COMPUTER BASED FLOW SIMULATION OF SARDA FEEDER CHANNEL

A DISSERTATION

Submitted in partial fulfillment of the
requirements for the award of the degree
of
MASTER OF TECHNOLOGY
in
WATER RESOURCES DEVELOPMENT

By
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CANDIDATE'S DECLARATION

I hereby declare that the work, which is being presented in the dissertation entitled **"COMPUTER BASED FLOW SIMULATION OF SARDA FEEDER CHANNEL"** submitted, in partial fulfilment of the requirements for award of the degree of **MASTER OF TECHNOLOGY** in **WATER RESOURCES DEVELOPMENT** at **DEPARTMENT** of **WATER RESOURCES DEVELOPMENT AND MANAGEMENT,** of Indian Institute of Technology Roorkee, is an authentic record of my own work carried out for a period from July, 2006 to June, 2007 under the supervision of **Prof. Nayan Sharma,** Professor, in the department of Water Resources Development and Management, Indian Institute of Technology Roorkee, India.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree.

Date: 29th June, 2007

Place: Roorkee

29.06.2007

(ADESH KUMAR)

This is to certify that the above mentioned statement made by the candidate is correct to the best of my knowledge.

....

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29th June, 2007

(ADESH KUMAR)

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SYNOPSIS

The assessment of sediment transport capacity of the channels is an important aspect and needs careful attention at the time of designing/planning a new canal project for maintaining its water carrying capacity during its life time. Two types of measures are normally adopted to get clear water from the barrage/weir which are as below:

1. Preventive measure which is applied just upstream of the head regulator to reduce the entry of sediment to the channel.
2. Curative measure which is applied just downstream of the head regulator to eliminate the problematic coarser fraction of sediment.

With the help of these measures, coarser fraction of the sediment responsible for the silting of the channels is reduced.

It has been observed that these measures are effective only within some specific conditions. Whenever the field conditions are different, the coarser sediment concentration increases in the channels creates the problem of silting due to which the flow carrying capacity of the channels reduces leading to the reduction in CCA of the canal.

For minimising these effects, it is essential that model studies be conducted for the entire canal system at the planning stage itself. Physical modelling of the entire canal system is not feasible due to modelling constraints as well as due to heavy financial requirements and long span of time involvements.

In view of the above constraints it is apparent that mathematical/numerical modelling techniques be used to study the changes in bed profile of the canal system due to silting occurring during operation of canals.

With the above object in mind, a numerical modelling of an existing Sarda Feeder Channel system has been carried out using HEC–6 software for studying the extent of silting and its profile in the entire length of Sarda Feeder Channel.

CHAPTER -1

INTRODUCTION

1.1 GENERAL

Hydraulic engineers are concern with the design, construction, operation, maintenance and improvement of channels running through loose, non-cohesive sandy/silty material. In an irrigation project, water must be conveyed from a storage reservoir or barrage/weir to the fields through main canals, branches, distributaries and minors. In the design of such channels the problem is to determine the correct shape, the cross-sectional area and the slope of the channel which will carry a given discharge of water and sediment.

Himalayan Rivers carry enormous sediment discharge with their flow in rainy season. The sediment inflow with water flow diverted to the canals creates instability in the channels. It is, therefore, necessary to predict the behaviour of the channels at the stage of planning for their better performance when these serve the actual purpose. It is only possible with the help of physical model simulation and mathematical model simulation. But it is difficult to prepare a physical model of entire length of the channel due to limitations of geometric scale, money, time and space in the laboratory/tray while the computer based numerical model provides facilities of flow simulation of the channels which requires less time and money as compared to the physical model.

This is why; Mathematical/numerical modelling of flow in channels is rapidly becoming an acceptable engineering tool, whose evolution can be compared to that of reduced scale modelling.

1.2 SCOPE OF THE STUDY AND OBJECTIVE

It has been reported that the Sarda Feeder Channel designed for carrying 650 cumec discharge has ceased to perform according to design requirements due to silting in the channel over the years. Silting has reduced the cross – section of channel and it is reported that the present discharge carrying capacity is around 500 cumec.

The objective of this study is to simulate the existing Sarda Feeder Channel for its water surface and bed profile and compare the results of the simulation study with the actual performance, so that in future, new canal projects can be simulated to predict the behaviour of the system and a better system can be designed to make assure about its good performance when it serves its purposes.

Except this, it is try to suggest the practicable modifications in the Sarda Feeder Channel so that it can run round-the-year hustle free.

1.3 FINDINGS OF THE STUDY

After simulation of the model for the period of a rainy season, the bed levels have been raised significantly in the downstream of the head regulator. At the head of the feeder channel, the maximum pond level is fixed. With these conditions, the effective operating head reduces appreciably, due to which the discharge diverted to the channel gets reduced to 500 cumec and the water surface profile of the channel gets lowered in the downstream of the head. When the water surface gets lowered as compared to the designed FSL at the location of head of the offtaking channels, the head regulators of the offtaking channels are unable to divert the desired discharges. Due to this stream power gets reduced and silting occurs in the bed of the offtaking channels also. In totality, it can be said that if silting occurs in the downstream of the head of a main canal, the entire system will be affected adversely.

1.4 ORGANISATION OF THE DISSERTATION

This dissertation is organised into the chapters as follows:

Chapter 1: Introduction to the problem and scope of the study.

Chapter 2: Literature review.

Chapter 3: Methodology.

Chapter 4: Analysis of data and computer simulation.

Chapter 5: Conclusions and suggestions for further study

References

Appendices

CHAPTER – 2

LITERATURE REVIEW

2.1 GENERAL

It is necessary to predict the behaviour of the channels at the stage of planning for their better performance when these serve the actual purpose. It is only possible with the help of physical model simulation and/or mathematical/numerical model simulation. It is difficult to prepare a physical model of entire length of the channel due to limitations of space in the laboratory while the computer based mathematical model provides facilities of flow simulation of the channels which requires lesser time and money as compared to the physical model simulation.

When the average shear stress on the bed of an alluvial channel exceeds the critical tractive stress for the bed material, statistically the particles on the bed may begin to move in the direction of the flow as per generally accepted. The particles move in different modes depending on the flow conditions, the ratio of the densities of the fluid and the sediment, and the size of the sediment. One mode of movement of sediment particles is by rolling or sliding along the bed. Such movement of the sediment is usually discontinuous; the particle may roll or slide for some time, remain stationary for a while, and again start rolling or sliding. Sediment transported in this way is known as contact load. A second mode of sediment movement is by hopping or bouncing along the bed whereby, for some time, the particle loses contact with the bed. Material transported in this way is known as saltation load. Saltation is an important mode of transport in case of noncohesive materials of relatively high fall velocities, such as sand in air and, to a lesser extent, gravel in water. The third mode of transport is in a state of suspension. In this case the particles are supported by the turbulent fluctuations. Material supported in this way and transported by the flow is known as suspended load. The Subcommittee on Sediment Terminology of the American Geophysical Union has defined the various loads as follows:

Contact load is the material rolled or slide along the bed in substantially continuous with the bed.

Saltation load is the material bouncing along the bed, or moved directly or indirectly by the impact of bouncing particles.

Suspended load is the material moving in suspension in a fluid, being kept in suspension by the turbulent fluctuations.

For a particular ratio of mass densities of the sediment and the fluid, the modes of transport generally depend on the average shear stress on the bed. For relatively low shear stresses, the material is transported almost entirely as contact load. Some material is transported as saltation load at slightly higher shear stresses, if such a type of motion can occur in significant amounts for the given value of ρ_s/ρ_f with a further increase in shear stress; a part of the material is transported in a state of suspension.

It is usually difficult to measure saltation load and furthermore, saltation load is very small in the case of flow of water over sandy beds. Hence contact load and saltation load are grouped together and called bed load. Thus bed load is the material transported on or near the bed.

Many attempts have been made so far to relate the bed load transport rate to the hydraulic conditions and the sediment characteristics. These equations have been developed primarily with the help of laboratory data, because field measurements of bed load transport rate are difficult and very few in number. Even in case of laboratory experiments it is difficult to measure bed load accurately; this is especially so in case of fine materials, since some suspended load is always entrapped with the measured bed load. Further, the rate of bed load transport at a given section varies considerably with time. Measurements have shown that the instantaneous rate may differ from the average rate by as much as 300-500 per cent. It can be shown analytically that the rate of bed load transport at a section varies directly with the bed elevation. Since the bed elevation at a section would change with time with the passage of dunes, such deviations in bed load transport from its average value can be partly explained.

Investigations concerning the bed load transport indicate that resistance to flow and bed load transport are also interrelated. Lack of complete understanding of the problem of resistance in alluvial channels, therefore, complicates the solution of the problem of bed load transport. The uncertainties involved in bed load measurement render the problem difficult. It is on account of these factors that the bed load equations developed so far are not as reliable as a hydraulic engineer would like them to be.

2.2 Sediment Transport

The bed material of an alluvial channel moves as contact load or saltation load and the stream will have only clear-water flow at low values of average shear stress on the bed. However with further increase in the shear stress, some of the bed particles are carried into the main flow and thus lose contact with the bed. These particles travel with a velocity almost equal to the flow velocity and they constitute the suspended load.

2.2.1 Suspended Load Transport

Suspended load transport is an advanced stage of bed load transport. Thus in the case of uniform sediment, one would expect only bed load transport at low shear stresses, while at high shear stresses both bed load transport and suspended load transport would occur. In the case of nonuniform sediment, the finer sizes of the bed material may move predominantly in suspension, while the coarser fractions of the bed material may move mostly (or totally) as bed load, if they move at all.

Observations in laboratory flumes and natural streams have shown that the concentration of suspended load in a vertical decreases with increase in distance from the bed. The concentration of suspended sediment can be expressed in various ways as described below:

(i) Absolute volume of solids per unit volume of water-sediment mixture. In this method the dry weight of sediment in a unit volume of mixture is first determined. Dividing this by the specific weight of sediment gives the absolute volume of sediment per unit volume of mixture. This can also be expressed as percentage by volume.

(ii) Dry weight of solids per unit volume of mixture. It is usually expressed as gm/litre, lb/cubic foot or kN per cubic metre.

(iii) Dry weight of solids per unit weight of mixture. This is customarily expressed in parts per million (ppm). One per cent equals 10,000 ppm.

(iv) Dry weight of solids per unit weight of pure water equal in volume to that of sample.

Of these methods the first and the third are commonly used for indicating the suspended sediment concentration.

One of the most interesting problems in the mechanics of suspension is the study of the method by which sediment particles resting on the bed are carried in suspension. Jeffreys proposed a theory based on hydrodynamic lift. According to him, when the lift on a particle is greater than its submerged weight, the particle moves up into the flow. On the other hand, it is also supposed by some that the turbulent fluctuations near the boundary are responsible for the entrainment of the sediment particles into the flow. It is known that for a rigid plane bed the vertical turbulent fluctuations must reduce to zero at the bed. However, since the alluvial bed is porous, it can permit vertical turbulent fluctuations of appreciable magnitude to occur at the bed.

Laursen visualized a somewhat different mechanism of sediment entertainment. When a particle is moving either over the surface of the dune or over any small irregularity on the bed, a stage is reached when the particle loses contact with the bed momentarily. If in such a case, the gravitational force is small and the flow pattern and the velocity of the particle are such that it can be taken into the main flow and the particle will move into the main flow. Since the amount of material in such an action will depend on (i) the number of particles moving, (ii) size of each particle and (iii) velocity of each particle (which, in fact, gives the rate of bed load transport in volume), Laursen concluded that the rate of bed load will govern the rate of suspended load transport.

Sutherland has closely observed the flow when particles on the bed are under incipient motion condition and also when there is movement of particles in suspension. The sequence of events leading to entrainment is hypothesized to be as follows: Turbulent flow can be visualized as consisting of round or oval shaped eddies. These eddies are distorted as they approach the bed, and the velocity of the fluid within the eddy increases. Such eddies disrupt the laminar sub layer and impinge on the surface layer of the particles. As a result the local shear stress at that spot increases and causes rolling of the particles at the incipient motion condition. Since the eddy is much larger than the particle, many particles move and then come to rest outside the area of influence of the eddy. At the incipient motion condition the eddies impinge at one spot once in a while and hence sediment movement is intermittent. At high rates of sediment transport, when eddies impinge onto the surface layer of particles often and at a number of places, they exert considerable drag on the particles and accelerate them. Some particles, because of their position or because of their rolling up and over neighbouring particles, project above the mean bed level. In such a position they are likely to be entrained because of the vertical velocity component of fluid within the eddy. If the velocity component is large enough and inclined upwards, the particle will leave the bed. Another factor that can assist suspension is the lift on the particle. Also, if the sediment bed is covered with dunes the bed features aid the entrainment process, the troughs and upstream slopes of the dunes being the most active regions.

It is fairly conclusive from the various theories for the entrainment of sediment, that turbulence in the flow is responsible for the suspension of particles in the stream. The instantaneous velocity at any point will, in general, have three components u, v and w in the directions of x, y and z axes respectively. If $\bar{u}$, $\bar{v}$ and $\bar{w}$ represent the average values of u, v, w over a sufficiently large time interval and u', v' and w' are the turbulent fluctuation velocities which are completely random, the following relations can be written:

$$
\left.\begin{aligned}
u &= \bar{u} + u', \quad \overline{u'} = 0 \\
v &= \bar{v} + v', \quad \overline{v'} = 0 \\
w &= \bar{w} + w', \quad \overline{w'} = 0
\end{aligned}\right\} \qquad \ldots\ldots\ldots\ldots 2.1
$$

in which quantities with bars represent mean values. Considering steady uniform flow in a wide channel with the general flow direction as the x-axis, v and w will be zero, because, averaged over time, there is no net flow in either y or z direction. However v' and w' do exist and they cause secondary movement in y and z directions. For very wide channels, the flow can be considered to be two-dimensional because the flow conditions do not vary in the z direction.

Material in suspension is subjected to two actions. The first is the action of the upward and downward turbulent velocity components v'. The second is the gravitational action which causes the settling of sediment which is heavier than water. Let us assume in the first place that the concentration of suspended material in the vertical is constant. As there is no net flow in the upward direction, the upward and downward flow of fluid must be equal. Settling will however help the downward flow of sediment: therefore it can be seen that more sediment will be transported in downward than in upward direction. This is true in the beginning. However, this will cause greater concentrations at greater depths from the water surface. Because of the concentration gradient thus created, eventually the upward and the downward sediment transport rates will be equal and thus there will be equilibrium. This transfer of sediment from one elevation to another is similar to the transfer of momentum. The net upward sediment transport will be proportional to the concentration gradient $\partial C/\partial y$ and hence it can be represented by $\in_s \partial C/\partial y$, in which $\in_s$ is the sediment transfer or sediment diffusion coefficient. The net downward sediment transport at any horizontal will be $\omega_o C$, in which ω_o is the fall velocity of sediment and C is the sediment concentration. It may be mentioned that C is the time-averaged concentration, but the bar over it has been omitted for convenience. Hence under equilibrium conditions the equation

$$
\omega_o C + \in_s \frac{\partial C}{\partial y} \qquad \ldots\ldots\ldots 2.2
$$

will hold good.

2.2.2 Total Load Transport

A knowledge of the rate of total sediment transport for given flow, fluid and sediment characteristics is necessary in the study of many alluvial-river/channel processes. Engineers always need to bear in mind the fact that alluvial streams carry not only water but also sediment and that the stability of a stream is closely linked with the sediment transport rate.

Alluvial channels must be designed to carry definite water and sediment discharges. In other words, the rate of total load transport must be treated as a variable affecting the design of the channel. Similarly, knowledge of the total sediment transport rate is required for estimating the rate of silting in reservoirs. Problems such as aggradation and degradation and river-training, etc. also need knowledge of the total load transport for their solution.

The topics of bed load transport, suspended load transport and wash load have been discussed in the previous paragraphs. A study of the total load transport is the next logical step. The total load is the sum of the bed load, suspended load and wash load. In flume experiments (except in special cases) wash load is absent and total load would be the bed-material load. On the other hand, in natural streams wash load is invariably present and the total load is the summation of the bed-material load and the wash load. Further, it is difficult to separate out the wash load from the measured total load. Thus the difference in the nature of laboratory and field data, mentioned above, makes it difficult to unify the total load data collected in the laboratory and in the field. But a majority of the total load relationships are based mainly on flume data and river data in which wash load is estimated and excluded from the measured total load; as such these relationships can be expected to yield the bed-material load.

2.2.2.1 Two Approaches to the Problem

The methods of computation of the total sediment transport rate can be broadly classified into two categories. The methods under the first category, described as microscopic methods, subdivide the total sediment load either into suspended load and bed load, or into measured load and unmeasured load. Since the suspended sediment sampler cannot sample the entire depth of the stream, some suspended load and the bed load remain to be sampled; this is designated as unmeasured load. Addition of the measured and the unmeasured load gives the total load. A method such as Einstein's estimates both suspended load and bed load by analytical means; on the other hand, methods such as Modified Einstein-Procedure make use of some sediment measurements. The advocates of the methods of the second category argue that the process of suspension is an advanced stage of traction along the bed; therefore the total sediment transport rate should be related primarily to the shear parameter and no distinction needs to be made between bed load and suspended load. These methods can be described as macroscopic. The relationships proposed under this category are based on dimensional analysis, intuition, or complete empiricism. Essentially, most of these methods use a single representative size for the entire mixture and thereby ignore the possibility of partial transport.

2.2.2.2 Microscopic Methods

The following microscopic methods may be listed after perusal of the literature in this field: Einstein, Colby and Hembree, Van Rijn, Samaga et al. and Swamee and Ojha. It may be mentioned that the method of Colby and Hembree is a modification of Einstein's method and usually goes under the name of Modified Einstein-Procedure.

2.2.2.3 Einstein's Method

Einstein has related the sediment concentration at 2d i.e. C_{2d}, to the rate of bed load transport. The knowledge of the value of C_{2d} enables construction of the curve of concentration distribution in the vertical. Later it was shown how the curve of (concentration x velocity) can be integrated. With this information, it is now possible to describe Einstein's method of total load computation. In short, Einstein's method involves the computation of bed load and suspended load for a given size range and addition of these to get the total load corresponding to that size range. The process is repeated for other size ranges and the loads are added.

The use of Einstein's relation for reference concentration C_{2d} in terms of the bed load transport rate

$$C_{2d} = \frac{i_B q_B}{23.2 u_*' d} \qquad \text{.......... 2.3}$$

and subsequent integration of (concentration x velocity) curve yields the relationship

$$i_s q_s = i_B q_B (PI_1 + I_2) \qquad \text{.......... 2.4}$$

Here i_s is the fraction of suspended load in a given size range and $P = 2.3 \log (30.2D/\Delta)$ where $\Delta = d_{65}/x$, x being the correction factor introduced by Einstein and the total load in a given size range will be given by

$$i_T q_T = i_B q_B (PI_1 + I_2 + 1) \qquad \text{............. 2.5}$$

where i_T is the fraction of total load in a given size range.

Einstein's method is commendable in that a rational approach has been sought at every step. However in doing this, the computational procedure has become very long and involves use of several graphs and coefficients which have been determined experimentally. Hence the accuracy of sediment computations depends on the validity and the accuracy of these graphs.

2.2.2.4 Modified Einstein-Procedure

Investigations on shallow alluvial streams in U.S.A. indicated that Einstein's method gives results which are far from the observed values. For this reason, Colby, Hembree and Schroeder developed a procedure called Modified Einstein-Procedure for determination of total load of such streams. This method is essentially based on Einstein's method described earlier; however, it uses some of the hydraulic and sediment data that are readily available. These data are supposed to be collected at one section or in a short reach of the stream and include:

(a) Discharge measurements:

(i) Stream width,

(ii) Mean depth,

(iii) Average velocity of flow.

(b) Depth integrated suspended sediment samples:

(i) Concentration of suspended sediment in the sampled depth D,

(ii) Mean depth of sampling vertical, D.

(iii) Particle size analysis of suspended load sampled.

(c) Size analysis of bed material.

(d) Water temperature.

Since Modified Einstein-Procedure uses measured quantities such as concentration of suspended sediment in sampled depth and the discharge, the method is expected to be more accurate than Einstein's method.

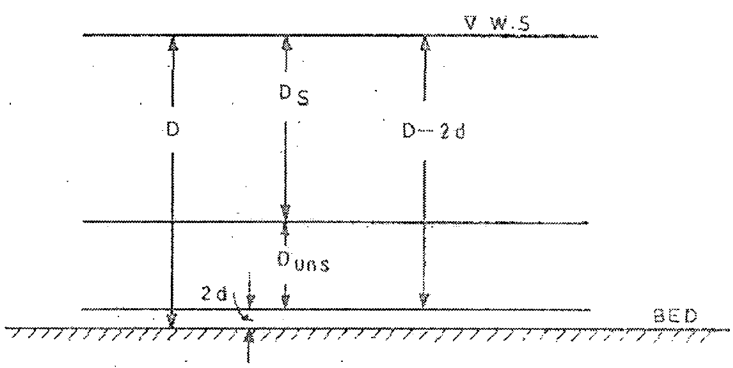


Fig. 2.1 Definition Sketch for modified Einstein – Procedure.

As in Einstein's procedure, the total load in a given size range is written as equal to the sediment load transported through the bed-layer (i.e. the bed load) plus the suspended load transported through the depth (D – 2d) (see Fig 2.1). However, the suspended sediment load carried through (D – 2d) is found as follows:

$$\begin{bmatrix}\text{Actual suspended}\\ \text{load flowing}\\ \text{through (D-2d)}\end{bmatrix} = \begin{bmatrix}\text{Measured suspended}\\ \text{load flowing through}\\ \text{sampled depth } D_S\end{bmatrix} \text{x} \begin{bmatrix}\dfrac{\begin{matrix}\text{Theoretical suspended}\\ \text{load flowing through}\\ \text{the depth (D - 2d)}\end{matrix}}{\begin{matrix}\text{Theoretical suspended}\\ \text{load flowing through}\\ \text{the depth } D_S\end{matrix}}\end{bmatrix} \quad \ldots\ldots\ldots 2.6$$

Fig. 2.2 enables computation of the fraction of the discharge flowing through the sampled depth. The product of this discharge and the measured mean concentration is the actual suspended load through the sampled depth. The ratio on the right hand side of Eq. (2.6) is obtained from the theoretical distribution of velocity and sediment concentration in the vertical. The exponent of the sediment distribution equation, viz. $Z_o = \frac{\omega_o}{u_* K_o}$, which is used in finding the ratio in Eq. (2.6), and which is designated as Z_o is obtained by trial and error. The correct value of Z_o is the one which gives a computed suspended transport rate for one sediment size equal to the measured rate over the sampled depth and is also consistent with the computed value of $i_B Q_B$. Once the value of Z_o is obtained for one size fraction, the value of Z_o for other size fractions can be obtained easily, since it was found that Z_o varied directly as 0.70 power of fall velocity.

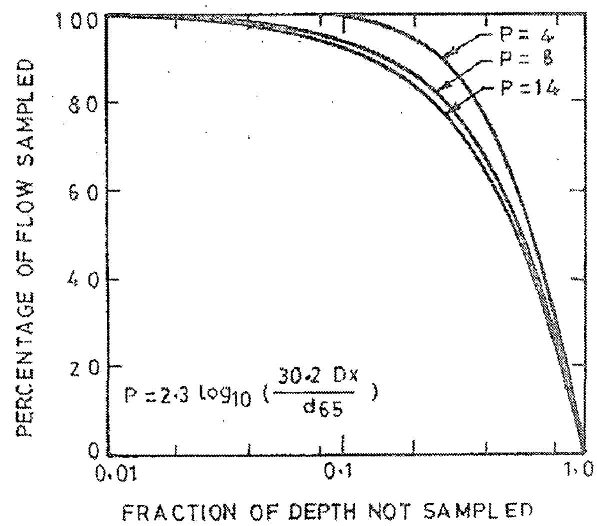


Fig. 2.2 Distribution of Flow in Vertical

The amount of bed load that is moving through the depth 2d is found essentially by the same method as Einstein's; however, some simplifications and corrections have been introduced. Below are given the simplifications used:

(i) The shear velocity u_* to be used in all the computations is defined as $u_* = \sqrt{g(RS)_m}$ which is obtained from the following equation:

$$U = 5.75\sqrt{g(RS)_m}\log\left(12.27\frac{D_x}{d_{65}}\right) \qquad \text{.............. 2.7}$$

(ii) $\xi Y(\beta/\beta_x)^2$ is assumed to be constant = 0.040

$$\text{Hence } \psi_* = \frac{0.40x1.65d}{(RS)_m} = \frac{0.66d}{(RS)_m} \text{ for natural sand.}$$

It is recommended that ψ_* should also be computed according to the formula $\psi_* = \frac{1.65d_{35}}{(RS)_m}$ and the larger of the two values used In the computations for each geometric mean particle size.

(iii) The intensity of bed load transport ϕ_* is obtained from Einstein's $\phi_* - \psi_*$ graph.

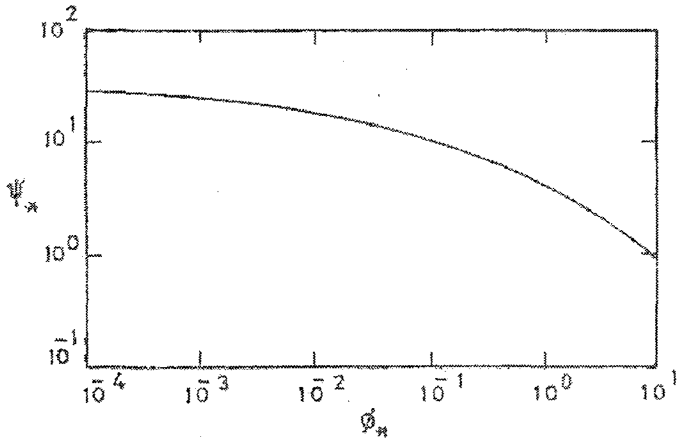


Fig. 2.3 Einstein's $\phi^* - \psi^*$ graph

The value of ϕ_* so obtained is divided by two to obtain the ϕ_* value to be used in bed load computation. The factor of two was introduced to get better fit.

This method, no doubt, contains several corrections which are arbitrary, e.g. rate of bed load transport is divided by two in order to get better agreement. Although the method has been found useful by U.S. Bureau of Reclamation and U.S. Geological Survey in their sediment investigations, it has not been subjected to checks with the help of field data in recent years, to extend its applicability to other regions

Toffaleti suggested a modification of Einstein's method of total load computation. Amongst the changes proposed are the adoption of a velocity distribution law of power type and sediment concentration distribution law of the type $C = C_a\left(\frac{y}{R}\right)^{z'}$; three different values of C_a and Z' are used over the entire depth of flow. The method is adaptable to computer programming.

2.2.2.5 Macroscopic Methods Based on A Single Size

Several methods of a macroscopic nature using a single representative size of bed material have been proposed for the determination of the total load transport. The salient features of these investigations and the final relationship are discussed below.

2.2.2.6 Laursen's Method

Laursen considered the following parameters to be important in the study of total sediment transport: u_*/ω_o, d / D, the total load concentration $\overline{C}$ in per cent by weight and the ratio of grain shear stress τ'_o to the critical shear stress τ'_{oc} for the given sediment size. His intuitive analysis gave the following functional relationship:

$$\frac{\overline{C}}{\left(\frac{d}{D}\right)^{7/6}\left[\left(\tau'_o/\tau'_{oc}\right)-1\right]}=f\left(\frac{u_*}{\omega_o}\right) \quad \ldots\ldots\ldots\ldots\ldots \quad 2.8$$

The effective shear stress τ'_o was computed from the Manning-Strickler equation and the critical shear stress τ'_{oc} from Shields' curve given in figure 2.5.

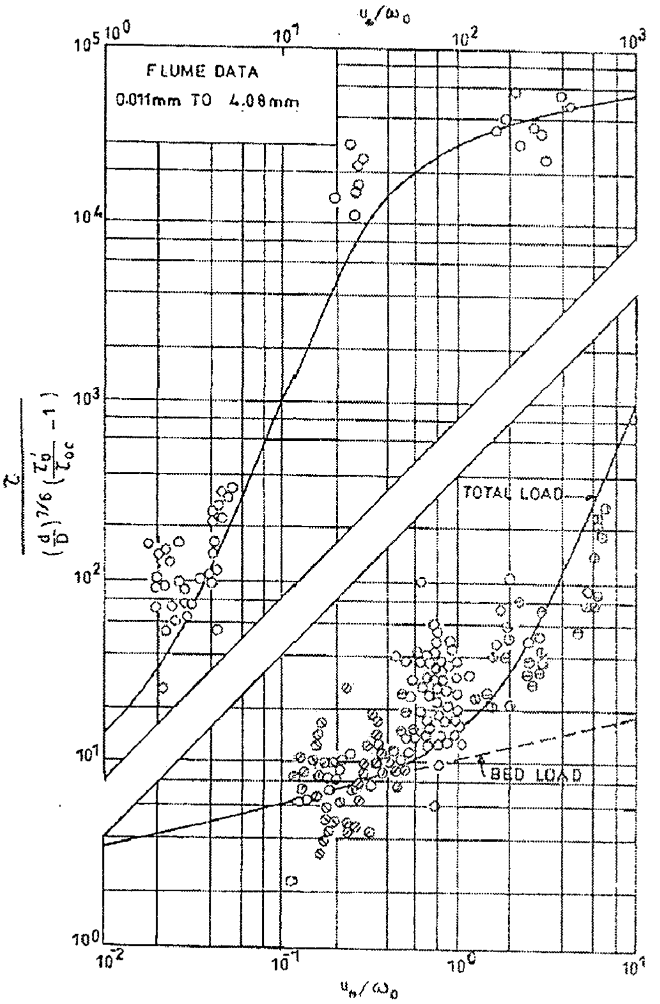


Fig. 2.4 Laursen's Total Load Relation

He used primarily flume data to determine the relation between the two parameters in Eq. (2.8); see Fig. 2.4. Application of this relation to rivers by different investigators has shown large errors.

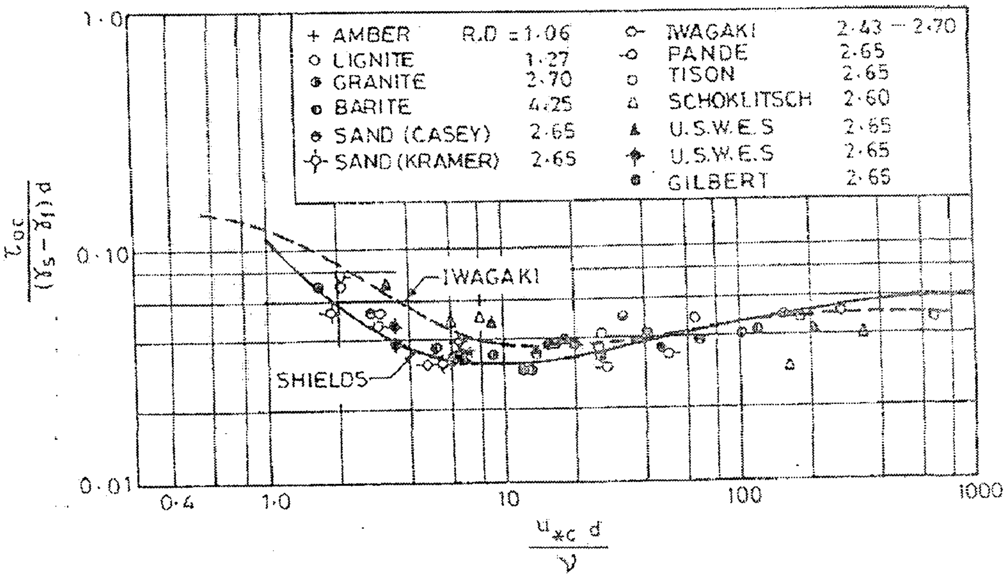


Fig.2.5 Shields' Curve

2.2.2.7 Engelund and Hansen's Method

Engelund and Hansen have proposed a total load equation relating the sediment transport to the shear stress and the friction factor of the bed. They postulated that in the case of a dune bed, the moving sediment particle is elevated through a height equal to the dune height h. The energy (per unit time per unit width) required for elevating the sediment load will be $(\gamma_s - \gamma_f)\frac{q_T}{\gamma_s}h$.

This gain in potential energy was equated to the work done by the drag forces on the moving particles during the same time. Assuming the particle velocity to be proportional to u_* and the shear transferred to the particles to be $(\tau'_o - \tau'_{oc})$, one can write

$$\frac{q_T}{\gamma_s}(\gamma_s - \gamma_f)h = K(\tau'_o - \tau'_{oc})Lu_* \qquad \text{.............. 2.9}$$

in which K is a nondimensional coefficient and L is the length of the dune.

2.2.2.8 Ackers and White's Method

Ackers and White postulated that only a part of the shear stress on the channel bed is effective in causing motion of coarse sediment, while in the case of fine sediment, suspended load movement predominates for which the total shear stress is effective in causing the sediment motion. On this premise the sediment mobility was described by the parameter

$$F_1 = \left[\frac{u_*^{c_1}}{\sqrt{\frac{\Delta\gamma_s}{\rho_f} d}} \right] \left[\frac{U}{\sqrt{32} \log \frac{10D}{d}} \right]^{1-c_1} \qquad \ldots\ldots\ldots\ldots 2.10$$

in which $C_1 = 0$ for coarse sediment and unity for fine sediment. The sediment transport parameter was formed as $(u_* / U)^{c_1} (\gamma_f / \gamma_s)(\bar{C}D / d)$, while the dimensionless particle diameter was defined as $d_* = (\Delta\gamma_s / (\rho_f \nu^2))^{1/3} d$.

This method of sediment computation has been applied to some field data successfully.

2.2.2.9 Yang's Equation

Yang contended that the rate of sediment transport in an alluvial channel is primarily governed by the rate of expenditure of potential energy per unit weight of water, i.e. the unit stream power. By analysis of a vast amount of data he obtained the following relation for $\bar{C}_T$, the load concentration in ppm by weigh.

$$\log \bar{C}_T = 5.435 - 0.286 \log \frac{\omega_o d}{\nu} - 0.457 \log u_* + \left(1.799 - 0.409 \log \frac{\omega_o d}{\nu} - 0.314 \log \frac{u_*}{\omega_o} \right) \log \left(\frac{US}{\omega_o} - \frac{U_{cr}}{\omega_o} \right) \qquad \ldots\ldots\ldots\ldots 2.11$$

Here U_{cr} is the critical velocity for incipient. Equation (2.11) was found to work satisfactorily both for laboratory and field data.

2.2.3 Comments on the Accuracy of Various Relations

Over a dozen total load relations essentially using a single representative size of the sediment mixture are available. While some of the methods may be considered semi-empirical, most of them are based on dimensional analysis and graphical plotting or regression analysis. Hence the basis for the choice of an appropriate sediment transport relation in practice can only be the relative accuracy of these methods. A few checks on the accuracy of practically all the methods available so far have been carried out using both field and laboratory data. Generally speaking, the methods of Ackers-White, Engelund-Hansen and Yang give better results than the other methods.

CHAPTER – 3

THEORETICAL BASIS AND METHODOLOGY OF HEC-RAS AND HEC-6

3.1 SIMULATION METHODOLOGY USING HEC-6 AND HEC-RAS

HEC-RAS numerical model developed by Hydrologic Engineering Centre, USA has been used for this study in order to calibrate the model for the values of Rugosity coefficient which have been used in the simulation of the model to predict the changes in channel profiles resulting from scour and/or deposition over rainy season. **HEC-RAS** is capable to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. This component of the modelling system is intended for calculating water surface profiles for steady/gradually varied flow. The system can handle a single channel reach, or a full network of channels. The steady flow component is capable of modelling subcritical, supercritical, and mixed flow regime water surface profiles.

The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profile is rapidly varied. These situations include mixed flow regime calculations (i.e., hydraulic jumps), hydraulics of bridges, and evaluating profiles at river confluences and channel junctions.

HEC-6 numerical model developed by Hydrologic Engineering Centre, USA has been used for the present study in order to simulate the water surface and bed profile of the Sarda Feeder Channel. HEC-6 is a one-dimensional movable boundary open channel flow numerical model designed to simulate and predict changes in channel profiles resulting from scour and/or deposition over moderate time periods. A continuous flow record is partitioned into a series of steady flows of variable discharges and durations. For each flow a water surface profile is calculated thereby providing energy slope, velocity, depth, etc. at each cross section. Potential sediment transport rates are then computed at each section.

HEC-6 processes a discharge hydrograph as a sequence of steady flows of variable durations. Using continuity of sediment, changes are calculated with respect to time and distance along the study reach for the following: total sediment load, volume and gradation of sediment that is scoured or deposited, armouring of the bed surface and the cross section elevations. In addition, sediment outflow at the downstream end of the study reach is calculated. The location and amount of material to be dredged can be obtained if desired.

3.2 Geometry

Geometry of the channel system is represented by cross sections which are specified by coordinate points (stations and elevations) and the distances between cross sections. HEC-6 raises or lowers cross section elevations to reflect deposition and scour. The horizontal locations of the channel banks are considered fixed; however, they will be moved vertically if they are within the movable bed limits specified by the user.

3.3 Hydraulics and Hydrology

The water discharge hydrograph is approximated by a sequence of steady flow discharges, each of which continues for a specified period of time. Water surface profiles are calculated for each flow using the standard-step method to solve the energy and continuity equations. Friction loss is calculated by Manning's equation and expansion and contraction losses are calculated if the loss coefficients are specified. Hydraulic roughness is described by Manning's n values and can vary from cross section to cross section

3.4 Sediment Transport

Inflowing sediment loads are related to water discharge by sediment-discharge curves for the upstream boundaries of the main channel and local inflow points. For realistic computation of stream behaviour, particularly scour and stable conditions, the gradation of the material forming the stream bed must be measured. HEC-6 allows a different gradation at each cross section. If only deposition is expected, the gradation of material in the bed is less important. Sediment gradations are classified by grain size using the American Geophysical Union scale. HEC-6 will compute transport potential for clay (particles less than 0.004 mm diameter), four classes of silt (0.004-0.0625 mm), five classes of sand (from very fine sand, 0.0625 mm, to very coarse sand, 2.0 mm), five classes of gravel (from very fine gravel, 2.0 mm, to very coarse gravel, 64 mm), two class of cobbles (from small, 64mm, to large cobbles, 256mm) and three classes of boulders (from small, 256mm, to large boulders, 2048mm). Transport potential is calculated at each cross section using hydraulic information from the water surface profile calculation (e.g., width, depth, energy slope, and flow velocity) and the gradation of bed material. Sediment is routed downstream after the backwater computations are made for each successive discharge (time step).

3.5 Theoretical Basis for Hydraulic Calculations

The basis for water surface profile calculations is essentially the method which is described in "Backwater Curves in Channels. Conveyance is calculated from average areas and average hydraulic radii for adjacent cross sections.

3.5.1 Equations for Water Surface Profile Calculations

The hydraulic parameters needed to calculate sediment transport potential are velocity, depth, width and energy slope – all of which are obtained from water surface profile calculations. The one dimensional energy equation is solved using the standard step method and the hydraulic parameters are calculated at each cross section for each successive discharge. Figure 3-1 shows a representation of the terms in the energy equation.

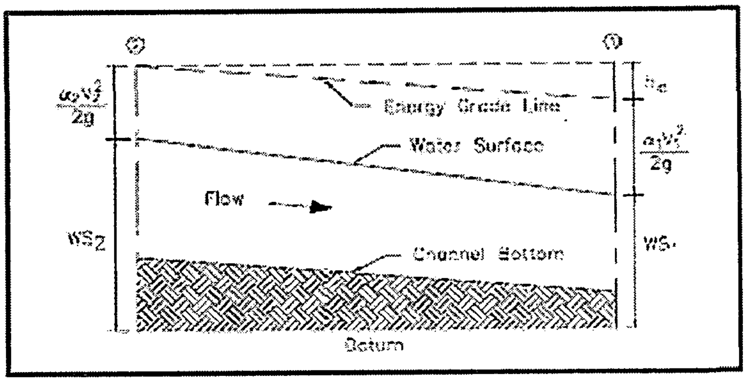


Fig. 3.1 Energy Equation Term

$$WS_2 + \frac{\alpha_2 V_2^2}{2g} = WS_1 + \frac{\alpha_1 V_1^2}{2g} + h_e \qquad \text{.................. 3.1}$$

where: g = acceleration of gravity

h_e = energy loss

V_1, V_2 = average velocities (total discharge ÷ total flow area) at ends of reach.

WS1, WS2 = water surface elevations at ends of reach

α_1, α_2 = velocity distribution coefficients for flow at ends of reach.

3.5.2 Hydraulic Losses

3.5.2.1 Friction Losses

Channel geometry is specified by cross sections and reaches lengths; friction losses are calculated by method given by USACE. The energy loss term, h_e, in Equation 3.1 is composed of friction loss, h_f, and form losses, h_o, as shown in Equation given below. Only contraction and expansion losses are considered in the geometric form loss term.

$$H_e = h_f + h_0$$

To approximate the transverse distribution of flow, the channel is divided into strips having similar hydraulic properties in the direction of flow. Each cross section is subdivided into portions that are referred to as subsections. Friction, h_f, loss is calculated as shown below:

$$h_f = \left[\frac{Q}{K_t'}\right]^2 \quad \text{..................3.2}$$

In which:

$$K_t' = \sum_{j=1}^{NSS}\left[\frac{1.49}{n_j}\right]\frac{\frac{(A_2+A_1)_j}{2}\left[\frac{R_2+R_1}{2}\right]_j^{2/3}}{L_j^{1/2}} \quad \text{.............3.3}$$

where: A_1, A_2 = downstream and upstream area, respectively, of the flow normal to the cross sections

NSS = total number of subsections across each cross section

K_t' = length-weighted subsection conveyance

L_j = length of the j^{th} strip between subsections

n = Manning's roughness coefficient

Q = water discharge

R_1, R_2 = downstream and upstream hydraulic radius, respectively.

3.5.2.2 Other Losses

Energy losses due to contractions and expansions are computed by the following equation:

$$h_0 = C_L\left[\frac{\alpha_2 V_2^2}{2g} - \frac{\alpha_1 V_1^2}{2g}\right] \quad \text{............................. 3.4.}$$

where: C_L = loss coefficient for expansion or contraction

If the quantity within the absolute value notation is negative, flow is contracting and C_L is the coefficient of contraction; if it is positive, flow is expanding and C_L is the coefficient of expansion.

3.5.3 Computation of Hydraulic Elements

Each cross section is defined by coordinates (X,Y) as shown in Figure 3-2. For convenience of assigning n values, reach lengths, etc., each cross section is divided into subsections, usually consisting of a main channel, with left and right overbanks.

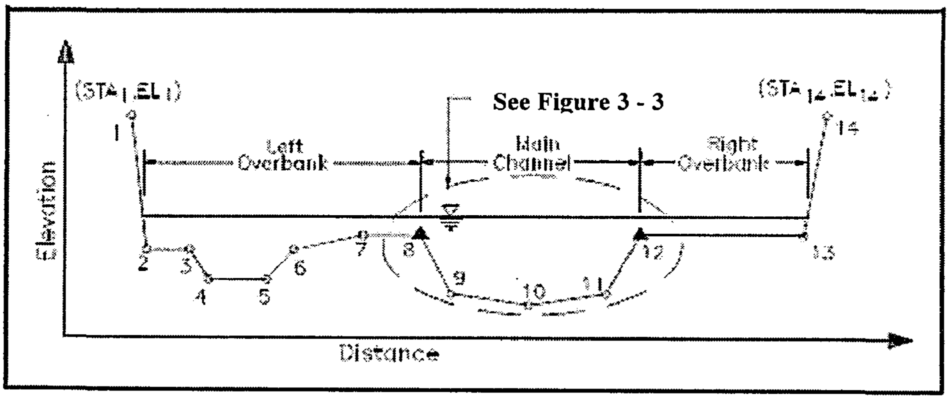


Fig. 3.2 Typical Representation of a Cross Section

3.5.3.1 Subsection Area

The area of each subsection is computed by summing incremental areas below the water surface between consecutive coordinates of the cross section. Figure 3-3 illustrates the technique with a subsection of Figure 3-2 where STCHL and STCHR are the lateral boundaries of the subsection.

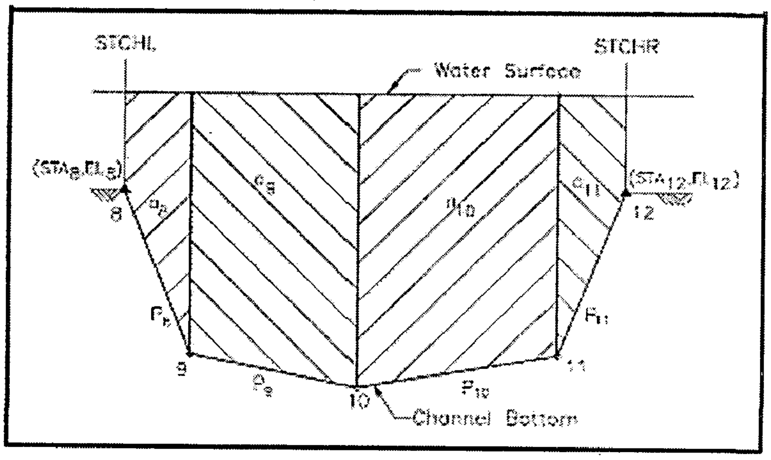


Fig. 3.3 Incremental Areas in Channel Subsection

The area of the channel subsection is:

$$A_j = a_8 + a_9 + a_{10} + a_{11} \quad \text{................3.5}$$

where : a_i = incremental area

The equation for incremental area, a_i is:

$$a_i = \frac{(d_i + d_{i+1})}{2} \quad \text{................. 3.6}$$

where: d_i, d_{i+1} = the left and right depth of each incremental area, respectively (see Figure 3.4)

W = width of an incremental area.

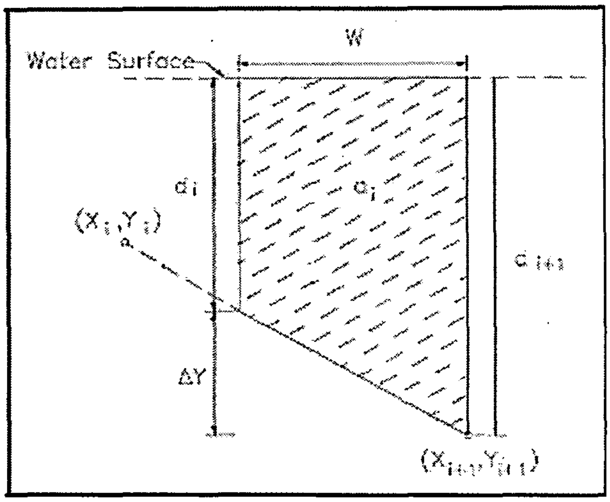


Fig. 3.4 Incremental Area

Normally, d_i, d_{i+1} and W are defined by two consecutive cross section coordinate points, as shown in Figure 3.4. However at the first and last increments in each subsection, a subsection station defines one side of the incremental area. If the subsection station does not coincide with an X coordinate, straight line interpolation is used to compute the length of either d_i, d_{i+1}, or both.

3.5.3.2 Wetted Perimeter

The wetted perimeter, P, is computed as the length of the cross section below the water surface. In the case of Figure 3.3, this is:

$$P = P_8 + P_9 + P_{10} + P_{11} \quad .... 3.7$$

where: P_j = incremental parameter.

The equation for the wetted perimeter of the incremental area in figure 3.4 is:

$$P_j = (\Delta Y^2 + W^2)^{1/2} \quad .... 3.8$$

where: ΔY and W are as shown in Figure 3.4.

Note that only the distance between coordinate points is considered in p_i, not the depths d_i and d_{i+1}. In other words, friction due to shear forces between subsections is not considered.

3.5.3.3 Hydraulic Radius

The hydraulic radius, R, is calculated for each subsection, j, by:

$$R_j = \frac{A_j}{P_j} \quad .... 3.9$$

where: A_j = area of subsection

P_j = wetted perimeter of subsection

R_j = hydraulic radius of subsection.

3.5.3.4 Conveyance

The conveyance, K_j, is computed for each subsection, j,.

The total conveyance, K_j, in the cross section is:

$$K_j = \frac{1.49}{n_j} A_j R_j^{2/3} \quad \text{.......3.10}$$

where: NSS = total number of subsections.

3.5.3.5 Velocity Distribution Factor, Alpha

Alpha is an energy correction factor to account for the transverse distribution of velocity across the floodplains and channel. Large values of alpha (>2) will occur if the depth of flow on the overbanks is shallow, the conveyance is small, and the area is large. Alpha is computed as follows:

$$\alpha = \frac{\sum_{j=1}^{NSS} \left[\frac{K_j^3}{A_j^2} \right]}{\left[\frac{K_t^3}{A_t^2} \right]} \quad \text{.................3.11}$$

3.5.3.6 Effective Depth and Width

The sediment transport capacity for non-rectangular sections is calculated using a weighted depth, EFD, called the effective depth. The corresponding effective width, EFW, is calculated from the effective depth to preserve $A(D^{2/3})$ for the cross section.

$$EFD = \frac{\sum_{i=1}^{i_t} D_{avg}.a_i.D_{avg}^{2/3}}{\sum_{i=1}^{i_t} a_i.D_{avg}^{2/3}} \quad \text{...3.12}$$

$$EFW = \frac{\sum_{i=1}^{i_t} a_i.D_{avg}^{2/3}}{EFD^{2/3}} \quad \text{...... 3.13}$$

where: a_i = flow area of each trapezoidal element

D_{avg} = average water depth of each trapezoidal element

i_t = the total number of trapezoidal elements in a subsection

The sediment transport computation is based upon hydraulics of the main channel only; therefore, the hydraulic elements are from the geometry within the channel limits only.

3.5.3.7 Critical Depth Calculations

To assess if the backwater profiles remain above critical depth, the critical section factor, CRT, is computed using Equation 3.14, and compared with the computed section factor at each cross section.

$$CRT = \frac{Q}{\left(\frac{g}{\alpha}\right)^{1/2}} \quad \text{...........} \; 3.14$$

A computed section factor, ZSQ, is calculated for comparison to CRT.

Where: A_t = total area of cross section

W_t = total water surface width

If CRT is less than ZSQ, subcritical flow exists and computations continue. Otherwise, critical depth is calculated by tracing the specific energy curve to the elevation of minimum total energy and the resulting water surface elevation is compared with the water surface elevation calculated by Equation 3.1 to decide if flow is supercritical. If supercritical flow is indicated, flow depth is determined as described in the following section.

3.5.3.8 Supercritical Flow

In the standard step method for water surface profile computations, calculations proceed from downstream to upstream based upon the reach's starting water surface elevation. At each cross section, HEC-6 examines the appropriate hydraulic parameters to determine if the reach is a subcritical or supercritical flow reach. If flow is subcritical, computations proceed upstream in the manner described in Section 3.5.1. If it is supercritical, HEC-6 approximates the channel geometry using the effective depth and width as described in Section 3.5.3.6 and determines the water surface elevation based upon the supercritical normal depth.

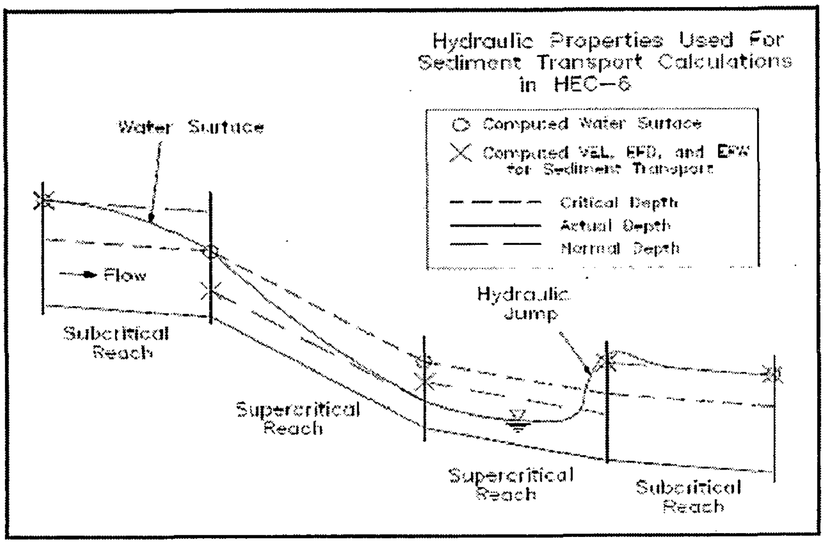


Figure 3-5
Subcritical, Critical, and Supercritical Flow Simulations in HEC-6

If a subcritical reach is eventually encountered, the downstream cross section of the reach is assumed to be at critical depth and backwater computations proceed upstream for assumed subcritical flow conditions. Note that for subcritical flow, M1 and M2 curves are possible in HEC-6 but under supercritical flow, S1 and S2 curves are not computed because only supercritical normal flow depths are calculated. An example of such a series of profiles is shown in Figure 3.5.

3.5.3.9 Convergence Equations

Three major steps are used to converge computational trials in computing the upstream cross section water surface elevation. Figure 3.6 demonstrates the sequence of successive trials to converge the standard step method.

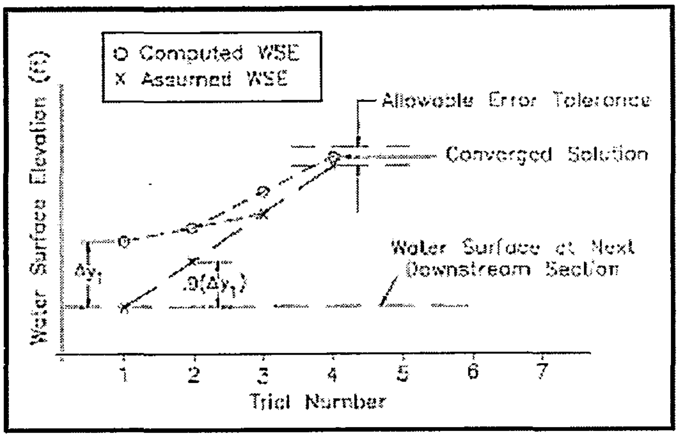


Figure 3-6
Convergence of Assumed and Computed
Water Surface Elevations

Computational Procedure:

Trial 1: Based on the previous water surface elevation.

Trial 2: Assumed change is ninety percent of ΔY1

Trial 3: Trial 1 and 2 elevations assumed are connected with a straight line and the computed Trial 1 and 2 solutions are also connected with a straight line. The intersection of these lines becomes Trial 3's assumed value.

Trial 4, etc.: This process continues until the assumed and computed values of water surface elevation are within the allowable error tolerance. If they are, the computed water surface elevation becomes the converged solution. Oscillation between positive and negative "error" is permitted. A note is printed in the event a solution is "forced" (after 20 trials) even though the "error" is greater than the allowable error. In this case, the last computed water surface elevation is used.

3.5.4 Representative Hydraulic Parameters Used in Sediment Calculations

Hydraulic parameters are converted into representative (weighted) values for each reach prior to calculating transport capacity. General equations are shown below. These weighting factors can be modified with input data.

Interior Point (section)

$$\left.\begin{aligned}
VEL &= XID * VEL(K-1) + XIN * VEL(K) + XIU * VEL(K+1) \\
EFD &= XID * EFD(K-1) + XIN * EFD(K) + XIU * EFD(K+1) \\
EFW &= XID * EFW(K-1) + XIN * EFW(K) + XIU * EFW(K-1) \\
SLO &= 0.5 * [SLO(K) + SLO(K+1)]
\end{aligned}\right\} \quad .... 3.15$$

Upstream Point (section)

$$\left.\begin{aligned}
VEL &= UBN * VEL(K) + UBI * VEL(K-1) \\
EFD &= UBN * EFD(K) + UBI * EFD(K-1) \\
EFW &= UBN * EFW(K) + UBI * EFW(K-1) \\
SLO &= SLO(K)
\end{aligned}\right\} \quad ....3.16$$

Downstream Point (section)

$$\left.\begin{aligned}
VEL &= DBN * VEL(K) + DBI * VEL(K+1) \\
EFD &= DBN * EFD(K) + DBI * EFD(K+1) \\
EFW &= DBN * EFW(K) + DBI * EFW(K+1) \\
SLO &= SLO(K)
\end{aligned}\right\} \quad ....3.17$$

where: DBN, DBI = coefficients for downstream reach boundary

K-1, K, K+1 = downstream, midpoint, and upstream locations, respectively, of a reach

SLO = friction slope

UBN, UBI = coefficients for upstream reach boundary

VEL = weighted velocity of the reach

XID, XIN, XIU = downstream, interior, and upstream coefficients, respectively, for interior points.

Several different weighting factors were investigated during the formulation of the computation scheme. Table 3.1 shows the set of factors which appeared to give the most stable calculation and thereby permits the longest time steps (Scheme 1) and the set which is the most sensitive to changes in bed elevation but requires shorter time steps to be stable (Scheme 2). Scheme 1 is often the best choice because the computed energy slope may vary drastically from section-to-section whereas the actual channel's behaviour may be dependent upon reach properties. HEC-6 defaults to Scheme 2 but this can be changed by entering other values for the weighting factors on the I5 record.

Table 3.1
Representative Hydraulic Parameter Weighting Factors

	DBI	DBN	XID	XIN	XIU	UBI	UBN	
Scheme 1	0.5	0.5	0.5	0.5	0.5	0.5	1.0	Most Stable
Scheme 2	0.0	1.0	0.0	1.0	0.0	0.0	1.0	Most Sensitive

3.5.5 Hydraulic Roughness

Boundary roughness of an alluvial stream is closely tied to sediment transport and the movement of bed material. Energy losses for water surface profile calculations must include the effects of all losses: grain roughness of the movable bed, drag losses from bed forms such as ripples and dunes, bank irregularities, vegetation, contraction/expansion losses, bend losses, and junction losses. All these losses except the contraction/expansion losses are embodied in a single roughness parameter, Manning's n.

3.6 Theoretical Basis for Sediment Calculations

Sediment transport rates are calculated for each flow in the hydrograph for each grain size. The transport potential is calculated for each grain size class in the bed as though that size comprised 100% of the bed material. Transport potential is then multiplied by the fraction of each size class present in the bed at that time to yield the transport capacity for that size class. These fractions often change significantly during a time step; therefore an iteration technique is used to permit these changes to affect the transport capacity. The basis for adjusting bed elevations for scour or deposition is the Exner equation (see Section 3.6.1.3).

3.6.1 Equation for Continuity of Sediment Material

3.6.1.1 Control Volume

Each cross section represents a control volume. The control volume width is usually equal to the movable bed width and its depth extends from the water surface to the top of bedrock or other geological control beneath the bed surface. In areas where no bedrock exists, an arbitrary limit (called the "model bottom") is assigned (see Figure 3-7). The control volume for cross section 2 is represented by the heavy dashed lines. The control volumes for cross sections 1 and 3 join that for cross section 2, etc.

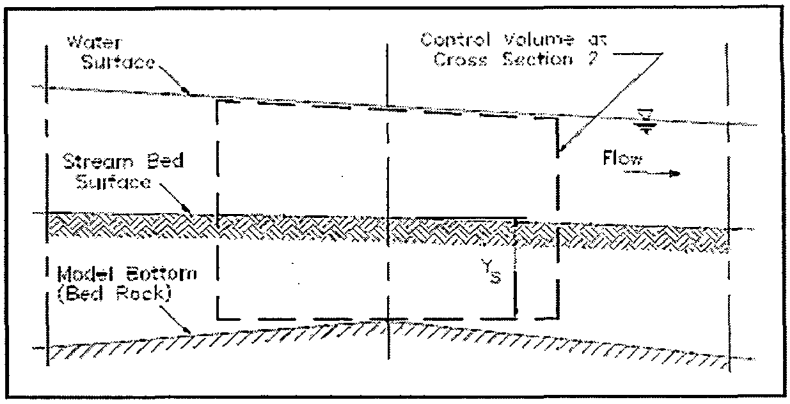


Figure 3-7 Control Volume for Bed Material

The sediment continuity equation is written for this control volume; however, the energy equation is written between cross sections. Because descriptions of both sediment continuity and conservation of energy should enclose the same space; and because the averaging of two cross sections tends to smooth numerical results, the shape of the control volume is conceptually deformed.

The amount of sediment in the stream bed, using an average end area approximation, is:

$$V_{sed} = B_o * Y_S * \frac{L_u + L_d}{2} \quad \text{..............3.18}$$

where: Bo = width of the movable bed

L_u, L_d = length of the upstream and downstream reach, respectively, used in control volume computation

V_{sed} = volume of sediment in control volume

Y_s = depth of sediment in control volume.

For a water depth, D, the volume of fluid in the water column is:

$$V_f = B_o * D * \frac{L_u + L_d}{2} \quad \text{.............. 3.19}$$

B_0 and D are hydraulic parameters, width and depth, which are calculated by averaging over the same space used in solving the energy equation as described in Sections 3.5.1 and 3.5.4. The solution of the continuity of sediment equation assumes that the initial concentration of suspended bed material is negligible. That is, all bed material is contained in the sediment reservoir at the start of the computation interval and is returned to the sediment reservoir at the end of the computation interval. Therefore, no initial concentration of bed material load need be specified in the control volume. The hydraulic parameters, bed material gradation and calculated transport capacity are assumed to be uniform throughout the control volume. The inflowing sediment load is assumed to be mixed uniformly with sediment existing in the control volume. HEC-6 assumes instantaneous diffusion of all grain size classes on a control volume basis.

3.6.1.2 Concepts of the Control Volume

The control volume concept employed in HEC-6 represents the alluvium of a natural channel. Over time, the channel will exchange sediment with its boundaries both vertically and laterally, changing its shape by forming channels, natural levees, meanders, islands, and other plan forms. HEC-6, however, only models vertical sediment exchange with the bed; the width and depth of which are user defined. Correct reproduction of the natural channel system depends on modelling the proper exchange of sediment between the flow field and the bed sediment. The physics of that exchange process are not well understood.

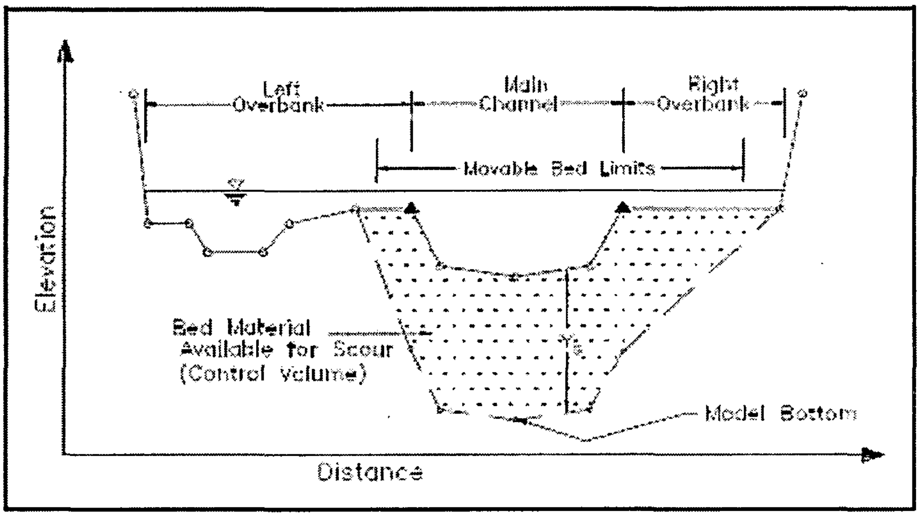


Fig. 3.8 Sediment Material in the Streambed

HEC-6 accounts for two sediment sources; the sediment in the inflowing water and the bed sediment. The inflowing sediment load is a boundary condition and is prescribed with input data. The bed sediment control volume provides the source-sink component and is also prescribed with input data. Transport theory for sand and larger sizes relates the transport rate to the gradation of sediment particles on the bed surface and the flow hydraulics. Armour calculations require the gradation of material beneath the bed surface. The depth to bedrock or some other material that might prevent degradation should also be identified to limit the scour process. These requirements are addressed in HEC-6 by separately computing the bed surface gradation and the sub-surface gradation. The coordinates connected by the solid line in Figure 3-8 define the initial cross section shape at the beginning of a simulation. For scour conditions, the difference between the inflowing sediment load and the reach's transport capacity is converted to a scour volume. After each time step, the coordinates within the "movable bed" are lowered by an amount which, when multiplied by the movable bed width and the representative reach length, equals the required scour volume. If a model bottom elevation is not specified in the initial conditions, a default value of 10 ft is used, which then becomes the maximum depth of bed material available for scour.

3.6.1.3 Exner Equation

The above description of the processes of scour and deposition must be converted into numerical algorithms for computer simulation. The basis for simulating vertical movement of the bed is the continuity equation for sediment material (the Exner equation):

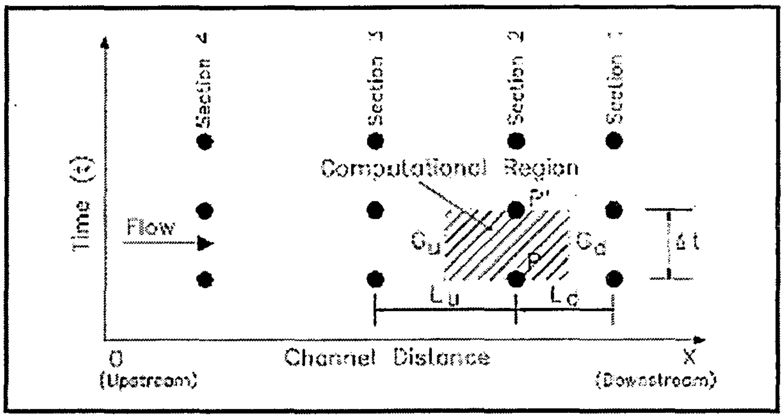


Figure 3- 9 Computation Grid

$$\frac{\partial G}{\partial x} + B_o \cdot \frac{\partial Y_S}{\partial t} = 0 \quad \text{......................} \; 3.20$$

where: B_o = width of movable bed

t = time

G = average sediment discharge (ft3/sec) rate during time step _t

x = distance along the channel

Y_s = depth of sediment in control volume.

Equations 3.21 and 3.22 represents the Exner Equation expressed in finite difference form for point P using the terms shown in Figure 3-9.

$$\frac{G_d - G_u}{0.5(L_d + L_u)} + \frac{B_{SP}(Y_{SP}{}' - Y_{SP})}{\Delta t} = 0 \quad \text{.......} 3.21$$

$$Y_{SP}{}' = Y_{SP} - \frac{\Delta t}{0.5 B_{SP}} \cdot \frac{G_d - G_u}{L_d + L_u} \quad \text{...........} \; 3.22$$

where: B_{sp} = width of movable bed at point P

G_u, G_d = sediment loads at the upstream and downstream cross sections, respectively

L_u, L_d = upstream and downstream reach lengths, respectively, between cross sections

Y_{sp}, Y_{1sp} = depth of sediment before and after time step, respectively, at point P

0.5 = the "volume shape factor" which weights the upstream and downstream reach lengths

Δt = computational time step

The initial depth of bed material at point P defines the initial value of Y_{sp}. The sediment load, G_u, is the amount of sediment, by grain size, entering the control volume from the upstream control volume. For the upstream-most reach, this is the inflowing load boundary condition provided by the user. The sediment leaving the control volume, G_d, becomes the G_u for the next downstream control volume. The sediment load, G_d, is calculated by considering the transport capacity at point P, the sediment inflow, availability of material in the bed, and armouring. The difference between G_d and G_u is the amount of material deposited or scoured in the reach labelled as "computational region" on Figure 3-9, and is converted to a change in bed elevation using Equation 3.22. The transport potential of each grain size is calculated for the hydraulic conditions at the beginning of the time interval and is not recalculated during that interval. Therefore, it is important that each time interval be short enough so that changes in bed elevation due to scour or deposition during that time interval do not significantly influence the transport potential by the end of the time interval. Fractions of a day are typical time steps for large water discharges and several days or even months may be satisfactory for low flows. The amount of change in bed elevation that is acceptable in one time step is a matter of judgment. Good results have been achieved by using either 1 ft or 10% of the water depth, whichever is less, as the allowable bed change in a computational time interval. The gradation of the bed material, however, is recalculated during the time interval because the amount of material transported is very sensitive to the gradation of bed material.

3.6.1.4 Bed Gradation Recomputations

HEC-6 solves the Exner equation for continuity of sediment. If transport capacity is greater than the load entering the control volume, available sediment is removed from the bed to satisfy continuity. Since transport capacity for a given size depends upon the fraction of that size on the bed, it is necessary to frequently recalculate fractions present as sediment is exchanged with the bed. The number of exchange increments, SPI, during a time step is theoretically related to the time step length, Δt, velocity, and reach length in each reach by:

$$\text{No. of Exchange Increments} = \frac{\Delta t \cdot \text{Velocity}}{\text{Reach Length}} \quad \text{...........3.23}$$

Usually the number of exchange increments can be less than this without generating significant numerical problems. Specify SPI in field 2 of the I1 record. Initially, SPI should be set to zero (which invokes Equation 3.23) and an extreme hydrologic event simulated. This should be the most stable (and computationally intensive) case. Then, starting from SPI=50 or more, one should decrease it in increments of 10 until the results become significantly different from the results with SPI=0. Use the smallest SPI that gives a solution close to that obtained with SPI=0.

3.6.2 Determination of the Active and Inactive Layers

HEC-6 implements the concept of an active and an inactive bed layer. The active layer is assumed to be continually mixed by the flow, but it can have a surface of slow moving particles that shield the finer particles from being entrained in the flow. Two different processes are simulated: (1) Mixing that occurs between the bed sediment particles and the fluid-sediment mixture due to the energy in the moving fluid and, (2) Mixing that occurs between the active layer and the inactive layer due to the movement of the bed surface. The mixing mechanisms are attributed to large scale turbulence and bed shear stress from the moving water. The mixing depth (termed "equilibrium depth") is expressed as a function of flow intensity (unit discharge), energy slope, and particle size.

3.6.2.1 Equilibrium Depth

The minimum energy hydraulic condition at which a particular grain size will just be stationary on the bed surface can be calculated by combining Manning's, Strickler's, and Einstein's equations, respectively:

$$V = \frac{1.49}{n} R^{2/3} S_f^{1/2} \quad \text{...............3.24}$$

$$n = \frac{d^{1/6}}{29.3} \quad \text{........................ 3.25}$$

$$\psi = \frac{\rho_s - \rho f}{\rho_f} \cdot \frac{d}{DS_f} \quad \text{.............. 3.26}$$

where: d = grain diameter

D = water depth

V = water velocity

ρ_s = density of sand grains

ρ_f = density of water

ψ = transport intensity from Einstein's bed load function, related to the inverse of

Shield's parameter

S_f = friction slope

For negligible transport, ψ equals 30 or greater. Solving Equation 3.26 in terms of S_f for a specific gravity of sand of 2.65 and with ψ set at 30 yields:

$$S_f = \frac{d}{18.18D} \quad \text{.............................} \; 3.27$$

Combining this with the Manning and Strickler equations, in which **R** has been replaced with **D,** and multiplying velocity by depth to get unit discharge yields:

$$q = \frac{(1.49)*(29.3)D^{5/3}}{d^{1/6}}\left[\frac{d}{18.18D}\right]^{1/2}$$

$$= 10.21 \cdot D^{7/6} \cdot D^{1/3} \quad \text{..........} \; 3.28$$

where: q = water discharge per unit width of flow

The equilibrium depth for a given grain size and unit discharge is therefore:

$$D_e = D = \left[\frac{q}{10.21d^{1/3}}\right]^{6/7} \quad \text{......................} \; 3.29$$

where: De = the minimum water depth for negligible sediment transport (i.e., equilibrium depth) for grain size d.

3.6.3 Hydraulic Sorting of the Bed Material – Method 1

Two methods are available in HEC-6 for computing the changes in composition (gradation) of the bed material with time. These methods are presented below. Note that, because of the limitations of each, neither method will be appropriate for all conditions. The primary restrictions on rate of scour are the thickness of the active bed layer and amount of surface area armoured. The active bed is the layer of material between the bed surface and a hypothetical depth at which no transport occurs for the given gradation of bed material and flow conditions. The thickness of the active bed is calculated at the beginning of each interval. The amount of surface area armoured is proportional to the amount of active bed removed by scour. It is assumed that the transport capacity can be satisfied, if the sediment is available, within each time step within each control volume. The depth of scour required to accumulate a sufficient amount of coarse surface material to armor the bed is calculated as follows: The number of grains times the surface area shielded by each grain equals the total surface area, **SA**, of a vertical column, as illustrated by Figure 3-10 and shown in Equations 3.30 and 3.3:

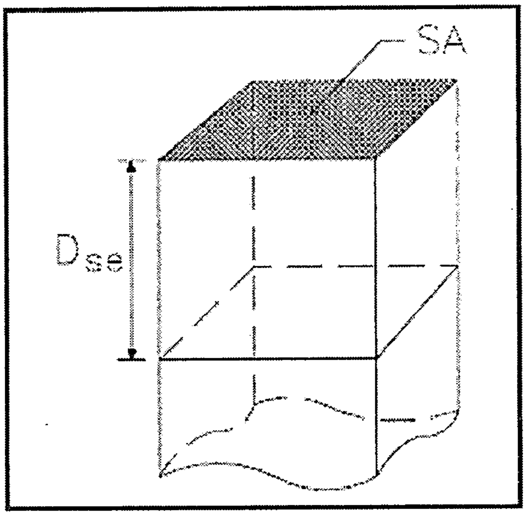


Figure 3-10 A Column of Bed Material Having Surface Area (SA)

$$SA = N\left[\frac{nd^2}{4}\right] \quad \ldots\ldots\ldots\ldots\ 3.30$$

$$N = \frac{SA}{\left[\frac{nd^2}{4}\right]} \quad \ldots\ldots\ldots\ldots\ 3.31$$

where: N = number of sediment grains on bed surface (assuming spherical particles)

SA = bed surface area.

3.6.4 Bed Elevation Change

When scour or deposition occurs during a time step, HEC-6 adjusts cross section elevations within the movable bed portion of the cross section. For deposition, the streambed portion is moved vertically only if it is within the movable bed specified by the H or HD record and is below the water surface (i.e., wetted). Deposition is allowed outside of the conveyance limits defined by the XL record. Scour occurs only if it is within the movable bed, within the conveyance limits, within the effective flow limits defined by the X3 record, and below the water surface. Once the scour or deposition limits are determined, the volume of scour or deposition is divided by the effective width and length of the control volume to obtain the bed elevation change. The vertical components of the cross section coordinates within these scour/deposition limits are then adjusted as shown in Figures 3-11 and 3-12.

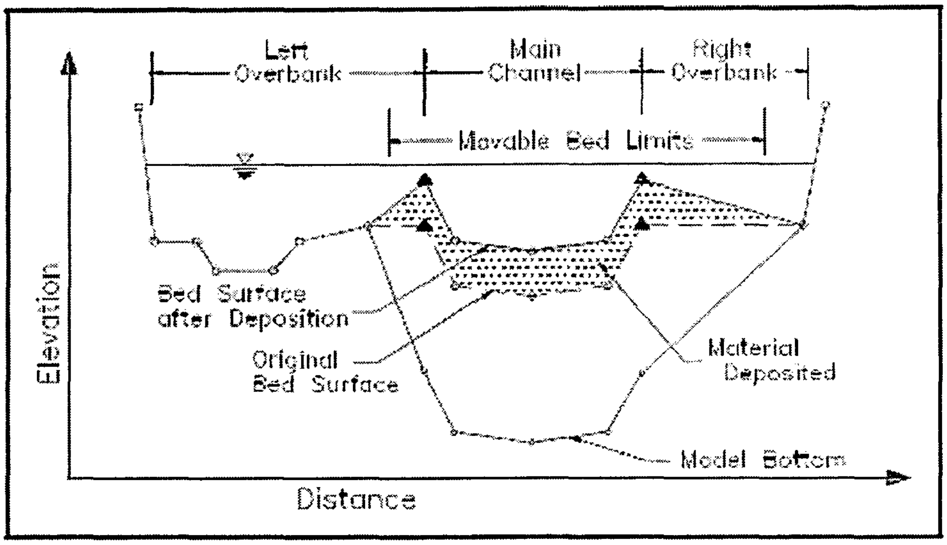


Figure 3-11 Cross Section Shape Due to Deposition

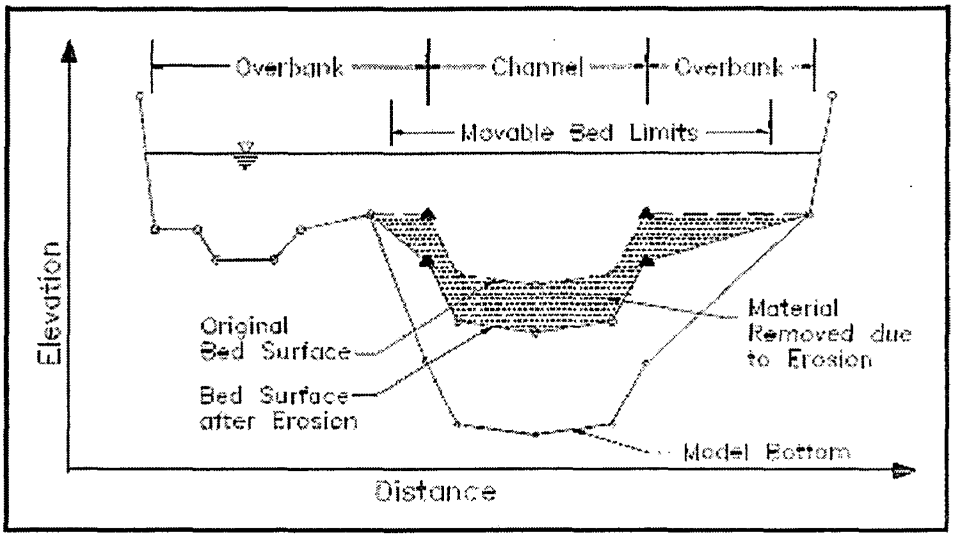


Figure 3-12 Cross Section Shape Due to Erosion

3.6.4.1 Hard Bottom Channel

The special condition of a hard channel bottom (as with a concrete channel) can be approximated by specifying zero sediment depth in the bed sediment reservoir. This is accomplished by specifying the model bottom, EMB, equal to the initial thalweg elevation, less a small amount. No sediment is contributed to the flow of sediment at that cross section. EMB is entered in field 2 of the H record.

3.6.5 Unit Weight of Deposits

3.6.5.1 Initial Unit Weight

Unit weight is the weight per unit volume of a deposit expressed as dry weight.

$$\gamma_S = (1 - P_d) \cdot SG \cdot \gamma \quad \text{.................. 3.32}$$

where: P_d = porosity of deposits

SG = specific gravity of sediment particles

γ = unit weight of water

γ_s = unit weight of sediment

Standard field tests are recommended when major decisions depend on the unit weight.

3.6.5.2 Composite Unit Weight

When dealing with mixtures of particle sizes, the composite unit weight, γ_s, of the mixture is computed using:

$$\gamma_{sc} = \frac{1}{\left[\frac{F_{SA}}{\gamma_{SA}} + \frac{F_{SL}}{\gamma_{SL}} + \frac{F_{CA}}{\gamma_{CA}}\right]} \quad \ldots\ldots\ldots\ldots\ldots 3.33$$

where: γ_{SA}, γ_{SL}, γ_{CA} = unit weight of sand, silt, and clay, respectively

F_{SA}, F_{SL}, F_{CL} = fraction of sand, silt, and clay, respectively, in the deposit.

3.6.5.3 Consolidated Unit Weight

Compaction of deposited sediments is caused by the grains reorienting and squeezing out the water trapped in the pores. The equation for consolidation is:

$$\gamma = \gamma_1 + B \cdot \log_{10} T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.34$$

where: B = coefficient of consolidation for silts or clay

T = accumulated time in years

γ_1 = initial unit weight of the sediment deposit, usually after one year of consolidation

The average consolidated unit weight over a time period **T** requires integration over time. This is computed using the following relationship.

$$\gamma_{avg} = \gamma_1 + B \cdot \left[\frac{T}{T-1}\right] \cdot \log_{10} T - 0.434B \quad \ldots\ldots\ldots 3.35$$

These unit weights are used to convert sediment weight to volume for computation of the bed elevation change.

3.6.6 Sediment Particle Properties

Four basic sediment properties are important in sediment transport prediction: size, shape factor, specific gravity, and fall velocity. Grain size classes are fixed in HEC-6 and given in table 3.2. The particle shape factor, **SF**, is defined by:

$$SF = \frac{c}{(a \cdot b)^{1/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.36$$

where: a, b, c = the lengths of the longest, intermediate, and shortest, respectively, mutually perpendicular axes of a sediment particle.

Table 3.2 Grain Size Classification of Sediment Material

Class	Class size number used in HEC – 6	Sediment Material	Grain Diameter (mm)
Clay	1	Clay	0.002 – 0.004
Silt	1	Very Fine Silt	0.004 – 0.008
	2	Fine Silt	0.008 – 0.016
	3	Medium Silt	0.016 – 0.032
	4	Coarse Silt	0.032 – 0.0625
Sand	1	Very Fine Sand	0.0625 – 0.125
	2	Fine Sand	0.125 – 0.250
	3	Medium Sand	0.250 – 0.500
	4	Coarse Sand	0.500 – 1.000
	5	Very Coarse Sand	1.000 – 2.000

The particle shape factor is 1.0 for a perfect sphere and can be as low as 0.1 for very irregularly shaped particles. HEC-6 uses a shape factor default of 0.667 but it can be user specified. If a "sedimentation diameter" is used, which is determined by the particle's fall velocity characteristics, the particle shape factor of 1.0 should be used. If the actual sieve diameter is used, the actual shape factor should be used. Specific gravity of a particle is governed by its mineral makeup. In natural channel systems the bed material is dominated by quartz which has a specific gravity of 2.65. HEC-6 uses 2.65 as a default; however, values of specific gravities for sand, silt, and clay may be input. Two techniques for calculating particle fall velocity are available in HEC-6

3.6.7 Silt and Clay Transport

3.6.7.1 Cohesive Sediment Deposition

The equation for silt and clay deposition in a recirculating flume at slow aggregation rates and suspended sediment load concentrations less than 300 mg/l is:

$$\ln \frac{C}{C_o} = -k't$$

$$\frac{C}{C_o} = e^{(-k't)} \quad \ldots\ldots\ldots\ldots\ldots 3.37$$

where: C = concentration at end of time period

Co = concentration at beginning of time period

D = water depth

$$k' = \frac{V_s P_r}{2.3D}$$

P_r = probability that a floc will stick to bed $(1 - \tau_b / \tau_d)$

t = time = reach length/flow velocity

V_s = settling velocity of sediment particles

τ_b = bed shear stress

τ_d = critical bed shear stress for deposition.

This ratio is multiplied by the inflowing clay or silt concentration to obtain the transport potential. The concentration is converted to volume and deposited on the bed.

3.6.7.2 Cohesive Sediment Scour

Particle erosion is determined by:

$$C = \frac{M_1 \cdot S_a}{Q \cdot \gamma} \cdot \left[\frac{\tau_b}{\tau_s} - 1 \right] + C_o \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.39$$

where: C = concentration at end of time period

C_o = concentration at beginning of time period

M_1 = erosion rate for particle scour

Q = water discharge

S_a = surface area exposed to scour

τ_b = bed shear stress

τ_s = critical bed shear for particle scour

γ =unit weight of water

As the bed shear stress increases, particle erosion gives way to mass erosion and the erosion rate increases. Because the mass erosion rate can theoretically be infinite, Ariathurai and Krone (1976) recommended that a "characteristic time", Te, be used. With a computation interval of Δt, the mass erosion equation becomes:

$$C = \frac{M_2 \cdot S_a}{Q \cdot \gamma} \cdot \frac{T_e}{\Delta t} + C_o \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.40$$

where: Δt = duration of time step

M_2 = erosion rate for mass erosion

T_e = characteristic time of erosion

3.6.7.3 Influence of Clay on the Active Layer

The presence of clay in the stream bed can cause the bed's strength to be greater than the shear stress required to move individual particles. This results in limiting the entrainment rate under erosion conditions. HEC-6 attempts to emulate this process by first checking the percentage of clay in the bed. If more than 10% of the bed is composed of clay, the entrainment rate of silts, sands and gravels is limited to the entrainment rate of the clay. This also prevents the erosion of silts, sands and gravels before the erosion of clay even if the bed shear is sufficient to erode those particles but not enough to erode the cohesive clay.

CHAPTER – 4

SIMULATION STUDY AND ANALYSIS OF DATA

4.1 General

A 158.8 km long Sarda Feeder channel takes off from the Sarda barrage across river Sarda which is located about 180 km downstream of Banbassa barrage and 25 km from Lakhimpur Kheri town in Uttar Pradesh. River Sarda carries heavy silt load during monsoons. The maximum concentration of suspended load varies from 400 to 8000 ppm.

A silt ejector is provided at km 0.3 on left bank of feeder channel to remove excessive sediment load entering the channel. It consists of 30 sub-tunnels followed by 6 main tunnels. The design discharge of silt ejector is 113.5 cumec with canal full supply level at 135.75 m. the total discharge including the flushing discharge is 763.5 cumec. The design discharge of the channel is 650 cumec.

The L – section of the Sarda Feeder Channel along with the sediment data i.e. gradation of the sediment, etc have been obtained from the Irrigation Department of Uttar Pradesh. In the present study, the numerical model simulation of entire reach of Sarda Feeder Channel have been performed to predict the changes in channel profiles resulting from scour and/or deposition over a period of a rainy season. The schematic diagram of the channel is shown in figure 4.1, in which, the details of the channel have been shown. The entire reach of the channel has been taken for the simulation and the discharges of water and sediment of each offtaking channel also have been taken in the study without including these in the schematic network of the model. First of all, it is necessary to calibrate the model for the values of roughness coefficient for lined and unlined reaches. HEC-RAS is used to get the appropriate values of rugosity coefficient. The values of rugosity coefficient have been used in the simulation of the model. In the simulation study, it is also tried to obtain the water surface and bed profile of the channel to simulate it for the period of a rainy season.

4.2 Data Available for the Study

Sarda feeder channel is 258.8 km long. It is single channel from its head to 26.3 km, twin channel from km. 26.3 to km 104.15 km and then again single channel up to the tail. The detailed data of the feeder channel is given in the Table – 4.1. This table has been prepared as the input data for HEC – RAS. A typical cross-section is shown in Figure – 4.1.

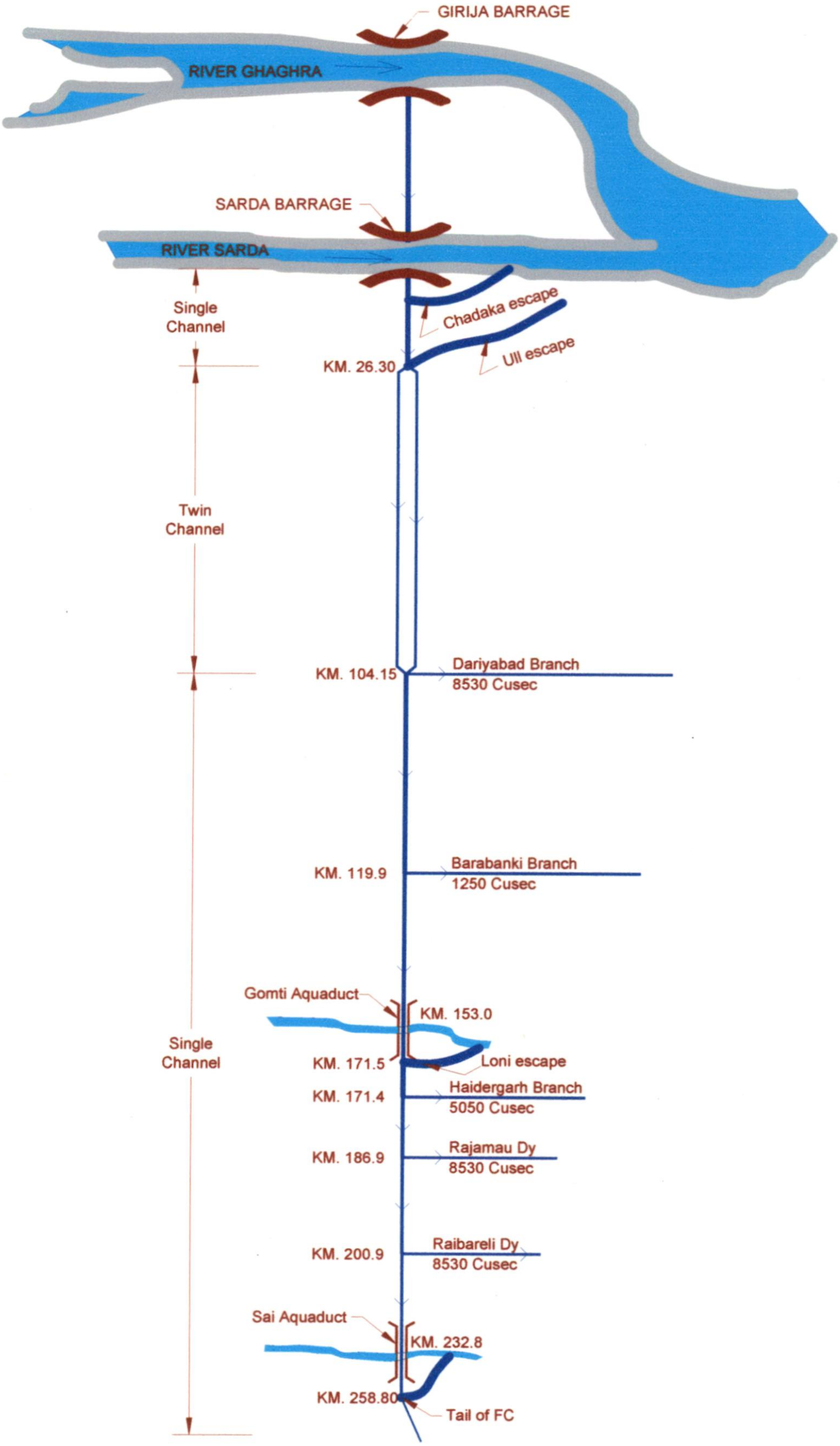


Fig. 4.1 Schematic Diagram of the Sarda Feeder Channel System

Sediment Data

The sediment inflow of the order of 4000 – 4500 ppm enters the feeder channel in rainy season. The maximum value i.e. 4500 ppm is taken for the simulation study. The gradation curve of the sediment is given in figure 4.4.

4.3 Calibration of the model using HEC – RAS

Calibration of the model for the value of rugosity coefficient has been performed using computer based numerical model HEC – RAS. The model has been run for the designed discharge of the channel with different combinations of the rugosity coefficient of lined and unlined reaches but only two combinations are shown in Figure 4.3 so that the figure will be easy to understand for comparison between the FSL given in the L-section and obtained from the model simulation. The values of the roughness coefficient for which the water surface profile is almost parallel to the FSL line given in the L–section are 0.018 and 0.024 for lined and unlined reaches. These values have been used for further model simulation using HEC – 6.

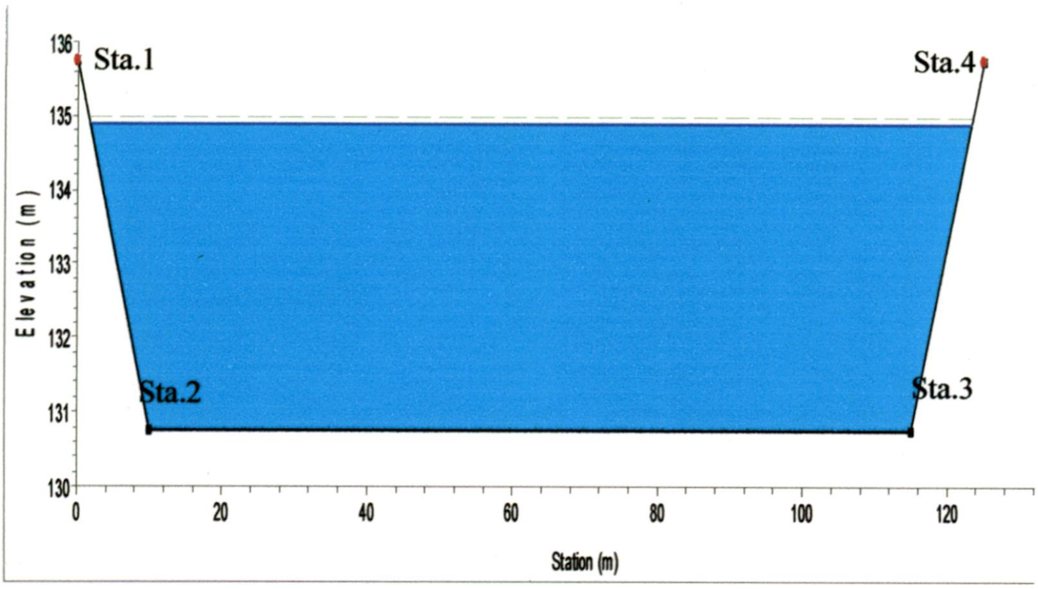


Fig. 4.2 Cross Section Plot in HEC- RAS Model

Input Data Sheet

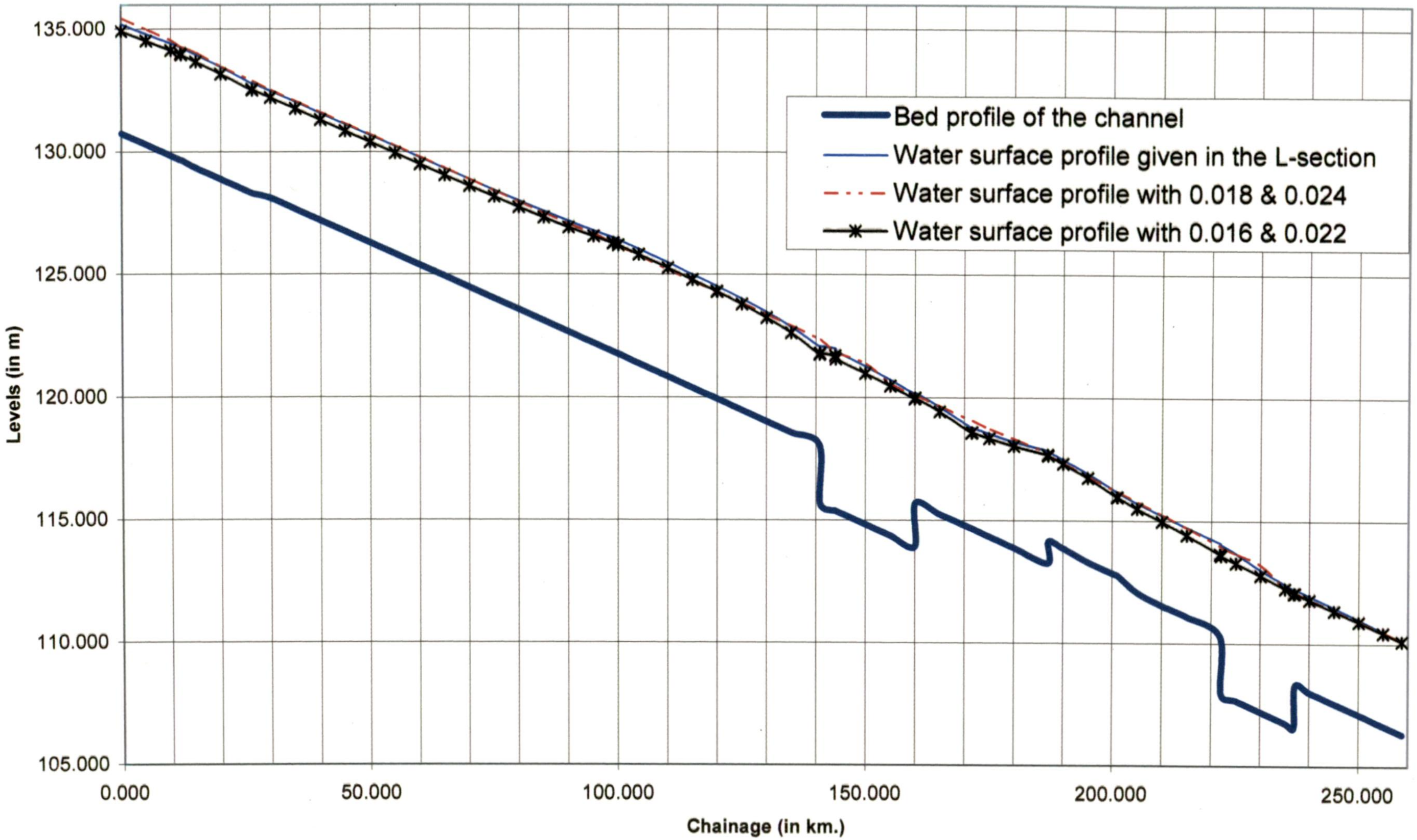
TABLE – 4.1

Sl. No.		Discharge (Cumec)	Depth of flow (m)	Discharge (Cumec)	Depth of flow (m)	Lined/ Unlined	n	Bed width (m)	Chainage (in km)	Canal Section from Head to Tail	Side Slope H:V	Station1 Dist (m)	Station1 Level (m)	Station2 Dist (m)	Station2 Level (m)	Station3 Dist (m)	Station3 Level (m)	Station4 Dist (m)	Station4 Level (m)
1	Single channel	650	4.7	397	3.62	Lined	0.018	105	0.000	258.800	2	0	135.750	10	130.750	115	130.750	125	135.750
2									5.000	253.800	2	0	135.295	10	130.295	115	130.295	125	135.295
3									10.000	248.800	2	0	134.840	10	129.840	115	129.840	125	134.840
4									11.900	246.900	2	0	134.667	10	129.667	115	129.667	125	134.667
5								90	12.000	246.800	2	0	134.658	10	129.658	100	129.658	110	134.658
6									15.000	243.800	2	0	134.335	10	129.335	100	129.335	110	134.335
7									20.000	238.800	2	0	133.880	10	128.880	100	128.880	110	133.880
8									26.300	232.500	2	0	133.307	10	128.307	100	128.307	110	133.307
9	Twin channel	650	4.4	397	3.35			50	26.300	232.500	2	0	133.307	10	128.307	60	128.307	70	133.307
10									30.000	228.800	2	0	133.120	10	128.120	60	128.120	70	133.120
11									35.000	223.800	2	0	132.665	10	127.665	60	127.665	70	132.665
12									40.000	218.800	2	0	132.210	10	127.210	60	127.210	70	132.210
13									45.000	213.800	2	0	131.755	10	126.755	60	126.755	70	131.755
14									50.000	208.800	2	0	131.300	10	126.300	60	126.300	70	131.300
15									55.000	203.800	2	0	130.845	10	125.845	60	125.845	70	130.845
16									60.000	198.800	2	0	130.390	10	125.390	60	125.390	70	130.390
17									65.000	193.800	2	0	129.935	10	124.935	60	124.935	70	129.935
18									70.000	188.800	2	0	129.480	10	124.480	60	124.480	70	129.480
19									75.000	183.800	2	0	129.025	10	124.025	60	124.025	70	129.025
20									80.000	178.800	2	0	128.570	10	123.570	60	123.570	70	128.570
21									85.000	173.800	2	0	128.115	10	123.115	60	123.115	70	128.115
22									90.000	168.800	2	0	127.660	10	122.660	60	122.660	70	127.660
23									95.000	163.800	2	0	127.205	10	122.205	60	122.205	70	127.205
24									98.900	159.900	2	0	126.850	10	121.850	60	121.850	70	126.850
25						Unlined	0.024	60	99.000	159.800	2	0	126.841	10	121.841	70	121.841	80	126.841
26									100.000	158.800	2	0	126.750	10	121.750	70	121.750	80	126.750
27									104.150	154.650	2	0	126.372	10	121.372	70	121.372	80	126.372
28	Single channel	380	4.4	247	3.35			70	104.150	154.650	2	0	126.372	10	121.372	80	121.372	90	126.372
29									110.000	148.800	2	0	125.840	10	120.840	80	120.840	90	125.840
30									115.000	143.800	2	0	125.385	10	120.385	80	120.385	90	125.385
31									119.900	138.900	2	0	124.939	10	119.939	80	119.939	90	124.939
32		357	6.7	217	5.1			65	120.000	138.800	2	0	127.930	16	119.930	81	119.930	97	127.930
33									125.000	133.800	2	0	127.475	16	119.475	81	119.475	97	127.475
34									130.000	128.800	2	0	127.020	16	119.020	81	119.020	97	127.020
35									135.000	123.800	2	0	126.565	16	118.565	81	118.565	97	126.565
36									140.700	118.100	2	0	126.046	16	118.046	81	118.046	97	126.046
37		357	6.7	217	5.1				140.800	118.000	2	0	123.669	16	115.669	81	115.669	97	123.669
38									143.900	114.900	2	0	123.387	16	115.387	81	115.387	97	123.387
39						Lined	0.18	23	144.000	114.800	2	0	123.378	16	115.378	39	115.378	55	123.378
40									150.000	108.800	2	0	122.832	16	114.832	39	114.832	55	122.832
41									155.000	103.800	2	0	122.377	16	114.377	39	114.377	55	122.377
42									159.900	98.900	2	0	121.931	16	113.931	39	113.931	55	121.931
43		357	4.4	217	3.2	Unlined	0.024	65	160.000	98.800	2	0	123.710	16	115.710	81	115.710	97	123.710
44									165.000	93.800	2	0	123.255	16	115.255	81	115.255	97	123.255

45									171.400	87.400	2	0	122.673	16	114.673	81	114.673	97	122.673
46									171.500	87.300	2	0	122.664	16	114.664	66	114.664	82	122.664
47		195	3.6	119	2.6			50	175.000	83.800	2	0	122.345	16	114.345	66	114.345	82	122.345
48									180.000	78.800	2	0	121.890	16	113.890	66	113.890	82	121.890
49									186.900	71.900	2	0	121.262	16	113.262	66	113.262	82	121.262
50									187.000	71.800	2	0	122.153	16	114.153	62	114.153	78	122.153
51		181	3.5	110	2.5				190.000	68.800	2	0	121.880	16	113.880	62	113.880	78	121.880
52									195.000	63.800	2	0	121.316	16	113.316	62	113.316	78	121.316
53									200.900	57.900	2	0	120.779	16	112.779	62	112.779	78	120.779
54								46	201.000	57.800	2	0	120.770	16	112.770	62	112.770	78	120.770
55									205.000	53.800	2	0	120.071	16	112.071	62	112.071	78	120.071
56		173	3.7	105	2.7				210.000	48.800	2	0	119.548	16	111.548	62	111.548	78	119.548
57									215.000	43.800	2	0	119.093	16	111.093	62	111.093	78	119.093
58									221.800	37.000	2	0	118.293	16	110.293	62	110.293	78	118.293
59									222.000	36.800	2	0	115.943	16	107.943	26	107.943	42	115.943
60									225.000	33.800	2	0	115.670	16	107.670	26	107.670	42	115.670
61		167	6.0	102	4.7	Lined	0.018	10	230.000	28.800	2	0	115.215	16	107.215	26	107.215	42	115.215
62									235.000	23.800	2	0	114.760	16	106.760	26	106.760	42	114.760
63									236.800	22.000	2	0	114.596	16	106.596	26	106.596	42	114.596
64									237.000	21.800	2	0	116.292	16	108.292	56	108.292	72	116.292
65									240.000	18.800	2	0	116.019	16	108.019	56	108.019	72	116.019
66		167	3.7	102	2.74	Unlined	0.024	40	245.000	13.800	2	0	115.564	16	107.564	56	107.564	72	115.564
67									250.000	8.800	2	0	115.109	16	107.109	56	107.109	72	115.109
68									255.000	3.800	2	0	114.654	16	106.654	56	106.654	72	114.654
69									258.800	0.000	2	0	114.308	16	106.308	56	106.308	72	114.308

4.4 Model Simulation Using HEC-6

The entire reach of the channel has been divided into 68 segments with entering 69 sections data. The numerical model simulation of entire reach of Sarda Feeder Channel has been performed for a period of 120 days of rainy season with a water discharge of 650 cumec (22950 cusecs) and sediment inflow of the order of 4500 ppm. The gradation of the sediment has been shown in figure 4.3. The input file is given in appendix A. The final bed profile after 120 days simulation is given in table 4.2 and it is plotted along with initial bed profile in figure 4.5. The complete output of simulation results is given in appendix B.



Water surface profiles for different values of 'n'

Fig 4.3

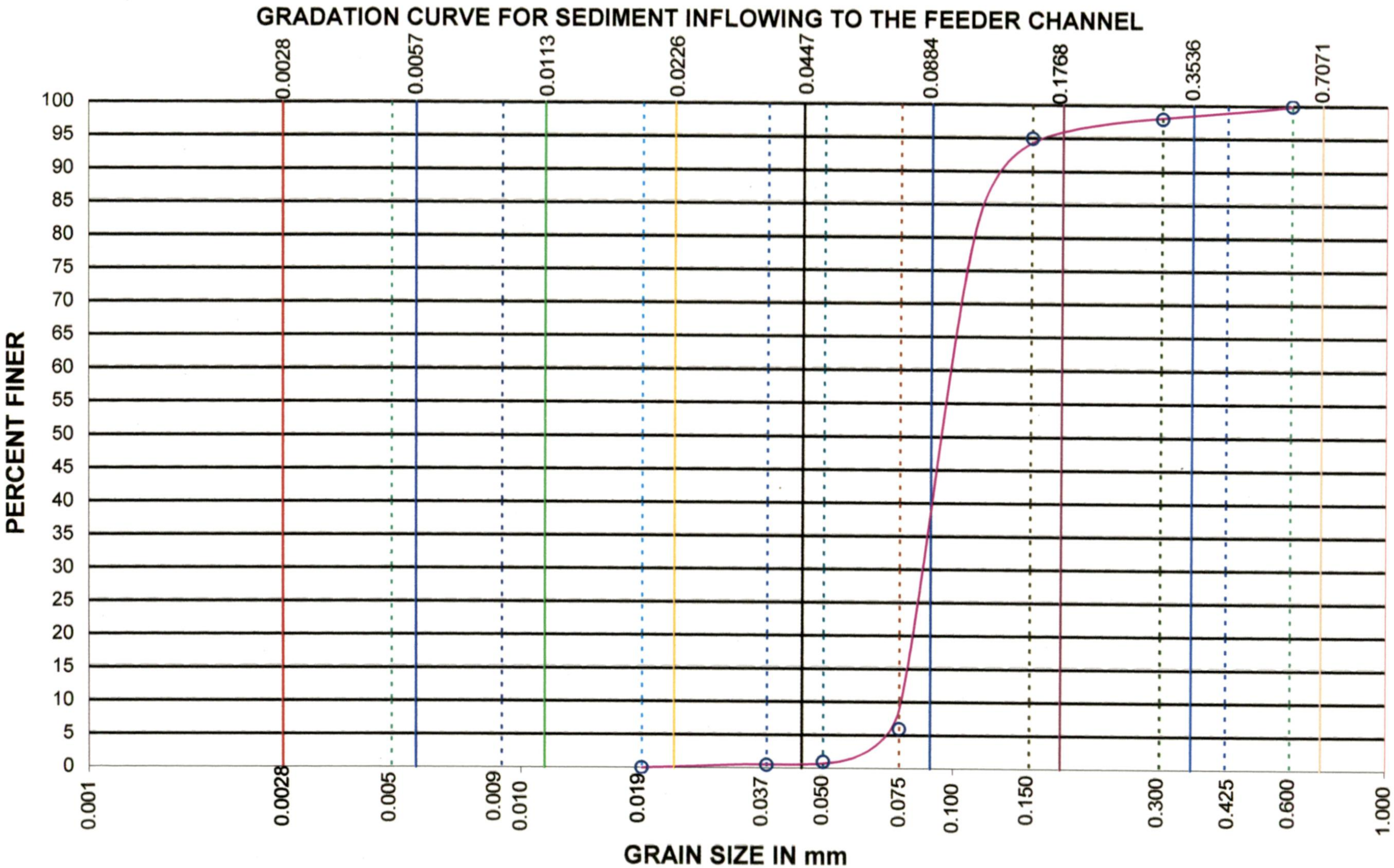

GRADATION CURVE FOR SEDIMENT INFLOWING TO THE FEEDER CHANNEL
0.0028
0.0057
0.0113
0.0226
0.0447
0.0884
0.1768
0.3536
0.7071
PERCENT FINER
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.001
0.0028
0.005
0.009
0.010
0.019
0.037
0.050
0.075
0.100
0.150
0.300
0.425
0.600
1.000
GRAIN SIZE IN mm

Fig. 4.4

Table 4.2
Initial bed levels and final bed levels after simulation

Chainage	FSL	Final Water Surface Profile	Chainage	FSL	Final Water Surface Profile	Chainage	FSL	Final Water Surface Profile
(km)	(m)	(m)	(km)	(m)	(m)	(km)	(m)	(m)
0.000	135.450	135.44	98.900	126.240	125.96	175.000	118.740	118.66
5.000	134.995	134.98	99.000	126.241	125.67	180.000	118.330	118.24
10.000	134.540	134.55	100.000	126.150	126.03	186.900	117.750	117.64
11.900	134.270	134.38	104.150	125.786	125.37	187.000	117.653	117.69
12.000	134.276	134.35	104.150	125.786	125.35	190.000	117.339	117.25
15.000	134.039	134.01	110.000	125.190	124.89	195.000	116.816	116.76
20.000	133.470	133.41	115.000	124.735	124.58	200.900	116.189	116.50
26.300	132.900	132.79	119.900	124.280	124.02	201.000	116.189	116.50
26.300	132.900	132.79	120.000	124.280	124.09	205.000	115.771	116.04
30.000	132.520	132.38	125.000	123.825	123.51	210.000	115.248	115.43
35.000	132.065	131.94	130.000	123.370	123.07	215.000	114.725	114.90
40.000	131.610	131.43	135.000	122.915	122.73	221.800	113.993	114.15
45.000	131.155	130.93	140.700	122.369	122.06	222.000	113.943	114.08
50.000	130.700	130.47	140.800	122.369	122.06	225.000	113.670	113.80
55.000	130.245	129.98	143.900	121.814	121.67	230.000	113.215	113.36
60.000	129.790	129.48	144.000	121.814	121.65	235.000	112.265	112.93
65.000	129.335	129.04	150.000	121.380	121.12	236.800	112.083	112.74
70.000	128.880	128.58	155.000	120.565	120.63	237.000	112.083	112.70
75.000	128.425	128.15	159.900	120.100	120.17	240.000	111.810	112.53
80.000	127.970	127.66	160.000	120.110	120.15	245.000	111.355	111.97
85.000	127.515	127.13	165.000	119.655	119.76	250.000	110.910	111.35
90.000	127.060	126.82	171.400	119.064	119.11	255.000	110.495	110.69
95.000	126.665	126.36	171.500	119.064	119.06	258.800	110.100	110.28

It is clear from table 4.2 and figure 4.5, the bed levels have been raised significantly after simulation which has resemblance with the actual prototype conditions. At the head of the feeder channel, the maximum pond level is fixed. With these conditions, the operating head reduces appreciably due to which the discharge diverted to the channel gets reduced to 500 cumec and the water surface profile of the channel gets lowered in the downstream of the head. When the water surface is lower as compare to the designed FSL at the location of head of the offtaking channels, the head regulators of the offtaking channels are unable to divert the desired discharges. Due to this stream power gets reduced and silting occurs in the bed of the offtaking channels also. In totality, we can say that if silting occurs in the downstream of the head of a main channel, the entire system will be affected adversely.

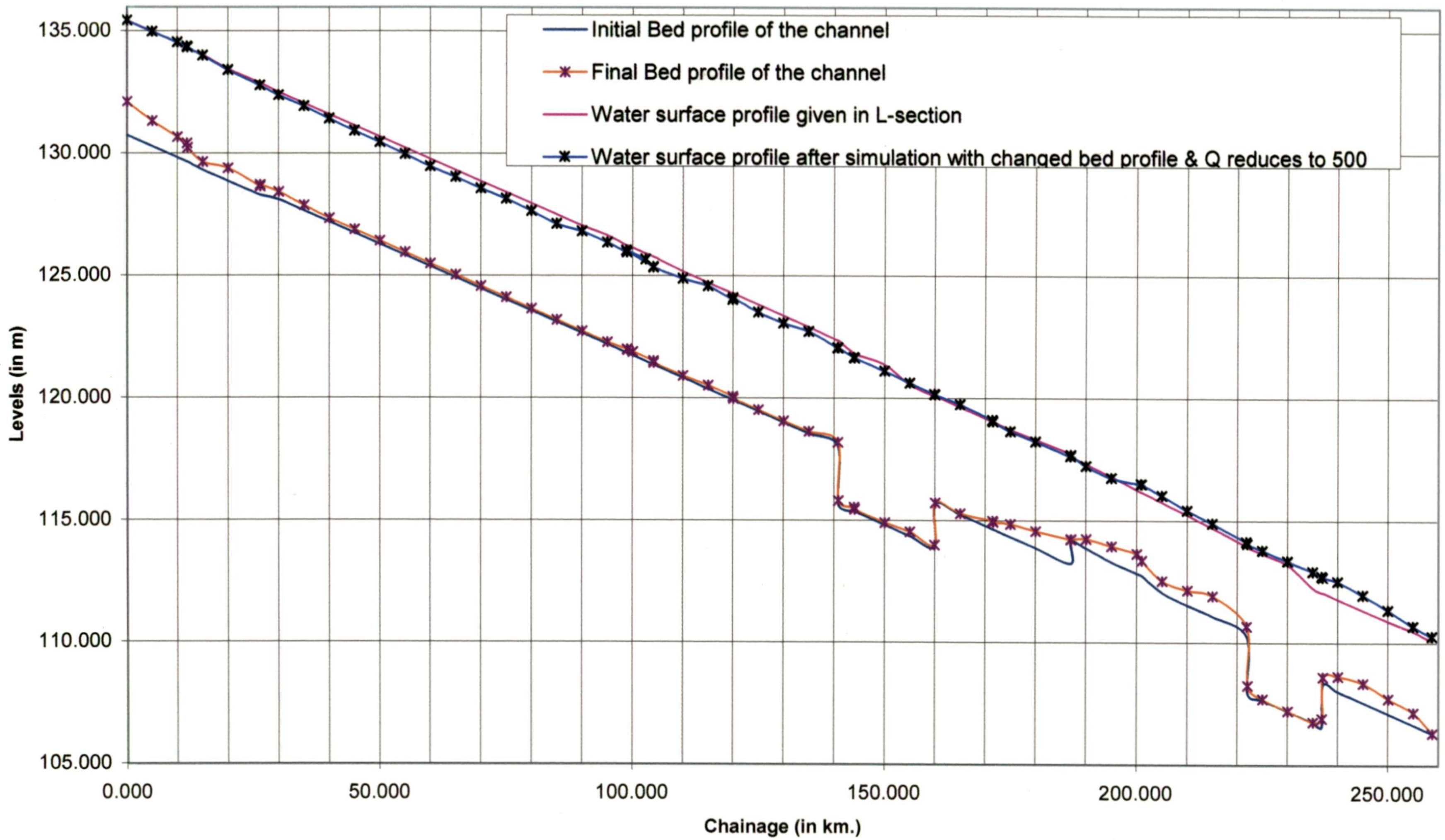


Fig. 4.5 Initial and Final Bed/Water Surface Profile

CHAPTER-5

OBSERVATIONS, CONCLUSIONS AND SUGESTIONS FOR FURTHER STUDY

5.1 OBSERVATIONS AND CONCLUSIONS

It has been reported in the Sarda Feeder Channel that Silt ejector provided at km 0.3 on left bank of Sarda feeder channel is not functioning properly at present and generally gets choked with sediment during high floods in river. From the study of the numerical model of the Sarda Feeder Channel, the following conclusions are drawn –

1. Silting in the channel do take place in its entire reach in rainy season when the sediment laden water enters the channel.
2. Extent of silting is predominant just at the downstream of head regulator of the channel.
3. Due to silting of bed of the feeder channel in the downstream of head regulator, bed gets raised and the operating head reduces appreciably.
4. Discharge diverted to the channel gets reduced to 500 cumec and the water surface profile of the channel gets lowered in the channel.
5. As the water surface gets lowered as compared to the designed FSL at the location of heads of the offtaking channels, the head regulators of the offtaking channels are unable to divert the full design discharges.
6. Due to the reduction in discharges in the offtaking channels, stream power gets reduced and silting will occur in the bed of the offtaking channels also.

In the view of above observations, it can be said that if the preventive and curative measures are not functioning properly, the entire system will be affected adversely. In the existing systems, it is almost impossible to make a change in the longitudinal slope of a channel in order to increase the stream power of the channel. Thus the preventive and curative measures of the system should be improved to reduce the entry sediment load. In context of curative measure, the layout of the existing silt ejector needs re-planning for improving its performance and efficiency during high floods.

In addition to the above, if possible, it must be thought about raising the pond level so that it helps in providing the flushing head in the silt ejector during high floods and helps in providing the sufficient operating head even when the bed gets raised in the downstream of the head regulator due to silt deposition.

5.2 SUGESTIONS FOR FURTHER STUDY

7. In the present study only the main feeder channel has been simulated, if entire network of the feeder channel system is taken for the simulation study, it may give the more realistic results.
8. The model has been simulated for a period of a rainy season, if it is simulated for a number of cycles of monsoon and non-monsoon periods, the simulation results will be more refined.
9. Study of the actual silting pattern in the Sarda Feeder Channel be evaluated to establish the correlation with the numerical modelling results for carrying out any improvement/changes in the input parameters.
10. One or more existing canal systems other than this system should be simulated using these computer based numerical models so that the numerical model simulation study of the new canal projects can be performed confidently for predicting the behaviour of the system in different conditions and accordingly improvements can be done, if required, at the stage of planning.

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APPENDIX A

INPUT FILE

```
T1        SARDA FEEDER CHANNEL SIMULATION
T2        # LINED/UNLINED REACH#
T3        # KM.0.0 TO 258.8 bed slope of 9.1cm/km
NC  .024     .024     .024       .1       .3

X1   1.0      4.0       0   231.2        0        0        0
GR374.08      0.0  349.08    50.0   349.08   181.02   374.08   231.2
HD   1.0        0

X1     2        0       0       0    12464    12464    12464        1     1.13
HD     2        0

X1     3        0       0       0    16400    16400    16400        1     1.49
HD     3        0

X1     4        0       0       0    16400    16400    16400        1     1.49
HD     4        0

X1     5        0       0       0    16400    16400    16400        1     1.49
HD     5        0

X1     6        0       0       0     9840     9840     9840        1     0.90
HD     6        0

NC  .018     .018     .018       .1       .3
X1     7        4       0   132.8      656      656      656
GR373.04      0.0  348.04    50.0   348.04     82.8   373.04   132.8
HD     7        0

X1     8        0       0       0    22304    22304    22304        1     3.71
HD     8        0

X1     9        0       0       0    16400    16400    16400        1     1.49
HD     9        0

X1    10        0       0       0     9840     9840     9840        1     0.90
HD    10        0

QT
NC  .024     .024     .024       .1       .3
X1    11        4       0   250.9      656      656      656
GR386.85      0.0  361.85    50.0   361.85    200.0   386.85   250.9
HD    11        0

X1  11.1        0       0       0    11152    11152    11152        1     1.20
HD  11.1        0

X1    12        0       0       0    11152    11152    11152        1     1.20
```

```
HD     12        0

X1     13        0        0        0   16400   16400   16400        1   1.49
HD     13        0

X1     14        0        0        0   16400   16400   16400        1   1.49
HD     14        0

X1     15        0        0        0   13120   13120   13120        1   2.47
HD     15        0

QT
X1     16        0        0        0   13120   13120   13120        1   0.03
HD     16        0

X1     17        0        0        0   19352   19352   19352        1   1.76
HD     17        0

X1     18        0        0        0   16400   16400   16400        1   1.49
HD     18        0

X1     19        0        0        0    9840    9840    9840        1   0.90
HD     19        0

QT
X1     20        4        0    264.0     328     328     328
GR399.19       0.0  374.19     50.0  374.19   214.0  399.19   264.0
HD     20        0

X1     21        0        0        0   22632   22632   22632        1   2.06
HD     21        0

X1     22        0        0        0   16800   16800   16800        1   1.49
HD     22        0

X1   22.1        0        0        0    5740    5740    5740        1   0.52
HD   22.1        0

X1     23        0        0        0    5740    5740    5740        1   0.52
HD     23

QT
X1     24        4        0    313.3     328     328     328
GR401.34       0.0  376.34     50.0  376.34   263.3  401.34   313.3
HD     24

X1     25        0        0        0   20992   20992   20992        1   1.91
HD     25

X1     26        0        0        0   16400   16400   16400        1   1.49
HD     26        0
```

```
NC   .018    .018    .018      .1      .3
X1     27       4       0   175.5     328     328     328
GR397.08      0.0  372.08    50.0  372.08   125.5  397.08   175.5
HD     27       0

X1     28       0       0       0   16072   16072   16072       1    1.46
HD     28       0

X1     29       0       0       0   16400   16400   16400       1    3.26
HD     29       0

X1     30       0       0       0   19680   19680   19680       1    1.79
HD     30       0

NC   .024    .024    .024      .1      .3
X1     31       4       0   313.3     328     328     328
GR403.62      0.0  378.62    50.0  378.62   263.3  403.62   313.3
HD     31       0

X1     32       0       0       0   10168   10168   10168       1    0.93
HD     32       0

X1     33       0       0       0     328     328     328       1    7.59
HD     33       0

X1     34       0       0       0   18696   18696   18696       1    1.70
HD     34       0

X1     35       0       0       0   16400   16400   16400       1    1.49
HD     35       0

X1     36       0       0       0   16400   16400   16400       1    1.49
HD     36       0

X1     37       0       0       0   16400   16400   16400       1    1.49
HD     37       0

QT
X1     38       4       0   329.7     328     328     328
GR418.34      0.0  393.34    50.0  393.34   279.7  418.34   329.7
HD     38       0

X1     39       0       0       0   16072   16072   16072       1    1.46
HD     39       0


X1     40       0       0       0   16400   16400   16400       1    1.49
HD     40       0

X1     41       0       0       0   19188   19188   19188       1    1.75
HD     41       0
```

```
QT
X1      42        4        0    296.8      492       492       492
GR423.09        0.0   398.09     50.0   398.09     246.8    423.09     296.8
HD      42        0

X1      43        0        0        0    13120     13120     13120         1      1.19
HD      43        0

NC    .018     .018     .018       .1       .3
X1      44        4        0    264.0     3280      3280      3280
GR424.58        0.0   399.58     50.0   399.58     214.0    424.58     264.0
HD      44        0

X1      45        0        0        0    13120     13120     13120         1      1.35
HD      45        0

X1      46        0        0        0    16400     16400     16400         1      1.49
HD      46        0

X1      47        0        0        0    16400     16400     16400         1      1.49
HD      47        0

X1      48        0        0        0    16400     16400     16400         1      1.49
HD      48        0

X1      49        0        0        0    16400     16400     16400         1      1.49
HD      49        0

X1      50        0        0        0    16400     16400     16400         1      1.49
HD      50        0

X1      51        0        0        0    16400     16400     16400         1      1.49
HD      51        0

X1      52        0        0        0    16400     16400     16400         1      1.49
HD      52        0

X1      53        0        0        0    16400     16400     16400         1      1.49
HD      53        0

X1      54        0        0        0    16400     16400     16400         1      1.49
HD      54        0

X1      55        0        0        0    16400     16400     16400         1      1.49
HD      55        0

X1      56        0        0        0    16400     16400     16400         1      1.49
HD      56        0

X1      57        0        0        0    16400     16400     16400         1      1.49
HD      57        0
```

```
X1     58        0        0        0   16400    16400    16400         1     1.49
HD     58        0

X1     59        0        0        0   12136    12136    12136         1     0.75
HD     59        0

QT
X1     60        4        0    395.3     984      984      984
GR446.18       0.0   421.18     50.0  421.18    345.3   446.18     395.3
HD     60        0

X1     61        0        0        0   19680    19680    19680         1     1.79
HD     61        0

X1     62        0        0        0   16400    16400    16400         1     1.49
HD     62        0

X1     63        0        0        0    9840     9840     9840         1     0.90
HD     63        0

X1     64        4        0    444.5     328      328      328
GR450.39       0.0   425.39     50.0  425.39    394.5   450.39     444.5
HD     64        0

X1     65        0        0        0    6332     6332     6332         1     0.90
HD     65        0

X1     66        0        0        0   16400    16400    16400         1     1.49
HD     66        0

X1     67        0        0        0   16400    16400    16400         1     1.49
HD     67        0


EJ
T4       SARDA** lined/unlined bed **
T5       LOAD CURVE FROM GAUGE DATA.
T6       BED GRADATIONS FROM FIELD SAMPLES
T7       Use full range of Sands and gravel
T8       SEDIMENT TRANSPORT BY Ackers-White (1973) transport function
I1              20
I2   CLAY        2
I2   CLAY        1      .02      .05       .1      1.5      20.
I2   CLAY        2      .02     .125      .23      2.0      10.
I3   SILT        2        1        4
I4   SAND        7        1        5
I5              .5       .5      .25       .5      .25        0      1.0

LQ             100      500     2000     5000    10000    15000    20000    25000
LT TOTAL       975     4890    19575    48940    97875   146820   235000   270000
LF   CLAY        0        0        0        0        0        0        0        0
LF SILT1         0        0        0        0        0        0        0        0
```

```
LF SILT2    .005   .005   .005   .005   .005   .015   .005   .005
LF SILT3    .005   .005   .005   .005   .005   .005   .005   .005
LF SILT4    0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34
LF   VFS    0.60   0.60   0.60   0.60   0.60   0.60   0.60   0.60
LF    FS    0.04   0.04   0.04   0.04   0.04   0.04   0.04   0.04
LF    MS    0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01
LF    CS    .000   .000   .000   .000   .000   .000   .000   .000
LF   VCS       0      0      0      0      0      0      0      0


PF SARDA      67    1.0    .85   .425   99.0   .212   94.0   .106    .25
PFC .053       0
$LOCAL
LQL         -214   -212
LTLTOTAL     1.0    1.0
LFL CLAY     1.0    1.0
LFLSILT1     1.0    1.0
LFLSILT2     1.0    1.0
LFLSILT3     1.0    1.0
LFLSILT4     1.0    1.0
LFL  VFS     1.0    1.0
LFL   FS     1.0    1.0
LFL   MS     1.0    1.0
LFL   CS     1.0    1.0
LFL  VCS     1.0    1.0

LQL         -284   -282
LTLTOTAL     1.0    1.0
LFL CLAY     1.0    1.0
LFLSILT1     1.0    1.0
LFLSILT2     1.0    1.0
LFLSILT3     1.0    1.0
LFLSILT4     1.0    1.0
LFL  VFS     1.0    1.0
LFL   FS     1.0    1.0
LFL   MS     1.0    1.0
LFL   CS     1.0    1.0
LFL  VCS     1.0    1.0

LQL         -496   -494
LTLTOTAL     1.0    1.0
LFL CLAY     1.0    1.0
LFLSILT1     1.0    1.0
LFLSILT2     1.0    1.0
LFLSILT3     1.0    1.0
LFLSILT4     1.0    1.0
LFL  VFS     1.0    1.0
LFL   FS     1.0    1.0
LFL   MS     1.0    1.0
LFL   CS     1.0    1.0
LFL  VCS     1.0    1.0
```

LQL	-5721	-5719
LTLTOTAL	1.0	1.0
LFL CLAY	1.0	1.0
LFLSILT1	1.0	1.0
LFLSILT2	1.0	1.0
LFLSILT3	1.0	1.0
LFLSILT4	1.0	1.0
LFL VFS	1.0	1.0
LFL FS	1.0	1.0
LFL MS	1.0	1.0
LFL CS	1.0	1.0
LFL VCS	1.0	1.0

LQL	-813	-811
LTLTOTAL	1.0	1.0
LFL CLAY	1.0	1.0
LFLSILT1	1.0	1.0
LFLSILT2	1.0	1.0
LFLSILT3	1.0	1.0
LFLSILT4	1.0	1.0
LFL VFS	1.0	1.0
LFL FS	1.0	1.0
LFL MS	1.0	1.0
LFL CS	1.0	1.0
LFL VCS	1.0	1.0

LQL	100	500	2000	5000	10000	15000	20000	25000
LTLTOTAL	975	4890	19575	48940	97875	146820	195750	246700
LFL CLAY	0	0	0	0	0	0	0	0
LFLSILT1	0	0	0	0	0	0	0	0
LFLSILT2	.005	.005	.005	.005	.005	.005	.005	.005
LFLSILT3	.005	.005	.005	.005	.005	.005	.005	.005
LFLSILT4	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
LFL VFS	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
LFL FS	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
LFL MS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LFL CS	.000	.000	.000	.000	.000	.000	.000	.000
LFL VCS	0	0	0	0	0	0	0	0

LQL	-214	-212
LTLTOTAL	1.0	1.0
LFL CLAY	1.0	1.0
LFLSILT1	1.0	1.0
LFLSILT2	1.0	1.0
LFLSILT3	1.0	1.0
LFLSILT4	1.0	1.0
LFL VFS	1.0	1.0
LFL FS	1.0	1.0
LFL MS	1.0	1.0
LFL CS	1.0	1.0
LFL VCS	1.0	1.0

APPENDIX B

OUTPUT OF SIMULATION STUDY

```
*****************************************************       ************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS   *       *  U.S. ARMY CORPS OF ENGINEERS     *
*      Version: 4.2    -  May 2004                  *       *  HYDROLOGIC ENGINEERING CENTER    *
*  INPUT FILE:  TOTS2.DAT                           *       *  609 SECOND STREET                *
*  OUTPUT FILE: TOTS2.OUT                           *       *  DAVIS, CALIFORNIA 95616-4687     *
*  RUN DATE: 14 JUN 07    RUN TIME: 19:39:24        *       *  (530) 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)               *
         *      500  Cross Sections                                          *
         *      200  Elevation/Station Points per Cross Section              *
         *       20  Grain Sizes                                             *
         *       20  Control Points                                          *
         *********************************************************************

T1      SARDA FEEDER CHANNEL SIMULATION
T2      # LINED/UNLINED REACH#
T3      # KM.0.0 TO 258.8 bed slope of 9.1cm/km

N values...  Left    Channel   Right    Contraction    Expansion
           0.0240   0.0240   0.0240      1.1000      0.7000

SECTION NO.      1.000
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      2.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     1.130 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      3.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      4.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      5.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      6.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     0.900 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

N values...  Left    Channel   Right    Contraction    Expansion
           0.0180   0.0180   0.0180      1.1000      0.7000

SECTION NO.      7.000
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      8.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by     3.710 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.      9.000
...Adjust Section WIDTH to 100.00% of original.
```

```
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    10.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.900 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  1 occurs upstream from Section No.       10.000

N values...  Left    Channel   Right    Contraction    Expansion
           0.0240   0.0240   0.0240       1.1000     0.7000

SECTION NO.    11.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    11.100
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.200 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    12.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.200 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    13.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    14.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    15.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    2.470 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  2 occurs upstream from Section No.       15.000

SECTION NO.    16.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.030 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    17.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.760 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    18.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    19.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.900 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  3 occurs upstream from Section No.       19.000

SECTION NO.    20.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    21.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    2.060 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    22.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.
```

```
SECTION NO.    22.100
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.520 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    23.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.520 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  4 occurs upstream from Section No.      23.000

SECTION NO.    24.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    25.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.910 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    26.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.0180   0.0180   0.0180       1.1000      0.7000

SECTION NO.    27.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    28.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.460 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    29.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    3.260 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    30.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.790 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

N values...  Left   Channel   Right    Contraction    Expansion
           0.0240   0.0240   0.0240       1.1000      0.7000

SECTION NO.    31.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    32.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.930 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    33.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    7.590 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    34.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.700 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    35.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    36.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    37.000
```

```
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  5 occurs upstream from Section No.      37.000

SECTION NO.    38.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    39.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.460 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    40.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    41.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.750 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

LOCAL INFLOW POINT  6 occurs upstream from Section No.      41.000

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

SECTION NO.    43.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.190 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

N values...  Left   Channel   Right    Contraction   Expansion
           0.0180   0.0180   0.0180       1.1000      0.7000

SECTION NO.    44.000
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    45.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.350 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    46.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    47.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    48.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    49.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    50.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    51.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =    0.00 ft.

SECTION NO.    52.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
```

```
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    53.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    54.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    55.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    56.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    57.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    58.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    59.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.750 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

LOCAL INFLOW POINT  7 occurs upstream from Section No.      59.000

SECTION NO.    60.000
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    61.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.790 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    62.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    63.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.900 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    64.000
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    65.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    0.900 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    66.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

SECTION NO.    67.000
...Adjust Section WIDTH to 100.00% of original.
...Adjust Section ELEVATIONS by    1.490 ft.
...DEPTH of the Bed Sediment Control Volume =     0.00 ft.

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 69
NO. OF INPUT DATA MESSAGES =   0
```

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  69
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA
```

```
T4      SARDA** lined/unlined bed **
T5      LOAD CURVE FROM GAUGE DATA.
T6      BED GRADATIONS FROM FIELD SAMPLES
T7      Use full range of Sands and gravel
T8      SEDIMENT TRANSPORT BY Ackers-White (1973) transport function

        SARDA FEEDER CHANNEL SIMULATION
        # LINED REACH#
        # KM.0.0 TO 258.8 bed slope of 9.1cm/km
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SEDIMENT PROPERITES AND PARAMETERS

       SPI     IBG    MNQ      SPGF      ACGR     NFALL    IBSHER
I1     20.       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    20.0000
INACTIVE LAYER  2       0.1250     0.2300      2.0000     19.0476    10.0000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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    20.0000
INACTIVE LAYER  2       0.1250     0.2300      2.0000     19.0476    10.0000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SANDS - BOULDERS ARE PRESENT

      MTC      IASA     LASA     SPGS       GSF       BSAE       PSI      UWDLB
```

I4 7 1 5 2.650 0.667 0.500 30.000 93.000

USING TRANSPORT CAPACITY RELATIONSHIP # 7, ACKERS-WHITE
GRAIN SIZES UTILIZED (mean diameter - mm)

CLAY.............	0.003	VERY FINE SAND....	0.088
VERY FINE SILT....	0.006	FINE SAND.........	0.177
FINE SILT.........	0.011	MEDIUM SAND.......	0.354
MEDIUM SILT.......	0.023	COARSE SAND.......	0.707
COARSE SILT.......	0.045	VERY COARSE SAND..	1.414

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)

FLOW	100.000	500.000	2000.00	5000.00	10000.0	15000.0	20000.0	25000.0
CLAY	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
VF SILT	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
F SILT	4.87500	24.4500	97.8750	244.700	489.375	2202.30	1175.00	1350.00
M SILT	4.87500	24.4500	97.8750	244.700	489.375	734.100	1175.00	1350.00
C SILT	331.500	1662.60	6655.50	16639.6	33277.5	49918.8	79900.0	91800.0
VF SAND	585.000	2934.00	11745.0	29364.0	58725.0	88092.0	141000.	162000.
F SAND	39.0000	195.600	783.000	1957.60	3915.00	5872.80	9400.00	10800.0
M SAND	9.75000	48.9000	195.750	489.400	978.750	1468.20	2350.00	2700.00
C SAND	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
VC SAND	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
TOTAL	975.000	4890.00	19575.0	48940.0	97875.0	148288.	235000.	270000.

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	0.000						
1.000		231.200	374.080	349.080	374.080	0.000	0.000
	12464.000						
2.000		231.200	375.210	350.210	375.210	12464.000	2.361
	16400.000						
3.000		231.200	376.700	351.700	376.700	28864.000	5.467
	16400.000						
4.000		231.200	378.190	353.190	378.190	45264.000	8.573
	16400.000						
5.000		231.200	379.680	354.680	379.680	61664.000	11.679
	9840.000						
6.000		231.200	380.580	355.580	380.580	71504.000	13.542
	656.000						
7.000		132.800	373.040	348.040	373.040	72160.000	13.667
	22304.000						
8.000		132.800	376.750	351.750	376.750	94464.000	17.891
	16400.000						
9.000		132.800	378.240	353.240	378.240	110864.000	20.997
	9840.000						

10.000	656.000	132.800	379.140	354.140	379.140	120704.000	22.861
11.000	11152.000	250.900	386.850	361.850	386.850	121360.000	22.985
11.100	11152.000	250.900	388.050	363.050	388.050	132512.000	25.097
12.000	16400.000	250.900	389.250	364.250	389.250	143664.000	27.209
13.000	16400.000	250.900	390.740	365.740	390.740	160064.000	30.315
14.000	13120.000	250.900	392.230	367.230	392.230	176464.000	33.421
15.000	13120.000	250.900	394.700	369.700	394.700	189584.000	35.906
16.000	19352.000	250.900	394.730	369.730	394.730	202704.000	38.391
17.000	16400.000	250.900	396.490	371.490	396.490	222056.000	42.056
18.000	9840.000	250.900	397.980	372.980	397.980	238456.000	45.162
19.000	328.000	250.900	398.880	373.880	398.880	248296.000	47.026
20.000	22632.000	264.000	399.190	374.190	399.190	248624.000	47.088
21.000	16800.000	264.000	401.250	376.250	401.250	271256.000	51.374
22.000	5740.000	264.000	402.740	377.740	402.740	288056.000	54.556
22.100	5740.000	264.000	403.260	378.260	403.260	293796.000	55.643
23.000	328.000	264.000	403.780	378.780	403.780	299536.000	56.730
24.000	20992.000	313.300	401.340	376.340	401.340	299864.000	56.792
25.000	16400.000	313.300	403.250	378.250	403.250	320856.000	60.768
26.000	328.000	313.300	404.740	379.740	404.740	337256.000	63.874
27.000	16072.000	175.500	397.080	372.080	397.080	337584.000	63.936
28.000	16400.000	175.500	398.540	373.540	398.540	353656.000	66.980
29.000	19680.000	175.500	401.800	376.800	401.800	370056.000	70.086
30.000	328.000	175.500	403.590	378.590	403.590	389736.000	73.814
31.000	10168.000	313.300	403.620	378.620	403.620	390064.000	73.876
32.000	328.000	313.300	404.550	379.550	404.550	400232.000	75.802
33.000	18696.000	313.300	412.140	387.140	412.140	400560.000	75.864
34.000	16400.000	313.300	413.840	388.840	413.840	419256.000	79.405
35.000	16400.000	313.300	415.330	390.330	415.330	435656.000	82.511
36.000	16400.000	313.300	416.820	391.820	416.820	452056.000	85.617
37.000	328.000	313.300	418.310	393.310	418.310	468456.000	88.723
38.000	16072.000	329.700	418.340	393.340	418.340	468784.000	88.785
39.000	16400.000	329.700	419.800	394.800	419.800	484856.000	91.829
40.000	19188.000	329.700	421.290	396.290	421.290	501256.000	94.935
41.000	492.000	329.700	423.040	398.040	423.040	520444.000	98.569
42.000	13120.000	296.800	423.090	398.090	423.090	520936.000	98.662
43.000	3280.000	296.800	424.280	399.280	424.280	534056.000	101.147
44.000	13120.000	264.000	424.580	399.580	424.580	537336.000	101.768
45.000	16400.000	264.000	425.930	400.930	425.930	550456.000	104.253
46.000	16400.000	264.000	427.420	402.420	427.420	566856.000	107.359

47.000		264.000	428.910	403.910	428.910	583256.000	110.465
	16400.000						
48.000		264.000	430.400	405.400	430.400	599656.000	113.571
	16400.000						
49.000		264.000	431.890	406.890	431.890	616056.000	116.677
	16400.000						
50.000		264.000	433.380	408.380	433.380	632456.000	119.783
	16400.000						
51.000		264.000	434.870	409.870	434.870	648856.000	122.889
	16400.000						
52.000		264.000	436.360	411.360	436.360	665256.000	125.995
	16400.000						
53.000		264.000	437.850	412.850	437.850	681656.000	129.102
	16400.000						
54.000		264.000	439.340	414.340	439.340	698056.000	132.208
	16400.000						
55.000		264.000	440.830	415.830	440.830	714456.000	135.314
	16400.000						
56.000		264.000	442.320	417.320	442.320	730856.000	138.420
	16400.000						
57.000		264.000	443.810	418.810	443.810	747256.000	141.526
	16400.000						
58.000		264.000	445.300	420.300	445.300	763656.000	144.632
	12136.000						
59.000		264.000	446.050	421.050	446.050	775792.000	146.930
	984.000						
60.000		395.300	446.180	421.180	446.180	776776.000	147.117
	19680.000						
61.000		395.300	447.970	422.970	447.970	796456.000	150.844
	16400.000						
62.000		395.300	449.460	424.460	449.460	812856.000	153.950
	9840.000						
63.000		395.300	450.360	425.360	450.360	822696.000	155.814
	328.000						
64.000		444.500	450.390	425.390	450.390	823024.000	155.876
	6332.000						
65.000		444.500	451.290	426.290	451.290	829356.000	157.075
	16400.000						
66.000		444.500	452.780	427.780	452.780	845756.000	160.181
	16400.000						
67.000		444.500	454.270	429.270	454.270	862156.000	163.287

BED MATERIAL GRADATION

SECNO	SAE	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size					
1.000	1.000	0.003	0.003	1.000	1.000	CLAY	0.000	C SILT	0.001	M SAND	0.040
						VF SILT	0.000	VF SAND	0.225	C SAND	0.008
						F SILT	0.000	F SAND	0.726	VC SAND	0.000
						M SILT	0.000				
2.000	1.000	0.003	0.003	1.000	1.000	CLAY	0.000	C SILT	0.001	M SAND	0.040
						VF SILT	0.000	VF SAND	0.225	C SAND	0.008
						F SILT	0.000	F SAND	0.726	VC SAND	0.000
						M SILT	0.000				
3.000	1.000	0.003	0.003	1.000	1.000	CLAY	0.000	C SILT	0.001	M SAND	0.040
						VF SILT	0.000	VF SAND	0.225	C SAND	0.008
						F SILT	0.000	F SAND	0.726	VC SAND	0.000
						M SILT	0.000				
4.000	1.000	0.003	0.003	1.000	1.000	CLAY	0.000	C SILT	0.001	M SAND	0.040
						VF SILT	0.000	VF SAND	0.225	C SAND	0.008
						F SILT	0.000	F SAND	0.726	VC SAND	0.000

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                                         | M  SILT  0.000 |

     5.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

     6.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

     7.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

     8.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

     9.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

    10.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

    11.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

    11.100  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

    12.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                         | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                         | M  SILT  0.000 |

    13.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                         | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
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                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   14.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   15.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   16.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   17.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   18.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   19.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   20.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   21.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   22.000  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
                                                  | VF SILT   0.000 | VF SAND   0.225 | C  SAND
0.008 |
                                                  | F  SILT   0.000 | F  SAND   0.726 | VC SAND
0.000 |
                                                  | M  SILT   0.000 |

   22.100  1.000  0.003  0.003  1.000  1.000 |      CLAY   0.000 | C  SILT   0.001 | M  SAND
0.040 |
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                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    23.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    24.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    25.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    26.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    27.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    28.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    29.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    30.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    31.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |
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```
     32.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     33.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     34.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     35.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     36.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     37.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     38.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     39.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     40.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                               | M  SILT  0.000 |

     41.000  1.000  0.003  0.003  1.000  1.000 |    CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                               | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                               | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
```

| M SILT 0.000 |

42.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

43.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

44.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

45.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

46.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

47.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

48.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

49.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

50.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |
| F SILT 0.000 | F SAND 0.726 | VC SAND
0.000 |
| M SILT 0.000 |

51.000 1.000 0.003 0.003 1.000 1.000 | CLAY 0.000 | C SILT 0.001 | M SAND
0.040 |
| VF SILT 0.000 | VF SAND 0.225 | C SAND
0.008 |

```
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    52.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    53.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    54.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    55.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    56.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    57.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    58.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    59.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    60.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                  | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                  | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                  | M  SILT  0.000 |

    61.000  1.000  0.003  0.003  1.000  1.000 |     CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
```

```
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    62.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    63.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    64.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    65.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    66.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |

    67.000  1.000  0.003  0.003  1.000  1.000 |   CLAY  0.000 | C  SILT  0.001 | M  SAND
0.040 |
                                                      | VF SILT  0.000 | VF SAND  0.225 | C  SAND
0.008 |
                                                      | F  SILT  0.000 | F  SAND  0.726 | VC SAND
0.000 |
                                                      | M  SILT  0.000 |
```

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 1
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-214.000	-212.000
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000
TOTAL	10.0000	10.0000

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1

AT LOCAL INFLOW POINT # 2
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-284.000	-282.000
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000
TOTAL	10.0000	10.0000

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 3
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-496.000	-494.000
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000
TOTAL	10.0000	10.0000

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 4
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-5721.00	-5719.00
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000
TOTAL	10.0000	10.0000

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 5
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-813.000	-811.000
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000

TOTAL	10.0000	10.0000

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 6
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	100.000	500.000	2000.00	5000.00	10000.0	15000.0	20000.0	25000.0
CLAY	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
VF SILT	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
F SILT	4.87500	24.4500	97.8750	244.700	489.375	734.100	978.750	1233.50
M SILT	4.87500	24.4500	97.8750	244.700	489.375	734.100	978.750	1233.50
C SILT	331.500	1662.60	6655.50	16639.6	33277.5	49918.8	66555.0	83878.0
VF SAND	585.000	2934.00	11745.0	29364.0	58725.0	88092.0	117450.	148020.
F SAND	39.0000	195.600	783.000	1957.60	3915.00	5872.80	9787.50	12335.0
M SAND	9.75000	48.9000	195.750	489.400	978.750	1468.20	1957.50	2467.00
C SAND	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
VC SAND	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19	0.100000E-19
TOTAL	975.000	4890.00	19575.0	48940.0	97875.0	146820.	197708.	249167.

..LOCAL INFLOW DATA...
SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
AT LOCAL INFLOW POINT # 7
LOAD BY GRAIN SIZE CLASS (tons/day)

FLOW	-214.000	-212.000
CLAY	1.00000	1.00000
VF SILT	1.00000	1.00000
F SILT	1.00000	1.00000
M SILT	1.00000	1.00000
C SILT	1.00000	1.00000
VF SAND	1.00000	1.00000
F SAND	1.00000	1.00000
M SAND	1.00000	1.00000
C SAND	1.00000	1.00000
VC SAND	1.00000	1.00000
TOTAL	10.0000	10.0000

BED SEDIMENT CONTROL VOLUMES

STREAM SEGMENT # 1: sARDA FEEDER CHANNEL SIMULATION

SECTION NUMBER	LENGTH (ft)	WIDTH (ft)	DEPTH (ft)	V O L U M E (cu.ft)	(cu.yd)
1.000	6232.000	231.200	0.000	0.00000	0.00000
2.000	14432.000	231.200	0.000	0.00000	0.00000
3.000	16400.000	231.200	0.000	0.00000	0.00000
4.000	16400.000	231.200	0.000	0.00000	0.00000
5.000	13120.000	231.200	0.000	0.00000	0.00000
6.000	5248.000	229.150	0.000	0.00000	0.00000
7.000	11480.000	133.737	0.000	0.00000	0.00000
8.000	19352.000	132.800	0.000	0.00000	0.00000
9.000	13120.000	132.800	0.000	0.00000	0.00000
10.000	5248.000	135.260	0.000	0.00000	0.00000

11.000	5904.000	248.713	0.000	0.00000	0.00000
11.100	11152.000	250.900	0.000	0.00000	0.00000
12.000	13776.000	250.900	0.000	0.00000	0.00000
13.000	16400.000	250.900	0.000	0.00000	0.00000
14.000	14760.000	250.900	0.000	0.00000	0.00000
15.000	13120.000	250.900	0.000	0.00000	0.00000
16.000	16236.000	250.900	0.000	0.00000	0.00000
17.000	17876.000	250.900	0.000	0.00000	0.00000
18.000	13120.000	250.900	0.000	0.00000	0.00000
19.000	5084.000	251.041	0.000	0.00000	0.00000
20.000	11480.000	263.938	0.000	0.00000	0.00000
21.000	19716.000	264.000	0.000	0.00000	0.00000
22.000	11270.000	264.000	0.000	0.00000	0.00000
22.100	5740.000	264.000	0.000	0.00000	0.00000
23.000	3034.000	264.888	0.000	0.00000	0.00000
24.000	10660.000	313.047	0.000	0.00000	0.00000
25.000	18696.000	313.300	0.000	0.00000	0.00000
26.000	8364.000	312.399	0.000	0.00000	0.00000
27.000	8200.000	176.419	0.000	0.00000	0.00000
28.000	16236.000	175.500	0.000	0.00000	0.00000
29.000	18040.000	175.500	0.000	0.00000	0.00000
30.000	10004.000	176.253	0.000	0.00000	0.00000
31.000	5248.000	311.865	0.000	0.00000	0.00000
32.000	5248.000	313.300	0.000	0.00000	0.00000
33.000	9512.000	313.300	0.000	0.00000	0.00000
34.000	17548.000	313.300	0.000	0.00000	0.00000
35.000	16400.000	313.300	0.000	0.00000	0.00000
36.000	16400.000	313.300	0.000	0.00000	0.00000
37.000	8364.000	313.407	0.000	0.00000	0.00000
38.000	8200.000	329.591	0.000	0.00000	0.00000
39.000	16236.000	329.700	0.000	0.00000	0.00000
40.000	17794.000	329.700	0.000	0.00000	0.00000
41.000	9840.000	329.426	0.000	0.00000	0.00000
42.000	6806.000	297.196	0.000	0.00000	0.00000
43.000	8200.000	294.613	0.000	0.00000	0.00000
44.000	8200.000	266.187	0.000	0.00000	0.00000
45.000	14760.000	264.000	0.000	0.00000	0.00000
46.000	16400.000	264.000	0.000	0.00000	0.00000
47.000	16400.000	264.000	0.000	0.00000	0.00000
48.000	16400.000	264.000	0.000	0.00000	0.00000
49.000	16400.000	264.000	0.000	0.00000	0.00000
50.000	16400.000	264.000	0.000	0.00000	0.00000
51.000	16400.000	264.000	0.000	0.00000	0.00000
52.000	16400.000	264.000	0.000	0.00000	0.00000
53.000	16400.000	264.000	0.000	0.00000	0.00000
54.000	16400.000	264.000	0.000	0.00000	0.00000
55.000	16400.000	264.000	0.000	0.00000	0.00000
56.000	16400.000	264.000	0.000	0.00000	0.00000
57.000	16400.000	264.000	0.000	0.00000	0.00000
58.000	14268.000	264.000	0.000	0.00000	0.00000
59.000	6560.000	267.283	0.000	0.00000	0.00000
60.000	10332.000	393.216	0.000	0.00000	0.00000
61.000	18040.000	395.300	0.000	0.00000	0.00000
62.000	13120.000	395.300	0.000	0.00000	0.00000
63.000	5084.000	395.829	0.000	0.00000	0.00000
64.000	3330.000	443.692	0.000	0.00000	0.00000
65.000	11366.000	444.500	0.000	0.00000	0.00000
66.000	16400.000	444.500	0.000	0.00000	0.00000
67.000	8200.000	444.500	0.000	0.00000	0.00000

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

```
$HYD
BEGIN COMPUTATIONS.
```

```
TIME STEP #        1
*   BB  PROFILE 1 = Design canal discharge

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SARDA FEEDER CHANNEL SIMULATION
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)
                            5897.000         62.00         361.220

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

 SECTION NO.      1.000

  Cross Section Geometry (STA,ELEV)
      0.000   374.080        0.001   374.079      50.000   349.080     181.020   349.080
231.199   374.080
    231.200   374.080

 ****   5897.000   361.220   361.372   0.152     1.000   179.667   350.724   0.000   3.127
0.000
                                                  FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE       0.000  548197.901       0.000
                           AREA        0.00     1885.87        0.00
                     HYD RADIUS      0.0000     10.1725      0.0000
   REACH...         Manning's N      0.0240      0.0240      0.0240
                        SQRT(L)      1.0000      0.0000      1.0000
   D/S SECTION...          AREA        0.00        0.00        0.00
                     HYD RADIUS       0.000       0.000       0.000


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        1.000      231.200       0.00000000          0.00000000
 SECTION NO.      2.000

  Cross Section Geometry (STA,ELEV)
      0.000   375.210        0.001   375.209       0.000   375.210      50.000   350.210
181.020   350.210
    231.199   375.210      231.200   375.210

 ****   5897.000   362.577   362.733   0.156     1.071   180.602   350.204   1.915   3.275
1.916
                                                  FLOW DISTRIBUTION (%) =     4.972  90.035
4.993

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE   29655.168  536966.184   29776.149
                           AREA      153.10     1621.13      153.65
                     HYD RADIUS      5.5335     12.3732      5.5374
   REACH...         Manning's N      0.0240      0.0240      0.0240
                        SQRT(L)    111.6423    111.6423    111.6423
   D/S SECTION...          AREA        0.00     1885.87        0.00
                     HYD RADIUS       0.000      10.172       0.000


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        2.000      231.200       0.00000000          0.00000000
 SECTION NO.      3.000

  Cross Section Geometry (STA,ELEV)
      0.000   376.700        0.001   376.699       0.000   376.700      50.000   351.700
181.020   351.700
    231.199   376.700      231.200   376.700

 ****   5897.000   364.161   364.314   0.153     1.072   181.000   351.689   1.899   3.246
1.899
                                                  FLOW DISTRIBUTION (%) =     5.008  89.963
5.029

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE   30294.623  544173.836   30418.212
                           AREA      155.56     1634.15      156.12
                     HYD RADIUS      5.5779     12.4726      5.5819
   REACH...         Manning's N      0.0240      0.0240      0.0240
                        SQRT(L)    128.0625    128.0625    128.0625
   D/S SECTION...          AREA      153.10     1621.13      153.65
                     HYD RADIUS       5.533      12.373       5.537
```

```
     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD       3.000     231.200      0.00000000          0.00000000
SECTION NO.      4.000

 Cross Section Geometry (STA,ELEV)
     0.000   378.190       0.001   378.189       0.000   378.190      50.000   353.190
181.020   353.190
    231.199   378.190     231.200   378.190

****   5897.000   365.705   365.855   0.151    1.072   181.319   353.153   1.885   3.224
1.886
                                                          FLOW DISTRIBUTION (%) =     5.037  89.905
5.058

     REACH PROPERTIES BY STRIP          1          2          3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     30813.138  549976.519   30938.843
                          AREA        157.56     1644.59      158.12
                    HYD RADIUS        5.6135     12.5522      5.6175
  REACH...         Manning's N        0.0240      0.0240      0.0240
                       SQRT(L)      128.0625    128.0625    128.0625
  D/S SECTION...          AREA        155.56     1634.15      156.12
                    HYD RADIUS         5.578      12.473       5.582


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD       4.000     231.200      0.00000000          0.00000000
SECTION NO.      5.000

 Cross Section Geometry (STA,ELEV)
     0.000   379.680       0.001   379.679       0.000   379.680      50.000   354.680
181.020   354.680
    231.199   379.680     231.200   379.680

****   5897.000   367.226   367.377   0.150    1.072   181.375   354.660   1.883   3.220
1.884
                                                          FLOW DISTRIBUTION (%) =     5.042  89.895
5.063

     REACH PROPERTIES BY STRIP          1          2          3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     30904.660  550996.919   31030.738
                          AREA        157.91     1646.42      158.48
                    HYD RADIUS        5.6198     12.5662      5.6238
  REACH...         Manning's N        0.0240      0.0240      0.0240
                       SQRT(L)      128.0625    128.0625    128.0625
  D/S SECTION...          AREA        157.56     1644.59      158.12
                    HYD RADIUS         5.614      12.552       5.618


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD       5.000     231.200      0.00000000          0.00000000
SECTION NO.      6.000

 Cross Section Geometry (STA,ELEV)
     0.000   380.580       0.001   380.579       0.000   380.580      50.000   355.580
181.020   355.580
    231.199   380.580     231.200   380.580

****   5897.000   368.138   368.288   0.151    1.072   181.346   355.579   1.884   3.222
1.885
                                                          FLOW DISTRIBUTION (%) =     5.039  89.901
5.060

     REACH PROPERTIES BY STRIP          1          2          3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     30856.348  550458.420   30982.230
                          AREA        157.72     1645.45      158.29
                    HYD RADIUS        5.6165     12.5588      5.6205
  REACH...         Manning's N        0.0240      0.0240      0.0240
                       SQRT(L)       99.1968     99.1968     99.1968
  D/S SECTION...          AREA        157.91     1646.42      158.48
                    HYD RADIUS         5.620      12.566       5.624


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
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 OLD         6.000      231.200       0.00000000           0.00000000
 SECTION NO.        7.000

  Cross Section Geometry (STA,ELEV)
       0.000   373.040        0.001   373.039       50.000   348.040       82.800   348.040
132.799   373.039
     132.800   373.040

 ****   5897.000   368.113   368.364   0.251    1.000   113.164   355.155   0.000   4.022
0.000
                                                              FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

      REACH PROPERTIES BY STRIP           1           2           3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE         0.000  632897.730       0.000
                           AREA          0.00     1466.29        0.00
                     HYD RADIUS        0.0000     11.9551      0.0000
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)       25.6125     25.6125     25.6125
   D/S SECTION...          AREA        157.72     1645.45      158.29
                     HYD RADIUS         5.616      12.559       5.620


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD         7.000      132.800       0.00000000           0.00000000
 SECTION NO.        8.000

  Cross Section Geometry (STA,ELEV)
       0.000   376.750        0.001   376.749        0.000   376.750       50.000   351.750
82.800   351.750
     132.799   376.749     132.800   376.750

 ****   5897.000   370.184   370.579   0.395    1.214   106.680   351.714   3.432   5.869
3.432
                                                              FLOW DISTRIBUTION (%) =    19.854   60.291
19.854

      REACH PROPERTIES BY STRIP           1           2           3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE    115079.834  349459.607  115079.834
                           AREA        341.14      605.81      341.14
                     HYD RADIUS        8.2600     18.4700      8.2600
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      149.3452    149.3452    149.3452
   D/S SECTION...          AREA          0.00     1466.29        0.00
                     HYD RADIUS         0.000      11.955       0.000


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD         8.000      132.800       0.00000000           0.00000000
 SECTION NO.        9.000

  Cross Section Geometry (STA,ELEV)
       0.000   378.240        0.001   378.239        0.000   378.240       50.000   353.240
82.800   353.240
     132.799   378.239     132.800   378.240

 ****   5897.000   371.864   372.250   0.386    1.214   107.270   353.246   3.394   5.804
3.394
                                                              FLOW DISTRIBUTION (%) =    19.950   60.100
19.950

      REACH PROPERTIES BY STRIP           1           2           3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE    117548.860  354126.951  117548.860
                           AREA        346.61      610.66      346.61
                     HYD RADIUS        8.3260     18.6176      8.3260
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        341.14      605.81      341.14
                     HYD RADIUS         8.260      18.470       8.260


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD         9.000      132.800       0.00000000           0.00000000
 SECTION NO.       10.000
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 Cross Section Geometry (STA,ELEV)
      0.000   379.140        0.001   379.139        0.000   379.140      50.000   354.140
82.800   354.140
    132.799   379.139      132.800   379.140

 ****   5897.000   372.845   373.224   0.379   1.215   107.704   354.119   3.367   5.757
3.367
                                                   FLOW DISTRIBUTION (%) =   20.019  59.961
20.019

      REACH PROPERTIES BY STRIP            1           2           3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE   119383.843  357571.945  119383.843
                           AREA       350.66      614.21      350.66
                     HYD RADIUS       8.3745     18.7260      8.3745
   REACH...         Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)      99.1968     99.1968     99.1968
   D/S SECTION...          AREA       346.61      610.66      346.61
                     HYD RADIUS        8.326      18.618       8.326


       SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        10.000      132.800      0.00000000           0.00000000

 --- LOCAL INFLOW POINT #  1 is upstream of Section No.       10.000 ---
                               DISCHARGE   TEMPERATURE
                                 (cfs)       (deg F)
            Local Inflow:      -213.000         0.00
                  Total:       6110.000        59.84

 SECTION NO.      11.000

 Cross Section Geometry (STA,ELEV)
      0.000   386.850        0.001   386.849       50.000   361.850     200.000   361.850
250.899   386.850
    250.900   386.850

 ****   6110.000   373.185   373.336   0.151   1.000   195.743   363.175   0.000   3.118
0.000
                                                   FLOW DISTRIBUTION (%) =    0.000 100.000
0.000

      REACH PROPERTIES BY STRIP            1           2           3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE        0.000  553477.850       0.000
                           AREA         0.00     1959.29        0.00
                     HYD RADIUS       0.0000      9.7452      0.0000
   REACH...         Manning's N       0.0240      0.0240      0.0240
                        SQRT(L)      25.6125     25.6125     25.6125
   D/S SECTION...          AREA       350.66      614.21      350.66
                     HYD RADIUS        8.375      18.726       8.375


       SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        11.000      250.900      0.00000000           0.00000000
 SECTION NO.      11.100

 Cross Section Geometry (STA,ELEV)
      0.000   388.050        0.001   388.049        0.000   388.050      50.000   363.050
200.000   363.050
    250.899   388.050      250.900   388.050

 ****   6110.000   374.482   374.637   0.156   1.060   196.338   363.001   1.903   3.254
1.907
                                                   FLOW DISTRIBUTION (%) =    4.105  91.706
4.189

      REACH PROPERTIES BY STRIP            1           2           3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE    24291.212  542679.718   24786.509
                           AREA       131.82     1722.18      134.19
                     HYD RADIUS       5.1345     11.4812      5.1526
   REACH...         Manning's N       0.0240      0.0240      0.0240
                        SQRT(L)     105.6030    105.6030    105.6030
   D/S SECTION...          AREA         0.00     1959.29        0.00
                     HYD RADIUS        0.000       9.745       0.000
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      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       11.100      250.900       0.00000000           0.00000000
 SECTION NO.     12.000

  Cross Section Geometry (STA,ELEV)
      0.000   389.250        0.001    389.249        0.000    389.250      50.000    364.250
200.000   364.250
     250.899   389.250     250.900   389.250

 ****   6110.000   375.678   375.835   0.157    1.060   196.160   364.241   1.911   3.267
1.915
                                                          FLOW DISTRIBUTION (%) =     4.090  91.736
4.174

     REACH PROPERTIES BY STRIP            1           2           3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     24043.619  539215.976   24533.867
                           AREA        130.81     1715.57      133.16
                     HYD RADIUS        5.1149     11.4372      5.1329
   REACH...         Manning's N        0.0240      0.0240      0.0240
                        SQRT(L)      105.6030    105.6030    105.6030
   D/S SECTION...          AREA        131.82     1722.18      134.19
                     HYD RADIUS         5.135      11.481       5.153


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       12.000      250.900       0.00000000           0.00000000
 SECTION NO.     13.000

  Cross Section Geometry (STA,ELEV)
      0.000   390.740        0.001    390.739        0.000    390.740      50.000    365.740
200.000   365.740
     250.899   390.740     250.900   390.740

 ****   6110.000   377.389   377.538   0.149    1.061   197.216   365.691   1.864   3.188
1.869
                                                          FLOW DISTRIBUTION (%) =     4.176  91.563
4.261

     REACH PROPERTIES BY STRIP            1           2           3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     25537.539  559918.418   26058.248
                           AREA        136.86     1754.80      139.32
                     HYD RADIUS        5.2318     11.6986      5.2502
   REACH...         Manning's N        0.0240      0.0240      0.0240
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        130.81     1715.57      133.16
                     HYD RADIUS         5.115      11.437       5.133


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       13.000      250.900       0.00000000           0.00000000
 SECTION NO.     14.000

  Cross Section Geometry (STA,ELEV)
      0.000   392.230        0.001    392.229        0.000    392.230      50.000    367.230
200.000   367.230
     250.899   392.230     250.900   392.230

 ****   6110.000   379.009   379.156   0.147    1.061   197.552   367.227   1.850   3.164
1.854
                                                          FLOW DISTRIBUTION (%) =     4.203  91.508
4.289

     REACH PROPERTIES BY STRIP            1           2           3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     26026.049  566588.820   26556.719
                           AREA        138.82     1767.31      141.32
                     HYD RADIUS        5.2691     11.7821      5.2877
   REACH...         Manning's N        0.0240      0.0240      0.0240
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        136.86     1754.80      139.32
                     HYD RADIUS         5.232      11.699       5.250


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       14.000      250.900       0.00000000           0.00000000
 SECTION NO.     15.000
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 Cross Section Geometry (STA,ELEV)
     0.000   394.700       0.001   394.699       0.000   394.700      50.000   369.700
200.000   369.700
    250.899   394.700     250.900   394.700

 ****   6110.000   380.476   380.655   0.179    1.057   193.462   369.707   2.039   3.487
2.044
                                                FLOW DISTRIBUTION (%) =     3.870  92.181
3.949

      REACH PROPERTIES BY STRIP            1            2            3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      20475.996  487714.870   20893.500
                           AREA         115.96     1615.29      118.05
                     HYD RADIUS         4.8159     10.7686      4.8328
   REACH...         Manning's N         0.0240      0.0240      0.0240
                        SQRT(L)       114.5426    114.5426    114.5426
   D/S SECTION...          AREA         138.82     1767.31      141.32
                     HYD RADIUS          5.269      11.782       5.288


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       15.000     250.900      0.00000000           0.00000000

 --- LOCAL INFLOW POINT #  2 is upstream of Section No.      15.000 ---
                                DISCHARGE   TEMPERATURE
                                  (cfs)       (deg F)
              Local Inflow:     -283.000        0.00
                     Total:     6393.000       57.19

 SECTION NO.      16.000

 Cross Section Geometry (STA,ELEV)
     0.000   394.730       0.001   394.729       0.000   394.730      50.000   369.730
200.000   369.730
    250.899   394.730     250.900   394.730

 ****   6393.000   382.020   382.167   0.146    1.063   199.595   369.732   1.849   3.162
1.854
                                                FLOW DISTRIBUTION (%) =     4.368  91.175
4.457

      REACH PROPERTIES BY STRIP            1            2            3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      29114.728  607726.691   29708.376
                           AREA         151.00     1843.22      153.72
                     HYD RADIUS         5.4954     12.2881      5.5148
   REACH...         Manning's N         0.0240      0.0240      0.0240
                        SQRT(L)       114.5426    114.5426    114.5426
   D/S SECTION...          AREA         115.96     1615.29      118.05
                     HYD RADIUS          4.816      10.769       4.833


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       16.000     250.900      0.00000000           0.00000000
 SECTION NO.      17.000

 Cross Section Geometry (STA,ELEV)
     0.000   396.490       0.001   396.489       0.000   396.490      50.000   371.490
200.000   371.490
    250.899   396.490     250.900   396.490

 ****   6393.000   383.794   383.939   0.146    1.064   199.718   371.475   1.844   3.154
1.849
                                                FLOW DISTRIBUTION (%) =     4.378  91.155
4.467

      REACH PROPERTIES BY STRIP            1            2            3
                  INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      29307.975  610244.658   29905.563
                           AREA         151.75     1847.80      154.48
                     HYD RADIUS         5.5091     12.3186      5.5285
   REACH...         Manning's N         0.0240      0.0240      0.0240
                        SQRT(L)       139.1115    139.1115    139.1115
   D/S SECTION...          AREA         151.00     1843.22      153.72
                     HYD RADIUS          5.495      12.288       5.515
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     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       17.000     250.900       0.00000000          0.00000000
 SECTION NO.      18.000

  Cross Section Geometry (STA,ELEV)
      0.000   397.980       0.001    397.979        0.000    397.980       50.000    372.980
200.000   372.980
     250.899   397.980     250.900   397.980

 ****   6393.000   385.290   385.435   0.146    1.064   199.706   372.974   1.845   3.155
1.849
                                                 FLOW DISTRIBUTION (%) =     4.377  91.157
4.466

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE    29289.369  610002.498   29886.578
                          AREA       151.68     1847.36      154.41
                    HYD RADIUS       5.5078     12.3157      5.5272
  REACH...         Manning's N       0.0240      0.0240      0.0240
                       SQRT(L)     128.0625    128.0625    128.0625
  D/S SECTION...          AREA       151.75     1847.80      154.48
                    HYD RADIUS        5.509      12.319       5.528


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       18.000     250.900       0.00000000          0.00000000
 SECTION NO.      19.000

  Cross Section Geometry (STA,ELEV)
      0.000   398.880       0.001    398.879        0.000    398.880       50.000    373.880
200.000   373.880
     250.899   398.880     250.900   398.880

 ****   6393.000   386.189   386.335   0.146    1.063   199.673   373.881   1.846   3.157
1.851
                                                 FLOW DISTRIBUTION (%) =     4.374  91.162
4.463

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE    29236.832  609318.405   29832.970
                          AREA       151.47     1846.11      154.20
                    HYD RADIUS       5.5040     12.3074      5.5234
  REACH...         Manning's N       0.0240      0.0240      0.0240
                       SQRT(L)      99.1968     99.1968     99.1968
  D/S SECTION...          AREA       151.68     1847.36      154.41
                    HYD RADIUS        5.508      12.316       5.527


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       19.000     250.900       0.00000000          0.00000000

 --- LOCAL INFLOW POINT #  3 is upstream of Section No.      19.000 ---
                           DISCHARGE    TEMPERATURE
                             (cfs)        (deg F)
           Local Inflow:    -495.000        0.00
                 Total:     6888.000       53.08

 SECTION NO.      20.000

  Cross Section Geometry (STA,ELEV)
      0.000   399.190       0.001    399.189       50.000    374.190      214.000    374.190
263.999   399.189
     264.000   399.190

 ****   6888.000   386.226   386.370   0.144    1.000   212.115   375.562   0.000   3.045
0.000
                                                 FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE        0.000  666740.831       0.000
                          AREA         0.00     2262.08        0.00
                    HYD RADIUS       0.0000     10.3863      0.0000
  REACH...         Manning's N       0.0240      0.0240      0.0240
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                       SQRT(L)       18.1108      18.1108      18.1108
    D/S SECTION...        AREA        151.47      1846.11       154.20
                    HYD RADIUS         5.504       12.307        5.523


        SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        20.000      264.000      0.00000000           0.00000000
  SECTION NO.      21.000

   Cross Section Geometry (STA,ELEV)
        0.000    401.250       0.001    401.249       0.000    401.250      50.000    376.250
 214.000   376.250
      263.999    401.249     264.000    401.250

 ****   6888.000    388.514    388.660    0.146    1.058   213.016   376.260   1.843   3.152
 1.843
                                                    FLOW DISTRIBUTION (%) =     4.018   91.963
 4.018

      REACH PROPERTIES BY STRIP           1            2            3
                   INEFF FLOW  EL   -99999.000   -99999.000   -99999.000
    U/S SECTION...    CONVEYANCE    28900.032   661381.279    28900.032
                            AREA       150.16      2009.67       150.16
                      HYD RADIUS       5.4802      12.2541       5.4802
    REACH...         Manning's N       0.0240       0.0240       0.0240
                         SQRT(L)     150.4394     150.4394     150.4394
    D/S SECTION...          AREA         0.00      2262.08         0.00
                      HYD RADIUS        0.000       10.386        0.000


        SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        21.000      264.000      0.00000000           0.00000000
  SECTION NO.      22.000

   Cross Section Geometry (STA,ELEV)
        0.000    402.740       0.001    402.739       0.000    402.740      50.000    377.740
 214.000   377.740
      263.999    402.739     264.000    402.740

 ****   6888.000    390.043    390.188    0.145    1.059   213.254   377.730   1.834   3.136
 1.834
                                                    FLOW DISTRIBUTION (%) =     4.036   91.927
 4.036

      REACH PROPERTIES BY STRIP           1            2            3
                   INEFF FLOW  EL   -99999.000   -99999.000   -99999.000
    U/S SECTION...    CONVEYANCE    29275.472   666738.270    29275.472
                            AREA       151.62      2019.42       151.62
                      HYD RADIUS       5.5068      12.3135       5.5068
    REACH...         Manning's N       0.0240       0.0240       0.0240
                         SQRT(L)     129.6148     129.6148     129.6148
    D/S SECTION...          AREA       150.16      2009.67       150.16
                      HYD RADIUS        5.480       12.254        5.480


        SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        22.000      264.000      0.00000000           0.00000000
  SECTION NO.      22.100

   Cross Section Geometry (STA,ELEV)
        0.000    403.260       0.001    403.259       0.000    403.260      50.000    378.260
 214.000   378.260
      263.999    403.259     264.000    403.260

 ****   6888.000    390.562    390.706    0.145    1.058   213.222   378.256   1.835   3.138
 1.835
                                                    FLOW DISTRIBUTION (%) =     4.034   91.932
 4.034

      REACH PROPERTIES BY STRIP           1            2            3
                   INEFF FLOW  EL   -99999.000   -99999.000   -99999.000
    U/S SECTION...    CONVEYANCE    29224.669   666014.901    29224.669
                            AREA       151.43      2018.10       151.43
                      HYD RADIUS       5.5032      12.3055       5.5032
    REACH...         Manning's N       0.0240       0.0240       0.0240
                         SQRT(L)      75.7628      75.7628      75.7628
    D/S SECTION...          AREA       151.62      2019.42       151.62
                      HYD RADIUS        5.507       12.314        5.507
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     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD      22.100     264.000      0.00000000          0.00000000
SECTION NO.     23.000

 Cross Section Geometry (STA,ELEV)
     0.000   403.780       0.001   403.779       0.000   403.780      50.000   378.780
214.000   378.780
    263.999   403.779     264.000   403.780

****   6888.000   391.081   391.226   0.145    1.058   213.199   378.781   1.836   3.139
1.836
                                                  FLOW DISTRIBUTION (%) =     4.032  91.935
4.032

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE    29188.889  665505.151   29188.889
                          AREA       151.29     2017.18      151.29
                    HYD RADIUS       5.5007     12.2999      5.5007
  REACH...          Manning's N      0.0240      0.0240      0.0240
                       SQRT(L)      75.7628     75.7628     75.7628
  D/S SECTION...          AREA       151.43     2018.10      151.43
                    HYD RADIUS        5.503      12.306       5.503


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD      23.000     264.000      0.00000000          0.00000000

--- LOCAL INFLOW POINT #  4 is upstream of Section No.      23.000 ---
                         DISCHARGE     TEMPERATURE
                           (cfs)         (deg F)
          Local Inflow:    -5720.000        0.00
                 Total:    12608.000       29.00

SECTION NO.     24.000

 Cross Section Geometry (STA,ELEV)
     0.000   401.340       0.001   401.339      50.000   376.340     263.300   376.340
313.299   401.339
    313.300   401.340

****  12608.000   391.105   391.297   0.192    1.000   272.381   377.936   0.000   3.515
0.000
                                                  FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE        0.000 1217750.121       0.000
                          AREA         0.00     3586.85        0.00
                    HYD RADIUS       0.0000     12.8397      0.0000
  REACH...          Manning's N      0.0240      0.0240      0.0240
                       SQRT(L)      18.1108     18.1108     18.1108
  D/S SECTION...          AREA       151.29     2017.18      151.29
                    HYD RADIUS        5.501      12.300       5.501


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD      24.000     313.300      0.00000000          0.00000000
SECTION NO.     25.000

 Cross Section Geometry (STA,ELEV)
     0.000   403.250       0.001   403.249       0.000   403.250      50.000   378.250
263.300   378.250
    313.299   403.249     313.300   403.250

****  12608.000   393.250   393.446   0.196    1.055   273.277   378.255   2.130   3.643
2.130
                                                  FLOW DISTRIBUTION (%) =     3.799  92.403
3.799

     REACH PROPERTIES BY STRIP           1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE    49501.427 1204130.406   49501.427
                          AREA       224.83     3198.28      224.83
                    HYD RADIUS       6.7056     14.9943      6.7056
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  REACH...          Manning's N       0.0240      0.0240      0.0240
                        SQRT(L)     144.8862    144.8862    144.8862
  D/S SECTION...           AREA         0.00     3586.85        0.00
                     HYD RADIUS        0.000      12.840       0.000


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        25.000     313.300     0.00000000          0.00000000
 SECTION NO.     26.000

  Cross Section Geometry (STA,ELEV)
      0.000   404.740      0.001   404.739       0.000   404.740      50.000   379.740
263.300   379.740
    313.299   404.739    313.300   404.740

 ****  12608.000   394.777   394.971   0.194    1.055   273.504   379.725   2.122   3.628
2.122
                                                FLOW DISTRIBUTION (%) =     3.812  92.376
3.812

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE    50002.726 1211737.374   50002.726
                           AREA       226.53     3210.38      226.53
                     HYD RADIUS       6.7310     15.0510      6.7310
  REACH...          Manning's N       0.0240      0.0240      0.0240
                        SQRT(L)     128.0625    128.0625    128.0625
  D/S SECTION...           AREA       224.83     3198.28      224.83
                     HYD RADIUS        6.706      14.994       6.706


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        26.000     313.300     0.00000000          0.00000000
 SECTION NO.     27.000

  Cross Section Geometry (STA,ELEV)
      0.000   397.080      0.001   397.079      50.000   372.080     125.500   372.080
175.499   397.079
    175.500   397.080

 ****  12608.000   394.703   395.033   0.330    1.000   166.082   378.233   0.000   4.609
0.000
                                                FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE        0.000 1402266.304       0.000
                           AREA         0.00     2735.38        0.00
                     HYD RADIUS       0.0000     15.4739      0.0000
  REACH...          Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)      18.1108     18.1108     18.1108
  D/S SECTION...           AREA       226.53     3210.38      226.53
                     HYD RADIUS        6.731      15.051       6.731


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        27.000     175.500     0.00000000          0.00000000
 SECTION NO.     28.000

  Cross Section Geometry (STA,ELEV)
      0.000   398.540      0.001   398.539       0.000   398.540      50.000   373.540
125.500   373.540
    175.499   398.539    175.500   398.540

 ****  12608.000   395.927   396.323   0.396    1.162   165.039   373.542   3.239   5.539
3.239
                                                FLOW DISTRIBUTION (%) =    12.874  74.252
12.874

     REACH PROPERTIES BY STRIP          1           2           3
                INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE   192143.321 1108182.744  192143.321
                           AREA       501.07     1690.04      501.07
                     HYD RADIUS      10.0107     22.3847     10.0107
  REACH...          Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)     126.7754    126.7754    126.7754
  D/S SECTION...           AREA         0.00     2735.38        0.00
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                    HYD RADIUS        0.000      15.474       0.000


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD        28.000     175.500      0.00000000          0.00000000
SECTION NO.     29.000

Cross Section Geometry (STA,ELEV)
     0.000   401.800        0.001   401.799       0.000   401.800      50.000   376.800
125.500   376.800
   175.499   401.799     175.500   401.800

****  12608.000   397.238   397.741   0.504    1.154   157.270   376.795   3.628   6.204
3.628
                                                        FLOW DISTRIBUTION (%) =   12.026  75.948
12.026

    REACH PROPERTIES BY STRIP          1           2           3
               INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...   CONVEYANCE    150837.222  952606.196  150837.222
                         AREA        417.89     1543.40      417.89
                   HYD RADIUS        9.1421     20.4424      9.1421
  REACH...        Manning's N        0.0180      0.0180      0.0180
                      SQRT(L)      128.0625    128.0625    128.0625
  D/S SECTION...         AREA        501.07     1690.04      501.07
                   HYD RADIUS        10.011      22.385      10.011


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD        29.000     175.500      0.00000000          0.00000000
SECTION NO.     30.000

Cross Section Geometry (STA,ELEV)
     0.000   403.590        0.001   403.589       0.000   403.590      50.000   378.590
125.500   378.590
   175.499   403.589     175.500   403.590

****  12608.000   399.209   399.704   0.494    1.154   157.857   378.620   3.596   6.149
3.596
                                                        FLOW DISTRIBUTION (%) =   12.091  75.817
12.091

    REACH PROPERTIES BY STRIP          1           2           3
               INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...   CONVEYANCE    153745.610  964044.934  153745.610
                         AREA        423.92     1554.50      423.92
                   HYD RADIUS        9.2078     20.5893      9.2078
  REACH...        Manning's N        0.0180      0.0180      0.0180
                      SQRT(L)      140.2854    140.2854    140.2854
  D/S SECTION...         AREA        417.89     1543.40      417.89
                   HYD RADIUS         9.142      20.442       9.142


     SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
OLD        30.000     175.500      0.00000000          0.00000000
SECTION NO.     31.000

Cross Section Geometry (STA,ELEV)
     0.000   403.620        0.001   403.619      50.000   378.620     263.300   378.620
313.299   403.619
   313.300   403.620

****  12608.000   399.679   399.765   0.085    1.000   297.534   381.602   0.000   2.344
0.000
                                                        FLOW DISTRIBUTION (%) =    0.000 100.000
0.000

    REACH PROPERTIES BY STRIP          1           2           3
               INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...   CONVEYANCE         0.000 2244221.920       0.000
                         AREA          0.00     5378.73        0.00
                   HYD RADIUS        0.0000     17.4931      0.0000
  REACH...        Manning's N        0.0240      0.0240      0.0240
                      SQRT(L)       18.1108     18.1108     18.1108
  D/S SECTION...         AREA        423.92     1554.50      423.92
                   HYD RADIUS         9.208      20.589       9.208
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      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        31.000      313.300       0.00000000           0.00000000
 SECTION NO.      32.000

  Cross Section Geometry  (STA,ELEV)
      0.000   404.550       0.001   404.549       0.000   404.550      50.000   379.550
263.300   379.550
    313.299   404.549     313.300   404.550

 ****  12608.000   400.000   400.098   0.098    1.072   295.075   379.556   1.520   2.600
1.520
                                                    FLOW DISTRIBUTION (%) =     5.040  89.920
5.040

     REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...     CONVEYANCE    113147.127 2018666.883  113147.127
                            AREA        417.95     4360.64      417.95
                      HYD RADIUS        9.1427     20.4437      9.1427
   REACH...          Manning's N        0.0240      0.0240      0.0240
                         SQRT(L)      100.8365    100.8365    100.8365
   D/S SECTION...           AREA          0.00     5378.73        0.00
                      HYD RADIUS         0.000      17.493       0.000


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        32.000      313.300       0.00000000           0.00000000
 SECTION NO.      33.000

  Cross Section Geometry  (STA,ELEV)
      0.000   412.140       0.001   412.139       0.000   412.140      50.000   387.140
263.300   387.140
    313.299   412.139     313.300   412.140

 ****  12608.000   399.895   400.173   0.278    1.048   264.422   387.115   2.528   4.322
2.528
                                                    FLOW DISTRIBUTION (%) =     3.275  93.451
3.275

     REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...     CONVEYANCE     32329.857  922656.004   32329.857
                            AREA        163.34     2726.06      163.34
                      HYD RADIUS        5.7156     12.7804      5.7156
   REACH...          Manning's N        0.0240      0.0240      0.0240
                         SQRT(L)       18.1108     18.1108     18.1108
   D/S SECTION...           AREA        417.95     4360.64      417.95
                      HYD RADIUS         9.143      20.444       9.143


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        33.000      313.300       0.00000000           0.00000000
 SECTION NO.      34.000

  Cross Section Geometry  (STA,ELEV)
      0.000   413.840       0.001   413.839       0.000   413.840      50.000   388.840
263.300   388.840
    313.299   413.839     313.300   413.840

 ****  12608.000   402.622   402.859   0.237    1.051   268.268   388.880   2.339   4.000
2.339
                                                    FLOW DISTRIBUTION (%) =     3.504  92.993
3.504

     REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION... .   CONVEYANCE     39229.705 1041230.430   39229.705
                            AREA        188.84     2931.16      188.84
                      HYD RADIUS        6.1456     13.7420      6.1456
   REACH...          Manning's N        0.0240      0.0240      0.0240
                         SQRT(L)      136.7333    136.7333    136.7333
   D/S SECTION...           AREA        163.34     2726.06      163.34
                      HYD RADIUS         5.716      12.780       5.716


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        34.000      313.300       0.00000000           0.00000000
 SECTION NO.      35.000
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 Cross Section Geometry (STA,ELEV)
      0.000   415.330      0.001   415.329       0.000   415.330      50.000   390.330
263.300  390.330
    313.299   415.329    313.300   415.330

 ****  12608.000   404.587   404.806   0.218    1.053   270.405   390.311   2.246   3.840
2.246
                                                        FLOW DISTRIBUTION (%) =     3.630  92.740
3.630

     REACH PROPERTIES BY STRIP          1            2            3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE     43429.994 1109573.454   43429.994
                           AREA        203.81      3045.13      203.81
                     HYD RADIUS        6.3845      14.2763      6.3845
  REACH...          Manning's N        0.0240       0.0240      0.0240
                        SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...           AREA        188.84      2931.16      188.84
                     HYD RADIUS         6.146       13.742       6.146


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        35.000      313.300      0.00000000           0.00000000
 SECTION NO.      36.000

 Cross Section Geometry (STA,ELEV)
      0.000   416.820      0.001   416.819       0.000   416.820      50.000   391.820
263.300  391.820
    313.299   416.819    313.300   416.820

 ****  12608.000   406.359   406.568   0.209    1.054   271.504   391.808   2.200   3.762
2.200
                                                        FLOW DISTRIBUTION (%) =     3.695  92.611
3.695

     REACH PROPERTIES BY STRIP          1            2            3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE     45693.598 1145373.282   45693.598
                           AREA        211.73      3103.70      211.73
                     HYD RADIUS        6.5074      14.5509      6.5074
  REACH...          Manning's N        0.0240       0.0240      0.0240
                        SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...           AREA        203.81      3045.13      203.81
                     HYD RADIUS         6.385       14.276       6.385


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        36.000      313.300      0.00000000           0.00000000
 SECTION NO.      37.000

 Cross Section Geometry (STA,ELEV)
      0.000   418.310      0.001   418.309       0.000   418.310      50.000   393.310
263.300  393.310
    313.299   418.309    313.300   418.310

 ****  12608.000   408.033   408.237   0.204    1.054   272.221   393.303   2.171   3.713
2.171
                                                        FLOW DISTRIBUTION (%) =     3.737  92.527
3.737

     REACH PROPERTIES BY STRIP          1            2            3
                INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE     47210.568 1168993.156   47210.568
                           AREA        216.98      3141.95      216.98
                     HYD RADIUS        6.5875      14.7302      6.5875
  REACH...          Manning's N        0.0240       0.0240      0.0240
                        SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...           AREA        211.73      3103.70      211.73
                     HYD RADIUS         6.507       14.551       6.507


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        37.000      313.300      0.00000000           0.00000000

 --- LOCAL INFLOW POINT #  5 is upstream of Section No.      37.000 ---
                                DISCHARGE    TEMPERATURE
                                  (cfs)        (deg F)
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           Local Inflow:      -812.000        0.00
                  Total:     13420.000       27.24

 SECTION NO.     38.000

  Cross Section Geometry (STA,ELEV)
      0.000  418.340       0.001  418.339      50.000  393.340     279.700  393.340
329.699  418.339
     329.700  418.340

 ****  13420.000   408.083   408.275   0.192    1.000   288.606   394.859   0.000   3.516
0.000
                                                FLOW DISTRIBUTION (%) =    0.000 100.000
0.000

      REACH PROPERTIES BY STRIP           1          2          3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE        0.000 1300597.633      0.000
                           AREA         0.00     3816.45       0.00
                     HYD RADIUS       0.0000     12.9126     0.0000
  REACH...          Manning's N       0.0240      0.0240     0.0240
                        SQRT(L)      18.1108     18.1108    18.1108
  D/S SECTION...           AREA       216.98     3141.95     216.98
                     HYD RADIUS        6.588      14.730      6.588


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       38.000     329.700      0.00000000          0.00000000
 SECTION NO.     39.000

  Cross Section Geometry (STA,ELEV)
      0.000  419.800       0.001  419.799       0.000  419.800      50.000  394.800
279.700  394.800
     329.699  419.799     329.700  419.800

 ****  13420.000   409.718   409.914   0.196    1.052   289.439   394.783   2.126   3.636
2.126
                                                FLOW DISTRIBUTION (%) =    3.534  92.933
3.534

      REACH PROPERTIES BY STRIP           1          2          3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE    48978.477 1288133.539  48978.477
                           AREA       223.04     3430.49     223.04
                     HYD RADIUS       6.6790     14.9347     6.6790
  REACH...          Manning's N       0.0240      0.0240     0.0240
                        SQRT(L)     126.7754    126.7754   126.7754
  D/S SECTION...           AREA         0.00     3816.45       0.00
                     HYD RADIUS        0.000      12.913      0.000


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       39.000     329.700      0.00000000          0.00000000
 SECTION NO.     40.000

  Cross Section Geometry (STA,ELEV)
      0.000  421.290       0.001  421.289       0.000  421.290      50.000  396.290
279.700  396.290
     329.699  421.289     329.700  421.290

 ****  13420.000   411.250   411.444   0.195    1.052   289.592   396.277   2.120   3.626
2.120
                                                FLOW DISTRIBUTION (%) =    3.542  92.916
3.542

      REACH PROPERTIES BY STRIP           1          2          3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE    49314.182 1293644.616  49314.182
                           AREA       224.19     3439.29     224.19
                     HYD RADIUS       6.6961     14.9730     6.6961
  REACH...          Manning's N       0.0240      0.0240     0.0240
                        SQRT(L)     128.0625    128.0625   128.0625
  D/S SECTION...           AREA       223.04     3430.49     223.04
                     HYD RADIUS        6.679      14.935      6.679


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD       40.000     329.700      0.00000000          0.00000000
```

```
 SECTION NO.     41.000

  Cross Section Geometry (STA,ELEV)
      0.000   423.040        0.001   423.039        0.000   423.040       50.000   398.040
279.700   398.040
    329.699   423.039      329.700   423.040

 ****  13420.000   413.028   413.222   0.194    1.052   289.702   398.027   2.116   3.618
2.116
                                                  FLOW DISTRIBUTION (%) =     3.548  92.904
3.548

      REACH PROPERTIES BY STRIP              1           2           3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...   CONVEYANCE       49555.721 1297601.134   49555.721
                          AREA          225.01     3445.60      225.01
                    HYD RADIUS          6.7084     15.0004      6.7084
   REACH...         Manning's N         0.0240      0.0240      0.0240
                       SQRT(L)        138.5208    138.5208    138.5208
   D/S SECTION...         AREA          224.19     3439.29      224.19
                    HYD RADIUS           6.696      14.973       6.696


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        41.000      329.700       0.00000000            0.00000000

 --- LOCAL INFLOW POINT #  6 is upstream of Section No.       41.000 ---
                               DISCHARGE   TEMPERATURE
                                 (cfs)        (deg F)
            Local Inflow:      1942.000         0.00
                   Total:     11478.000        31.85

 SECTION NO.     42.000

  Cross Section Geometry (STA,ELEV)
      0.000   423.090        0.001   423.089       50.000   398.090      246.800   398.090
296.799   423.089
    296.800   423.090

 ****  11478.000   413.087   413.264   0.177    1.000   256.732   399.853   0.000   3.378
0.000
                                                  FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

      REACH PROPERTIES BY STRIP              1           2           3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...   CONVEYANCE           0.000 1155892.976       0.000
                          AREA            0.00     3397.66        0.00
                    HYD RADIUS          0.0000     12.8794      0.0000
   REACH...         Manning's N         0.0240      0.0240      0.0240
                       SQRT(L)         22.1811     22.1811     22.1811
   D/S SECTION...         AREA          225.01     3445.60      225.01
                    HYD RADIUS           6.708      15.000       6.708


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        42.000      296.800       0.00000000            0.00000000
 SECTION NO.     43.000

  Cross Section Geometry (STA,ELEV)
      0.000   424.280        0.001   424.279        0.000   424.280       50.000   399.280
246.800   399.280
    296.799   424.279      296.800   424.280

 ****  11478.000   414.337   414.523   0.186    1.059   256.979   399.292   2.081   3.558
2.081
                                                  FLOW DISTRIBUTION (%) =     4.104  91.793
4.104

      REACH PROPERTIES BY STRIP              1           2           3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...   CONVEYANCE       49946.734 1117219.795   49946.734
                          AREA          226.34     2960.80      226.34
                    HYD RADIUS          6.7282     15.0447      6.7282
   REACH...         Manning's N         0.0240      0.0240      0.0240
                       SQRT(L)        114.5426    114.5426    114.5426
   D/S SECTION...         AREA            0.00     3397.66        0.00
                    HYD RADIUS           0.000      12.879       0.000
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      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        43.000     296.800       0.00000000            0.00000000
 SECTION NO.      44.000

  Cross Section Geometry (STA,ELEV)
      0.000   424.580       0.001   424.579       50.000   399.580     214.000   399.580
263.999   424.579
    264.000   424.580

 ****  11478.000   414.507   414.751   0.243    1.000   223.826   401.550   0.000   3.958
0.000
                                                     FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE         0.000 1293818.943        0.000
                           AREA          0.00     2900.26         0.00
                     HYD RADIUS        0.0000     12.5613       0.0000
   REACH...         Manning's N        0.0180      0.0180       0.0180
                        SQRT(L)       57.2713     57.2713      57.2713
   D/S SECTION...          AREA        226.34     2960.80       226.34
                     HYD RADIUS         6.728      15.045        6.728


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        44.000     264.000       0.00000000            0.00000000
 SECTION NO.      45.000

  Cross Section Geometry (STA,ELEV)
      0.000   425.930       0.001   425.929        0.000   425.930      50.000   400.930
214.000   400.930
    263.999   425.929     264.000   425.930

 ****  11478.000   415.537   415.812   0.275    1.068   222.362   400.946   2.541   4.345
2.541
                                                     FLOW DISTRIBUTION (%) =     4.712  90.575
4.712

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     61368.755 1179531.488    61368.755
                           AREA        212.88     2392.85       212.88
                     HYD RADIUS        6.5251     14.5905       6.5251
   REACH...         Manning's N        0.0180      0.0180       0.0180
                        SQRT(L)      114.5426    114.5426     114.5426
   D/S SECTION...          AREA          0.00     2900.26         0.00
                     HYD RADIUS         0.000      12.561        0.000


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        45.000     264.000       0.00000000            0.00000000
 SECTION NO.      46.000

  Cross Section Geometry (STA,ELEV)
      0.000   427.420       0.001   427.419        0.000   427.420      50.000   402.420
214.000   402.420
    263.999   427.419     264.000   427.420

 ****  11478.000   416.829   417.111   0.282    1.067   221.772   402.386   2.569   4.393
2.569
                                                     FLOW DISTRIBUTION (%) =     4.669  90.661
4.669

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     59728.120 1159722.944    59728.120
                           AREA        208.60     2368.66       208.60
                     HYD RADIUS        6.4591     14.4430       6.4591
   REACH...         Manning's N        0.0180      0.0180       0.0180
                        SQRT(L)      128.0625    128.0625     128.0625
   D/S SECTION...          AREA        212.88     2392.85       212.88
                     HYD RADIUS         6.525      14.591        6.525


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
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OLD        46.000      264.000        0.00000000            0.00000000
SECTION NO.      47.000

 Cross Section Geometry (STA,ELEV)
     0.000   428.910        0.001    428.909        0.000   428.910       50.000   403.910
214.000   403.910
    263.999   428.909     264.000    428.910

 ****  11478.000   418.174   418.464   0.290    1.066   221.036   403.915   2.605   4.455
2.605
                                                   FLOW DISTRIBUTION (%) =     4.615  90.769
4.615

      REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     57720.492 1135203.531   57720.492
                           AREA        203.32     2338.48      203.32
                     HYD RADIUS        6.3768     14.2590      6.3768
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        208.60     2368.66      208.60
                     HYD RADIUS         6.459      14.443       6.459


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        47.000      264.000        0.00000000            0.00000000
 SECTION NO.      48.000

 Cross Section Geometry (STA,ELEV)
     0.000   430.400        0.001    430.399        0.000   430.400       50.000   405.400
214.000   405.400
    263.999   430.399     264.000    430.400

 ****  11478.000   419.574   419.870   0.296    1.066   220.507   405.447   2.632   4.501
2.632
                                                   FLOW DISTRIBUTION (%) =     4.576  90.847
4.576

      REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     56303.176 1117700.717   56303.176
                           AREA        199.56     2316.78      199.56
                     HYD RADIUS        6.3177     14.1267      6.3177
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        203.32     2338.48      203.32
                     HYD RADIUS         6.377      14.259       6.377


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        48.000      264.000        0.00000000            0.00000000
 SECTION NO.      49.000

 Cross Section Geometry (STA,ELEV)
     0.000   431.890        0.001    431.889        0.000   431.890       50.000   406.890
214.000   406.890
    263.999   431.889     264.000    431.890

 ****  11478.000   421.006   421.304   0.298    1.066   220.359   406.917   2.640   4.514
2.640
                                                   FLOW DISTRIBUTION (%) =     4.565  90.869
4.565

      REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     55909.986 1112815.936   55909.986
                           AREA        198.52     2310.70      198.52
                     HYD RADIUS        6.3011     14.0896      6.3011
   REACH...         Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        199.56     2316.78      199.56
                     HYD RADIUS         6.318      14.127       6.318


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD        49.000      264.000        0.00000000            0.00000000
 SECTION NO.      50.000
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 Cross Section Geometry (STA,ELEV)
      0.000   433.380       0.001   433.379        0.000   433.380      50.000   408.380
214.000   408.380
    263.999   433.379     264.000   433.380

 ****  11478.000   422.451   422.750   0.299    1.066   220.244   408.390   2.646   4.524
2.646
                                                    FLOW DISTRIBUTION (%) =     4.557  90.886
4.557

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     55607.400 1109047.984   55607.400
                           AREA        197.71     2306.00      197.71
                     HYD RADIUS        6.2883     14.0610      6.2883
   REACH...          Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        198.52     2310.70      198.52
                     HYD RADIUS        `6.301      14.090       6.301


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        50.000     264.000       0.00000000           0.00000000
 SECTION NO.      51.000

 Cross Section Geometry (STA,ELEV)
      0.000   434.870       0.001   434.869        0.000   434.870      50.000   409.870
214.000   409.870
    263.999   434.869     264.000   434.870

 ****  11478.000   423.907   424.208   0.301    1.065   220.110   409.880   2.652   4.536
2.652
                                                    FLOW DISTRIBUTION (%) =     4.547  90.906
4.547

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     55255.445 1104655.590   55255.445
                           AREA        196.77     2300.52      196.77
                     HYD RADIUS        6.2733     14.0276      6.2733
   REACH...          Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        197.71     2306.00      197.71
                     HYD RADIUS         6.288      14.061       6.288


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        51.000     264.000       0.00000000           0.00000000
 SECTION NO.      52.000

 Cross Section Geometry (STA,ELEV)
      0.000   436.360       0.001   436.359        0.000   436.360      50.000   411.360
214.000   411.360
    263.999   436.359     264.000   436.360

 ****  11478.000   425.374   425.676   0.302    1.065   220.019   411.369   2.657   4.544
2.657
                                                    FLOW DISTRIBUTION (%) =     4.540  90.919
4.540

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL    -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE     55017.396 1101678.787   55017.396
                           AREA        196.14     2296.80      196.14
                     HYD RADIUS        6.2632     14.0049      6.2632
   REACH...          Manning's N       0.0180      0.0180      0.0180
                        SQRT(L)      128.0625    128.0625    128.0625
   D/S SECTION...          AREA        196.77     2300.52      196.77
                     HYD RADIUS         6.273      14.028       6.273


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        52.000     264.000       0.00000000           0.00000000
 SECTION NO.      53.000

 Cross Section Geometry (STA,ELEV)
      0.000   437.850       0.001   437.849        0.000   437.850      50.000   412.850
214.000   412.850
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    263.999   437.849     264.000   437.850

 ****  11478.000   426.847   427.150   0.302    1.065   219.966   412.856   2.660   4.548
2.660
                                                        FLOW DISTRIBUTION (%) =    4.537  90.927
4.537

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL      -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      54878.568 1099940.523   54878.568
                           AREA         195.76     2294.62      195.76
                     HYD RADIUS         6.2572     13.9916      6.2572
   REACH...         Manning's N         0.0180      0.0180      0.0180
                        SQRT(L)       128.0625    128.0625    128.0625
   D/S SECTION...          AREA         196.14     2296.80      196.14
                     HYD RADIUS          6.263      14.005       6.263


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        53.000     264.000      0.00000000          0.00000000
 SECTION NO.     54.000

  Cross Section Geometry (STA,ELEV)
      0.000   439.340       0.001   439.339       0.000   439.340      50.000   414.340
214.000   414.340
    263.999   439.339     264.000   439.340

 ****  11478.000   428.325   428.628   0.303    1.065   219.927   414.344   2.662   4.552
2.662
                                                        FLOW DISTRIBUTION (%) =    4.534  90.933
4.534

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL      -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      54774.635 1098638.091   54774.635
                           AREA         195.49     2292.99      195.49
                     HYD RADIUS         6.2528     13.9817      6.2528
   REACH...         Manning's N         0.0180      0.0180      0.0180
                        SQRT(L)       128.0625    128.0625    128.0625
   D/S SECTION...          AREA         195.76     2294.62      195.76
                     HYD RADIUS          6.257      13.992       6.257


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        54.000     264.000      0.00000000          0.00000000
 SECTION NO.     55.000

  Cross Section Geometry (STA,ELEV)
      0.000   440.830       0.001   440.829       0.000   440.830      50.000   415.830
214.000   415.830
    263.999   440.829     264.000   440.830

 ****  11478.000   429.807   430.110   0.303    1.065   219.896   415.833   2.664   4.555
2.664
                                                        FLOW DISTRIBUTION (%) =    4.531  90.937
4.531

     REACH PROPERTIES BY STRIP            1           2           3
                INEFF FLOW  EL      -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE      54693.457 1097620.174   54693.457
                           AREA         195.27     2291.72      195.27
                     HYD RADIUS         6.2493     13.9739      6.2493
   REACH...         Manning's N         0.0180      0.0180      0.0180
                        SQRT(L)       128.0625    128.0625    128.0625
   D/S SECTION...          AREA         195.49     2292.99      195.49
                     HYD RADIUS          6.253      13.982       6.253


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
 OLD        55.000     264.000      0.00000000          0.00000000
 SECTION NO.     56.000

  Cross Section Geometry (STA,ELEV)
      0.000   442.320       0.001   442.319       0.000   442.320      50.000   417.320
214.000   417.320
    263.999   442.319     264.000   442.320
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 ****  11478.000   431.291   431.594   0.303   1.065   219.874   417.322   2.665   4.556
2.665
                                                      FLOW DISTRIBUTION (%) =    4.530  90.941
4.530

     REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     54637.156 1096913.859   54637.156
                          AREA        195.12      2290.83      195.12
                    HYD RADIUS        6.2469      13.9685      6.2469
  REACH...         Manning's N        0.0180       0.0180      0.0180
                       SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...          AREA        195.27      2291.72      195.27
                    HYD RADIUS         6.249       13.974       6.249


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      56.000     264.000      0.00000000            0.00000000
 SECTION NO.    57.000

 Cross Section Geometry (STA,ELEV)
      0.000   443.810       0.001    443.809       0.000   443.810      50.000   418.810
214.000   418.810
    263.999   443.809     264.000    443.810

 ****  11478.000   432.776   433.080   0.304   1.065   219.859   418.811   2.665   4.558
2.665
                                                      FLOW DISTRIBUTION (%) =    4.529  90.943
4.529

     REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     54598.545 1096429.308   54598.545
                          AREA        195.02      2290.22      195.02
                    HYD RADIUS        6.2452      13.9648      6.2452
  REACH...         Manning's N        0.0180       0.0180      0.0180
                       SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...          AREA        195.12      2290.83      195.12
                    HYD RADIUS         6.247       13.968       6.247


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      57.000     264.000      0.00000000            0.00000000
 SECTION NO.    58.000

 Cross Section Geometry (STA,ELEV)
      0.000   445.300       0.001    445.299       0.000   445.300      50.000   420.300
214.000   420.300
    263.999   445.299     264.000    445.300

 ****  11478.000   434.263   434.567   0.304   1.065   219.848   420.301   2.666   4.559
2.666
                                                      FLOW DISTRIBUTION (%) =    4.528  90.944
4.528

     REACH PROPERTIES BY STRIP           1            2            3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
  U/S SECTION...    CONVEYANCE     54570.485 1096077.091   54570.485
                          AREA        194.94      2289.78      194.94
                    HYD RADIUS        6.2440      13.9621      6.2440
  REACH...         Manning's N        0.0180       0.0180      0.0180
                       SQRT(L)      128.0625     128.0625    128.0625
  D/S SECTION...          AREA        195.02      2290.22      195.02
                    HYD RADIUS         6.245       13.965       6.245


      SECTION NO   BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      58.000     264.000      0.00000000            0.00000000
 SECTION NO.    59.000

 Cross Section Geometry (STA,ELEV)
      0.000   446.050       0.001    446.049       0.000   446.050      50.000   421.050
214.000   421.050
    263.999   446.049     264.000    446.050

 ****  11478.000   435.335   435.622   0.287   1.067   221.254   421.021   2.595   4.437
2.595
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                                                        FLOW DISTRIBUTION (%) =    4.631  90.737
4.631

     REACH PROPERTIES BY STRIP              1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE     58310.514 1142442.264   58310.514
                           AREA        204.88     2347.42      204.88
                     HYD RADIUS        6.4012     14.3135      6.4012
  REACH...          Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      110.1635    110.1635    110.1635
  D/S SECTION...           AREA        194.94     2289.78      194.94
                     HYD RADIUS         6.244      13.962       6.244


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      59.000     264.000      0.00000000            0.00000000

 --- LOCAL INFLOW POINT #  7 is upstream of Section No.       59.000 ---
                                 DISCHARGE   TEMPERATURE
                                   (cfs)       (deg F)
            Local Inflow:       -11475.000       0.00
                  Total:        22953.000       15.93

 SECTION NO.      60.000

  Cross Section Geometry (STA,ELEV)
      0.000   446.180        0.001   446.179       50.000   421.180      345.300   421.180
395.299   446.179
    395.300   446.180

 ****  22953.000   435.452   435.837   0.385    1.000   352.261   422.363   0.000    4.978
0.000
                                                        FLOW DISTRIBUTION (%) =    0.000 100.000
0.000

     REACH PROPERTIES BY STRIP              1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE         0.000 2087551.328       0.000
                           AREA          0.00     4610.67        0.00
                     HYD RADIUS        0.0000     12.8437      0.0000
  REACH...          Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)       31.3688     31.3688     31.3688
  D/S SECTION...           AREA        204.88     2347.42      204.88
                     HYD RADIUS         6.401      14.314       6.401


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      60.000     395.300      0.00000000            0.00000000
 SECTION NO.      61.000

  Cross Section Geometry (STA,ELEV)
      0.000   447.970        0.001   447.969        0.000   447.970       50.000   422.970
345.300   422.970
    395.299   447.969      395.300   447.970

 ****  22953.000   437.680   438.053   0.374    1.041   354.127   422.973   2.921    4.994
2.921
                                                        FLOW DISTRIBUTION (%) =    2.752  94.496
2.752

     REACH PROPERTIES BY STRIP              1           2           3
                INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
  U/S SECTION...     CONVEYANCE     62681.224 2152152.222   62681.224
                           AREA        216.29     4342.92      216.29
                     HYD RADIUS        6.5771     14.7068      6.5771
  REACH...          Manning's N        0.0180      0.0180      0.0180
                        SQRT(L)      140.2854    140.2854    140.2854
  D/S SECTION...           AREA          0.00     4610.67        0.00
                     HYD RADIUS         0.000      12.844       0.000


      SECTION NO    BED WIDTH  ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD      61.000     395.300      0.00000000            0.00000000
 SECTION NO.      62.000

  Cross Section Geometry (STA,ELEV)
      0.000   449.460        0.001   449.459        0.000   449.460       50.000   424.460
345.300   424.460
```

```
    395.299   449.459     395.300   449.460

 ****  22953.000   439.322   439.686   0.364    1.041   354.835   424.438   2.884   4.932
2.884
                                                       FLOW DISTRIBUTION (%) =     2.783  94.433
2.783

      REACH PROPERTIES BY STRIP          1            2            3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE    64713.323 2195498.428   64713.323
                           AREA       221.53      4395.19      221.53
                     HYD RADIUS       6.6562      14.8838      6.6562
   REACH...         Manning's N       0.0180       0.0180      0.0180
                        SQRT(L)     128.0625     128.0625    128.0625
   D/S SECTION...          AREA       216.29      4342.92      216.29
                     HYD RADIUS        6.577       14.707       6.577


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        62.000     395.300      0.00000000           0.00000000
  SECTION NO.     63.000

   Cross Section Geometry (STA,ELEV)
        0.000   450.360       0.001    450.359        0.000    450.360       50.000    425.360
345.300   425.360
    395.299   450.359     395.300   450.360

 ****  22953.000   440.278   440.639   0.361    1.041   355.066   425.336   2.872   4.911
2.872
                                                       FLOW DISTRIBUTION (%) =     2.794  94.413
2.794

      REACH PROPERTIES BY STRIP          1            2            3
                 INEFF FLOW  EL   -99999.000  -99999:000  -99999.000
   U/S SECTION...    CONVEYANCE    65384.393 2209700.331   65384.393
                           AREA       223.25      4412.22      223.25
                     HYD RADIUS       6.6820      14.9415      6.6820
   REACH...         Manning's N       0.0180       0.0180      0.0180
                        SQRT(L)      99.1968      99.1968     99.1968
   D/S SECTION...          AREA       221.53      4395.19      221.53
                     HYD RADIUS        6.656       14.884       6.656


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        63.000     395.300      0.00000000           0.00000000
  SECTION NO.     64.000

   Cross Section Geometry (STA,ELEV)
        0.000   450.390       0.001    450.389       50.000    425.390      394.500    425.390
444.499   450.389
    444.500   450.390

 ****  22953.000   440.418   440.677   0.259    1.000   404.515   426.527   0.000   4.085
0.000
                                                       FLOW DISTRIBUTION (%) =     0.000 100.000
0.000

      REACH PROPERTIES BY STRIP          1            2            3
                 INEFF FLOW  EL   -99999.000  -99999.000  -99999.000
   U/S SECTION...    CONVEYANCE        0.000 2649719.436       0.000
                           AREA         0.00      5619.04        0.00
                     HYD RADIUS       0.0000      13.6517      0.0000
   REACH...         Manning's N       0.0180       0.0180      0.0180
                        SQRT(L)      18.1108      18.1108     18.1108
   D/S SECTION...          AREA       223.25      4412.22      223.25
                     HYD RADIUS        6.682       14.941       6.682


       SECTION NO   BED WIDTH  ACTIVE LAYER(tons)  INACTIVE LAYER(tons)
  OLD        64.000     444.500      0.00000000           0.00000000
  SECTION NO.     65.000

   Cross Section Geometry (STA,ELEV)
        0.000   451.290       0.001    451.289        0.000    451.290       50.000    426.290
394.500   426.290
    444.499   451.289     444.500   451.290
```

```
 ****  22953.000    440.890    441.172    0.283     1.035    403.093    426.241    2.534    4.333
2.534
                                                         FLOW DISTRIBUTION (%) =     2.369   95.262
2.369

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...     CONVEYANCE     62018.624 2494101.801   62018.624
                            AREA        214.57      5046.34      214.57
                      HYD RADIUS        6.5509      14.6483      6.5509
   REACH...          Manning's N        0.0180       0.0180      0.0180
                         SQRT(L)       79.5739      79.5739     79.5739
   D/S SECTION...           AREA          0.00      5619.04        0.00
                      HYD RADIUS         0.000       13.652       0.000


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD         65.000      444.500       0.00000000            0.00000000
 SECTION NO.     66.000

  Cross Section Geometry (STA,ELEV)
       0.000    452.780        0.001    452.779        0.000    452.780       50.000    427.780
394.500    427.780
     444.499    452.779      444.500    452.780

 ****  22953.000    442.181    442.475    0.293     1.035    402.067    427.789    2.581    4.414
2.581
                                                         FLOW DISTRIBUTION (%) =     2.329   95.342
2.329

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...     CONVEYANCE     59164.008 2421719.514   59164.008
                            AREA        207.12      4957.95      207.12
                      HYD RADIUS        6.4362      14.3917      6.4362
   REACH...          Manning's N        0.0180       0.0180      0.0180
                         SQRT(L)      128.0625     128.0625    128.0625
   D/S SECTION...           AREA        214.57      5046.34      214.57
                      HYD RADIUS         6.551       14.648       6.551


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD         66.000      444.500       0.00000000            0.00000000
 SECTION NO.     67.000

  Cross Section Geometry (STA,ELEV)
       0.000    454.270        0.001    454.269        0.000    454.270       50.000    429.270
394.500    429.270
     444.499    454.269      444.500    454.270

 ****  22953.000    443.537    443.836    0.299     1.034    401.546    429.276    2.606    4.456
2.606
                                                         FLOW DISTRIBUTION (%) =     2.309   95.382
2.309

      REACH PROPERTIES BY STRIP            1            2            3
                 INEFF FLOW  EL     -99999.000  -99999.000  -99999.000
   U/S SECTION...     CONVEYANCE     57748.137 2385333.383   57748.137
                            AREA        203.39      4913.12      203.39
                      HYD RADIUS        6.3780      14.2616      6.3780
   REACH...          Manning's N        0.0180       0.0180      0.0180
                         SQRT(L)      128.0625     128.0625    128.0625
   D/S SECTION...           AREA        207.12      4957.95      207.12
                      HYD RADIUS         6.436       14.392       6.436


       SECTION NO    BED WIDTH   ACTIVE LAYER(tons)   INACTIVE LAYER(tons)
 OLD         67.000      444.500       0.00000000            0.00000000

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 SARDA FEEDER CHANNEL SIMULATION
        ACCUMULATED TIME (yrs)....        0.329
        FLOW DURATION (days)......      120.000

 UPSTREAM BOUNDARY CONDITIONS
 ---------------------------------------------------------------------------------
 Stream Segment # 1       |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
 Section No.      67.000 |     (cfs)      |  (tons/day)   |   (deg F)
```

```
-------------------------------------------------------------------------
                 INFLOW |     22953.00 |     256023.82 |         15.93
 ** Q ABOVE TABLE **
**INLOAD**
 **WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT**       -11475.00                0.00
1.000000

 Upstream of SECTION NO.      59.000 is...
 LOCAL INFLOW POINT # 7 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |     22953.00 |     256023.82 |         15.93
       LOCAL     INFLOW |    -11475.00 |    -125243.27 |          0.00
-------------------------------------------------------------------------
                  TOTAL |     11478.00 |     130780.55 |         31.85

 Upstream of SECTION NO.      41.000 is...
 LOCAL INFLOW POINT # 6 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |     11478.00 |     130780.55 |         31.85
       LOCAL     INFLOW |      1942.00 |      19007.02 |          0.00
-------------------------------------------------------------------------
                  TOTAL |     13420.00 |     149787.57 |         27.24
 ** Q ABOVE TABLE **
**INLOAD**
 **WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT**         -812.00                0.00
1.000000

 Upstream of SECTION NO.      37.000 is...
 LOCAL INFLOW POINT # 5 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |     13420.00 |     149787.57 |         27.24
       LOCAL     INFLOW |      -812.00 |      -8567.22 |          0.00
-------------------------------------------------------------------------
                  TOTAL |     12608.00 |     141220.34 |         29.00
 ** Q ABOVE TABLE **
**INLOAD**
 **WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT**        -5720.00                0.00
1.000000

 Upstream of SECTION NO.      23.000 is...
 LOCAL INFLOW POINT # 4 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |     12608.00 |     141220.34 |         29.00
       LOCAL     INFLOW |     -5720.00 |     -59933.25 |          0.00
-------------------------------------------------------------------------
                  TOTAL |      6888.00 |      81287.10 |         53.08
 ** Q ABOVE TABLE **
**INLOAD**
 **WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT**         -495.00                0.00
1.000000

 Upstream of SECTION NO.      19.000 is...
 LOCAL INFLOW POINT # 3 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |      6888.00 |      81287.10 |         53.08
       LOCAL     INFLOW |      -495.00 |      -5109.16 |          0.00
-------------------------------------------------------------------------
                  TOTAL |      6393.00 |      76177.94 |         57.19
 ** Q ABOVE TABLE **
**INLOAD**
 **WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT**         -283.00                0.00
1.000000

 Upstream of SECTION NO.      15.000 is...
 LOCAL INFLOW POINT # 2 |   DISCHARGE    | SEDIMENT LOAD | TEMPERATURE
                        |     (cfs)      |  (tons/day)   |   (deg F)
-------------------------------------------------------------------------
       MAINSTEM  INFLOW |      6393.00 |      76177.94 |         57.19
       LOCAL     INFLOW |      -283.00 |      -2784.29 |          0.00
-------------------------------------------------------------------------
                  TOTAL |      6110.00 |      73393.65 |         59.84
 ** Q ABOVE TABLE **
**INLOAD**
```

WATER DISCHARGE, WATER-SEDIMENT LOAD TABLE ENDPOINT -213.00 0.00
1.000000

Upstream of SECTION NO. 10.000 is...

LOCAL INFLOW POINT # 1	DISCHARGE (cfs)	SEDIMENT LOAD (tons/day)	TEMPERATURE (deg F)
MAINSTEM INFLOW	6110.00	73393.65	59.84
LOCAL INFLOW	-213.00	-2035.70	0.00
TOTAL	5897.00	71357.95	62.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
sARDA FEEDER CHANNEL SIMULATION
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	CLAY INFLOW	CLAY OUTFLOW	CLAY TRAP EFF	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
120.00	67.000	0.00			31648.07			41079.29		
	59.000	0.00			-15821.97			-19857.66		
	41.000	0.00			2349.53			3049.70		
	37.000	0.00			-1099.75			-1346.16		
	23.000	0.00			-7746.99			-9379.82		
	19.000	0.00			-670.41			-792.62		
	15.000	0.00			-383.29			-419.41		
	10.000	0.00			-288.48			-300.88		
TOTAL=	1.000	0.00	0.00	0.00	7986.71	7986.71	0.00	12032.44	7844.27	0.35

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.............	0.00	VERY FINE SAND....	153614.29
VERY FINE SILT....	0.00	FINE SAND.........	10240.95
FINE SILT.........	1280.12	MEDIUM SAND.......	2560.24
MEDIUM SILT.......	1280.12	COARSE SAND.......	0.00
COARSE SILT.......	87048.10	VERY COARSE SAND..	0.00
		TOTAL =	256023.82

SEDIMENT OUTFLOW from the Downstream Boundary

GRAIN SIZE	LOAD (tons/day)	GRAIN SIZE	LOAD (tons/day)
CLAY.............	0.00	VERY FINE SAND....	31721.76
VERY FINE SILT....	0.00	FINE SAND.........	53.55
FINE SILT.........	323.05	MEDIUM SAND.......	2.44
MEDIUM SILT.......	323.05	COARSE SAND.......	0.00
COARSE SILT.......	21967.48	VERY COARSE SAND..	0.00
		TOTAL =	54391.34

TABLE SB-2: STATUS OF THE BED PROFILE AT TIME = 120.000 DAYS

SECTION NUMBER	BED CHANGE (ft)	WS ELEV (ft)	THALWEG (ft)	Q (cfs)	TRANSPORT RATE (tons/day) CLAY	SILT	SAND
67.000	4.50	443.54	434.77	22953.	0.	89608.	164760.
66.000	3.41	442.18	429.19	22953.	0.	89608.	163911.
65.000	2.75	440.89	428.04	22953.	0.	89608.	163180.
64.000	2.49	440.42	429.88	22953.	0.	89608.	162632.
63.000	1.92	440.28	428.28	22953.	0.	89608.	162155.
62.000	1.06	439.32	425.52	22953.	0.	89608.	161708.
61.000	1.71	437.68	423.68	22953.	0.	89608.	161295.

60.000	1.16	435.45	422.34	22953.	0.	89608.	160911.
59.000	1.38	435.33	422.43	11478.	0.	44810.	80284.
58.000	1.05	434.26	420.95	11478.	0.	44810.	80099.
57.000	0.73	432.78	419.34	11478.	0.	44810.	79927.
56.000	0.50	431.29	417.82	11478.	0.	44810.	79765.
55.000	0.47	429.81	416.30	11478.	0.	44810.	79613.
54.000	0.44	428.33	414.78	11478.	0.	44810.	79470.
53.000	0.41	426.85	413.26	11478.	0.	44810.	79335.
52.000	0.39	425.37	411.75	11478.	0.	44810.	79207.
51.000	0.37	423.91	410.24	11478.	0.	44810.	79087.
50.000	0.35	422.45	408.73	11478.	0.	44810.	78973.
49.000	0.33	421.01	407.22	11478.	0.	44810.	78865.
48.000	0.31	419.57	405.71	11478.	0.	44810.	78762.
47.000	0.30	418.17	404.21	11478.	0.	44810.	78665.
46.000	0.28	416.83	402.70	11478.	0.	44810.	78573.
45.000	0.30	415.54	401.23	11478.	0.	44810.	78485.
44.000	0.52	414.51	400.10	11478.	0.	44810.	78399.
43.000	0.44	414.34	399.72	11478.	0.	44810.	78317.
42.000	0.49	413.09	398.58	11478.	0.	44810.	78240.
41.000	0.52	413.03	398.56	13420.	0.	51462.	90462.
40.000	0.26	411.25	396.55	13420.	0.	51462.	90342.
39.000	0.26	409.72	395.06	13420.	0.	51462.	90231.
38.000	0.48	408.08	393.82	13420.	0.	51462.	90129.
37.000	0.44	408.03	393.75	12608.	0.	48349.	84585.
36.000	0.21	406.36	392.03	12608.	0.	48349.	84500.
35.000	0.20	404.59	390.53	12608.	0.	48349.	84419.
34.000	0.18	402.62	389.02	12608.	0.	48349.	84343.
33.000	0.31	399.90	387.45	12608.	0.	48349.	84270.
32.000	0.55	400.00	380.10	12608.	0.	48349.	84199.
31.000	0.51	399.68	379.13	12608.	0.	48349.	84133.
30.000	0.53	399.21	379.12	12608.	0.	48349.	84070.
29.000	0.28	397.24	377.08	12608.	0.	48349.	84011.
28.000	0.30	395.93	373.84	12608.	0.	48349.	83955.
27.000	0.56	394.70	372.64	12608.	0.	48349.	83901.
26.000	0.25	394.78	379.99	12608.	0.	48349.	83850.
25.000	0.11	393.25	378.36	12608.	0.	48349.	83802.
24.000	0.18	391.10	376.52	12608.	0.	48349.	83756.
23.000	1.07	391.08	379.17	6888.	0.	26414.	45734.
22.100	0.97	390.56	381.62	6888.	0.	26414.	45350.
22.000	1.72	390.04	378.41	6888.	0.	26414.	45199.
21.000	2.26	388.51	376.34	6888.	0.	26414.	45163.
20.000	3.21	386.23	376.30	6888.	0.	26414.	44681.
19.000	0.32	386.19	374.20	6393.	0.	24516.	41440.
18.000	1.28	385.29	374.78	6393.	0.	24516.	40999.
17.000	2.15	383.79	377.64	6393.	0.	24516.	38949.
16.000	2.88	382.02	371.61	6393.	0.	24516.	38382.
15.000	2.03	380.48	369.73	6110.	0.	23430.	36675.
14.000	1.57	379.01	369.80	6110.	0.	23430.	35968.
13.000	2.04	377.39	365.79	6110.	0.	23430.	35954.
12.000	2.75	375.68	367.00	6110.	0.	23430.	35247.
11.100	1.33	374.48	364.38	6110.	0.	23430.	34971.
11.000	1.06	373.18	361.91	6110.	0.	23430.	34965.
10.000	0.13	372.84	354.27	5897.	0.	22614.	33740.
9.000	0.05	371.86	353.29	5897.	0.	22614.	33735.
8.000	0.03	370.18	351.78	5897.	0.	22614.	33730.
7.000	1.05	368.11	348.09	5897.	0.	22614.	33725.
6.000	1.05	368.14	355.63	5897.	0.	22614.	33721.
5.000	2.05	367.23	354.73	5897.	0.	22614.	33709.
4.000	2.61	365.70	357.80	5897.	0.	22614.	32435.
3.000	2.03	364.16	351.73	5897.	0.	22614.	32427.
2.000	1.66	362.58	352.87	5897.	0.	22614.	31781.
1.000	0.03	361.22	349.11	5897.	0.	22614.	31778.

```
$$END

      0   DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ =          1
TOTAL NO. OF WS PROFILES =              1
ITERATIONS IN EXNER EQ =             1380

COMPUTATIONS COMPLETED
RUN TIME =  0 HOURS,   0 MINUTES &   1.00 SECONDS
```