

# Appendix A: References

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# Appendix B: List of Variables

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- $\bar{n}$  = the composite n-value for the total where:
- $\bar{V}$  = average velocity
- $\bar{R}$  = the composite hydraulic radius
- $\gamma$  = unit weight of water
- $\gamma_s$  = unit weight of riprap
- $\gamma_w$  = unit weight of water
- $\Theta$  = Shield's parameter
- $\nu$  = kinematic viscosity of water - ft<sup>2</sup>/sec
- $\rho_f$  = density of fluid
- $\rho_s$  = density of sediment particles
- $\sigma$  = the geometric standard deviation of the sediment mixture, where
- $\tau$  = bed shear stress
- $\tau_c$  = critical shear stress
- A = area
- $A_i$  = cross-sectional area of panel i,  $\Delta X D_i$
- B = effective width of flow (width of portion of cross section which is transporting sediment)
- C = Chezy coefficient; also bed-material sediment concentration - in parts per million
- $C_B$  = bend correction for average velocity ( $V_{SS}/V_{AVE}$ )
- CH = channel
- $C_i$  = the panel Chezy roughness coefficient
- $C_S$  = Coefficient of incipient failure
- $C_T$  = coefficient for riprap thickness
- $C_V$  = vertical velocity coefficient
- D = depth, ft; or local water depth; or effective depth of flow; or water depth
- $d_{30CR}$  = Critical  $d_{30}$  (i.e. minimum  $d_{30}$ ) size for stable riprap
- $d_{50}$  = median grain size of bed material, mm, or the particle size for which 50% of the sediment mixture is finer.
- $d_{84}$  = the particle size, ft, for which 84% of the sediment mixture is finer (Data ...
- $d_e$  = effective particle size for the mixture
- $D_i$  = average depth in the panel i,  $\frac{1}{2}(A+B)$
- $d_s$  = geometric mean of particles in size class i
- EFD = Effective Depth of the cross section
- EFW = Effective Width of the cross section
- $f(X_1)$  = is the difference between the calculated depth for  $X_1$  and the true depth, or between  $Q_{true}$  and the calculated Q for  $X_1$

$f(X_2)$  = is the difference between the calculated depth for  $X_2$  and the true depth,  
 or between  $Q_{true}$  and calculated  $Q$  for  $X_2$

$F_B$  = bed factor  
 $F_g$  = grain Froude number.  
 $F_s$  = side factor  
 $g$  = acceleration of gravity - ft/sec<sup>2</sup>  
 $G_{sf}$  = grain shape factor  
 $G_{s_i}$  = transport rate for size class  $i$   
 $i$  = panel number  
 $i_b$  = fraction of size class  $i$  in bed  
 $k$  = number of panels  
 $K$  = conveyance  
 $K_1$  = Correction for side slope steepness  
 LCB = left channel bank  
 LOB = Left overbank  
 $n$  = Manning's  $n$  value  
 $n_i$  =  $n$ -value in wet panel  $i$   
 $P_i$  = Wetted perimeter in wet panel  $i$   
 $Q$  = water discharge, cfs  
 $R$  = hydraulic radius of the bed portion of the cross section, ft  
 RCB = right channel bank section  
 $R_i = A_i / P_i$   
 $R_n$  = Reynolds number,  $4RV/v$   
 ROB = right overbank  
 $S$  = slope; bed slope or energy slope  
 $S_e$  = energy slope  
 $S_f$  = Safety factor  
 $s_s$  = specific gravity of sediment particles.  
 $T$  = temperature of fluid  
 $U_*$  = boundary shear velocity,  $\sqrt{gRS}$   
 $V$  = average flow velocity  
 $V_{AVE}$  = average channel velocity  
 $W$  = channel width, ft; or bottom width  
 $X_1$  = is the first trial value of  $Q$ , or of  $k_s$   
 $X_2$  = is the second trial value of  $Q$ , or of  $k_s$   
 $X_3$  = is the next trial value of  $Q$ , or of  $k_s$   
 $z$  = side slopes of the channel

# Appendix C: Data Records for Hydraulic Calculations

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## GENERAL NOTES

The following are conventions used in the record descriptions in this appendix.

- a1.@!        These characters in the "value" column means that any alpha or numeric characters can go in that field; generally it is a comment field.
  
- b             This character in the "value" column indicates a blank field.

Records that are not available in SAMwin are still useable -- use an editor to insert the record into a data file and execute the program from the "RUN" dropdown menu of the SAMwin main menu.

## T1 RECORDS

Up to 10 title records are permitted. These records are for the user's information only and are therefore optional. TI is also an acceptable record identification for title records.

Example:

```
T1    Use these title cards to define the job, the date, the Investigator, the
T1    model #, the data source, the purpose for this run, and changes from
T1    previous runs.
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		T1 or TI	Record Identification in columns 1 and 2. TI is preferred.

## F# RECORDS

Marks each data field by column numbers, each field being 8 columns wide. There can be only 1 F# record. This record is for the user's information only and is therefore optional. This record is not always printed to the output file.

Example:

```
T1      Title cards
T1      Title cards
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		F#	<u>Record</u> Identification in columns 1 and 2.

## TR RECORD

**SAMwin** – only fields 1 and 2 of the first TR record are used.

The TR record controls the printout and selects the Compositing Method. There can be up to 2 TR records.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
TRKSW(1) KSW(2) KSW(3) KSW(..)
```

```
TR          1
```

**Note:** The equal velocity method is suggested for cross sections with rough vertical walls or steep side slopes. See Chapter 2. Also see Chapter 2, “Compositing compound channels and overbanks,” for further guidance on choosing a compositing method.

Field	Variable	Value	Description
0		TR	Record Identification = TRace printout.
		TR	Record Identification for continuation record.
1	KSW(1)		Method for Compositing Hydraulic Radius and n-values:
		b,1	Composite by Alpha Method.
		2	Composite by equal velocity method.
		3	Composite by total force method.
		4	Composite by conveyance method.
2	KSW(2)	1	Print out flow distribution in each panel.
3	KSW(3)		Trace... Normal depth calculations.
4	KSW(4)		Trace... Fixed-bed bottom width calculation.
5	KSW(5)	1	Trace... CI-Option (Subroutine gmsex.for)
6	KSW(6)	1	Trace... Alpha Method for Compositing Hydraulic Radius and n-values
7	KSW(7)	1	Trace... Brownlie Method
8	KSW(8)	1	Trace... Trapezoidal Integration, (Subroutine tzin.for).
9	KSW(9)	1,2	Trace... Copeland's analytical method for width, depth and slope.
10	KSW(10)		Trace... Riprap Design Computations
11	KSW(11)		Trace... Water Discharge Calculations.
12	KSW(12)		Trace... n-Value Calculations.
13	KSW(13)		Trace... Slope Calculations.
14	KSW(14)		Trace... Reading Input

## CT RECORD

The CT Record is an option for prescribing simple rectangular, triangular or trapezoidal, channel cross sections. Invert elevation is always 0.0. A gage zero (GZ) record can be used to convert output to actual elevations. Up to 3 CT records can be stacked to form a complex geometry. For Bottom Width calculations, the number of discharges coded on the QW record must equal the number of CT records in the data file.

If riprap design is desired, include RR and RT records. Be sure to also include the PF record. Riprap is calculated only if the bed is not stable, and the program uses D50 in Shield's curve to test for stability.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
CT  BW      CD      SSL      SSR  NEQBED  KsBED  NEQBKL  KSBKL  NEQBKR  KSBKR
CT  120      10      3        3        4          1      .25      1      .25
```

Field	Variable	Value	Description
0		CT	<u>Record</u> Identification = Channel Template.
1	BW	0,+ b	Bottom <u>width</u> , ft. Program calculates bottom width for the prescribed hydraulic parameters.
2	CD	-,0,+	Bank height, ft.
3	SSL	+ b	Side <u>Slope</u> , Left side of channel facing downstream, 1V:[_]H. <u>Default</u> = 0.
4	SSR	0,+ b	<u>Side Slope</u> , Right side of channel facing downstream, 1V:[_]H. <u>Default</u> = 0.
5	NEQBED	0,+ b,0	<u>Equation</u> Number for the n-value calculation on the channel bed. <u>value</u> coded in KSBED(CT-6) is n-value.
		1	Keulegan <u>Equation</u> . Program expects Ks value for bed (CT-6).
		2	Strickler n- <u>value</u> equation. Program expects Ks value for bed (CT-6).
		3	Limerinos n- <u>value</u> equation. Program expects a D84, either on a BR record (not available in SAMwin) or calculated from a PF record.
		4	Brownlie <u>bed</u> roughness equations. Program expects a D84, either on a BR record or will be calculated from a PF record.
		5	SCS Grass lining, type E.
		6	SCS <u>grass</u> , type D.

CT RECORD, continued

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
		7	SCS grass, type C.
		8	SCS grass, type B.
		9	SCS grass, type A.
6	KSBED	+	<p>If NEQBED =0, Code the Manning n-value here.</p> <p>If NEQBED =1 or 2, Code the surface roughness for the bed, ft, here.</p> <p>If NEQBED =3 or 4, This field can be blank, but program expects BR or PF record to prescribe the bed surface gradation. The BR record is not available in SAMwin.</p> <p>If NEQBED =5 thru 9, This field can be blank.</p>
7	NEQBKL	0,+	Equation Number for the n-value calculation on LEFT bank. Same rules apply as described for NEQBED.
		b	Manning n-value is coded in field 8.
8	KSBKL	+	Hydraulic roughness for the LEFT bank. Same rules apply as described for KSBED.
9	NEQBKR	0,+	Equation Number for the n-value calculation on RIGHT bank. Same rules apply as described above for NEQBED.
		b	Manning n-value is coded in field 10.
10	KSBKR	0,+	Hydraulic roughness for the RIGHT bank. Same rules apply as described above for KSBED.

## CI RECORD

### Not available in SAMwin.

The CI Record provides input for the channel improvement option. This option simulates the modification of cross section data, GR records, by a trapezoidal excavation. Up to 3 CI records are allowed. The channel improvements are performed in the order that the records are specified.

**Note:** HEC-2 allows the natural channel to be filled prior to excavation if desired, see variable BW. Low areas of the natural cross section may be filled by the sediment option in HEC-2. But neither of these options are available in SAM at this time.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
CI CLSTA  CELCH XLCH.CN  XLSS  RSS  BW
CI 50 -15 2 2 20
```

Field	Variable	Value	Description
0		CI	Record Identification = Channel Improvement.
1	CLSTA	+	Station of centerline of trapezoidal channel excavation expressed in terms of the stations used in the natural cross section descriptions, on the GR records.
		-1	Program determines CLSTA to be halfway between bank stations.
2	CELCH	+ or -	Elevation of channel invert, but not -1.
		-1 .1>=CELCH>=.00001	Elevation of channel invert is equal to minimum elevataion in cross section Elevation of channel invert is based on CELCH (slope) and XLCH.CN (channel reach length). This is an HEC-2 option and is <u>NOT NEEDED IN SAM</u> .
3	XLCH.CN	0 or +	New channel reach length and n-value for HEC-2. ( <u>NOT NEEDED IN SAM</u> )
4	XLSS	0	Left side slope will be vertical.
		+	Left side slope of excavation, 1V:[_]H.
5	RSS	0 or +	Right side slope of excavation, 1V:[_]H, same as for left side.
6-10	BW	+	Bottom width of channel. Same as + but the old channel will be filled up to an elevation equal to the minnum bank elevation. This HEC-2 option NOT YET working in SAM.
		.01	Signals the program to stop modifications. This HEC-2 option <u>NOT NEEDED IN SAM</u> .

## X1 RECORD

This record is used to prescribe the cross section location and the program options which are applicable to that cross section. Since SAMwin looks at only one cross section, there may be only 1 X1 record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
X1  ASN      NXY    STCHL   STCHR
X1  22.5      9      337     387
```

Field	Variable	Value	Description
0	ICG,IDT	X1	Identification characters = X-Section.
1	RMILE	-,0,+	River Mile, for identification only, not for measuring distance.
2	NXY	+	Total number of coordinate points on the following GR record set.
3	STCHL	-,+	The station of the left bank of the channel. Use top bank so the bank roughness will be included in the composite n-values for the channel. The value <u>MUST</u> equal one of the station values on GR record.
4	STCHR	+	Station of the right bank of the channel. Same rules as for STCHL above.

## GR RECORD

This record is used when coding cross sections by coordinate point (Elevation, Station). Code stations in increasing order. Negative values are permitted, in which case "increasing order" means "the positive direction of the x-axis." A maximum of 20 GR records is allowed.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
GR EL(1) STA(1) EL(2) STA(2) EL(3) STA(3) EL(..) STA(..)

GR4496.0      0 4494.5      52 4495.3      146 4493.9      266 4492.2      337
GR4490.3     348 4490.3     360 4489.7     367 4495      387
```

Field	Variable	Value	Description
0	ICG,IDT	GR	Record Identification = GRound co-ordinates
		GR	Record Identification for continuation records, also.
1	EL(1)	-,0,+	Elevation of first coordinate, in ft.
2	STA(1)	-,0,+	Station corresponding to EL(1), in ft.
3	EL(2)	-,0,+	Elevation of second coordinate.
4	STA(2)	-,0,+	Station corresponding to EL(2).
.			
.			
.			
10	STA(10)	-,0,+	Station corresponding to EL(9).

Continue for up to 100 points. Each continuation record is identified with GR, and the format is identical for all records.

## GL RECORD

### Not available in SAMwin.

This Record is used to prescribe reach lengths, if necessary. There can be up to 10 GL records.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
GLTZL(1) TZL(2) TZL(3) TZL(...)
```

```
GL 500 1000 1500
```

Field	Variable	Value	Description
0	ICG,IDT	GL GL	Record Identification = Reach Length. Record Identification on continuation records also.
1	TZL(1)	+ b(1)	Reach length for panel 1 in the cross section. There is no default for panel 1.
2	TZL(2)	+	Reach length for panel 2.
3	TZL(3)	+	Reach length for panel 3.
4	TZL(...)	+	Code as necessary.

If the cross section contains more than 10 panels, continue coding lengths using field 1 on each continuation GL record. The number of values needed by the program is NXY-1. However, the program will supply missing values by linear interpolation between values which are coded.

## NE RECORD

This record is used with the HEC-2 format (i.e. X1-GR records) to prescribe the n-value (i.e. hydraulic roughness) equation to use in each “panel” across the section. There must be NXY-1 values. Code the number from the following list of n-value equations. See Table 4, Characteristics of Grass Cover, Chapter 2, for details on the grass equations.

- 0 = Manning n-values are coded.
- 1 = Keulegan equations
- 2 = Strickler Equation
- 3 = Limerinos Equation
- 4 = Brownlie Bed Roughness Predictor
- 5 = Grass lining, Type E
- 6 = Grass lining, Type D
- 7 = Grass lining, Type C
- 8 = Grass lining, Type B
- 9 = Grass lining, Type A

**Do not mix KN and KS records at this time.**

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
NE EQNV1 EQNV2 EQNV3 EQNV( . . )

NE 5 5 2 2 2 3 3 1
```

Field	Variable	Value	Description
0	ICG,IDT	NE NE	Record Identification = N-value Equations Record Identification on continuation records also.
1	EQNV		Roughness equation for panel 1.
		0	Manning's n-value will be coded for panel 1 on a KN record. (Note: It will be read and converted to Strickler's Ks. Equation 2, from the above list, will then be used in the computations.)
		1	Keulegan Equations. Program expects Ks value for panel 1 (KS record).
		2	Strickler n-value equation. Program expects Ks value for panel 1 (KS record).
		3	Limerinos n-value equation. Program expects Bed Gradation Data (PF records)
		4	Brownlie bed roughness equations. Program expects Bed Gradation Data. (PF records)

SCS Grass lining, type E. See Text for details.

NE RECORD, continued

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
		6	SCS grass lining, type D. etc...
		7	SCS grass lining, type C.
		8	SCS grass lining, type B.
		9	SCS grass lining, type A.
2	EQNV	+	Roughness equation for panel 2.
		b,0	If Manning's n-values are being used, the default is 0. However, if Manning n-values are not being used, the program considers blank and 0 as missing data and will supply the equation number from the n-1 panel.
3	EQNV	+	Continue coding RTYPE values until there is one for each panel in the cross section. Begin in Field 1 of each record.

## KS RECORD

This record is used to prescribe the effective roughness height when calculating n-values from the Keulegan or Strickler equations, when coding cross sections in HEC-2 format, (i.e. X1-GR records). A roughness value is needed in each panel across the section, i.e. between each pair of coordinate points on the GR record. There can be up to 10 KS records.

**NOTE:** Limerinos, Brownlie and the Grass equations are not to be used with negative roughness values because there is nothing to calculate — the roughness is implicitly determined by the bed gradation or the grass.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
KS KS(1) KS(2) KS(3) KS(...)
```

KS .4 10 .007

Field	Variable	Value	Description
0	ICG,IDT	KS KS	Record Identification = Effective Roughness. Code on continuation records, also.
1	KS(1)	+  b,0  -	Effective roughness height-ft in panel 1.  There is no default for panel 1.  The negative is a flag for the program, telling it to make the hydraulic roughness calculations. The absolute value of the number in the field tells the program the ratios of roughness in that element to the composite roughness.
2	KS(2)	+  b -	Effective Roughness height, ft, in panel 2.  The value for KS(1) is used. See description for field 1.
3	KS(3)	+	Continue coding Ks values until there is one for each panel in the cross section. There will be up to NXY-1 values. The program will supply missing values using the rule: KS(N) = KS(N-1). However,

**NOTE:** Currently the above does not work, and  
**data for all fields should be supplied by the user.**

Continue in field 1 on continuation records.

## KN RECORD

This record is used to prescribe the Manning's n-value, n-value equation number 0, when coding cross sections with X1-GR records. An n-value is needed in each panel across the section, i.e. between each pair of coordinate points on the GR record. There may be up to 10 KN records per cross section.

**NOTE:** If the NE record has equation number 0 and others on it, KS record values can be put on a KN record.

**NOTE:** Limerinos, Brownlie and the Grass equations are not to be used with negative roughness values because there is nothing to calculate — the roughness is implicitly determined by the bed gradation or the grass.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
KN KN(1)  KN(2)  KN(3)  KN(..)
KN  .05      .04      .04      .04      .04      .04      .04      .04      .04      .04
KN  .018
```

Field	Variable	Value	Description
0		KN	Record Identification = Roughness, Manning's n-values.
		KN	Record Identification on continuation records also.
1	KN(1)	+	Manning's n-value in panel 1.
		b(1)	There is no default for panel 1.
2	KN(2)	+	Manning's n-value in the panel 2.
		b	The value for KN(1) is used.
3	KN(3)	+	Continue coding n-values until there is one for each panel in the cross section. There will be up to NXY-1 values. The program will supply missing values using the rule: KN(N) = KN(N-1).

**NOTE:** Currently the above does not work, and  
**data for all fields should be supplied by the user.**

Continue in field 1 on continuation records.

## PF RECORD

This record prescribes the gradation of the bed sediment reservoir at a cross section. Code Continuation records as **PFC** records. It is not necessary that a PF coordinate correspond to a class interval boundary although it can. Otherwise, semilog interpolation is used to calculate the percent finer at each class interval boundary. These are then subtracted to calculate the fraction of sediment in each size class. The program assigns a percent finer = 100 to correspond with DMAX. There can be up to 18 data points, i.e., 1 PF and 3 PFC records.

The data **MUST** be coded in decreasing order; i.e., the largest grain size (after DMAX) and corresponding percent are to be coded in fields 5 and 6, respectively.

Example:

F#	45678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678
PF	cmt	ASN	SAE	DMAX	DAXIS	PFXIS	DAXIS	PFXIS	DAXIS	..etc
PF		308.0	1.0	18.29	9.14	95.0	1.0	94.2	.5	78.0
PFC	.25	46.7	.125	14.3	.0625	9.9	.004	4.9		

Field	Variable	Value	Description
0	ICG,IDT	PF PFC	Record Identification = Percent Finer Record Identification = Continuation record
1	ISI	1234	Comment field for PF record-use numeric characters only.
	DAXIS	+	For PFC (continuation) records, code the particle diameter, mm.
2	RMILE	-,0,+,b	Identifier of this Cross Section (ie, River Mile); this field is optional.
	PFXIS	+	For PFC records, code the percent finer.
3	SAE	b	SAE is not needed for this code, but it is provided for compatibility with HEC-6.
	DAXIS	+	For PFC records, code the particle diameter, mm.
4	DMAX	+	The diameter of the maximum particle size,in mm.
		b	Not allowed -- ALWAYS code a value.
	PFXIS	+	For PFC records, code the percent finer.
5	DAXIS(2)	+	On the PF record, this is the first coordinate point down the percent finer curve from DMAX. If this particle size is larger than 64 MM, choose a point that will approximate the PF curve with 2 straight line segments from DMAX to 64mm.
6	PFXIS(2)	0,+	The percent finer corresponding to DAXIS(2). Code as a percent.
7	DAXIS(3)	0,+	Continue to code points from the percent finer curve, with the DAXIS in the odd-numbered fields and the PFXIS in the even-numbered fields. Up to 16 points, including the DMAX point, are permitted. Use a continuation record when coding more than 4 points.

## BR RECORD

### Not available in SAMwin.

This Record is used to prescribe the D50 and the Geometric Standard Deviation of the bed sediment. Only 1 BR record is permitted.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
BR d84 d50 d16 DQDT SPGS
BR 2.0 .35 .125
```

Field	Variable	Value	Description
0	ICG,IDT	BR	Record Identification = BRownlie parameters.
1	D84	+	D84 of the bed surface in mm.
2	D50	+	D50 of the bed surface in mm.
3	D16	+	D16 of the bed surface in mm.
4	DQDT		Rate of change of the water discharge hydrograph. i.e. rising side or falling side. (The Discharge at which the bed regime will transition from lower to upper and back, is different on the rising side and the falling side of the hydrograph.)
		-1	Use the upper regime equation to define this point in the transition zone.
		0	The default. Use the equation which is closest to the current point in the transition zone.
		+1	Use the lower regime equation to define this point in the transition zone.
5	SPGS	+	Specific Gravity of sediment particles.
		b	Default = 2.65

## RC RECORD

### Not available in SAMwin.

This Record is used to prescribe the cost-in-place per ton of each riprap size in the Standard Gradation Table. See Chapter 2 for more details. The program expects 13 values. For quarry run stone, code on the RQ record.

#### Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
RC RC(1) RC(2) RC(3) ... max is RC(13)

RC .5      1      1.5    2.0    2.5    3      4      5      6      7
RC 8      9      10
```

Field	Variable	Value	Description
0	ICG,IDT	RC	Record Identification = Riprap Cost
1	RC(1)	+	Riprap cost for the first size of riprap in the Standard Gradation table.
2	RC(2)	+	Riprap cost for the second riprap size.
.			
.			
.			
n	RC(3)	+	Program expects up to 13 values -- one for each riprap size in the Standard Gradation Table.

## RQ RECORD

**Not available in SAMwin.**

This Record is used to describe quarry run riprap gradation. There can be up to 5 RQ records. The gradations should be entered one size per record starting with the smallest and ending with the largest size. When this information is present, riprap size computations use the quarry run stone. When quarry run stone is prescribed, those stone sizes are used in lieu of the gradation tables encoded in SAM.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
RQDMAXRR D90RR D50RR D30RR PORRAP RRCPT
RQ 24.0 17.7 14.4 7.9 38
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	ICG,IDT	RQ	Record Identification = Riprap - Quarry run.
1	DMAXRR	+	Dmax for the quarry run riprap, in inches.
2	D90RR	+	D90 for the quarry run riprap, in inches.
3	D50RR	+	D50 for the quarry run riprap, in inches.
4	D30RR	+	D30 for the quarry run riprap, in inches.
5	PORRAP	b	Porosity, volume of voids divided by total volume expressed as percent. Default = 38.
6	RRCPT		Unit cost for the quarry run stone in place, \$/ton.

## RR RECORD

This record is used to prescribe the general design parameters needed in sizing the riprap. There can be only 1 RR record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
RR SGRR BENDR BENDA NTRAP SAFEF CIFRRS

RR 2.48 600 1
```

Field	Variable	Value	Description
0	ICG,IDT	RR	Record Identification = RipRap properties
1	SGRR	+ b,0	Specific gravity of the riprap Default = 2.65.
2	BENDR	+ b,0	Bend radius in feet. Default = Straight channel.
3	BENDA	+	LEAVE BLANK
4	NTRAP	1 b,0	Trapezoidal Cross Section in a bend - not a natural river bend. Default = Cross section is a natural riverbend.
5	SAFEF	b,0 +	Safety factor above failure. Default is recommended. Default = 1.1, the EM value. Enter your own safety factor.
6	CIFRRS	b,0 +	Multiplier to calculate the stability coefficient of incipient failure ratio for rounded rock from the stability coefficient of incipient failure for angular rock (Coefficient of incipient failure ratio for rounded stone). Default = 1.25, the EM value. Enter your own value.

When making riprap calculations in the cross-section-shape option, it is important that the side slope protection be defined as a single panel in the geometry input. SAM will use 0.8 times the maximum depth in the panel for the local flow depth in the riprap equation. When a bend radius is specified, SAM uses the average velocity in the cross section in the riprap equation. When a bend radius is not specified, SAM uses the calculated panel velocity in the riprap equation. Careful study of the recommendations and guidelines described in EM 1110-2-1601 should be considered essential. Also see Chapter 2, "Riprap Size for a Given Discharge and Cross Section Shape."

**NOTE:** In each panel designated as having riprap, the hydraulic roughness equation is automatically changed to the Strickler equation with the Strickler coefficient set equal to 0.034. Normal depth is calculated for the resulting n-values. The alpha method is used to calculate normal depth and flow is distributed across the section. The riprap size equation is solved for each panel. When the resulting size is stable in each panel, riprap computations are finished. Otherwise, computations move to the next larger riprap size and the procedure is repeated. After the stable stone size is determined, a stage discharge curve is calculated for the riprapped channel. The Strickler coefficient, which was 0.034 when determining stone size, is increased to 0.038 in this calculation for flow capacity. This calculation determines the rating curve with the selected riprap in place.

## RS RECORD

This record is used to prescribe the general design parameters needed to calculate the size of riprap when velocity and depth are known. There can be only 1 RS record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
RS  VAVG      WS      SSL  SUMWWS      RSEC
RS  6.48      12      2    600        1
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	ICG,IDT	RS	Record Identification = Riprap Size.
1	VAVG	+	Water velocity, fps, over toe.
2	WS	+	Water depth over toe.
3	SSL	+ b	Side Slope (Bank slope) of revetment (1V:[Z]H). Default = 1.5
4	SUMWWS	+ b	Water Surface Width. Required if in a bend. Default = D*Z
5	RSEC	+ b -	Ratio of riprap layer thickness to DMAX. Default = 1.*Dmax A flag for the program to use rounded stone.

## RT RECORD

This record is used to prescribe the riprap thickness across each panel in the cross section. Only those panels having a positive RT value will get riprap. There can be up to 10 RT records.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
RT RT(1) RT(2) RT(3) RT(...)
```

```
RT      1      0      1
```

Field	Variable	Value	Description
0	ICG, IDT	RT RT	Record Identification = Riprap Thickness Record Identification for continuation records, also.
1	RT(1)	+ b,0 -	Riprap thickness in panel 1 expressed as the ratio times Dmax, i.e. [RT]*DMAX. Values usually range from 1 to 1.5. Default = no riprap. Indicates cobbles, i.e., rounded stone.
2	RT(2)	+ b,0 -	Thickness of riprap in panel 2. Default = no riprap. Indicates cobbles, i.e., rounded stone.
3	RT(3)	+,-,b	Continue coding RT values as above until there is one for each panel in the cross section. The program will accept NXY-1 values.
.	.	.	.
11	RT(11)	+,-,b	There are only 10 fields on a record. For panel 11, code in field 1 of the second RT record.

## BL RECORD

### Not available in SAMwin.

This Record is used to request the BLENCH REGIME values for width, depth and slope using equations shown on pp 127-128 of ASCE Manual 54, "Sedimentation Engineering." There can be only 1 BL record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
BL      FS

BL      .2
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	ICG,IDT	BL	Record Identification = BLench Regime parameters.
1	FS		"Side Factor" which measures the tendency of the bank to resist erosion.
		.1	Sand banks, very little resistance to erosion.
		.2	Silty clay-loam banks, moderate resistance to erosion.
		.3	Tough Clay banks, high resistance to erosion.
			<b>Default = 0.2</b>
2	REGCON +		Bed-material sediment concentration.
			<b>Default = 0.0</b>

NOTE: The bed factor needed for the Blench equation, the variable FB, defaults to 0.95, which corresponds to a  $d_{50}$  of 0.25mm. This variable will be calculated if there is a PF record in the data set.

## QW RECORD

This record is used to prescribe water discharge(s). **Caution:** They must be coded from the smallest to the largest to plot rating curves. Only 1 QW record is permitted.

**NOTE:** For the Bottom Width calculations only, the number of discharges prescribed must equal the number of CT records in the data file.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QW Q(1)   Q(2)   Q(3)  Q(...)
```

```
QW   10    100    1000   10000   20000   23750
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QW	Record identification = Water Discharge
1	Q(1)	+	Enter water discharge in cfs.
2-10	Q(2)-Q(10)	+	Up to 10 discharges may be entered.

## WS RECORD

This record prescribes the water surface elevations. Same rules apply as for discharges coded on the QW record. There can be only 1 WS record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
WS WS(1)  WS(2)  WS(3) WS(...)
```

```
WS    402      405    410.3
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		WS	Record identification = Water Surface elevation.
1	WS(1)	+	Enter the value that goes with Q(1) when a water surface elevation is needed; enter the value in feet
2	WS(2)-WS(10)	+	Enter the water surface elevation for Q(2)-Q(10).

## GZ RECORD

### Not available in SAMwin.

The GZ Record is an option which allows a gage zero elevation to be input and subtracted from all water surface elevations to provide water depth. This is sometimes useful when working with CT records. There can only be 1 GZ record.

#### Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
GZ  GZRO

GZ 129.7
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		GZ	Record Identification = Gage Zero
1	GZRO	+	Gage zero reading.

## ES RECORD

This record prescribes the energy slope, in ft/ft, corresponding to each discharge on the QW record. A slope is needed for each Q(i) on the QW record, but the program will fill in missing values, so it is only necessary to code those which change. There can be only 1 ES record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
ES S(1) S(2) S(3) S(...)
```

ES284E-6 .000174 .000170

Field	Variable	Value	Description
0		ES	Record identification = Energy Slope
1	SLOA(1)	+	Energy slope corresponding with Q(1). If field width does not permit sufficient accuracy, code in scientific notation as shown above. If 3 significant digits do not provide sufficient accuracy, code a dummy Q in the first field and begin the real problem in field 2.
2-10	SLOA(2)-SLOA(10)	+	The slope can change with each Q on the QW record. However, the program will fill in missing values using the rule, ES(I)=ES(I-1) so only those which change must be coded.

## WT RECORD

This record is used to prescribe the water temperature, degrees Fahrenheit. There can be only 1 WT record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
WT WT(1)  WT(2)  WT(3) WT(...)
```

```
WT    55      60      75
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		WT	Record identification = Water Temperature.
1	WT(1)	+ b	Water temperature for Q(1). Default = 60.
2-10	WT(2)-WT(10)	+	A water temperature is needed for each water discharge, but only those values which change must be coded. The program will supply missing values using the rule: WT(I) = WT(I-1).

## GC RECORD

The GC Record initiates Copeland's Analytical stable channel dimensions computations. In SAMwin, only one GC record is allowed per data set. If the input file is edited and run outside SAMwin, up to 10 GC records may be stacked in one job.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
GC   Q  CONPPM   SLOV   SSLAM   SSRAM  NEQLAM  BANKKL  NEQRAM  BANKKR  FIXBAM

GC 3680           .00162     3     3     2     .7     2     .7
GC 4850           .00162     3     3     0     .050   0     .050
```

Field	Variable	Value	Description
0		GC	Record Identification = Geometry by Copeland's method
1	Q	+	Water discharge in cfs.
2	CONPPM	+	Design sediment concentration in PPM.
		-1,b,0	Program will calculate the DESIGN SEDIMENT CONCENTRATION for the DESIGN WATER DISCHARGE, Q(GC-1); i.e., all concentrations will be calculated from the supply reach parameters.
		-Q	When a negative value other than 1 is coded, it is interpreted as the water discharge to use for calculating the DESIGN SEDIMENT CONCENTRATION, i.e., the water discharge for the approach reach.
			NOTE: Channel geometry and gradation of bed sediment, CT and PF records, must be supplied for the approach channel when concentrations are to be calculated.
3	SLOV	0,+	Valley slope, used as the maximum feasible slope, in ft/ft.
4	SSLAM	0,+	Side Slope, left side of channel facing downstream, 1V:[_]H.
5	SSRAM	0,+	Side Slope, right side of channel facing downstream, 1V:[_]H.
6	NEQLAM		Code the equation number for the n-value calculation, left bank of project channel. Note that only the Manning and Strickler equations are available for bank roughness calculations in this option.
		b,0	value coded in BANKKL(GC-7) is n-value.
		2	value coded in BANKKL(GC-7) is $K_s$ for Strickler n-value equation. For riprap, $k_s$ should be set equal to the minimum design $d_{90}$ .
7	BANKKL	0,+	Hydraulic roughness value, left bank If NEQLAM = 0 Code as Manning n-value. If NEQLAM = 2 Code the surface roughness, $K_s$ -ft. For riprap, $k_s$ should be set equal to the minimum design $d_{90}$ .

GC RECORD, continued

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
8	NEQRAM		Code the equation number for the n-value calculation, right bank of project channel, same rules as for field 6.
		b,0	value coded in BANKKR(GC-9) is n-value.
		2	value coded in BANKKR(GC-9) is "Ks" for Strickler n-value equation.
9	BANKKR	0,+	Hydraulic roughness, right bank.  If NEQRAM = 0 Code as Manning n-value.  If NEQRAM = 2 Code the surface roughness, Ks-ft.
10	FIXBAM	+	Option to prescribe width for median position in Table of Stable Channel Dimensions. FIXBAM/10 = incremental width used in same table.

## GB RECORD

The GB record provides options when using Copeland's Analytical stable channel dimensions computations. Only one record is allowed. The user can make these calculations using a sand bed or a gravel bed equation, and can apply the Cowan multipliers to either. If sandbed calculations are to be made, and the defaults for the Cowan method to increase channel roughness are used, no GB record is necessary. This record is optional.

Note the defaults.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
GB  MTC    COWM   COWXN  COWMAX  COWXNAX
GB   10     1.2           1.1
```

Field	Variable	Value	Description
0	GB		Record Identification = Gravel Bed option parameters
1	MTC		Sets the equations to be used:
		0	Sandbed calculations using the Brownlie equation No DEFAULT
		10	Gravelbed calculations using the Meyer-Peter Muller equation
2	COWM	+	Cowan meander multiplier, for the <b>study</b> reach. DEFAULT = 1.0
3	COWXN	0,+	Increase in n-value for surface irregularities, variation in channel cross section and obstructions, for the <b>study</b> reach. DEFAULT = 0.0.
4	COWMAX	+	Cowan meander multiplier, for the <b>supply</b> reach. DEFAULT = 1.0
5	COWXNAX	0,+	Increase in n-value for surface irregularities, variation in channel cross section and obstructions, for the <b>supply</b> reach. DEFAULT = 0.0

## MG RECORD

The MG record sets parameters for the meander calculations. Only one record is allowed.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
MGXLAMDA      XML
MG      10      1.2
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	MG		Record Identification = Meander Geometry Calculations
1	XLAMDA	+	Wavelength – the length of one full meander, along the valley. Must be shorter than the meander length.
2	XML	+	Meander Length – the actual length of the channel.

## IE RECORD

### Not available in SAMwin.

The IE Record allows the user to specify ineffective flow area in the overbanks. If an elevation is given in fields 1 and/or 3, all water is confined to the channel, as defined by variables STCHL and STCHR on the **X1** record, until the calculated water surface elevation exceeds the elevations given by EMIN. This record can be used only with the X1/GR-type geometry. Only 1 IE record is allowed, and may not be used with an IQ record.

#### Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
IEEMIN(1) EMIN(2) EMIN(3)
IE 342 344
```

Field	Variable	Value	Description
0		IE	Record Identification = Ineffective flow area by Elevation.
1	EMIN(1)	-,0,+	Left overbank limiting elevation for ineffective flow area calculations.
2	EMIN(2)	b	Leave this field blank. The printout will show the "Ineffective Flow Elevation" for the channel, strip 2, to be -9999, the default.
3	EMIN(3)	-,0,+	Right overbank limiting elevation for ineffective flow area calculations.

## IQ RECORD

### Not available in SAMwin.

The IQ Record allows the user to exclude flow from the overbanks up to a specified total discharge. Once the specified total discharge is exceeded, the flow is distributed without restriction. This record can be used only with the X1/GR-type geometry. Only 1 IQ record is allowed, and may not be used with an IE record.

### Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
IQEMIN(1) EMIN(2) EMIN(3)
```

```
Iq 342 342
```

Field	Variable	Value	Description
0		IQ	Record Identification = Ineffective overbank flow area by discharge.
1	EMIN(1)	+	Left overbank limiting discharge.
2	EMIN(2)	b	Leave this field blank. The printout will show the "Ineffective Flow Discharges" for the channel, strip 2, to be 0.
3	EMIN(3)	+	Right overbank limiting discharge.

## SP RECORD

The SP record allows user to prescribe the specific gravity of sediment particles. Some functions do not permit changing the specific gravity. This record can be omitted if the default value is used. There can be only one SP record.

Note that this record is not used in the SAM.hyd calculations. However, since it can be input along with the PF record in PSAM in the hydraulic calculations option, the SP record is described here with the SAM.hyd records. If input in a SAM.hyd data set, the SP record will simply be echoed to the subsequent SAM.sed input file.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
SP SPGS
SP 2.0
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		SP	Record Identification = Specific Gravity
1	SPGS	+	Specific Gravity of Inflowing Sediment
		b	Default = 2.65.

## \$JOB RECORD

### Not available in SAMwin.

Jobs may be stacked one after the other by substituting the \$JOB record for the \$\$END record at the end of each data set. Place the \$\$END after the last job in the stack. A stacked SAM.hyd data set will create a similarly stacked SAM.sed input data file.

#### Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$JOB
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$JOB	Record identification = NEW JOB.

## \$\$END RECORD

This record signifies the end of the run.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$$END
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$\$END	Record identification = END OF RUN.



# Appendix D: Data Records for Sediment Transport Functions

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## GENERAL NOTES

The following are conventions used in the record descriptions in this appendix.

- a1.@!            These characters in the "value" column means that any alpha or numeric characters can go in that field; generally it is a comment field.
  
- b                 This character in the "value" column indicates a blank field.

Records that are not available in SAMwin are still useable -- use an editor to insert the record into a data file and execute the program from the “RUN” dropdown menu of the SAMwin main menu

## T1 RECORDS

Up to 10 title records are permitted. These records are for the user's information only and are therefore optional. TI is also an acceptable record identification for title records.

Example:

```
T1    Use these title cards to define the job, the date, the investigator, the
T1    model #, the data source, the purpose for this run, and changes from
T1    previous runs.
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		T1	Record Identification in columns 1 and 2. TI is also accepted.

## F# RECORDS

Marks each data field by column numbers, each field being 8 columns wide. There can be only 1 F# record. This record is for the user's information only and is therefore optional. This record is not always printed to the output file.

Example:

```
TI      Title cards
TI      Title cards
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		F#	<u>Record</u> Identification in columns 1 and 2.

## TR RECORD

**Not available in SAMwin.**

The TR record controls the printout. There is only one TR record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
TRKSW(1) KSW(2) KSW(3) KSW(..)
```

```
TR      -1                                     2
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	-	<u>TR</u>	Record Identification - TRace printout.
1	KSW(1)	-1	Causes only the Summary Table to be sent to the default output file.
10	KSW(14)	b,0	Normal operation -- the regular output goes to the default output file.
		1	Causes extra output from many transport functions to be printed to the default output file.
		2	Causes an extreme amount of output from all transport functions to be printed to the default output file -- used for debugging the code as most of the output is in terms of code variables.

TF RECORD

There are a series of TF records, each representing a transport function option. Each TF record in the data set has either a YES or a NO in a column after the function names. The YES signals the program to calculate the sediment transport using that function; a NO leaves that function turned off. Only those functions being used are required in the data set. "Laursen(Madden),1985" defaults to YES when the SAM.sed input file is written by SAM.hyd. There can be up to 20 TF records, as follows. Be sure that the "Y" of YES is in column 25, and that the "N" of NO is in column 26, and that the function names are spelled and punctuated exactly as given below.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
TF TOFFALETI .                YES
TF YANG .                      YES
TF EINSTEIN (TOTAL-LOAD)      NO
TF ACKERS-WHITE .            NO
TF COLBY                      NO
TF TOFFALETI-SCHOKLITSC      NO
TF MPM (1948) .              NO
TF BROWNLIE ,D50             NO
TF TOFFALETI-MPM             NO
TF LAURSEN (MADDEN) ,1985    NO
TF LAURSEN (COPELAND)        NO
TF YANG ,D50                 NO
TF ACKERS-WHITE ,D50         NO
TF MPM (1948) ,D50           NO
TF PARKER                     NO
TF EINSTEIN (BED-LOAD)        NO
TF PROFITT (SUTHERLAND)      NO
TF ENGELUND-HANSEN           NO
TF SCHOKLITSCH               NO
TF VAN .RIJN                 NO
```

Field	Variable	Value	Description
0	-	TF	Record Identification - Transport Function [This name is 21 columns long and must match one in the above example in every detail-- spelling, parentheses, dashes, periods and spaces.]
	YANG	YES	Transport function turned on
		NO	Transport function turned off

**NOTES**

Parker: Finer sizes, less than 2 mm, must be excluded from the specified surface size distribution; there must be a size for which 0% of the material is finer; the bed material sizes used must be representative of the coarse upper layer of the bed.

Van Rijn Recommended use is for grain sizes between 0.1 and 0.5 mm.

## ME RECORD

### **Not available in SAMwin.**

The ME record controls whether the calculations are made in English or in metric units. There is only one ME record. If this record is omitted, the calculations are made in English. All input must be in the same system of units as selected for the calculations, except that PF record data is input in percent and millimeters for both systems.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
ME METRIC
ME      1
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		ME	Record Identification - Metric or English flag.
1	METRIC	0	Calculations made in English units. This is the default.
		1	Calculations made in metric units.

## SP RECORD

The SP record allows user to prescribe the specific gravity of sediment particles. Some functions do not permit changing the specific gravity. Inserting this record is optional if the default value is used. There can be only one SP record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
SP SPGS
SP 2.0
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		SP	Record Identification = Specific Gravity
1	SPGS	+	Specific Gravity of Inflowing Sediment
		b	Default = 2.65.

## VE RECORD

The VE record prescribes the water velocity for up to 10 discharges. There can be only one VE record.

For the VE, DE, WI, QW, ES, and WT records, each field represents one set of test conditions. For example, the data in the first field of these 6 records contains the hydraulic input for the first discharge; the data in the 2nd field for the second discharge, etc., up to a maximum of 10 discharges. Missing data will be filled in by the program at execution time, using the rule  $VELA(N) = VELA(N-1)$ .

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
VE VELA1  VELA2  VELA3  VELA4  VELA5  ... up to 10 ...
VE 1.19    2.89    5.17    6.55    8.42
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		VE	Record Description - VELOCITY, Water
1	VELA(1)	+	Enter Water Velocity: in fps for English calculations; in cms for metric.
2-10	VELA(2) -	+	Up to 10 Velocities may be entered
.			
.			
.			
.	VELA(10)		

DE RECORD

The DE record prescribes the effective depth. There can be only one DE record. The depths will be paired with data on the VE, WI, QW, ES, and WT records. Missing data will be filled in by the program at execution time using the rule,  $EFDA(N) = EFDA(N-1)$ .

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
DE EFDA1 EFDA2 EDFA3 EDFA4 EDFA5 ... up to 10
DE .82 3.11 7.50 10.71 15.66
```

Field	Variable	Value	Description
0		DE	Record Identification = DEpth, hydraulic
1	EFDA(1)	+	Effective depth, ft for English calculations; m for metric.
2-10	EFDA(2)	+	Up to 10 depths may be entered
.			
.			
.			
	EFDA(10)		

## WI RECORD

The WI record prescribes the effective width. The width will be paired with data on the VE, DE, QW, ES, and WT records. Missing data will be filled in by the program at execution time using the rule,  $EFWA(N) = EFWA(N-1)$ .

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
WI EFWA1  EFWA2  EFWA3  EFWA4  EFWA5  ... up to 10
WT 103.   111.   129.   143.   152.
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		WI	Record Identification - top Width
1	EFWA(1)	+	Top Width, in ft for English calculations; m for metric.
2-10	EFWA(2)	+	Up to 10 Top widths may be entered
.			
.			
.			
	EFWA(10)		

QW RECORD

The QW record prescribes the discharge. There can be only one QW record. The discharges will be paired with data on the VE, WI, DE, ES and WT records. Missing data will be filled in by the program at execution time using the rule,  $Q(N) = Q(N-1)$ .

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QW  Q1      Q2      Q3      Q4      Q5      ... up to 10
QW  100     1000    5000   10000   20000
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QW	Record Identification - Water Discharge
1	Q(1)	+	Discharge, in cfs for English calculations; cms for metric.
2-10	Q(2)	+	Up to 10 discharges may be entered
.			
.			
.			
	Q(10)		

## ES RECORD

This record prescribes the energy slope. A slope is needed for each Q(i) on the QW record, but the program will fill in missing values using the rule,  $S(N) = S(N-1)$ . There can be only 1 ES record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
ES S(1) S(2) S(3) S(...)
```

ES284E-6 .000174 .000170

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		ES	Record identification = Energy Slope
1	ESA(1)	+	Energy slope corresponding with Q(1), in ft/ft for English calculations; m/m for metric.
NOTE: If field width does not permit sufficient accuracy, code in scientific notation as shown above. If 3 significant digits do not provide sufficient accuracy, code a dummy Q in the first field and begin the real problem in field 2.			
2-10	ESA(2)-ESA(10)	+	The slope can change with each Q on the QW record. However, the program will fill in missing values using the rule, $ES(I) = ES(I-1)$ , so only those which change must be coded.

## WT RECORD

This record is used to prescribe the water temperature. There can be only 1 WT record.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
WT WT(1)  WT(2)  WT(3) WT(...)
```

```
WT    55      60      75
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		WT	Record identification = Water Temperature.
1	WT(1)	+ b	Water temperature for Q(1), degrees Fahrenheit for English calculations, degrees centigrade for metric. Default = 60° F, English; 15.6° C, metric.
2-10	WT(2)-WT(10)	+	A water temperature is needed for each water discharge, but only those values which change must be coded. The program will supply missing values using the rule: WT(I) = WT(I-1).

PF RECORD

This record prescribes the gradation of the bed sediment reservoir at a cross section. Code “Continuation” records as PFC records. It is not necessary that a PF-coordinate correspond to a class interval boundary although it can. If it does not, semi-log interpolation is used to calculate the percent finer at each class interval boundary, and these are subtracted to calculate the fraction of sediment in each size class. The program assigns a percent finer of 100 to the given DMAX. There can be up to 18 data points, which is 1 PF and 3 PFC records.

The data **must** be coded in decreasing order; i.e., the largest grain size (after DMAX) and corresponding percent are to be coded in fields 5 and 6, respectively.

The particle diameters are input in millimeters for both the English and the metric calculation options.

Example:

F#	45678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678
PF	cmt	ASN	SAE	DMAX	DAXIS	PFXIS	DAXIS	PFXIS	DAXIS..etc	
PF		308.0	1.0	18.29	9.14	95.0	1.0	94.2	.5	78.0
PFC	.25	46.7	.125	14.3	.0625	9.9	.004	4.9		

Field	Variable	Value	Description
0	ICG, IDT	PF	Record Identification = Percent Finer
		PFC	Record Identification = Continuation record
1	ISI	1234	Comment field for PF record-- use numeric characters only.
		DAXIS	+ For PFC (continuation) records, code the particle diameter, mm.
2	RMILE	-,0,+,b	Identifier of this Cross Section (i.e., River Mile); this field is optional.
		PFXIS	+ For PFC records, code the percent finer.
3	SAE	b	SAE is not needed for this code, but it is provided for compatibility with HEC-6.
		DAXIS	+ For PFC records, code the particle diameter, mm.
4	DMAX	+	The diameter of the maximum particle size, in mm.
		b	Not allowed -- <b>ALWAYS code a value.</b>
	PFXIS	+	For PFC records, code the percent finer.

PF/PFC RECORD — continued

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
5	DAXIS(2)	+	On the PF record, this is the first coordinate point down the percent finer curve from DMAX. If this particle size is larger than 64MM, choose a point that will approximate the PF curve with 2 straight line segments from DMAX to 64mm.
6	PFXIS(2)	0,+	The percent finer corresponding to DAXIS(2).Code as a percent.
7	DAXIS(3)	0,+	Continue to code points from the percent finer curve, with the DAXIS in the odd-numbered fields and the PFXIS in the even-numbered fields. Up to 18 points, including the DMAX point, are permitted. Use a continuation record when coding more than 4 points.

## \$JOB RECORD

### **Not available in SAMwin.**

Jobs may be stacked one after the other by substituting the \$JOB record for the \$\$END record at the end of each data set. Place the \$\$END after the last job in the stack. A stacked SAM.sed data set will create a stacked SAM.yld input data file.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$JOB
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$JOB	Record identification = NEW JOB

## \$\$END RECORD

This record signifies the end of the run.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$$END
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$\$END	Record identification = END OF RUN.



# Appendix E: Data Records For Sediment Yield Calculations

---

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QQ RECORD -- Water Discharge Record.....	E-7
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SC RECORD -- Sediment Discharge Record (in mg/l).....	E-12
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\$JOB RECORD -- "\$JOB" Record .....	E-14
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## GENERAL NOTES

The following are conventions used in the record descriptions in this appendix.

- a1.@!            These characters in the "value" column means that any alpha or numeric characters can go in that field; generally it is a comment field.
  
- b                 This character in the "value" column indicates a blank field.

Records that are not available in SAMwin are still useable -- use an editor to insert the record into a data file and execute the program from the "RUN" dropdown menu of the SAMwin main menu.

## T1 RECORDS

Up to 10 title records are permitted. These records are for the user's information only and are therefore optional. TI is also an acceptable record identification for title records.

Example:

```
TI    Use these title cards to define the job, the date, the Investigator, the
TI    model #, the data source, the purpose for this run, and changes from
TI    previous runs.
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		T1	Record Identification in columns 1 and 2. TI is also accepted.

## F# RECORDS

Marks each data field by column numbers, each field being 8 columns wide. There can be only 1 F# record. This record is for the user's information only and is therefore optional. This record is not always printed to the output file.

Example:

```
TI      Title cards
TI      Title cards
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		F#	Record Identification in columns 1 and 2.

## ME RECORD

### **Not available in SAMwin.**

The ME record controls whether the calculations are made in English or in metric units. There is only one ME record. If this record is omitted, the calculations are made in English. All input must be in the same system of units as selected for the calculations.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
ME METRIC
ME      0
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	-	ME	Record Identification - Metric or English flag.
1		METRIC	1 Calculations made in English units. This is the default.
			0 Calculations made in metric units.

JP RECORD

The JP record provides data for the basic options in the yield calculations. There can be only 1 JP record.

Example:

The following example shows typical input specifying 20 intervals for output display. The time step for a hydrograph is 5 minutes, or 0.083 hours. For all other fields the defaults are accepted, as indicated by the blank fields.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
JP NCLCD IFMT NIS RWY YEAR PER UWD
JP .083
```

Field	Variable	Value	Description
0		JP	Record Identification
1	NCLPD	+ b	Number of class intervals to use for displaying results. default = 20 max = 365
2	IFMT	+ b,1	Format of input. <b>This field is no longer used.</b> Input described in these instructions.
3	NCLCD	+ b	Number of integration steps for Flow-Duration Option. default = 365 max = 2000.
4	RWY	+ b	Ratio to multiply times the water discharge to scale water yield value. default = 1.
5	YEAR	b,+  b	Time period represented by the flow duration curve in days. Usually the curve represents a year so the program defaults to 365 days. In some cases a curve may represent a day, a month or a single event in which case that number of days should be coded here. default = 365

[Continued on next page]

JP RECORD -- continued

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
6	PER	+	Time between hydrograph ordinates, in hours, when using the hydrograph option.
		b	default = 24.
7	UWD	+	Specific Weight of sediment in pounds/cubic foot.
		b	default = 93.

**NOTE:** This default is a good estimate for streams that are largely medium sand. This default is also a good estimate for sand bed streams when making BED MATERIAL LOAD calculations. Modify this parameter as appropriate for wash load or total load calculations, and for calculations of bed material load on gravel bed streams.

## QQ RECORD

The QQ record is the listing of all discharges, Q, to be used for this run, in **either** increasing or decreasing order. There can be a maximum of 10 QQ records. Each Q will be paired with a duration, from the QD record.

NOTE: Do not use zero as the first or last discharge -- perhaps use 0.0001.

Example.

The following example shows typical input specifying 21 different Q's.

F#	45678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678	2345678
QQ	FLOW1	FLOW2	FLOW3	FLOW4	FLOW5	...	up to 10,000			
QQ	15	326	633	939	1244	1550	1856	2162	2469	2774
QQ	3080	3386	3692	3998	4304	4610	4916	5222	5528	5834
QQ	6140									

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QQ	Record Identification = Discharge list
1	FLOW(1)	+	First discharge
2-10	FLOW(2)	+	Continue coding discharges, 10 per record.
.			
.			
.			
	FLOW(10)		

QD RECORD

The QD record is the listing of the percent of time, QD, the corresponding discharge on the QQ record is equaled or exceeded. Durations do not have to be at a constant interval, and can be in increasing or decreasing order. There can be a maximum of 10 QD records.

Example.

The following example shows typical input specifying 21 different QD's.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QD DUR1   DUR2   DUR3   DUR4   DUR5   ... up to 10,000
QD 100.0  44.37   14.5   6.49   3.52   2.16   1.34   .83   0.52   0.36
QD 0.26   0.18   0.12   0.08   0.08   0.05   0.05   0.05   0.05   0.01
QD 0.0
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QD	Record Identification = Discharge duration
1	DUR(1)	+	Duration for 1st discharge,
2-10	DUR(2)	+	Continue coding durations, 1 for each discharge, maximum of 10 per record.
.			
.			
.			
	DUR(10)		

## QH RECORD

The QH record is the listing of the water discharge, in cfs, by the hydrograph ordinate. There can be a maximum of 25 QH records. Zero is an acceptable discharge on the QH record.

Example.

The following example shows typical input specifying 4 different QH's.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QH FLOH1 FLOH2 FLOH3 FLOH4 FLOH5 ... up to 10,000
QH 1 300 1300 7000
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QH	Record Identification = Discharge -- Hydrograph.
1	FLOH(1)	+	Hydrograph ordinate for flow 1, cfs.
2-10	FLOH(2)	+	Hydrograph ordinate for each flow, maximum of 10 per record.
.			
.			
.			
	FLOH(10)		

QW RECORD

The QW record is the listing of the water discharge in cfs, and will be paired with a sediment discharge from the QS or SC record. The water discharges may be in **either** increasing or decreasing order, and there can be up to 10 values. Each QW field corresponds to exactly one QS field so the two records must be in the same order. There can be only 1 QW record.

NOTE: Do not use zero as the first or last discharge -- perhaps use 0.0001.

Example.

The following example shows typical input specifying 4 different QW's.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QW  Q1      Q2      Q3      Q4      Q5      ... up to 10
QW   1      300    1300    7000
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QW	Record Identification = Discharge - water.
1	Q(1)	+	1st discharge, cfs.
2-10	Q(2)	+	List each water discharge, in cfs; maximum of 10 per record.
.			
.			
.			
	Q(10)		

## QS RECORD

### **Not available in SAMwin.**

The QS record is the listing of the sediment discharge in tons per day, and will be paired with a water discharge from the QW record. Each QS field corresponds to exactly one QW field so the two records must be in the same order. There can be only 1 QS record.

### Example.

The following example shows typical input specifying 4 different QS's.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
QS QSR1   QSR2   QSR3   QSR4   QSR5   ... up to 10
QS    1     300   1300   7000
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		QS	Record Identification = Discharge -- sediment.
1	QSR(1)	+	First sediment discharge, in tons per day.
2-10	QSR(2)	+	Continue coding sediment discharge, 1 for each water discharge, to a maximum of 10 per record.
.			
.			
.			
	QSR(10)		

## SC RECORD

The SC record is the listing of the sediment concentration in mg/l, and will be paired with a water discharge in cfs from the QW record. There can be only 1 SC record.

Example.

The following example shows typical input specifying 4 different SC's.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
SC QSR1    QSR2    QSR3    QSR4    QSR5    QSR6    QSR7    QSR8    QSR9    QSR10
SC      1      5      13      60
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		SC	Record Identification = Sediment Concentration
1-10	QSR(1)	+	List each sediment concentration in mg/l; maximum of 10.
.			
.			
.			
	QSR(10)		

## SE RECORD

### **Not available in SAMwin.**

The SE record allows the user to specify the variables for the power equation from which to calculate the sediment discharge in tons/day. There can be only 1 SC record. The fields on the record prescribe 2 of the variables in the power equation:

$$QSR = AX (QW)^{BX}$$

Example.

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678
SE   AX      BX
SE 1.356 0.47529
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0	SE		Record Identification = Sediment power Equation
1	AX		The AX variable in the above power equation.
2	BX		The BX variable in the above power equation.

## \$JOB RECORD

For stacked runs, the \$JOB record indicates the end of one job and the start of a new input data set.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$JOB
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$JOB	Record identification = NEW JOB

## \$\$END RECORD

This record signifies the end of the run.

Example:

```
F# 45678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678 2345678  
$$END
```

<u>Field</u>	<u>Variable</u>	<u>Value</u>	<u>Description</u>
0		\$\$END	Record identification = END OF RUN.



# Appendix F: SAM.Aid—Guidance in Sediment Transport Function Selection

F-1. SAM.aid is on the Tools dropdown menu in SAMwin. Figure F-1 shows the opening screen for SAM.aid. There are three kinds of information on this screen: commands; input data; and output data. Only D50, Slope, Velocity, Width, and Depth can be input, but they do not have to be input manually. They can be read from a SAM.sed input file. If a SAM.sed input file is read, the 5 “input” areas, in the “Criteria Data” section of the screen, will be filled with data. The output areas are the two large, now blank, gray areas.

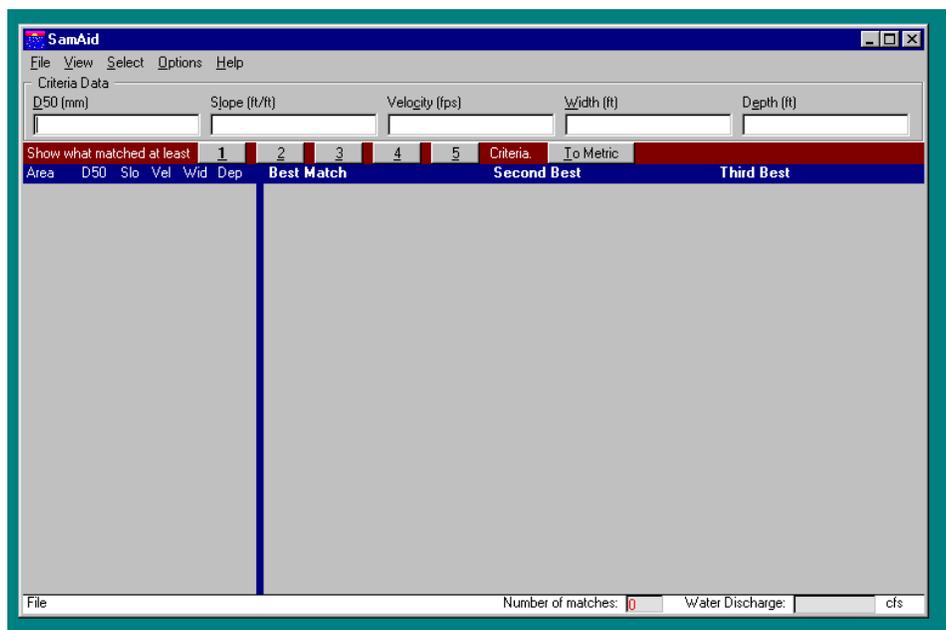


Figure F-1. SAM.aid Main Screen.

F-2. Using SAM.aid. The flow of events through SAM.aid is straightforward:

1. Read in an input file using the File dropdown menu or enter data in each of the 5 input areas.
2. If an input file has been read in, select a "data set," Figure F-2.
3. Review the listed best functions to use, checking the description of the Brice data, Figure F-6.
4. Turn on the desired functions -- Figure F-4 or Figure F-5.
5. Save the input file, exit, and run SAM.sed.

The most advantageous way to utilize SAM.aid is to go through steps 1 through 3 several times, examining several ranges of data within the input file.

F-3. The “File” dropdown menu offers standard choices. With the “View” dropdown menu the user can choose the display results or may view any of the Brice data set descriptions. With “Select,” the user can select a Data Set or a sediment transport function. The “Options” menu allows the user to choose English or metric units, and to set two configuration choices for ease in running. In the “Configure Options” the user can set a startup folder, or not, and also check whether or not to write the last used filename to the FILES.SAM file on exiting SAM.aid. The FILES.SAM file sets the input data file SAM.sed will use when run. The “Help” menu provides rudimentary information on using SAM.aid as well as information on the version, and creation, of the program.

F-4. View Menu. The user can choose how to view results – choosing to display only results that matched 1, 2, 3, 4, or all 5 parameters. This can also be accomplished by mouse clicking a number on the line above the output areas. The “Area Information” choice on this dropdown menu allows the user to view information on any Brice data set in the program, see Figure F-6.

F-5. Select Menu. The dropdown menu offers two choices, “Data Set...” or “Transport Function...” A mouse click on “Data Set...” will bring up the Select Data Set screen, Figure F-2. This screen appears automatically when a SAM.sed input file is opened, and will stay available. This dropdown menu choice is convenient if the user wishes to reopen the Select Data Screen once it has been closed.

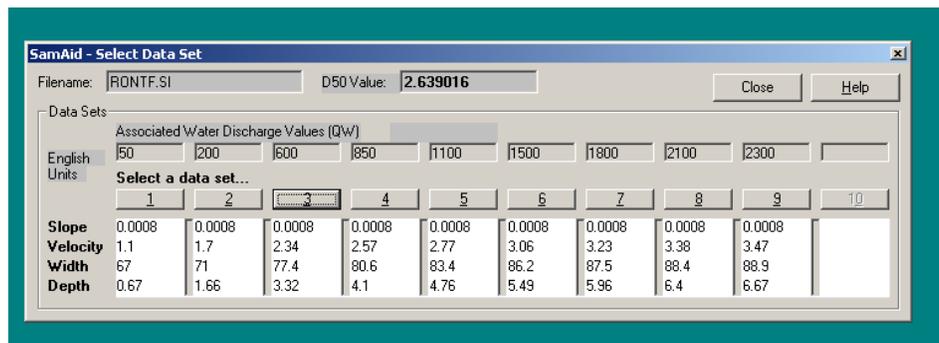


Figure F-2. Select Data Set screen showing input read from a file.

This screen echoes the data from the input file selected, arranging the information into columns of related slope, velocity, width, depth, and water discharge. The D50 value shown on the screen is calculated from the bed gradation information (the PF-records) in the input file. Data cannot be changed on this screen. Using the mouse to select a column will highlight the button for that column and cause the program to present the suggested transport functions for that one column of data, as in Figure F-3. The user selects one column of related data at a time to be used in the SAM.aid comparison. The Select Data Set screen stays visible. This is a convenient aid to comparing the results from selecting different columns. Figure F-3 shows the Select Data set screen with the results of a column selection on the main screen.

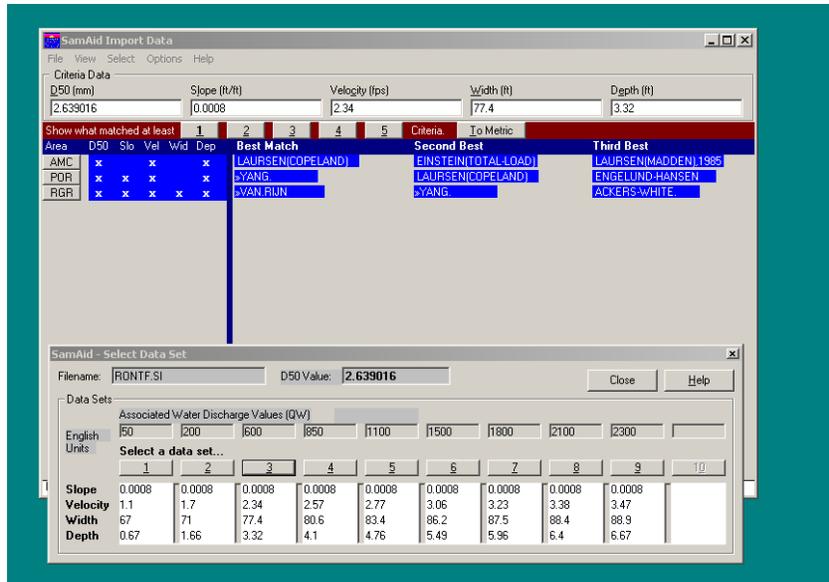


Figure F-3. Select Data screen with results.

Choosing “Transport Functions...” brings up the screen in Figure F-4. Any sediment transport function can be turned on or off in the input file by clicking on the function name.

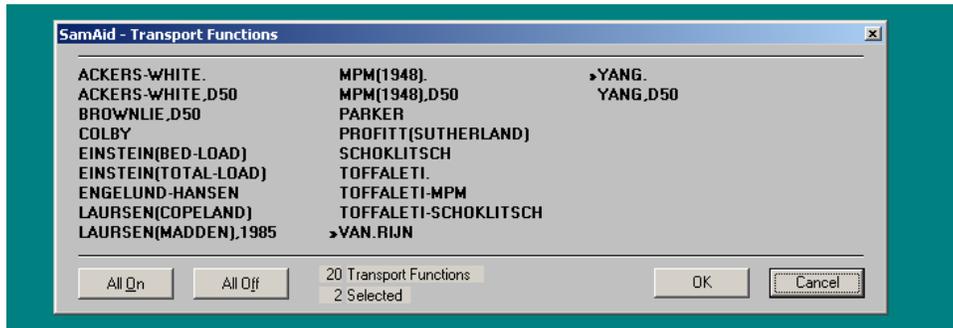


Figure F-4. Transport Functions screen, showing 2 functions selected.

If a “>” appears next to the name, as by "YANG" and “VAN.RIJN” in Figure F-4, then the function will be turned in the input file. Mouse clicks toggle the functions on and off. The selections made on this screen are transferred to the main screen once "OK" is selected. They are transferred to the input file when the user saves the file.

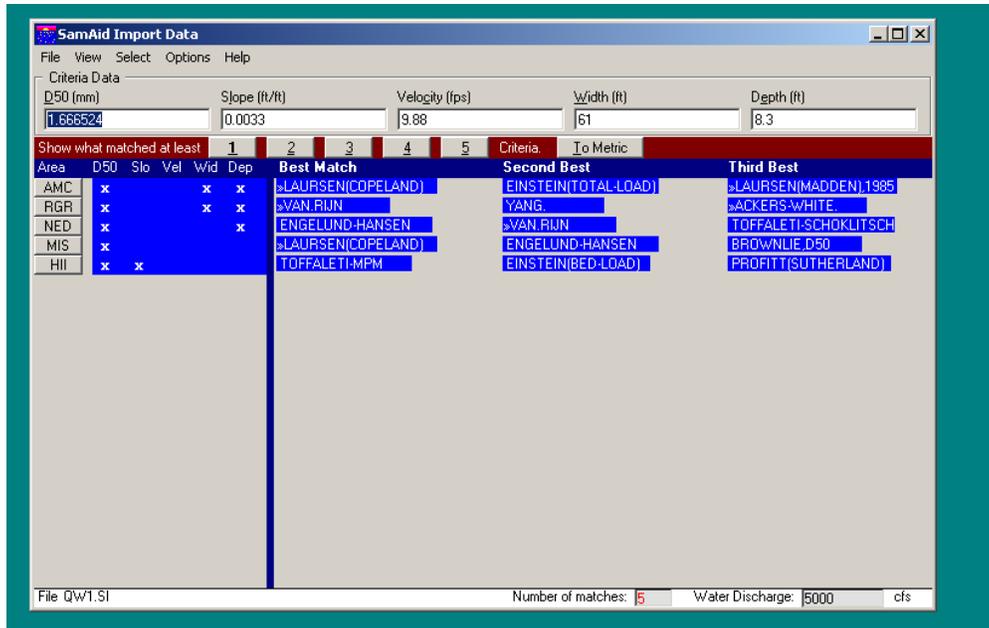


Figure F-5. SAM.aid output screen

The output screen, shown in Figure F-5, lists the various sediment transport functions that are recommended by SAM.aid. The parameters of the chosen “column” from the input file are echoed in the “Criteria Data” area. The parameters from this data that fell within the data ranges of the listed Brice data sets are checked with an “x”. The transport functions that are turned on in the input file are marked with a small “>>”. A mouse click on a function name on this screen will toggle that function on and off.

The “Area” column lists the Brice data set that matched the marked parameters with the input file chosen. Each button has a 3-letter identifier. The complete list of abbreviations and names is in the SAM.aid chapter of the “SAM User’s Manual,” or can be viewed by clicking the “View\Area Information” on the main menu. A mouse click on a button will display information on that Brice data set as well as the data ranges and the parameters on which each sediment transport function was rated, Figure F-6. The scroll arrows and bar on the side of this screen allow the user to access all information about, in this case, COL – the Colorado River Data of the U.S. Bureau of Reclamation (1958), including the ranges of the data and statistical parameters of the results of the attempt of each function in SAM.sed to reproduce this data.

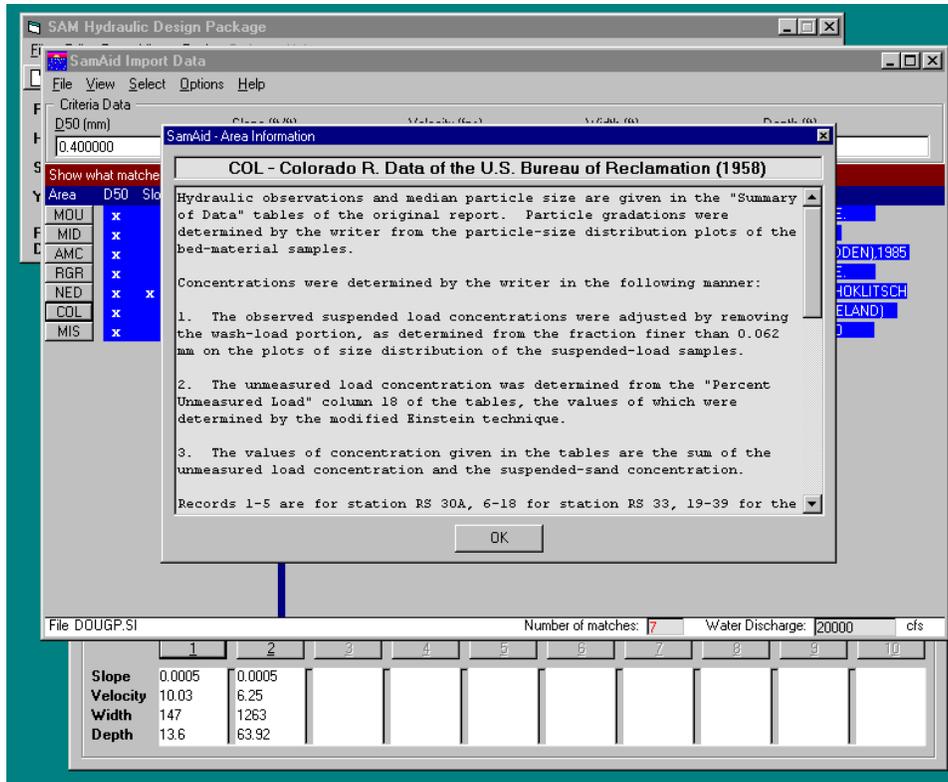


Figure F-6. Example Area Information Screen, shown as it appears over other screens.

F-6. Saving. Once the user is satisfied with the functions selected through this process, the "File" dropdown menu offers "Save," "Save as..." and "Exit" options. As discussed in F-3, the filename saved here can be written to a file that will cause this SAM.sed input file to be used when SAM.sed is run.