Appendix C: Data Records for Hydraulic Calculations

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 2345678
```

Field	Variable	Value	Description
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 2345678
```

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

CT RECORD, continued

Field	Variable	Value	Description
		7	SCS grass, type C.
		8	SCS grass, type B.
		9	SCS grass, type A.
6	KSBED	+	If NEQBED =0, Code the Manning n-value here.
			If NEQBED =1 or 2, Code the surface roughness for the bed, ft, here.
			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.
			If NEQBED =5 thru 9, This field can be blank.
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 trapeziodal 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	Elevation of channel invert is equal to minimum elevataion in cross section
	.1>=CELCH>=.00001		Elevation of channel invert is based on CELCH (slope) and XLCH.CN (channel reach length). This is an HEC-2 option and is NOT NEEDED IN SAM.
3	XLCH.CN	0 or +	New channel reach length and n-value for HEC-2. (NOT NEEDED IN SAM)
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 minmum bank elevation. This HEC-2 option NOT YET working in SAM.
		.01	Signals the program to stop modifications. This HEC-2 option NOT NEEDED IN SAM.

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 MUST 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 GR	Record Identification = GRound co-ordinates 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	Record Identification = Reach Length.
		GL	Record Identification on continuation records also.
1	TZL(1)	+	Reach length for panel 1 in the cross section.
		b(1)	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	Record Identification = N-value Equations
		NE	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

Field	Variable	Value	Description
		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)	+	Effective roughness height-ft in panel 1.
		b,0	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)	+	Effective Roughness height, ft, in panel 2.
		b -	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 KN	Record Identification = Roughness, Manning's n-values. 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	+ b	The diameter of the maximum particle size,in mm. 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
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
```

Field	Variable	Value	Description
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	+	Specific gravity of the riprap
		b,0	Default = 2.65.
2	BENDR	+	Bend radius in feet.
		b,0	Default = Straight channel.
3	BENDA	+	LEAVE BLANK
4	NTRAP	1	Trapezoidal Cross Section in a bend - not a natural river bend.
		b,0	Default = Cross section is a natural riverbend.
5	SAFEF		Safety factor above failure. Default is recommended.
		b,0	Default = 1.1, the EM value.
		+	Enter your own safety factor.
6	CIFRRS		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.
		b,0	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
```

Field	Variable	Value	Description
0	ICG,IDT	RS	Record Identification = Riprap Size.
1	VAVG	+	Water velocity, fps, over toe.
2	WS	+	Water depth over toe.
3	SSL	+	Side Slope (Bank slope) of revetment (1V:[Z]H).
		b	Default = 1.5
4	SUMWWS	+	Water Surface Width. Required if in a bend.
		b	Default = D*Z
5	RSEC	+	Ratio of riprap layer thickness to DMAX.
		b	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	Record Identification = Riprap Thickness
		RT	Record Identification for continuation records, also.
1	RT(1)	+	Riprap thickness in panel 1 expressed as the ratio times Dmax, i.e. [RT]*DMAX. Values usually range from 1 to 1.5.
		b,0	Default = no riprap.
		-	Indicates cobbles, i.e., rounded stone.
2	RT(2)	+	Thickness of riprap in panel 2.
		b,0	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
```

Field	Variable	Value	Description
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.
			Default = 0.2
2	REGCON	+	Bed-material sediment concentration.
			Default = 0.0

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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
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, ks should be set equal to the minimum design d90.
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, ks should be set equal to the minimum design d90.

Field	Variable	Value	Description
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 **study** reach. DEFAULT = 1.0
3	COWXN	0,+	Increase in n-value for surface irregularities, variation in channel cross section and obstructions, for the **study** reach. DEFAULT = 0.0.
4	COWMAX	+	Cowan meander multiplier, for the **supply** reach. DEFAULT = 1.0
5	COWXNAX	0,+	Increase in n-value for surface irregularities, variation in channel cross section and obstructions, for the **supply** 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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
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
```

Field	Variable	Value	Description
0		$$END	Record identification = END OF RUN.