OUTFLOW FROM SECTION NO.      6.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....          40.64  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          91.22  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         230.08  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          70.67  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..           0.00  |  VERY COARSE GRAVEL          0.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  4
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND             *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   52.00       6.000 *      8.81                    *
   TOTAL=      1.000 *      8.81     15.35     -0.74 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  4
-------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....          34.51  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          74.83  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         188.73  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          57.98  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..           0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                  TOTAL =        356.05
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....          34.75  |  VERY FINE GRAVEL..          0.01
    FINE SAND.........          90.86  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         261.12  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          68.94  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..           0.35  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                  TOTAL =        456.03

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    52.000 DAYS
-------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)        (cfs)       SAND
      6.000      -0.10    988.47    984.70       450.        433.
      4.000       0.08    982.54    980.38       450.        428.
      2.100      -5.56    979.39    973.74       450.        461.
      1.000      -2.93    979.22    976.07       450.        456.

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EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
       ACCUMULATED TIME (yrs)....      0.142
       FLOW DURATION (days)......      5.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 3      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |       200.00 |         85.67 |       53.50
```

```
TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  3
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
*******************************************************
    TIME       ENTRY *            SAND              *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   52.00       6.000 *      2.12                    *
               2.100 *     15.35                    *
   TOTAL=      1.000 *     17.46     18.72     -0.07 *
*******************************************************


TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  3
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....         13.47  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         25.63  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         45.58  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.98  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                        -------------                        -------------
                                                 TOTAL =         85.67
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....         37.77  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         62.53  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         97.21  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         19.34  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.13  |  VERY COARSE GRAVEL          0.00
                        -------------                        -------------
                                                 TOTAL =        216.98

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    52.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.000       0.05    985.16    982.85       200.         69.
      4.000       0.02    979.89    978.32       200.         73.
      2.100      -2.39    979.22    974.91       650.        589.
      1.000       4.42    979.11    972.82       650.        217.


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EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
       ACCUMULATED TIME (yrs)....      0.142
       FLOW DURATION (days)......      5.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 2      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.200 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        300.00 |         40.00 |        72.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  2
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
*******************************************************
    TIME       ENTRY *            SAND              *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   52.00       6.200 *      0.99                    *
   TOTAL=      1.000 *      0.99      0.76      0.23 *
*******************************************************


TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  2
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          7.04  |  VERY FINE GRAVEL..          0.48
    FINE SAND.........         14.50  |  FINE GRAVEL.......          0.20
    MEDIUM SAND.......         14.10  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          2.57  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          1.10  |  VERY COARSE GRAVEL          0.00
                        -------------                        -------------
                                                 TOTAL =         40.00
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          5.88  |  VERY FINE GRAVEL..          0.65
    FINE SAND.........         13.30  |  FINE GRAVEL.......          1.02
    MEDIUM SAND.......         11.37  |  MEDIUM GRAVEL.....          0.57
    COARSE SAND.......          2.01  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.99  |  VERY COARSE GRAVEL          0.00
                        -------------                        -------------
                                                 TOTAL =         35.77
```

```
TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    52.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.200       0.06    973.80    972.06       300.         32.
      4.000       0.03    970.92    968.33       300.         26.
      3.000       0.02    966.52    964.32       300.         22.
      1.000       0.21    965.15    960.01       300.         36.


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EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
       ACCUMULATED TIME (yrs)....      0.142
       FLOW DURATION (days)......      5.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |       1400.00 |        529.98 |       62.04

  SEDIMENT INFLOW at SECTION NO.     58.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    VERY FINE SAND....         265.63  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         173.06  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          82.59  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......           6.27  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..           2.42  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                              TOTAL =       529.98

    FALL VELOCITIES - Method 2
              DIAMETER   VELOCITY       REY. NO.          CD
    ------------------------------------------------------------
    VF SAND   0.000290  0.1863592E-01  0.4575463       59.10251
    F  SAND   0.000580  0.5772227E-01   2.834376       12.32115
    M  SAND   0.001160  0.1329160       13.05331       4.647428
    C  SAND   0.002320  0.2804704       55.08844       2.087483
    VC SAND   0.004640  0.4808243       188.8821       1.420545
    VF GRVL   0.009280  0.7191678       565.0209       1.269982
    F  GRVL   0.018559   1.039734       1633.750       1.215185
    M  GRVL   0.037118   1.472894       4628.774       1.211086
    C  GRVL   0.074237   2.082985       13092.12       1.211086
    VC GRVL   0.148474   2.945788       37030.19       1.211086

******************************************************************************************
                  TRACE OUTPUT FOR SECTION NO.     55.000
           -------------------------------------------------------

HYDRAULIC PARAMETERS:
      VEL      SLO        EFD        EFW     N-VALUE     TAU      USTARM    FROUDE NO.
     2.978  0.000661      6.346     86.708    0.0450   0.26180   0.36726     0.208

BED SEDIMENT CONTROL VOLUME COMPUTATIONS:
NEW SURFACE AREA (SQ FT):     TOTAL        K-PORTION      S-PORTION
                            230938.67     230938.67           0.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER              BED FRACTION  PERCENT FINER
                       VF SAND      0.003404      0.340403      VF GRVL      0.106364      90.239202
                       F  SAND      0.023017      2.642100      F  GRVL      0.039881      94.227344
                       M  SAND      0.043820      7.024101      M  GRVL      0.000336      94.260950
                       C  SAND      0.506025     57.626611      C  GRVL      0.028706      97.131515
                       VC SAND      0.219762     79.602775      VC GRVL      0.028685      99.999998

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=     0.84259
MIN.GRAIN DIAM       =    0.003556
BED SURFACE EXPOSED  =     1.00000

        INACTIVE LAYER      ACTIVE LAYER
         %       DEPTH      %      DEPTH
 CLAY   0.0000    0.00     0.0000    0.00
 SILT   0.0000    0.00     0.0000    0.00
 SAND   1.0000    9.82     1.0000    0.06
TOTAL   1.0000    9.82     1.0000    0.06

       AVG. UNIT              AVG. UNIT
         WEIGHT                 WEIGHT
        0.046500               0.046500

    COMPOSITE UNIT WT OF ACTIVE LAYER   (t/cf)=       0.046500
    COMPOSITE UNIT WT OF INACTIVE LAYER (t/cf)=       0.046500
    DEPTH OF SURFACE LAYER (ft)            DSL=            0.1
    WEIGHT IN SURFACE LAYER (tons)        WTSL=          894.9
    DEPTH OF NEW ACTIVE LAYER (ft)         DSE=         0.0159
    WEIGHT IN NEW ACTIVE LAYER(tons)    WTMXAL=          170.4
    WEIGHT IN OLD ACTIVE LAYER(tons)       WAL=          625.6
    USEABLE WEIGHT, OLD INACTIVE LAYER     WIL=       105466.0
    SURFACE AREA OF DEPOSIT (sq ft)       SABK= 0.23093867E+06
```

```
** INACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER            BED FRACTION  PERCENT FINER
                       VF SAND      0.000671      0.067089      VF GRVL      0.105367     90.305284
                       F  SAND      0.023154      2.382439      F  GRVL      0.039383     94.243549
                       M  SAND      0.043769      6.759378      M  GRVL      0.000335     94.277093
                       C  SAND      0.509027     57.662047      C  GRVL      0.028615     97.138545
                       VC SAND      0.221065     79.768566      VC GRVL      0.028615     99.999998

** ACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER            BED FRACTION  PERCENT FINER
                       VF SAND      0.464173     46.417286      VF GRVL      0.274462     79.098798
                       F  SAND      0.000000     46.417286      F  GRVL      0.123966     91.495417
                       M  SAND      0.052353     51.652597      M  GRVL      0.000440     91.539461
                       C  SAND      0.000000     51.652597      C  GRVL      0.044068     95.946230
                       VC SAND      0.000000     51.652597      VC GRVL      0.040538    100.000000

C FINES, COEF(CFFML), MX POTENTIAL= 0.000000E+00 0.100000E+01 0.302400E+07
POTENTIAL TRANSPORT (tons/day):  VF SAND 0.101876E+05  VF GRVL 0.133530E+02
                                 F  SAND 0.305709E+04  F  GRVL 0.122091E+02
                                 M  SAND 0.170276E+04  M  GRVL 0.100000E-06
                                 C  SAND 0.126234E+04  C  GRVL 0.100000E-06
                                 VC SAND 0.124827E+04  VC GRVL 0.100000E-06

  SEDIMENT OUTFLOW FROM SECTION NO.     55.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  -------------------------------------------------------------------------
    VERY FINE SAND....        294.06  |  VERY FINE GRAVEL..          2.48
    FINE SAND.........        175.65  |  FINE GRAVEL.......          0.96
    MEDIUM SAND.......         69.90  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         30.28  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..         13.04  |  VERY COARSE GRAVEL          0.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
```

```
Q    A     FLOW 3 = NEAR BANK FULL DISCHARGE

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  4
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   53.00       6.000 *      8.87                    *
   TOTAL=      1.000 *      8.87     15.87     -0.79 *
******************************************************

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  3
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   53.00       6.000 *      2.13                    *
               2.100 *     15.87                    *
   TOTAL=      1.000 *     18.00     20.27     -0.13 *
******************************************************

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  2
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   53.00       6.200 *      1.00                    *
   TOTAL=      1.000 *      1.00      0.97      0.03 *
******************************************************

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   53.00      58.000 *     13.25                    *
              53.000 *     20.27                    *
              42.000 *      0.36                    *
   TOTAL=     35.000 *     33.88      0.34      0.99 *
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   53.00      35.000 *      0.34                    *
              15.000 *      0.97                    *
   TOTAL=      1.000 *      1.31      0.08      0.94 *
******************************************************

==========================================================================================
TIME STEP #       4
Q    B     FLOW 4 = BASE FLOW 0F 500 CFS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
       ACCUMULATED TIME (yrs)....      0.151
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 4      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |         90.00 |         23.96 |       73.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  4
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - TAKEO CREEK - Stream Segment 4
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *           SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   55.00       6.000 *      8.90                    *
   TOTAL=      1.000 *      8.90     16.24     -0.83 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  4
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  --------------------------------------------------------------------------
    VERY FINE SAND....          4.84  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........          8.23  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......         10.86  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.02  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                      -------------                       -------------
                                                 TOTAL =         23.96
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  --------------------------------------------------------------------------
    VERY FINE SAND....         15.35  |  VERY FINE GRAVEL..          0.09
    FINE SAND.........         91.96  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......        244.08  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......         22.05  |  COARSE GRAVEL.....          0.00
```

```
    VERY COARSE SAND..          1.39  |  VERY COARSE GRAVEL         0.00
                       -------------                       -------------
                                                TOTAL =        374.91

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    55.000 DAYS
-------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.000      -0.10    986.44    984.70        90.         34.
      4.000       0.00    981.30    980.30        90.         35.
      2.100      -6.28    976.88    973.02        90.        375.
      1.000      -2.99    976.52    976.01        90.        375.

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EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
       ACCUMULATED TIME (yrs)....      0.151
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 3      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |         38.00 |          3.96 |       52.79

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  3
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - BEAR CREEK - Stream Segment 3
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   55.00       6.000 *      2.13                     *
               2.100 *     16.24                     *
   TOTAL=      1.000 *     18.37     20.32     -0.11 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  3
-------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  --------------------------------------------------------------------------
    VERY FINE SAND....          0.80  |  VERY FINE GRAVEL..         0.00
    FINE SAND.........          1.36  |  FINE GRAVEL.......         0.00
    MEDIUM SAND.......          1.79  |  MEDIUM GRAVEL.....         0.00
    COARSE SAND.......          0.00  |  COARSE GRAVEL.....         0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL         0.00
                       -------------                       -------------
                                                TOTAL =          3.96
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  --------------------------------------------------------------------------
    VERY FINE SAND....          9.72  |  VERY FINE GRAVEL..         0.01
    FINE SAND.........         15.97  |  FINE GRAVEL.......         0.00
    MEDIUM SAND.......         26.14  |  MEDIUM GRAVEL.....         0.00
    COARSE SAND.......          2.18  |  COARSE GRAVEL.....         0.00
    VERY COARSE SAND..          0.09  |  VERY COARSE GRAVEL         0.00
                       -------------                       -------------
                                                TOTAL =         54.11

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    55.000 DAYS
-------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.000      -0.10    983.91    982.70        38.          3.
      4.000       0.00    978.95    978.30        38.          9.
      2.100      -2.90    975.20    974.40       128.        718.
      1.000       4.08    974.82    972.48       128.         54.

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EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
       ACCUMULATED TIME (yrs)....      0.151
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 2      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.      6.200 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |         61.00 |          4.32 |       72.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  2
            EXAMPLE 6 Cont. ZUMBRO RIVER Project - CASCADE CREEK - Stream Segment 2
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *            SAND               *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
   55.00       6.200 *      1.00                     *
   TOTAL=      1.000 *      1.00      0.98      0.02 *
******************************************************
```

```
TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  2
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          2.87  |  VERY FINE GRAVEL..          0.01
    FINE SAND.........          0.89  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          0.37  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.13  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.03  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =          4.32
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          1.47  |  VERY FINE GRAVEL..          3.51
    FINE SAND.........          0.46  |  FINE GRAVEL.......          1.94
    MEDIUM SAND.......          0.19  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.07  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.02  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =          7.65

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    55.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
      6.200       0.00    972.81    972.00        61.          3.
      4.000       0.00    969.50    968.30        61.          3.
      3.000       0.00    965.80    964.30        61.          2.
      1.000      -0.30    960.06    959.50        61.          8.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
       ACCUMULATED TIME (yrs)....      0.151
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1     |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        282.00 |         28.81 |        62.06

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 6.  South Fork, ZUMBRO RIVER - Stream Segment 1
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
******************************************************
    TIME       ENTRY *         SAND              *
    DAYS        POINT *   INFLOW   OUTFLOW  TRAP EFF *
   55.00       58.000 *    13.28                 *
               53.000 *    20.32                 *
               42.000 *     0.36                 *
   TOTAL=      35.000 *    33.96      0.34      0.99 *
******************************************************
    TIME       ENTRY *         SAND              *
    DAYS        POINT *   INFLOW   OUTFLOW  TRAP EFF *
   55.00       35.000 *     0.34                 *
               15.000 *     0.98                 *
   TOTAL=       1.000 *     1.32      0.09      0.93 *
******************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          9.03  |  VERY FINE GRAVEL..          0.00
    FINE SAND.........         10.94  |  FINE GRAVEL.......          0.00
    MEDIUM SAND.......          8.84  |  MEDIUM GRAVEL.....          0.00
    COARSE SAND.......          0.00  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          0.00  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =         28.81
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    VERY FINE SAND....          1.82  |  VERY FINE GRAVEL..          0.12
    FINE SAND.........          1.76  |  FINE GRAVEL.......          0.15
    MEDIUM SAND.......          4.38  |  MEDIUM GRAVEL.....          0.05
    COARSE SAND.......          3.89  |  COARSE GRAVEL.....          0.00
    VERY COARSE SAND..          1.61  |  VERY COARSE GRAVEL          0.00
                       -------------                       -------------
                                                TOTAL =         13.77

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =    55.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       SAND
     58.000      -1.28    977.69    974.12       282.         81.
     55.000      -0.13    976.93    972.77       282.        111.
     53.000       0.12    974.82    972.32       410.        279.
     44.000       1.53    973.46    968.63       410.         78.
     42.000       0.26    973.12    970.06       439.          1.
     35.000       0.02    973.00    963.32       439.          0.
     33.900       0.00    964.90    962.65       439.          0.
```

```
     33.300      0.00    964.25   962.49       439.          0.
     33.000      0.00    962.87   961.00       439.          0.
     32.000     -0.54    961.80   955.96       439.        211.
     15.000     -0.12    957.22   953.58       500.       1054.
      1.000      1.37    955.00   946.07       500.         14.

------------------------------------------------------------------------------------------
$$END

       0   DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ =         4
TOTAL NO. OF WS PROFILES =            13
ITERATIONS IN EXNER EQ =            1560

COMPUTATIONS COMPLETED
RUN TIME =  0 HOURS,  0 MINUTES &  9.00 SECONDS
```

6.7 Example Problem 7 - Cohesive Sediment

Example Problem 7 illustrates the deposition of clays and silts in an impoundment at the downstream end of a single stream segment. Subsequent lowering of the pool level in that impoundment causes erosion of the cohesive deposits. Table 6-7a shows the input data for this example and Table 6-7b shows the output.

6.7.1 Cohesive Sediment Data

This example uses Method 2 (see Sections 2.3.8, 3.3.4.1 and the I2 record in Appendix A) to compute the deposition and erosion rates for clay and silts. This method requires the addition of two Special I2 records to provide the data; one for the active layer and one for the inactive layer. The data for the active layer is described below and is illustrated (along with the data for the inactive layer) in Figure 6-7.

The shear stress threshold above which clays and silts will not deposit is 0.02 lb/ft^2. The shear stress at which deposited cohesive material will scour is 0.05 lb/ft^2. The shear stress above which mass erosion occurs is 0.10 lb/ft^2. The erosion rate at that shear stress is 1.5 lb/ft^2/hr. The slope of the mass erosion rate curve is 60/hr. These values are depicted in Figure 30 for both the active and inactive layers. Note that the shear strength of the inactive layer is larger than that of the active layer and it erodes more slowly. This represents, perhaps, the effect of consolidation.

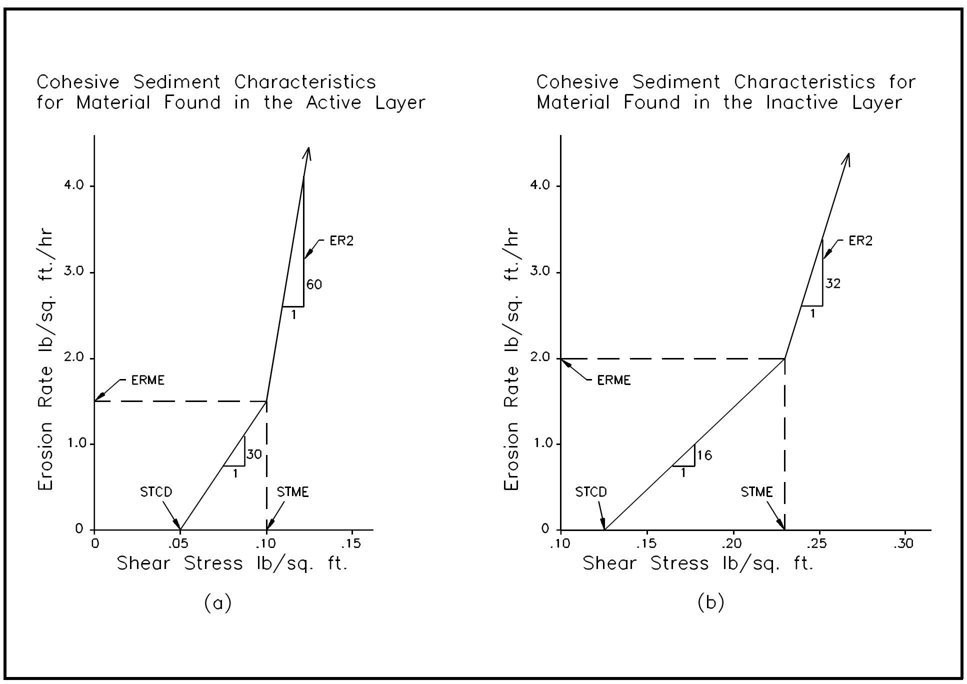

Figure 6-7
Erosion Rate Characteristics

Caution, the cohesive sediment values given in Example Problem 7 are not factual and should not be used under any circumstances without field verification. To determine these values, laboratory tests must be performed on the sediments to be simulated. These tests must be done under the same physical and chemical conditions as in the prototype (see Section 2.3.8).

Table 6-7a
Example Problem 7 - Input
Cohesive Sediment

```
T1      EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
T2      A LAKE IS CREATED.
T3      SOUTH FORK, ZUMBRO RIVER     ** Example Problem 7 **
NC    .1      .1     .04      .1      .3
X1   1.0      31  10077.  10275.      0.      0.      0.
GR 1004.   9915.   978.4  10002.   956.0  10060.   959.2  10077.   959.3  10081.
GR 950.0  10092.  948.48  10108.   946.6  10138.   944.7  10158.   955.2  10225.
GR 956.2  10243.   958.9  10250.   959.8  10275.   959.8  10300.   959.9  10325.
GR 958.8  10350.   957.4  10400.   970.0  10700.   966.0  10960.   970.0  11060.
GR 968.0  11085.   968.0  11240.   970.0  11365.   970.0  11500.   970.0  11615.
GR 962.0  11665.   962.0  12400.   976.0  12550.   980.0  12670.   982.0  12730.
GR 984.0  12735.
HD   1.0     10.  10081.  10250.
NV    22    .045   965.6    .064   988.8
NV    12     .08   965.6     .13   988.8
NV    33      .1   965.6     .11   982.0     .12   988.8
X1  15.0      27  10665.  10850.   3560.   3030.   3280.
X3                        10700.   961.0  11000.   970.0
GR 992.0   9570.   982.0  10110.   976.0  10300.   976.0  10490.   966.0  10610.
GR 964.7  10665.   956.0  10673.   953.0  10693.   954.0  10703.   955.6  10723.
GR 958.6  10750.   959.3  10800.   957.0  10822.   957.3  10825.   961.5  10850.
GR 962.0  10852.   964.0  10970.   966.0  11015.   961.0  11090.   962.0  11150.
GR 970.0  11190.   972.0  11310.   980.0  11410.   984.0  11570.   990.0  11770.
GR 990.0  11865.  1000.0  12150.
HD  15.0     10.  10673.  10852.
NC    .1      .1     .05
   CASCADE CREEK
X1  32.0      29  10057.  10271.   3630.   3060.   4240.
GR 998.0   9080.   982.0   9250.   982.0   9510.   980.0   9600.  980.01   9925.
GR979.48  10000.   978.5  10057.   968.6  10075.  959.82  10087.   956.5  10097.
GR 956.8  10117.   957.8  10137.   959.4  10157.   959.6  10177.  959.82  10196.
GR 966.5  10225.   971.2  10250.   978.5  10271.   978.5  10300.   978.6  10350.
GR978.91  10370.  978.96  10387.   980.0  10610.   982.0  10745.   982.0  11145.
GR 984.0  11150.   992.0  11240.  1000.0  11330.   1008.  11425.
HD  32.0     10.  10075.  10275.
NC   .06     .06    .045
X1  42.0      32   9880.  10130.   8500.   8250.   8530.
GR 996.0   7130.   998.0   7310.   998.0   7930.   992.0   8205.   990.0   8495.
GR 988.0   8780.   986.0   8990.   985.7   9570.  986.45   9707.  989.44   9857.
GR 990.0   9880.   969.8   9881.   969.8   9941.   985.8   9941.   985.8   9943.
GR 969.8   9943.   969.8  10001.   986.7  10001.   986.7  10003.   969.8  10003.
GR 969.8  10067.   985.8  10067.   985.8  10069.   969.8  10069.   969.8  10129.
GR 989.9  10130.   989.5  10180.   988.6  10230.   987.6  10280.   985.2  10430.
GR 986.8  11720.   989.9  12310.
HD  42.0       0   9881.  10021.
  SILVER CREEK
X1  44.0      28   9845.  10127.   3200.   3800.   3500.
XL                         9850.  10200.
GR 1002.   8035.   992.0   8150.   990.0   8305.   990.0   8735.   988.0   8835.
GR 996.0   9285.  1017.6   9425.   990.0   9505.   986.0   9650.   984.1   9788.
GR 980.6   9845.   970.9   9868.   972.2   9898.   970.5   9968.   967.5   9998.
GR 968.9  10028.   967.4  10058.   967.1  10078.   971.9  10118.   976.8  10127.
GR 977.8  10150.   976.9  10193.   982.0  10206.   981.2  10300.   979.2  10325.
GR 983.1  10400.   999.8  10450.  1002.4  10464.
HD  44.0     10.   9868.  10193.
X1  53.0      22  10000.  10136.   3366.   2832.   2942.
GR 1004.   7550.  1000.0   7760.   998.0   8440.   996.0   8640.   996.0   8780.
GR 994.0   8940.   986.0   9245.   986.3   9555.   986.3   9825.   983.8   9900.
GR 982.8  10000.   978.2  10011.   974.0  10041.   972.2  10071.   972.6  10101.
GR 978.2  10121.   988.7  10136.   989.3  10154.   999.2  10200.  1000.1  10320.
GR 1002.  10470.  1004.0  10700.
HD  53.0     10.  10000.  10136.
  BEAR CREEK
X1  55.0      18   9931.  10062.   2275.   3430.   2770.
GR 1004.   7592.  1000.0   7947.   996.0   8627.   990.0   9052.   986.0   9337.
GR 984.3   9737.   984.7   9837.   985.5   9910.   987.2   9931.   978.1   9955.
GR 974.8   9975.   974.2  10005.   972.9  10035.   973.2  10045.   983.8  10062.
GR 985.8  10187.   986.0  10307.   990.0  10497.
HD  55.0     10.   9931.  10062.
X1  58.0      22   9912.  10015.   1098.   1012.   1462.
GR 1006.   8542.  1004.0   8952.  1000.0   9702.   997.2   9812.   996.3   9912.
GR 976.2   9944.   975.4   9974.   978.2   9991.   990.4  10015.   988.3  10062.
GR 988.8  10065.   988.3  10065.   989.3  10169.   990.0  10172.   992.0  10242.
GR 992.0  10492.   988.0  10642.   986.7  10852.   988.0  11022.   986.0  11097.
GR 986.0  11137.   988.0  11192.
HD  58.0     3.4   9912.  10015.
EJ
```

```
T4      South Fork, Zumbro River      ** Example Problem 7 **
T5      LOAD CURVE FROM GAGE DATA.
T6      BED GRADATIONS FROM FIELD SAMPLES.
T7      CLAY and SILT added to full range of Sands and Gravels.
T8      SEDIMENT TRANSPORT BY Yang's STREAM POWER [ref ASCE JOURNAL (YANG 1971)]
I1     0       5
I2  CLAY       2
I2  CLAY       1     .02     .05      .1     1.5     60.
I2  CLAY       2     .02    .125     .23     2.0     32.
I3  SILT       2       1       4
I4  SAND       4       1      10
I5            .5      .5     .25      .5     .25       0     1.0
LQ             1      50    1000    5800   90000
LT TOTAL   .0220     3.0     640   9000.  800000
LF  CLAY     .22     .22     .15     .13     .10
LF SILT1     .25     .25     .15    .104     .07
LF SILT2     .18     .18     .13     .12     .05
LF SILT3     .13     .13     .17    .145     .08
LF SILT4     .10     .10    .185    .170    .150
LF   VFS     .06     .06    .105    .156    .230
LF    FS     .04     .04    .066    .090    .160
LF    MS     .02     .02    .027    .060    .115
LF    CS       0       0    .014    .016    .030
LF   VCS       0       0    .003    .005    .010
LF   VFG       0       0       0    .002    .004
LF    FG       0       0       0    .001    .001
LF    MG       0       0       0       0       0
LF    CG       0       0       0       0       0
LF   VCG       0       0       0       0       0
PF EXAMP     1.0     1.0    32.0    16.0    96.5     8.0    95.0     4.0    91.0
PFC  2.0    85.0     1.0    73.0      .5    37.0     .25     8.0    .125     1.0
PFC.0625     0.0
PF EXAMP    32.0     1.0    64.0    32.0    99.5    16.0    99.0     8.0    98.5
PFC  4.0    96.0     2.0    93.5     1.0    83.0     .50    45.5    .250     8.0
PFC .125     1.0   .0625     0.0
PF EXAMP    58.0     1.0    64.0    32.0    97.0    16.0    94.0     8.0    94.0
PFC  4.0    90.0     2.0    79.0     1.0    56.0     .50     4.0    .125     0.0
$HYD
Q    B     FLOW 1 = WARM-UP BASE FLOW 0F 750 CFS, LAKE IMPOUNDED.
Q    750
R    985
T     65
W      1
$PRT
CP             1
PS          32.0
END
Q   AB     FLOW 2 = 100 DAYS AT BANK FULL Q, LAKE IMPOUNDED.
Q  1250.
R    985
X             10     100
$RATING
RC            40    2000       0       0   950.0   955.1   958.0   960.0   962.0
RC         963.6   965.1   966.2   967.0   967.7   968.3   968.9   969.4   969.8
RC         970.2   970.6   971.0   971.4   971.8   972.1   972.4   972.7   972.9
RC         973.1   973.3   973.5   973.7   973.8   973.9   974.0   974.1   974.2
RC         974.3   974.4   974.5   974.6   974.7   974.8   974.9   975.0
Q   AC     FLOW 3 = NEAR BANK FULL Q, LAKE LOWERED.
Q  1250.
W     .2
$PRT   A
Q    B     FLOW 4 = NEAR BANK FULL Q, LAKE LOWERED.
Q  1250.
X              1     20.
Q    B     FLOW 5 = LAST FLOW, BASE FLOW OF 750 CFS, LAKE IS LOWERED.
Q   750.
X              2     20.
$$END
```

6.7.2 Output

EFFICIENCY..." table, TABLE SA-1, shows that only 7% of the inflowing clay load was deposited in the reservoir since the beginning of the simulation, while 73% of the inflowing silts and 100% of the inflowing sands and gravels were deposited. TABLE SB-2, the "STATUS OF THE BED PROFILE...", shows the outflowing load at each cross section for this time step and the cumulative bed change since the start of the simulation. Only Section No. 58.0 shows a significant bed change, but because there are no local inflows, diversions, or tributaries affecting the load at any cross section, the progressive decrease in the outflowing load at each cross section indicates deposition.

In this example, time step 2 represents 10 separate (incremental) time steps each having a duration of 10 days with a starting water surface of 985 ft and a flow of 1250 cfs. At the end of the last incremental time step, output is produced depicting the state of the reservoir for the last 10 day time step (i.e., instantaneous values such as the sediment load data in TABLE SB-2 are only for the last 10 days, while cumulative data, such as trap efficiency and bed change, represent changes since the start of the simulation - 101 days.) Because of this, output produced by this time step can be misleading. For example, the trap efficiency of clay has decreased since time step 1 indicating that erosion has occurred during the 100 days of this time step. However, the outflowing clay load compared to the inflowing clay load (as shown in TABLE SB-1) indicates that deposition is occurring which reflects the difference between instantaneous and cumulative values.

A rating curve representing channel control at the downstream-most section precedes the data for time step 3. Although the flow for time step 3 and 4 remains at 1250 cfs, the starting water surface obtained from the rating curve is much lower, significantly altering the hydraulic parameters. C-level output was requested for time step 3 and limited to Sections 32.0 and 42.0. The increased velocity at Section No. 32.0 results in a bed shear stress of 0.2980 lb/sq ft, which, from Figure 6-7, results in mass erosion of both layers. The computed potential erosion rates for both clay and silt are 141,700 and 44,214 tons/day for the active and inactive layers respectively. The actual erosion rates will be limited by the availability of these materials.

Table 6-7b
Example Problem 7 - Output
Cohesive Sediment

```
*****************************************************     **********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS   *
*       Version: 4.1.00 -  AUGUST 1993            *     *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  EXAMPLE7.DAT                      *     *  609 SECOND STREET              *
*  OUTPUT FILE: EXAMPLE7.OUT                      *     *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 31 AUG 93    RUN TIME: 08:21:08      *     *  (916) 756-1104                 *
*****************************************************     **********************************

                       X     X  XXXXXXX   XXXXX          XXXXX
                       X     X  X        X     X        X     X
                       X     X  X        X              X
                       XXXXXXX  XXXX     X       XXXXX  XXXXXX
                       X     X  X        X              X     X
                       X     X  X        X     X        X     X
                       X     X  XXXXXXX   XXXXX          XXXXX

         **********************************************************************
         *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
         *       10  Stream Segments (Main Stem + Tributaries)                *
         *      150  Cross Sections                                           *
         *      100  Elevation/Station Points per Cross Section               *
         *       20  Grain Sizes                                              *
         *       10  Control Points                                           *
         **********************************************************************

T1      EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
T2      A LAKE IS CREATED.
T3      SOUTH FORK, ZUMBRO RIVER     ** Example Problem 7 **

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0400   0.1000       1.1000     0.7000
```

```
SECTION NO.     1.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

N-Values vs. Elevation Table
       Channel           Left Overbank        Right Overbank
  0.0450     966.       0.0800     966.       0.1000     966.
  0.0640     989.       0.1300     989.       0.1100     982.
  0.0000       0.       0.0000       0.       0.1200     989.

SECTION NO.    15.000
...Left Encroachment defined at station 10700.000 at elevation   961.000
...Right Encroachment defined at station 11000.000 at elevation   970.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.1000   0.0500   0.1000       1.1000     0.7000

SECTION NO.    32.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.0600   0.0450   0.0600       1.1000     0.7000

SECTION NO.    42.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    44.000
...Limit CONVEYANCE between stations    9850.000 and   10200.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    53.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    55.000
...DEPTH of the Bed Sediment Control Volume =   10.00 ft.

SECTION NO.    58.000
...DEPTH of the Bed Sediment Control Volume =    3.40 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT=  8
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =   8
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

==============================================================================================================

T4      South Fork, Zumbro River      ** Example Problem 7 **
T5      LOAD CURVE FROM GAGE DATA.
T6      BED GRADATIONS FROM FIELD SAMPLES.
T7      CLAY and SILT added to full range of Sands and Gravels.
T8      SEDIMENT TRANSPORT BY Yang's STREAM POWER [ref ASCE JOURNAL (YANG 1971)]

        EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
        A LAKE IS CREATED.
        SOUTH FORK, ZUMBRO RIVER     ** Example Problem 7 **

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SEDIMENT PROPERTIES AND PARAMETERS

       SPI     IBG    MNQ      SPGF      ACGR     NFALL    IBSHER
I1      5.       0       1     1.000    32.174        2        1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
CLAY IS PRESENT.

       MTCL    SPGC      PUCD      UWCL      CCCD
I2      2     2.650    78.000    30.000    16.000


  DEPOSITION COEFFICIENTS BY LAYER
                     DEPOSITION
                     THRESHOLD
                       SHEAR
              LAYER      STRESS
               NO.      lb/sq.ft

  ACTIVE LAYER  1      0.0200
INACTIVE LAYER  2      0.0200

  EROSION COEFFICIENTS BY LAYER
                   PARTICLE   MASS       MASS       SLOPE OF   SLOPE OF
                   EROSION    EROSION    EROSION    PARTICLE   MASS
                   SHEAR      SHEAR      RATE       EROSION    EROSION
              LAYER  STRESS     STRESS                LINE=ER1   LINE=ER2
               NO    lb/sq.ft   lb/sq.ft.  lb/sf/hr   1/hr       1/hr

  ACTIVE LAYER  1      0.0500     0.1000     1.5000    30.0000    60.0000
INACTIVE LAYER  2      0.1250     0.2300     2.0000    19.0476    32.0000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SILT IS PRESENT

       MTCL   IASL   LASL    SGSL    PUSDLB    UWSDLB    CCSDLB
I3      2      1      4     2.650    82.000    65.000     5.700
```

```
  DEPOSITION COEFFICIENTS BY LAYER
                     DEPOSITION
                     THRESHOLD
                       SHEAR
              LAYER    STRESS
               NO.     lb/sq.ft

  ACTIVE LAYER  1      0.0200
INACTIVE LAYER  2      0.0200

  EROSION COEFFICIENTS BY LAYER
                   PARTICLE   MASS       MASS       SLOPE OF   SLOPE OF
                   EROSION    EROSION    EROSION    PARTICLE   MASS
                   SHEAR      SHEAR      RATE       EROSION    EROSION
              LAYER STRESS    STRESS                LINE=ER1   LINE=ER2
               NO   lb/sq.ft  lb/sq.ft.  lb/sf/hr   1/hr       1/hr

  ACTIVE LAYER  1      0.0500     0.1000     1.5000    30.0000    60.0000
INACTIVE LAYER  2      0.1250     0.2300     2.0000    19.0476    32.0000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SANDS - BOULDERS ARE PRESENT

      MTC     IASA    LASA     SPGS      GSF      BSAE       PSI     UWDLB
I4      4       1      10     2.650     0.667     0.500    30.000    93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG
GRAIN SIZES UTILIZED (mean diameter - mm)
----------------------------------------------------------------------
    CLAY.............    0.003  |  COARSE SAND.......    0.707
    VERY FINE SILT....   0.006  |  VERY COARSE SAND..    1.414
    FINE SILT.........   0.011  |  VERY FINE GRAVEL..    2.828
    MEDIUM SILT.......   0.022  |  FINE GRAVEL.......    5.657
    COARSE SILT.......   0.044  |  MEDIUM GRAVEL.....   11.314
    VERY FINE SAND....   0.088  |  COARSE GRAVEL.....   22.627
    FINE SAND.........   0.177  |  VERY COARSE GRAVEL   45.255
    MEDIUM SAND.......   0.354  |
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

COEFFICIENTS FOR COMPUTATION SCHEME WERE SPECIFIED
        DBI      DBN      XID      XIN      XIU      UBI      UBN      JSL
I5    0.500    0.500    0.250    0.500    0.250    0.000    1.000       1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   1
          LOAD BY GRAIN SIZE CLASS (tons/day)
---------------------------------------------------------------------------
LQ       | 1.00000    | 50.0000    | 1000.00    | 5800.00    | 90000.0    |
          ------------ ------------ ------------ ------------ ------------
LF  CLAY |0.484000E-02|0.660000    | 96.0000    | 1170.00    | 80000.0    |
LF SILT1 |0.550000E-02|0.750000    | 96.0000    | 936.000    | 56000.0    |
LF SILT2 |0.396000E-02|0.540000    | 83.2000    | 1080.00    | 40000.0    |
LF SILT3 |0.286000E-02|0.390000    | 108.800    | 1305.00    | 64000.0    |
LF SILT4 |0.220000E-02|0.300000    | 118.400    | 1530.00    | 120000.    |
LF   VFS |0.132000E-02|0.180000    | 67.2000    | 1404.00    | 184000.    |
LF    FS |0.880000E-03|0.120000    | 42.2400    | 810.000    | 128000.    |
LF    MS |0.440000E-03|0.600000E-01| 17.2800    | 540.000    | 92000.0    |
LF    CS |0.100000E-19|0.100000E-19| 8.96000    | 144.000    | 24000.0    |
LF   VCS |0.100000E-19|0.100000E-19| 1.92000    | 45.0000    | 8000.00    |
LF   VFG |0.100000E-19|0.100000E-19|0.100000E-19| 18.0000    | 3200.00    |
LF    FG |0.100000E-19|0.100000E-19|0.100000E-19| 9.00000    | 800.000    |
LF    MG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LF    CG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
LF   VCG |0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|0.100000E-19|
          ------------ ------------ ------------ ------------ ------------
   TOTAL |0.220000E-01| 3.00000    | 640.000    | 8991.00    | 800000.    |
---------------------------------------------------------------------------


REACH GEOMETRY FOR STREAM SEGMENT  1
------------------------------------
  CROSS         REACH    MOVABLE      INITIAL BED-ELEVATIONS      ACCUMULATED CHANNEL DISTANCE
  SECTION       LENGTH     BED    LEFT SIDE  THALWEG  RIGHT SIDE        FROM DOWNSTREAM
    NO.          (ft)     WIDTH      (ft)      (ft)      (ft)          (ft)        (miles)
-----------------------------------------------------------------------------------------------
                0.000
   1.000                 183.500   959.300   944.700   958.900        0.000         0.000
             3280.000
  15.000                 242.000   961.000   953.700   962.000     3280.000         0.621
             4240.000
  32.000                 219.500   968.600   956.500   978.500     7520.000         1.424
             8530.000
  42.000                 154.500   969.800   969.800   969.800    16050.000         3.040
             3500.000
  44.000                 337.500   970.900   967.100   976.900    19550.000         3.703
             2942.000
  53.000                 195.000   982.800   972.200   988.700    22492.000         4.260
             2770.000
  55.000                 204.000   987.200   972.900   983.800    25262.000         4.784
             1462.000
  58.000                 176.500   996.300   975.400   990.400    26724.000         5.061
```

```
BED MATERIAL GRADATION
----------------------
   SECNO    SAE   DMAX   DXPI   XPI TOTAL       BED MATERIAL FRACTIONS
                  (ft)   (ft)        BED            per grain size
------------------------------------------------------------------------------------------------------------
   1.000 1.000  0.105  0.105 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.360 | M  GRVL  0.015 |
                                         | VF SILT  0.000 | VF SAND  0.010 | VC SAND  0.120 | C  GRVL  0.035 |
                                         | F  SILT  0.000 | F  SAND  0.070 | VF GRVL  0.060 | VC GRVL  0.000 |
                                         | M  SILT  0.000 | M  SAND  0.290 | F  GRVL  0.040 |

  15.000 1.000  0.151  0.151 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.367 | M  GRVL  0.011 |
                                         | VF SILT  0.000 | VF SAND  0.010 | VC SAND  0.113 | C  GRVL  0.022 |
                                         | F  SILT  0.000 | F  SAND  0.070 | VF GRVL  0.045 | VC GRVL  0.002 |
                                         | M  SILT  0.000 | M  SAND  0.327 | F  GRVL  0.033 |

  32.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.375 | M  GRVL  0.005 |
                                         | VF SILT  0.000 | VF SAND  0.010 | VC SAND  0.105 | C  GRVL  0.005 |
                                         | F  SILT  0.000 | F  SAND  0.070 | VF GRVL  0.025 | VC GRVL  0.005 |
                                         | M  SILT  0.000 | M  SAND  0.375 | F  GRVL  0.025 |

  42.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.439 | M  GRVL  0.003 |
                                         | VF SILT  0.000 | VF SAND  0.006 | VC SAND  0.161 | C  GRVL  0.016 |
                                         | F  SILT  0.000 | F  SAND  0.048 | VF GRVL  0.063 | VC GRVL  0.016 |
                                         | M  SILT  0.000 | M  SAND  0.217 | F  GRVL  0.032 |

  44.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.466 | M  GRVL  0.002 |
                                         | VF SILT  0.000 | VF SAND  0.004 | VC SAND  0.183 | C  GRVL  0.021 |
                                         | F  SILT  0.000 | F  SAND  0.039 | VF GRVL  0.078 | VC GRVL  0.021 |
                                         | M  SILT  0.000 | M  SAND  0.153 | F  GRVL  0.034 |

  53.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.488 | M  GRVL  0.001 |
                                         | VF SILT  0.000 | VF SAND  0.002 | VC SAND  0.202 | C  GRVL  0.024 |
                                         | F  SILT  0.000 | F  SAND  0.031 | VF GRVL  0.091 | VC GRVL  0.024 |
                                         | M  SILT  0.000 | M  SAND  0.098 | F  GRVL  0.037 |

  55.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.509 | M  GRVL  0.000 |
                                         | VF SILT  0.000 | VF SAND  0.001 | VC SAND  0.220 | C  GRVL  0.028 |
                                         | F  SILT  0.000 | F  SAND  0.024 | VF GRVL  0.104 | VC GRVL  0.028 |
                                         | M  SILT  0.000 | M  SAND  0.047 | F  GRVL  0.039 |

  58.000 1.000  0.210  0.210 1.000 1.000 |    CLAY  0.000 | C  SILT  0.000 | C  SAND  0.520 | M  GRVL  0.000 |
                                         | VF SILT  0.000 | VF SAND  0.000 | VC SAND  0.230 | C  GRVL  0.030 |
                                         | F  SILT  0.000 | F  SAND  0.020 | VF GRVL  0.110 | VC GRVL  0.030 |
                                         | M  SILT  0.000 | M  SAND  0.020 | F  GRVL  0.040 |

 BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT #  1: EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
|  SECTION  |   LENGTH   |   WIDTH    |  DEPTH    |        V O L U M E         |
|  NUMBER   |    (ft)    |    (ft)    |   (ft)    |    (cu.ft)    |   (cu.yd)  |
-------------------------------------------------------------------------------
|     1.000 |   1640.000 |    203.000 |   10.000 |0.332920E+07 | 123304.     |
|    15.000 |   3760.000 |    229.266 |   10.000 |0.862040E+07 | 319274.     |
|    32.000 |   6385.000 |    207.517 |   10.000 |0.132500E+08 | 490740.     |
|    42.000 |   6015.000 |    187.610 |    0.000 |0.000000     |0.000000     |
|    44.000 |   3221.000 |    282.665 |   10.000 |0.910465E+07 | 337209.     |
|    53.000 |   2856.000 |    220.920 |   10.000 |0.630947E+07 | 233684.     |
|    55.000 |   2116.000 |    198.870 |   10.000 |0.420808E+07 | 155855.     |
|    58.000 |    731.000 |    185.667 |    3.400 | 461456.     | 17091.0     |

NO. OF INPUT DATA MESSAGES=    0
END OF SEDIMENT DATA

==========================================================================================

$HYD
BEGIN COMPUTATIONS.

==========================================================================================
TIME STEP #       1
Q    B     FLOW 1 = WARM-UP BASE FLOW 0F 750 CFS, LAKE IMPOUNDED.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
       ACCUMULATED TIME (yrs)....      0.003
       FLOW DURATION (days)......      1.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1      |    DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |      (cfs)      |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |        750.00 |        373.33 |       65.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**************************************************************************************************************
    TIME     ENTRY *            CLAY              *            SILT              *            SAND              *
    DAYS     POINT *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *
    1.00    58.000 *    0.09                     *    0.17                     *    0.04                      *
   TOTAL=    1.000 *    0.09      0.09      0.07 *    0.17      0.05      0.73 *    0.04      0.00      1.00 *
**************************************************************************************************************
```

```
TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    CLAY.............         59.51  |  COARSE SAND.......         0.09
    VERY FINE SILT....         60.24  |  VERY COARSE SAND..         0.02
    FINE SILT.........         51.29  |  VERY FINE GRAVEL..         0.00
    MEDIUM SILT.......         63.35  |  FINE GRAVEL.......         0.00
    COARSE SILT.......         66.69  |  MEDIUM GRAVEL.....         0.00
    VERY FINE SAND....         38.05  |  COARSE GRAVEL.....         0.00
    FINE SAND.........         24.05  |  VERY COARSE GRAVEL         0.00
    MEDIUM SAND.......         10.03  |
                        ------------                      ------------
                                            TOTAL =        373.33
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    CLAY.............         55.63  |  COARSE SAND.......         0.00
    VERY FINE SILT....         45.88  |  VERY COARSE SAND..         0.00
    FINE SILT.........         17.36  |  VERY FINE GRAVEL..         0.00
    MEDIUM SILT.......          0.88  |  FINE GRAVEL.......         0.00
    COARSE SILT.......          0.00  |  MEDIUM GRAVEL.....         0.00
    VERY FINE SAND....          0.00  |  COARSE GRAVEL.....         0.00
    FINE SAND.........          0.00  |  VERY COARSE GRAVEL         0.00
    MEDIUM SAND.......          0.00  |
                        ------------                      ------------
                                            TOTAL =        119.76

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =     1.000 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)       (ft)      (ft)        (cfs)       CLAY        SILT        SAND
     58.000       0.02    985.12    975.42        750.         60.        242.          5.
     55.000       0.00    985.06    972.90        750.         60.        242.          0.
     53.000       0.00    985.01    972.20        750.         59.        196.          0.
     44.000       0.00    985.01    967.10        750.         59.        144.          0.
     42.000       0.00    985.01    969.80        750.         58.        100.          0.
     32.000       0.00    985.00    956.50        750.         57.         79.          0.
     15.000       0.00    985.00    953.70        750.         56.         69.          0.
      1.000       0.00    985.00    944.70        750.         56.         64.          0.

------------------------------------------------------------------------------------------
$PRT
...Selective Printout Option
     - Print at the following cross sections
CP           1
PS          32.0
END

==========================================================================================
TIME STEP #       2
Q   AB     FLOW 2 = 100 DAYS AT BANK FULL Q, LAKE IMPOUNDED.
COMPUTING FROM TIME=      1.0000 DAYS TO TIME=    101.0000 DAYS IN    10 COMPUTATION STEPS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
ACCUMULATED TIME (yrs)..........      0.003

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  1 at Control Point #  1 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)       (deg F)       (ft)
                             1250.000      65.00       985.000

****  DISCHARGE    WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)     SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.     32.000
****   1250.000   985.002   985.002   0.001   3.255  1943.167   963.558   0.037   0.214   0.037
                                                FLOW DISTRIBUTION (%) =   10.548  78.455  10.997

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
       ACCUMULATED TIME (yrs)....      0.277
       FLOW DURATION (days)......     10.000

UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1     |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |       1250.00 |        890.88 |       65.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**************************************************************************************************************
    TIME     ENTRY *          CLAY          *          SILT          *          SAND          *
 DAYS     POINT *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *
  101.00    58.000 *   20.27                   *   39.47                   *   10.04                      *
   TOTAL=    1.000 *   20.27     19.54      0.04 *   39.47     13.42      0.66 *   10.04      0.00      1.00 *
**************************************************************************************************************
```

```
TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
---------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  -----------------------------------------------------------------------------
    CLAY.............        131.86  |  COARSE SAND.......         12.75
    VERY FINE SILT....       128.18  |  VERY COARSE SAND..          2.87
    FINE SILT.........       115.20  |  VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......       149.14  |  FINE GRAVEL.......          0.00
    COARSE SILT.......       163.84  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....        98.84  |  COARSE GRAVEL.....          0.00
    FINE SAND.........        61.46  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......        26.75  |
                       ------------                          ------------
                                              TOTAL =        890.88
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  -----------------------------------------------------------------------------
    CLAY.............        127.12  |  COARSE SAND.......          0.00
    VERY FINE SILT....       110.63  |  VERY COARSE SAND..          0.00
    FINE SILT.........        64.14  |  VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......        14.76  |  FINE GRAVEL.......          0.00
    COARSE SILT.......         0.02  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....         0.00  |  COARSE GRAVEL.....          0.00
    FINE SAND.........         0.00  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......         0.00  |
                       ------------                          ------------
                                              TOTAL =        316.67

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =   101.000 DAYS
---------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)        (ft)      (ft)       (cfs)       CLAY        SILT        SAND
     58.000       -0.25    985.38    975.15       1250.        132.        556.        216.
     55.000        1.18    985.20    974.08       1250.        132.        556.         79.
     53.000        0.24    985.04    972.44       1250.        132.        556.          3.
     44.000        0.43    985.03    967.53       1250.        131.        430.          0.
     42.000        0.35    985.01    970.15       1250.        130.        292.          0.
     32.000        0.14    985.00    956.64       1250.        129.        232.          0.
     15.000        0.10    985.00    953.80       1250.        128.        202.          0.
      1.000        0.12    985.00    944.82       1250.        127.        190.          0.

-------------------------------------------------------------------------------------------
$RATING

Downstream Boundary Condition - Rating Curve
  Elevation      Stage     Discharge | Elevation      Stage     Discharge
 ------------------------------------|------------------------------------
    950.000     950.000        0.000 |    972.400     972.400    40000.000
    955.100     955.100     2000.000 |    972.700     972.700    42000.000
    958.000     958.000     4000.000 |    972.900     972.900    44000.000
    960.000     960.000     6000.000 |    973.100     973.100    46000.000
    962.000     962.000     8000.000 |    973.300     973.300    48000.000
    963.600     963.600    10000.000 |    973.500     973.500    50000.000
    965.100     965.100    12000.000 |    973.700     973.700    52000.000
    966.200     966.200    14000.000 |    973.800     973.800    54000.000
    967.000     967.000    16000.000 |    973.900     973.900    56000.000
    967.700     967.700    18000.000 |    974.000     974.000    58000.000
    968.300     968.300    20000.000 |    974.100     974.100    60000.000
    968.900     968.900    22000.000 |    974.200     974.200    62000.000
    969.400     969.400    24000.000 |    974.300     974.300    64000.000
    969.800     969.800    26000.000 |    974.400     974.400    66000.000
    970.200     970.200    28000.000 |    974.500     974.500    68000.000
    970.600     970.600    30000.000 |    974.600     974.600    70000.000
    971.000     971.000    32000.000 |    974.700     974.700    72000.000
    971.400     971.400    34000.000 |    974.800     974.800    74000.000
    971.800     971.800    36000.000 |    974.900     974.900    76000.000
    972.100     972.100    38000.000 |    975.000     975.000    78000.000

===========================================================================================
TIME STEP #       3
Q   AC     FLOW 3 = NEAR BANK FULL Q, LAKE LOWERED.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
ACCUMULATED TIME (yrs)..........      0.277

--- Downstream Boundary Condition Data for STREAM SEGMENT NO.  1 at Control Point #  1 ---
                            DISCHARGE   TEMPERATURE  WATER SURFACE
                              (cfs)       (deg F)        (ft)
                              1250.000       65.00        953.188

****  DISCHARGE     WATER    ENERGY  VELOCITY   ALPHA     TOP      AVG       AVG VEL (by subsection)
        (CFS)      SURFACE    LINE     HEAD              WIDTH     BED        1       2       3

SECTION NO.     32.000
****    1250.000   965.170   965.207   0.037    1.000   138.791   959.334   0.000   1.543   0.000
                                                 FLOW DISTRIBUTION (%) =    0.000 100.000   0.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
       ACCUMULATED TIME (yrs)....      0.277
       FLOW DURATION (days)......      0.200
```

```
UPSTREAM BOUNDARY CONDITIONS
----------------------------------------------------------------------
Stream Segment # 1      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.    58.000 |     (cfs)     |  (tons/day)   |   (deg F)
----------------------------------------------------------------------
                INFLOW |      1250.00 |       890.88 |       65.00


  SEDIMENT INFLOW at SECTION NO.     58.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  --------------------------------------------------------------------------
    CLAY..............        131.86  |  COARSE SAND.......         12.75
    VERY FINE SILT....        128.18  |  VERY COARSE SAND..          2.87
    FINE SILT.........        115.20  |  VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......        149.14  |  FINE GRAVEL.......          0.00
    COARSE SILT.......        163.84  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....         98.84  |  COARSE GRAVEL.....          0.00
    FINE SAND.........         61.46  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......         26.75  |
                         -------------                       -------------
                                                 TOTAL =        890.88

    FALL VELOCITIES - Method 2
              DIAMETER   VELOCITY       REY. NO.          CD
    ------------------------------------------------------------
       CLAY   0.000009  0.2105298E-04  0.1671599E-04   1437286.
    VF SILT   0.000018  0.8390687E-04  0.1332435E-03   180969.4
```

```
SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=     0.71485
MIN.GRAIN DIAM       =    0.000290
BED SURFACE EXPOSED  =     1.00000

        INACTIVE LAYER      ACTIVE LAYER
          %       DEPTH      %      DEPTH
 CLAY   0.0000    0.00     0.0121    0.01
 SILT   0.0000    0.00     0.5279    0.14
 SAND   1.0000    9.92     0.4600    0.08
TOTAL   1.0000    9.92     1.0000    0.23

       AVG. UNIT              AVG. UNIT
         WEIGHT                 WEIGHT
        0.046500               0.037114

    COMPOSITE UNIT WT OF ACTIVE LAYER   (t/cf)=       0.037114
    COMPOSITE UNIT WT OF INACTIVE LAYER (t/cf)=       0.046500
    DEPTH OF SURFACE LAYER (ft)           DSL=             0.1
    WEIGHT IN SURFACE LAYER (tons)       WTSL=          3419.4
    DEPTH OF NEW ACTIVE LAYER (ft)        DSE=          0.0032
    WEIGHT IN NEW ACTIVE LAYER(tons)   WTMXAL=             0.0
    WEIGHT IN OLD ACTIVE LAYER(tons)      WAL=          7434.0
    USEABLE WEIGHT, OLD INACTIVE LAYER    WIL=        406905.7
    SURFACE AREA OF DEPOSIT (sq ft)      SABK= 0.88241952E+06

** INACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER             BED FRACTION  PERCENT FINER
                          CLAY      0.000000      0.000000      C  SAND      0.375000     82.999998
                       VF SILT      0.000000      0.000000      VC SAND      0.105000     93.499998
                       F  SILT      0.000000      0.000000      VF GRVL      0.025000     95.999998
                       M  SILT      0.000000      0.000000      F  GRVL      0.025000     98.499998
                       C  SILT      0.000000      0.000000      M  GRVL      0.005000     98.999998
                       VF SAND      0.010000      1.000000      C  GRVL      0.005000     99.499998
                       F  SAND      0.070000      8.000000      VC GRVL      0.005000     99.999998
                       M  SAND      0.375000     45.499999
** ACTIVE LAYER **
BED MATERIAL PER GRAIN SIZE:    BED FRACTION  PERCENT FINER             BED FRACTION  PERCENT FINER
                          CLAY      0.012145      1.214493      C  SAND      0.172485     92.180679
                       VF SILT      0.045067      5.721205      VC SAND      0.048296     97.010260
                       F  SILT      0.130056     18.726806      VF GRVL      0.011499     98.160160
                       M  SILT      0.290883     47.815126      F  GRVL      0.011499     99.310060
                       C  SILT      0.061889     54.003994      M  GRVL      0.002300     99.540040
                       VF SAND      0.004600     54.463954      C  GRVL      0.002300     99.770020
                       F  SAND      0.032197     57.683674      VC GRVL      0.002300    100.000000
                       M  SAND      0.172485     74.932177

C FINES, COEF(CFFML), MX POTENTIAL= 0.329756E+05 0.208796E+01 0.258871E+07
POTENTIAL TRANSPORT (tons/day):     CLAY 0.142505E+06  C  SAND 0.443530E+04
                                 VF SILT 0.144493E+06  VC SAND 0.420230E+04
                                 F  SILT 0.150708E+06  VF GRVL 0.729210E+02
                                 M  SILT 0.176257E+06  F  GRVL 0.831880E+02
                                 C  SILT 0.205679E+06  M  GRVL 0.212266E+02
                                 VF SAND 0.420247E+05  C  GRVL 0.208796E-06
                                 F  SAND 0.119823E+05  VC GRVL 0.208796E-06
                                 M  SAND 0.630429E+04

  SEDIMENT OUTFLOW FROM SECTION NO.     32.000
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    CLAY.............       1286.69  | COARSE SAND.......       1543.60
    VERY FINE SILT....      4498.13  | VERY COARSE SAND..        411.34
    FINE SILT.........     13872.54  | VERY FINE GRAVEL..          1.77
    MEDIUM SILT.......     45399.24  | FINE GRAVEL.......          2.01
    COARSE SILT.......     66309.32  | MEDIUM GRAVEL.....          0.10
    VERY FINE SAND....       709.63  | COARSE GRAVEL.....          0.00
    FINE SAND.........       723.23  | VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......      2142.73  |

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**************************************************************************************************************
    TIME     ENTRY *           CLAY            *           SILT            *           SAND            *
    DAYS     POINT *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *
  101.20    58.000 *   20.31                     *   39.55                     *   10.06                     *
   TOTAL=    1.000 *   20.31      20.04     0.01 *   39.55     33.04      0.16 *   10.06      0.25      0.97 *
**************************************************************************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    CLAY.............        131.86  | COARSE SAND.......         12.75
    VERY FINE SILT....       128.18  | VERY COARSE SAND..          2.87
    FINE SILT.........       115.20  | VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......       149.14  | FINE GRAVEL.......          0.00
    COARSE SILT.......       163.84  | MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....        98.84  | COARSE GRAVEL.....          0.00
    FINE SAND.........        61.46  | VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......        26.75  |
                       -------------                         -------------
                                                 TOTAL =        890.88
  SEDIMENT OUTFLOW from the Downstream Boundary
```

```
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    CLAY.............        1653.47  |  COARSE SAND.......        688.85
    VERY FINE SILT....       5805.04  |  VERY COARSE SAND..        226.85
    FINE SILT.........      17130.54  |  VERY FINE GRAVEL..          7.90
    MEDIUM SILT.......      49534.84  |  FINE GRAVEL.......          8.66
    COARSE SILT.......      66420.63  |  MEDIUM GRAVEL.....          3.69
    VERY FINE SAND....        381.98  |  COARSE GRAVEL.....          0.76
    FINE SAND.........        369.78  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......        859.25  |
                        -------------                        -------------
                                                 TOTAL =     143092.25

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =   101.200 DAYS
---------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER       (ft)       (ft)      (ft)        (cfs)       CLAY        SILT        SAND
     58.000      -0.39    982.31    975.01       1250.        132.        556.      2349.
     55.000       0.98    981.20    973.88       1250.        132.        556.     12521.
     53.000       0.23    976.09    972.43       1250.        132.        694.     13246.
     44.000       0.07    974.32    967.17       1250.        304.      49975.      1816.
     42.000       0.00    971.56    969.80       1250.        835.     110457.      1550.
     32.000      -0.02    965.17    956.48       1250.       1287.     130079.      5534.
     15.000      -0.07    959.04    953.63       1250.       1512.     136006.     11706.
      1.000       0.23    953.19    944.93       1250.       1653.     138891.      2548.


Accumulated Water Discharge from day zero (sfd)
     MAIN
    1000.00

-------------------------------------------------------------------------------------------

$PRT   A
...Selective Printout Option
   A - Print at all cross sections

===========================================================================================
TIME STEP #       4
Q    B     FLOW 4 = NEAR BANK FULL Q, LAKE LOWERED.
COMPUTING FROM TIME=    101.2000 DAYS TO TIME=    121.2000 DAYS IN    20 COMPUTATION STEPS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
       ACCUMULATED TIME (yrs)....      0.332
       FLOW DURATION (days)......      1.000

UPSTREAM BOUNDARY CONDITIONS
-----------------------------------------------------------------------
Stream Segment # 1      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
-----------------------------------------------------------------------
                INFLOW |      1250.00 |        890.88 |       65.00


TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
****************************************************************************************************************
    TIME     ENTRY *           CLAY              *           SILT              *           SAND              *
    DAYS     POINT *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *
  121.20    58.000 *   24.35                     *   47.41                     *   12.06                     *
   TOTAL=    1.000 *   24.35     24.08      0.01 *   47.41     40.90      0.14 *   12.06     23.31     -0.93 *
****************************************************************************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
---------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    CLAY.............         131.86  |  COARSE SAND.......         12.75
    VERY FINE SILT....        128.18  |  VERY COARSE SAND..          2.87
    FINE SILT.........        115.20  |  VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......        149.14  |  FINE GRAVEL.......          0.00
    COARSE SILT.......        163.84  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....         98.84  |  COARSE GRAVEL.....          0.00
    FINE SAND.........         61.46  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......         26.75  |
                        -------------                        -------------
                                                 TOTAL =        890.88
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ---------------------------------------------------------------------------
    CLAY.............         131.86  |  COARSE SAND.......        766.23
    VERY FINE SILT....        128.18  |  VERY COARSE SAND..        223.60
    FINE SILT.........        115.20  |  VERY FINE GRAVEL..          0.27
    MEDIUM SILT.......        149.14  |  FINE GRAVEL.......          0.18
    COARSE SILT.......        163.84  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....        124.04  |  COARSE GRAVEL.....          0.00
    FINE SAND.........        317.26  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......        833.35  |
                        -------------                        -------------
                                                 TOTAL =       2953.15

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =   121.200 DAYS
```

```
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER      (ft)        (ft)      (ft)        (cfs)       CLAY        SILT        SAND
     58.000      -1.32    980.72    974.08      1250.        132.        556.        225.
     55.000      -0.89    979.73    972.01      1250.        132.        556.        581.
     53.000      -0.28    975.71    971.92      1250.        132.        556.        888.
     44.000       0.10    973.98    967.20      1250.        132.        556.       1078.
     42.000       0.06    971.56    969.86      1250.        132.        556.       1029.
     32.000      -0.23    964.05    956.27      1250.        132.        556.       1091.
     15.000      -0.96    959.43    952.74      1250.        132.        556.       2278.
      1.000       1.63    953.19    946.33      1250.        132.        556.       2265.


==========================================================================================
TIME STEP #       5
Q    B     FLOW 5 = LAST FLOW, BASE FLOW OF 750 CFS, LAKE IS LOWERED.
COMPUTING FROM TIME=    121.2000 DAYS TO TIME=    141.2000 DAYS IN    10 COMPUTATION STEPS

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
       ACCUMULATED TIME (yrs)....      0.387
       FLOW DURATION (days)......      2.000

UPSTREAM BOUNDARY CONDITIONS
-------------------------------------------------------------------------
Stream Segment # 1      |   DISCHARGE   | SEDIMENT LOAD | TEMPERATURE
Section No.     58.000 |     (cfs)     |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
                INFLOW |        750.00 |        373.33 |       65.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            EXAMPLE PROBLEM NO 7.  COHESIVE SEDIMENT.
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**************************************************************************************************************
    TIME     ENTRY *           CLAY               *           SILT               *           SAND             *
    DAYS     POINT *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *  INFLOW   OUTFLOW  TRAP EFF *
  141.20    58.000 *   26.17                      *   50.82                      *   12.78                      *
   TOTAL=    1.000 *   26.17     25.90      0.01 *   50.82     44.32      0.13 *   12.78     32.67     -1.56 *
**************************************************************************************************************

TABLE SB-1:  SEDIMENT LOAD PASSING THE  BOUNDARIES OF STREAM SEGMENT #  1
--------------------------------------------------------------------------------
  SEDIMENT INFLOW at the Upstream Boundary:
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    CLAY.............          59.51  |  COARSE SAND.......          0.09
    VERY FINE SILT....         60.24  |  VERY COARSE SAND..          0.02
    FINE SILT.........         51.29  |  VERY FINE GRAVEL..          0.00
    MEDIUM SILT.......         63.35  |  FINE GRAVEL.......          0.00
    COARSE SILT.......         66.69  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....         38.05  |  COARSE GRAVEL.....          0.00
    FINE SAND.........         24.05  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......         10.03  |
                         -------------                         -------------
                                                   TOTAL =        373.33
  SEDIMENT OUTFLOW from the Downstream Boundary
      GRAIN SIZE      LOAD (tons/day) |    GRAIN SIZE      LOAD (tons/day)
  ----------------------------------------------------------------------------
    CLAY.............          59.51  |  COARSE SAND.......        334.69
    VERY FINE SILT....         60.24  |  VERY COARSE SAND..        120.51
    FINE SILT.........         51.29  |  VERY FINE GRAVEL..          0.21
    MEDIUM SILT.......         63.35  |  FINE GRAVEL.......          0.10
    COARSE SILT.......         66.69  |  MEDIUM GRAVEL.....          0.00
    VERY FINE SAND....         40.39  |  COARSE GRAVEL.....          0.00
    FINE SAND.........         51.68  |  VERY COARSE GRAVEL          0.00
    MEDIUM SAND.......        156.84  |
                         -------------                         -------------
                                                   TOTAL =       1005.51

TABLE SB-2:  STATUS OF THE BED PROFILE AT TIME =   141.200 DAYS
--------------------------------------------------------------------------------
  SECTION   BED CHANGE   WS ELEV   THALWEG        Q      TRANSPORT RATE (tons/day)
  NUMBER      (ft)        (ft)      (ft)        (cfs)       CLAY        SILT        SAND
     58.000      -1.76    978.97    973.64       750.         60.        242.        168.
     55.000      -1.15    978.10    971.75       750.         60.        242.        254.
     53.000      -0.57    974.57    971.63       750.         60.        242.        507.
     44.000       0.12    973.19    967.22       750.         60.        242.        437.
     42.000       0.03    970.80    969.83       750.         60.        242.        532.
     32.000      -0.23    962.77    956.27       750.         60.        242.        558.
     15.000      -1.13    958.12    952.57       750.         60.        242.        582.
      1.000       1.09    951.91    945.79       750.         60.        242.        704.

------------------------------------------------------------------------------------------
$$END

       0   DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ =         5
TOTAL NO. OF WS PROFILES =            42
ITERATIONS IN EXNER EQ =            1680

COMPUTATIONS COMPLETED
RUN TIME =  0 HOURS,  0 MINUTES & 10.00 SECONDS
```