APPENDIX B

ENGINEERING ANALYSES

B.1 RADON Analyses - New for 2012 Update

B.2 - Retained from Original Closeout Plan, 1998

- SURFACE WATER HYDROLOGIC ANALYSIS
  - FLOOD HYDROGRAPH (HEC-1) ANALYSES
  - WATER SURFACE PROFILE (HEC-2) ANALYSES
- REVISED UNIVERSAL SOIL LOSS EQUATION (RUSLE) ANALYSES
- SLOPE STABILITY (SB-SLOPE) ANALYSES
- DESIGN RUNOFF AND SHEAR CALCULATIONS

These calculations were based on full build-out of the mine site.

As-is conditions are less than full build-out, therefore these calculations are conservative for as-is conditions.

B.1 RADON ANALYSIS

WATER TREATMENT PONDS AND WASTE ROCK PILE AFTER CLOSURE

Table B.1 Input Parameters and Radon Flux - RADON modeling of Mine Water Treatment Pond Cover and Waste Rock Pile

Pond	Pond Sediment		Fill from Area A and Ore Stockpile Pad		Contaminated Soil Fill		Soil Cover		Total Fill Depth, ft (1)	Calculated Radon Flux from Cover, pCi/m^2 S
	Average Thickness, ft (2)	Average Ra-226, pCi/g	Average Thickness, ft	Average Ra-226, pCi/g	Average Thickness, ft	Average Ra-226, pCi/g (3)	Average Thickness, ft	Average Ra-226, pCi/g		
1	1.5	119	1.0	214	11.0	44	2.0	6.8	14	19.7
2	1.5	224	0.0	NA	11.0	44	2.0	6.8	13	19.9
3	1.65	21	1.0	214	13.0	44	2.0	6.8	16	19.1
4	0.75	18	0.0	NA	10.0	44	2.0	6.8	12	18.8
5	1.7	11	0.0	NA	13.0	44	2.0	6.8	15	18.8
6	1.5	6	0.0	NA	13.0	44	2.0	6.8	15	18.8
7	1.4	10	0.0	NA	13.0	44	2.0	6.8	15	18.9
8	2.25	27	0.0	NA	7.0	44	2.0	6.8	9	18.4
Waste Rock Pile	Waste Rock				Contaminated Soil Fill		Soil Cover			
	17	50 (4)			1.6 (5)	44	2.0	6.8		19.9

(1) Total fill depth is design top of cover to existing top of pond sediment

(2) Pond sediment thicknesses are average values from test pit logs, April 2012. Pond 2 sediment thickness estimated because of standing water

(3) Average of 10 pond surface sediment samples, to represent source of soil contamination

(4) Conservative estimate based on low concentrations of Ra-226 in SPLP leachate from waste pile tests, Table 2, Kleinfelder, 2012

(5) 1.4 ft over 21.7 acres based on 48,660 BCY contaminated soil, 1.6 ft thick with 15% swell for LCY placed.

The RADON model was run in accordance with:
U.S. Nuclear Regulatory Commission Office of Research, RADON, Version 1.2, May 22, 1989, and
U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research, “Regulatory Guide 3.64, "Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers”, June 1989.

RADON Model – Mt Taylor Mine July, 2012

Pond #1

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 43.30 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.364 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.45	119	.25	0.4	5	2.704E-6
2	0.3	214	.25	0.4	5	2.704E-6
3	3.3	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.45	3.964	109.4E3	0.850
2	0.3	31.44	104.5E3	0.850
3	3.3	20.75	18.20E3	0.700
4	0.6	19.67	0E0	0.700

Total cover radon retention: 54.57%

Pond #2

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 81.50 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.364 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.45	224	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	3.3	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.45	38.88	118.6E3	0.850
2	0.01	39.70	118.2E3	0.850
3	3.3	20.99	18.39E3	0.700
4	0.6	19.86	0E0	0.700

Total cover radon retention: 75.63%

Pond #3

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 9.818 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.468 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.6	21	.25	0.4	5	2.704E-6
2	0.3	214	.25	0.4	5	2.704E-6
3	3.9	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.6	-23.6	72.31E3	0.850
2	0.3	12.41	73.85E3	0.850
3	3.9	20.04	17.62E3	0.700
4	0.6	19.10	0E0	0.700

Total cover radon retention: -94.5%

Pond #4

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 3.474 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.193 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.23	18	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	3	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.23	-5.23	45.65E3	0.850
2	0.01	-3.79	45.69E3	0.850
3	3	19.68	17.34E3	0.700
4	0.6	18.82	0E0	0.700

Total cover radon retention: -442.%

Pond #5

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 4.474 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.407 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.51	11	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	3.9	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.51	-10.8	37.92E3	0.850
2	0.01	-9.26	38.01E3	0.850
3	3.9	19.72	17.37E3	0.700
4	0.6	18.85	0E0	0.700

Total cover radon retention: -321.%

Pond #6

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 2.183 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.364 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.45	6	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	3.9	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.45	-11.2	37.21E3	0.850
2	0.01	-9.68	37.31E3	0.850
3	3.9	19.72	17.37E3	0.700
4	0.6	18.84	0E0	0.700

Total cover radon retention: -763.%

Pond #7

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 3.417 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.342 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.42	10	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	3.9	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.42	-9.87	39.37E3	0.850
2	0.01	-8.38	39.46E3	0.850
3	3.9	19.74	17.38E3	0.700
4	0.6	18.86	0E0	0.700

Total cover radon retention: -452.%

Pond #8

---------------- Input Parameters ----------------

Number of Layers: 4

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 13.98 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.518 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	0.68	27	.25	0.4	5	2.704E-6
2	0.01	214	.25	0.4	5	2.704E-6
3	2.1	44	.25	0.4	10	1.602E-6
4	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	0.68	-6.44	39.93E3	0.850
2	0.01	-4.96	39.99E3	0.850
3	2.1	19.10	16.86E3	0.700
4	0.6	18.35	0E0	0.700

Total cover radon retention: -31.2%

Waste Rock Pile

---------------- Input Parameters ----------------

Number of Layers: 3

Radon Flux into Layer 1: 0 pCi/m2s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 43.68 pCi/m2s

Specific Bare Source Flux from Layer 1: 0.874 pCi/m2s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanat Fract	Porosity	Moisture [dry wt_%]	Diff Coeff [m2/s]
1	4.5	50	.25	0.4	7.000	2.216E-6
2	0.5	44	.25	0.4	10	1.602E-6
3	0.6	6.8	.25	0.4	10	1.602E-6

-------- Results of Radon Diffusion Calculation --------

Layer No.	Thickness [m]	Exit Flux [pCi/m2s]	Exit Conc. [pCi/L]	MIC
1	4.5	13.07	35.47E3	0.790
2	0.5	21.08	18.47E3	0.700
3	0.6	19.94	0E0	0.700

Total cover radon retention: 54.35%

REVISED UNIVERSAL SOIL LOSS EQUATION
INPUT/OUTPUT FILE

File Exit Help Screen

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Conservation Planning Alternatives - Soil Loss Computation Worksheet

filename	R	x	K	x	LS	x	C	x	P	=	A
MTTAYLR2	27		0.12		0.62		0.203		0.50	=	0.2
MTTAYLR1	27		0.12		0.93		0.662		0.57	=	1.1
RGRPILE1	27		0.12		0.07		0.370		0.25	=	0.02
RGRPILE2	27		0.12		0.07		0.008		0.03	=	0
	0		0		0		0		0	=	0
	0		0		0		0		0	=	0
	0		0		0		0		0	=	0
	0		0		0		0		0	=	0
	0		0		0		0		0	=	0
	0		0		0		0		0	=	0

< F4 Calls Factor, Esc Returns to RUSLE Main Menu >

Tab Esc F1 F2 F4 F9
FUNC esc help clr call info

Filename Key:

MTTAYLR2	Reclaimed surface of stockpile and laydown areas east of WSP
MTTAYLR1	Disturbed surface of stockpile and laydown areas east of WSP
RGRPILE1	Pile surface before revegetation
RGRPILE2	Pile surface after revegetation

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Mt Taylor Mine Closeout Plan, Old Waste Rock Pile Stability
Location: San Mateo, NM
Filename: RGROLDPI   Description: Old Waste Pile, Max Buildout, Mt. Taylo:

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	550.0	307.0	1	1	2	1
2	615.0	310.0	2	2	3	2
3	750.0	346.0	3	3	4	2
4	775.0	346.0	4	4	5	2
5	865.0	373.0	5	5	6	2
6	1050.0	371.0	6	2	7	1
7	1050.0	330.0				
8	0.0	0.0				
9	0.0	0.0				
10	0.0	0.0				
11	0.0	0.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	112.0	250	20.0
2	102.0	0	34.0

Seismic coefficient, horizontal = 0.100
vertical = 0.100

Range search; initial parameters:

	min	max	increment
left x	551.0	650.0	10.0
right x	775.0	1050.0	10.0

radius increment is 10.0
minimum perpendicular depth is 15.0
limit at elevation 270.0
OVERALL MINIMUM: x = 686.7, y = 562.5, r = 267.2, FS = 2.418

Range search; initial parameters:

	min	max	increment
left x	551.0	750.0	10.0
right x	775.0	950.0	10.0

radius increment is 10.0
minimum perpendicular depth is 15.0
limit at elevation 270.0
OVERALL MINIMUM: x = 691.5, y = 567.7, r = 281.8, FS = 1.606

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Mt Taylor Mine Closeout Plan, New Waste Rock Pile Stability
Location: San Mateo, NM
Filename: RGRNEWPI   Description:

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	1.0	273.0	1	1	2	1
2	95.0	276.0	2	2	3	2
3	180.0	304.0	3	3	4	2
4	205.0	304.0	4	4	5	2
5	287.0	332.0	5	5	6	2
6	312.0	332.0	6	6	7	2
7	395.0	360.0	7	7	8	2
8	545.0	359.0	8	2	9	1
9	110.0	270.0	9	9	10	1
10	545.0	270.0				
11	0.0	0.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	112.0	250	20.0
2	102.0	0	34.0

Seismic coefficient, horizontal = 0.100
vertical = 0.100

OVERALL MINIMUM: x = 180.3, y = 550.9, r = 300.2, FS = 1.585

Range search; initial parameters:

	min	max	increment
left x	2.0	180.0	10.0
right x	312.0	545.0	10.0

radius increment is 10.0
minimum perpendicular depth is 15.0
limit at elevation 250.0
OVERALL MINIMUM: x = 180.3, y = 550.9, r = 300.2, FS = 2.324

RUNOFF AND EROSION PROTECTION ANALYSIS PARAMETERS

MT. TAYLOR MINE
RIO GRANDE RESOURCES

Design Precipitation Events

100 YR, 24 HR.	3.20	inches
100 YR, 1 HR TS	2.00	inches

C, runoff coeff.		0.40	for woodlands on shallow clay over rock - undisturbed surface	(Table 4.5, NUREG/CR-4620)
		0.50	for rolling surface on cultivated clay loam soil, and bare clay	(Table 4.4 and 4.6, NUREG/CR-4620)
		0.40	for clay with light vegetation	(Table 4.6, NUREG/CR-4620)
	use:	0.45	for waste rock surface, unvegetated	
	use:	0.50	for clay cover surface before vegetation is reestablished	

Manning coeff., n,	0.050	for steep natural channels on rock with some vegetation	(Table B-6, USBR Design of Small Dams, 1987)
	0.035	for earth channels and slopes with small growth	(Table B-6, USBR Design of Small Dams, 1987)
	0.02	for sand, sandy loam and other non-colloidal soils (waste rock surface)	(Table 4.2, NUREG/CR-4620)
	0.025	for clays and shales (clay cover)	(Table 4.2, NUREG/CR-4620)

n=0.0456(d50 x S)^0.159 — for riprap channels — (NUREG/CR-4651)

Cover Factor, **Cf**, for native soil and natural vegetation = 0.5 * 20⁽ 0.1 , for bare surface = 0 — (USDA Ag. Handbook 667, Table 3.1) (USDA Ag. Handbook 667, page 12)

d75

of native CL/SC soils = 0.14 mm, or 0.0055 inches

of waste rock = 0.3 mm, or 0.0118 inches — (USDA Ag. Handbook 667, page 12)

Soil Grain Roughness, = d75^(1/6)/39, min. of 0.0156

for native CL/SC soils = 0.0156 inches — (USDA Ag. Handbook 667, Figure 3.2)

for waste rock = 0.3962 mm, or 0.0156 inches — (USDA Ag. Handbook 667, page 14)

Void Ratio Correction Factor, **Ce** = 1.125 for native clay at 100 pcf d 1.10 for waste rock (SP to SM) — (USDA Ag. Handbook 667, Table 3.3)

Allowable shear stress, **Ta**, in psf,

for native soil CL/SC with PI = 19 0.079 = (1.07 PI^2+14.3 PI+47.7) x 10^-4 x Ce — (USDA Ag. Handbook 667, Figure 3.1)

for waste rock (SP, SM) = 0.02 psf

riprap rock = 0.4*d75 = 0.4*1.25*d50 = 0.5*d50

flow concentration factor, F =	3	assumed based on vegetation over 30 % or less of area	(p. 68, NUREG/CR-4620)
Stephenson factor, Cs =	0.27	for blasted/ crushed rock	(p. 48, NUREG/CR-4620)
rock cover porosity, P =	0.45		(Table B.1, NUREG/CR-4651)
rock spec. gravity, G =	2.65		

slope angle, SA (design values)

channel banks	0.33	18.3	degrees,	0.3194	radians	
cover slope =	0.30, or	16.7	degrees,	0.2915	radians	(Figure 4.8, NUREG/CR-4620)
friction angle of rock, FA =		40	degrees,	0.6981	radians	

Sm, factor of safety against rock movement without flow, tan FA/tan SA= 0.00

hydraulic gradient, S

EQUATIONS

tc, time of concentratioı 0.00013*(L^0.77/S^0.385), and minimum value is 0.04

i, rainfall intensity = rainfall depth * 60/rainfall duration, inches/hr

q, unit discharge = C*i*a

Q, total runoff = C*i*A

y, max. flow depth = (q*n/1.486*S^.5)^0.6

v, max. flow velocity = (1.486/n)*y^.667*S^.5 for sheet flow = (1.486/n)*R^.667*S^.5 for channelized flow

R = hydraulic radius = cross section area of flow/ wetted perimeter

Tp, peak shear stress = 62.4*S*y * (Ns/n)^2 on bare soil, = 62.4*S*y*(1-Cf)*(Ns/n)^2 on native soil with natural vegetation

Ss, critical slope (limiting value for erosional stability) for sheet flow = ((65*Ta^(5/3))/(i*L*F*n))^(6/7)

d50, mean rock diameter

by Safety Factors Method,

for flow down slopes with gradient < 0.1 , Safety Factor, SF = (cos SA)*(tan FA)/((21*y*S/(G-1)*d50)*(tan FA)+sin SA)

for horizontal flow , Safety Factor, SF = (Sm/2)*((Sm^2*(21*y*S/((G-1)*d50))^2*(sec SA)^2+4)^0.5-(Sm*(21*y*S/((G-1)*d50))*sec SA))

for slopes with gradients > 0.1

Stephenson Method, d50 = [(q*(tan SA)^7/6*P^1/6)/(Cs*g^.5*((1-P)*(G-1)*(cosSA)*(tanFA-tanSA))^1.667]^.667*12

100-YEAR STORM RUNOFF AND RESULTING PEAK SHEAR STRESSES ON WASTE ROCK PILES

SEGMENT	FLOW PATH PARAMETERS				PEAK RUNOFF PARAMETERS						
	LENGTH ft	GRADIENT S	SLOPE ANGLE degrees	ELEMENT tc hours	RAINFALL WITHIN tc (1)	RAINFALL INTENSITY i in./hr.	RATE q cfs/ft	DEPTH y ft	VELOCITY v fps	SHEAR STRESS psf	ALLOWABLE SHEAR STRESS psf
FLOW OVER WASTE ROCK											
maximum simple top slope >>	400	0.050	2.86	0.042	0.40	9.52	0.21	0.012	0.87	0.02	0.02
design top slope >>	400	0.035	2.00	0.048	0.70	14.69	0.32	0.014	0.81	0.019	0.02
maximum simple side slope >>	80	0.10	5.71	0.042	0.40	9.52	0.04	0.006	0.74	0.02	0.02
design simple side slope >>	80	0.33	18.26	0.042	0.40	9.52	0.04	0.008	1.71	0.10	0.02
FLOW OVER CLAY COVER											
maximum simple top slope >>	1070	0.01	0.57	0.165	1.60	9.72	0.57	0.016	0.37	0.004	0.079
design top slope >>	383	0.010	0.57	0.075	0.85	11.39	0.240	0.009	0.26	0.002	0.079
maximum side slope below design to	92.4	0.33	18.26	0.115	1.10	9.59	0.289	0.029	3.25	0.235	0.079
apron beyond maximum slope	10	0.01	0.57	0.155	1.30	8.41	0.294	0.010	0.28	0.003	0.079
upper west slope	82	0.33	18.26	0.042	0.40	9.52	0.04	0.009	1.51	0.075	0.079
lower west slope	140	0.267	14.95	0.042	0.40	9.52	0.07	0.012	1.62	0.079	0.079
	350	0.010	0.57	0.042	0.92	21.90	0.42	0.013	0.33	0.003	0.079
	89	0.33	18.42	0.084	0.92	10.95	0.48	0.040	3.99	0.321	0.079
maximum simple side slope >>	90	0.33	18.42	0.042	0.40	9.52	0.05	0.010	1.58	0.080	0.079
design simple side slope >>	79	0.33	18.42	0.042	0.40	9.52	0.04	0.009	1.50	0.074	0.079
FLOW TO TOP SURFACE CHANNELS	383	0.01	0.57	0.075	0.40	5.36	0.11	0.006	0.19	0.001	0.079

ROCK SIZES REQUIRED FOR MT TAYLOR WASTE ROCK PILE EROSION PROTECTION

RUNOFF FROM	ELEMENT LENGTH L ft	ELEMENT WIDTH W ft	MAX. ELEV.	MIN. ELEV.	GRADIENT S	SLOPE ANGLE degrees	tc (minimum is 0.042) hours	RAINFALL WITHIN tc (1) inches	i in/hr	Peak Unit Discharge q cfs/ft	d50 for S>0.1, inches	S<0.1, inches	Manning Coeff. n	Peak Flow Depth, y ft	Peak Flow Velocity on Rock v fps	Safety Factor of Rock
OLD WASTE ROCK PILE																
TOP SURFACE SLOPING EAST	383	1	7371	7366.2	0.0100	0.57	0.075	0.80	10.72	0.0942		**0.20**	0.0170	0.10	1.87	1.25
TOP SURFACE SLOPING N & S	350	1	7373	7371	0.0100	0.57	0.070	0.75	10.77	0.0865						
EAST SLOPE WITH RUN-ON	92	1	7366.2	7338	0.3330	18.42	0.081	0.90	11.10	0.0973	**2.7**		0.0448	0.06	3.02	
UPPER SLOPES W/O RUN-ON	82	1	7371	7346	0.3330	18.42	0.042	0.40	9.52	0.0287	**1.2**		0.0394	0.03	2.00	
LOWER SLOPES W/O RUN-ON	140	1	7346	7326	0.2670	14.95	0.042	0.40	9.52	0.0490	**1.2**		0.0381	0.04	2.37	
UPPER SLOPES WITH RUN-ON	90	1	7371	7342.5	0.3330	18.42	0.076	0.80	10.53	0.1213	**3.1**					
NEW WASTE ROCK PILE																
PILE TOP SURFACE	1070	1	7377.5	7376	0.0100	0.57	0.165	1.60	9.72	0.2387		**0.30**	0.0181	0.18	2.62	1.03
EAST SIDE SLOPE	75	1	7376	7351	0.3330	18.42	0.170	1.65	9.70	0.2654	**5.3**		0.0499	0.12	4.25	
OTHER SIDE SLOPES	90	1	7313	7276	0.3330	18.42	0.042	0.40	9.52	0.0315	**1.3**		0.0398	0.03	2.06	
COMPOSITE SIDE SLOPES	210	1			0.3330	18.42	0.054	0.60	11.07	0.0854	**N/A**					

DIVERSION DITCHES AND BENCH CHANNELS

DIVERSION LOCATION	CAPACITY NEEDED cfs	DRAINAGE AREA acres	DITCH DIMENSIONS DEPTH ft	WIDTH ft	LENGTH ft	AREA ft^2	HYDRAULIC PARAMETERS Capacity cfs	R	n	S	PEAK VELOCITY fps	AVERAGE SHEAR psf	ROCK SIZE d_{50} inches
OLD WASTE ROCK PILE													
WEST BENCH	21.54		2	20.00	355	50	11.65	1.62	0.0176	0.01	0.233	1.01	**0.3**
NORTH 7346 BENCH	15.17		2	20.00	250	50	11.65	1.62	0.0176	0.01	0.233	1.01	**0.3**
WEST BENCH OUTFALL	36.70		2	25.00	210	60	20.50	1.68	0.0463	0.205	0.342	21.42	**5.4**
EAST TOE OF TOP SLOPE	27		1	150.00	550	152.5	9.19	0.98	0.0168	0.0111	0.06	0.68	**0.2**
NEW WASTE ROCK PILE													
BENCH DITCHES	8.50		1	20.00	540	22.5	8.56	0.89	0.0160	0.01	0.38	0.55	**0.1**
BENCH CHUTES													
ON BENCHES	8.50		1	10.00	30	13	10.20	0.84	0.0225	0.03	0.78	1.58	**0.4**
ON SLOPES	8.50		1	10.00	90	12.5	15.47	0.81	0.0480	0.33	1.24	16.72	**4.2**
EAST TOE (OUT-OF-BANKS FLOW	31.8		10	150.00	90	1750	32.84	8.58	0.0321	0.029	0.02	15.30	**3.8**
NORTH AND SOUTH TOES	28.47		7	50.00	91	472.5	28.69	5.38	0.0356	0.050	0.06	16.79	**4.2**

HEC1 S/N: 1343001323   HMVersion: 6.33   Data File: MARQEZ.HC1

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY  1991               *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  09/06/1996  TIME  10:53:37 *
*                                      *
****************************************
```

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***************************************
*                                     *
*   U.S. ARMY CORPS OF ENGINEERS      *
*   HYDROLOGIC ENGINEERING CENTER     *
*        609 SECOND STREET            *
*     DAVIS, CALIFORNIA 95616         *
*         (916) 756-1104              *
*                                     *
***************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

```
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
:::                                     :::
:::  Full Microcomputer Implementation  :::
:::                 by                  :::
:::         Haestad Methods, Inc.       :::
:::                                     :::
:::::::::::::::::::::::::::::::::::::::::::
:::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID  PRECIP DEPTH- AREA SIMULATION FOR MARQUEZ CANYON WATERSHED - MT. TAYLOR MINE
ID  100 YEAR, 24 HOUR STORM EVENT
IT     15       0       0      96
IO      1
JD    3.2    5.02
PH                    1.2    1.70    2.00     2.1     2.3     2.5     2.7     3.2

KK     10 RUNOFF FROM UPPER MARQUEZ CANYON TO MARUCA JUNCTION
KO      0
BA   2.76       0
BF      0       0       1
LS      0      71       0
UD    .57

KK   1040  ROUTE MARQUEZ RUNOFF TO JUNCTION
RD  26805    .067     .06            TRAP     4.5     1.9

KK     20  RUNOFF FROM MARUCA CANYON
KO      0
BA   1.63       0
BF      0       0       1
LS      0      71       0
UD    .54

KK   2040  ROUTE MARUCA RUNOFF TO JUNCTION
RD  26214    .074     .06            TRAP     4.5     1.9

KK     30 RUNOFF FROM LOWER MARQUEZ CANYON
BA    .63       0
BF      0       0       1
LS      0      78       0
UD    .20

KK     40 COMBINE 10, 20,30 RUNOFF
KM  COMBINE RUNOFF FROM UPPER MARQUEZ AND MARUCA CANYONS AND LOWER MARQUEZ
HC      3       0
KO      0

KK   4050 ROUTE COMBINED 10,20, AND 30 RUNOFF TO WEST SIDE OF MINE PROPERTY
RD   5507    .068     .06            TRAP     4.5     1.9
ZZ
```

C1 S/N: 1343001323 HMVersion: 6.33 Data File: MARQEZ.HC1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	10	990.	12.50	213.	65.	65.	2.76		
ROUTED TO	1040	929.	13.00	210.	63.	63.	2.76		
HYDROGRAPH AT	20	604.	12.50	126.	38.	38.	1.63		
ROUTED TO	2040	593.	13.00	131.	39.	39.	1.63		
HYDROGRAPH AT	30	625.	12.00	73.	22.	22.	0.63		
3 COMBINED AT	40	1579.	13.00	407.	123.	123.	5.02		
ROUTED TO	4050	1502.	13.00	406.	123.	123.	5.02		

100 YEAR- 24 HOUR EVENT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	3.000	0.00	0.00	0.00	318.50	361.00	320.18	320.18	320.73	232.10	5.94	60.75	23.70
	2.000	800.00	0.00	0.00	331.75	361.00	333.96	333.73	334.43	135.64	5.51	65.48	31.00
	1.000	900.00	0.00	0.00	344.00	361.00	346.37	346.15	346.94	141.74	6.10	59.21	30.32

100 YEAR- 24 HOUR EVENT

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	3.000	361.00	320.18	0.00	0.00	0.00	56.32	0.00
	2.000	361.00	333.96	0.00	13.78	0.00	45.22	800.00
	1.000	361.00	346.37	0.00	12.41	0.00	36.07	900.00

```
:2 S/N: 1363001292        HMVersion: 6.52    Data File: 31MARQUZ.HC2

*******************************************            ****************************************
HEC-2 WATER SURFACE PROFILES                *           *  U.S. ARMY CORPS OF ENGINEERS        *
                                            *           *  HYDROLOGIC ENGINEERING CENTER       *
Version    4.6.2;  May 1991                 *           *  609 SECOND STREET, SUITE D          *
                                            *           *  DAVIS, CALIFORNIA 95616-4687        *
 JN DATE     6SEP96    TIME    10:59:50     *           *          (916) 756-1104              *
*******************************************            ****************************************


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

                :::::::::::::::::::::::::::::::::::::::::::::
                :::::::::::::::::::::::::::::::::::::::::::::
                :::                                       :::
                :::   FULL MICRO-COMPUTER IMPLEMENTATION  :::
                :::                                       :::
                :::::::::::::::::::::::::::::::::::::::::::::
                :::::::::::::::::::::::::::::::::::::::::::::

                           ==========================
                           H A E S T A D   M E T H O D S
                           ==========================
           37 Brookside Road  *  Waterbury, Connecticut  06708  *  (203) 755-1666


                                                                              Page    1
Run Date:   6SEP96    Run Time: 10:59:50    HMVersion: 6.52    Data File:   31MARQUZ.HC2


                                                    THIS RUN EXECUTED   6SEP96     10:59:50

************************************
EC-2 WATER SURFACE PROFILES

ersion    4.6.2;   May 1991
************************************

 WATER PROFILE ANALYSES FOR MARQUEZ CANYON ARROYO ACROSS MINE SITE
MT. TAYLOR MINE, WITHOUT CHANNEL IMPROVEMENTS
      100 YEAR- 24 HOUR EVENT

  ICHECK     INQ     NINV      IDIR      STRT     METRIC     HVINS     Q       WSEL      FQ
               0        0         0        -1         0         0   1579                 0

  NPROF    IPLOT    PRFVS     XSECV     XSECH       FN     ALLDC     IBW     CHNIM    ITRACE
    -1        1        0         0         0         0       -1       0         0         1

  VARIABLE CODES FOR SUMMARY PRINTOUT
   150

  LPRNT    NUMSEC               ********REQUESTED SECTION NUMBERS********
    -1       -10

  IHLEQ     ICOPY    SUBDIV    STRTDS     RMILE
     1         1         0         0         0

C      .03      .03      .040       .1       .3        0        0        0        0        1
1        3        8        10       50        0       19      257       22      257       28
R      270        0       265       10      260       68
R      260       35       265       50      267

         2       11        40      108     1200     1200     1200        0        0        1
       305        0       300       40      285       50      280       62      277       67
R      276       77       277       87      280       90      285       92      300      108
R      305      118

1        1        9        29       80      350      350      350        0        0        1
R      320       29       310       37      300       40      290       49      289       51
R      290       53       300       68      310       77      320       80
```

CROSS SECTION 1.00
STREAM 100 YEAR- 24 HOUR EVENT
DISCHARGE= 1579.

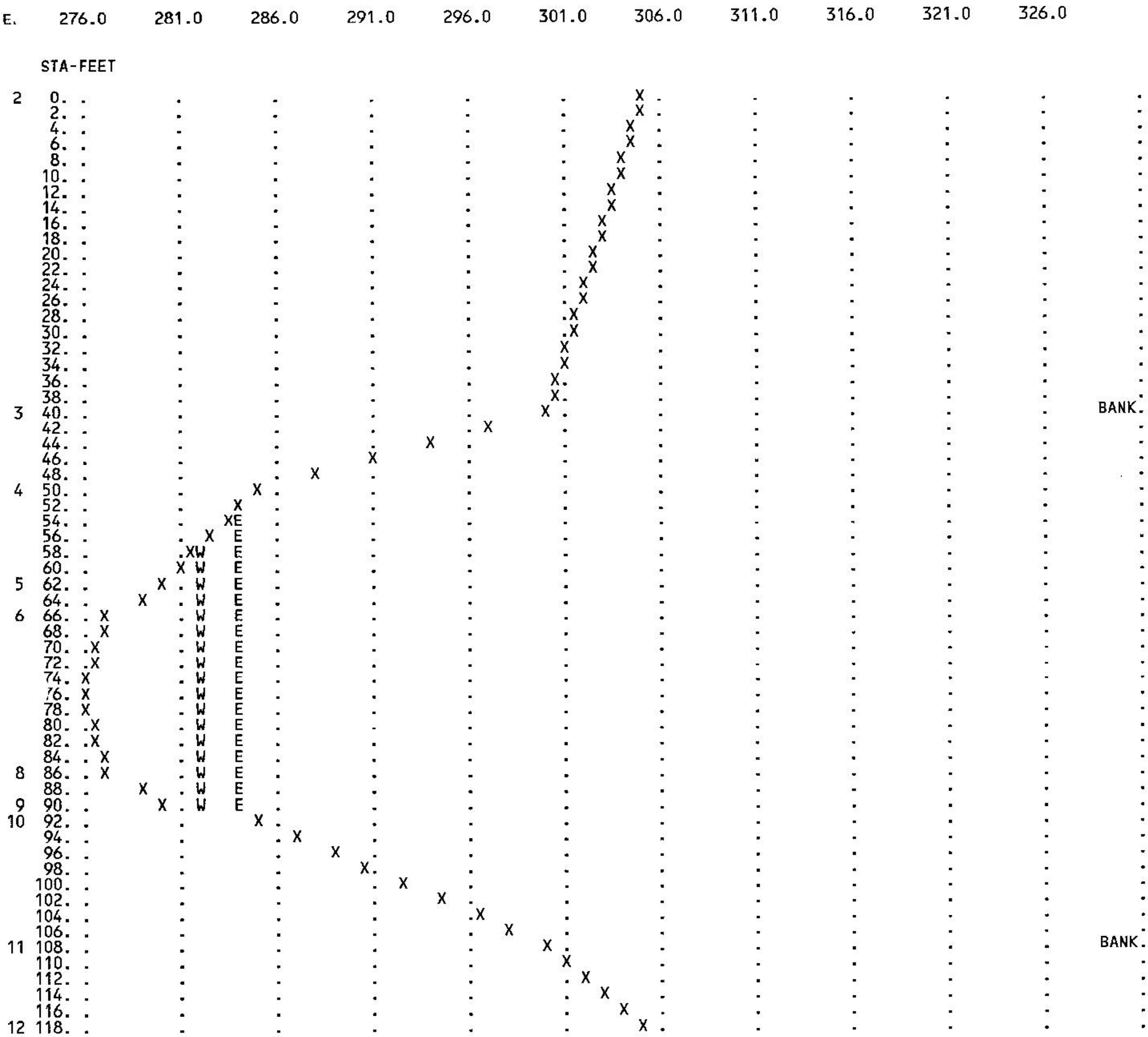
PLOTTED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL

```
E       289.0     294.0     299.0     304.0     309.0     314.0     319.0     324.0     329.0     334.0     339.0

    STA-FEET
 2 29. .         .         .         .         .         .         .X        .         .         .     BANK.
   30. .         .         .         .         .         .        X.         .         .         .         .
   31. .         .         .         .         .         .     X   .         .         .         .         .
   32. .         .         .         .         .         .   X     .         .         .         .         .
   33. .         .         .         .         .         .X        .         .         .         .         .
   34. .         .         .         .         .         X         .         .         .         .         .
   35. .         .         .         .         .      X  .         .         .         .         .         .
   36. .         .         .         .         .    X    .         .         .         .         .         .
 3 37. .         .         .         .         . X       .         .         .         .         .         .
   38. .         .         .         .    X    .         .         .         .         .         .         .
   39. .         .         .        X.         .         .         .         .         .         .         .
 4 40. .         .         . X E     .         .         .         .         .         .         .         .
   41. .         .         X   E     .         .         .         .         .         .         .         .
   42. .         .       XW.   E     .         .         .         .         .         .         .         .
   43. .         .    X   W.   E     .         .         .         .         .         .         .         .
   44. .         .  X     W.   E     .         .         .         .         .         .         .         .
   45. .         .X       W.   E     .         .         .         .         .         .         .         .
   46. .        X.        W.   E     .         .         .         .         .         .         .         .
   47. .     X   .        W.   E     .         .         .         .         .         .         .         .
   48. .   X     .        W.   E     .         .         .         .         .         .         .         .
 5 49. . X       .        W.   E     .         .         .         .         .         .         .         .
   50. .X        .        W.   E     .         .         .         .         .         .         .         .
 6 51. X         .        W.   E     .         .         .         .         .         .         .         .
   52. .X        .        W.   E     .         .         .         .         .         .         .         .
 7 53. . X       .        W.   E     .         .         .         .         .         .         .         .
   54. .  X      .        W.   E     .         .         .         .         .         .         .         .
   55. .    X    .        W.   E     .         .         .         .         .         .         .         .
   56. .     X   .        W.   E     .         .         .         .         .         .         .         .
   57. .      X  .        W.   E     .         .         .         .         .         .         .         .
   58. .        X.        W.   E     .         .         .         .         .         .         .         .
   59. .         X        W.   E     .         .         .         .         .         .         .         .
   60. .         .X       W.   E     .         .         .         .         .         .         .         .
   61. .         .  X     W.   E     .         .         .         .         .         .         .         .
   62. .         .   X    W.   E     .         .         .         .         .         .         .         .
   63. .         .    X   W.   E     .         .         .         .         .         .         .         .
   64. .         .      X W.   E     .         .         .         .         .         .         .         .
   65. .         .       XW.   E     .         .         .         .         .         .         .         .
   66. .         .        X.   E     .         .         .         .         .         .         .         .
   67. .         .         .X  E     .         .         .         .         .         .         .         .
 8 68. .         .         . X E     .         .         .         .         .         .         .         .
   69. .         .         .   X     .         .         .         .         .         .         .         .
   70. .         .         .     X   .         .         .         .         .         .         .         .
   71. .         .         .        X.         .         .         .         .         .         .         .
   72. .         .         .         .X        .         .         .         .         .         .         .
   73. .         .         .         .  X      .         .         .         .         .         .         .
   74. .         .         .         .    X    .         .         .         .         .         .         .
   75. .         .         .         .       X .         .         .         .         .         .         .
   76. .         .         .         .         X         .         .         .         .         .         .
 9 77. .         .         .         .         . X       .         .         .         .         .         .
   78. .         .         .         .         .        X.         .         .         .         .         .
   79. .         .         .         .         .         .    X    .         .         .         .         .
10 80. .         .         .         .         .         .         . X       .         .         .     BANK.
```

CROSS SECTION 2.00
STREAM 100 YEAR- 24 HOUR EVENT
DISCHARGE= 1579.

PLOTTED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL



```
CROSS SECTION     3.00
STREAM  100 YEAR- 24 HOUR EVENT
DISCHARGE=     1579.

P.   ED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL

ELEV    257.0     259.0     261.0     263.0     265.0     267.0     269.0     271.0     273.0     275.0     277.0

   STA-FEET

2    0. .         .         .         .         .         .    X    .         .         .         .         .
     2. .         .         .         .         .         X         .         .         .         .         .
     4. .         .         .         .         .    X    .         .         .         .         .         .
     6. .         .         .         .         X         .         .         .         .         .         .
     8. .         .         .         .    XE   .         .         .         .         .         .         .
3   10. .         .         .         X     E   .         .         .         .         .     BANK.
    12. .         .         .   X W   .     E   .         .         .         .         .         .
    14. .         .        X.     W   .     E   .         .         .         .         .         .
    16. .         .  X      .     W   .     E   .         .         .         .         .         .
4   18. .    X    .         .     W   .     E   .         .         .         .         .         .
    20. .    X    .         .     W   .     E   .         .         .         .         .         .
5   22. X         .         .     W   .     E   .         .         .         .         .         .
    24. X         .         .     W   .     E   .         .         .         .         .         .
    26. X         .         .     W   .     E   .         .         .         .         .         .
6   28. X         .         .     W   .     E   .         .         .         .         .         .
    30. .   X     .         .     W   .     E   .         .         .         .         .         .
    32. .        X.         .     W   .     E   .         .         .         .         .         .
7   34. .         .    X    .     W   .     E   .         .         .         .         .         .
    36. .         .       X .     W   .     E   .         .         .         .         .         .
    38. .         . X       .     W   .     E   .         .         .         .         .         .
    40. .         .    X    .     W   .     E   .         .         .         .         .         .
    42. .         .       X .     W   .     E   .         .         .         .         .         .
    44. .         .         .  X  W   .     E   .         .         .         .         .         .
    46. .         .         .    XW   .     E   .         .         .         .         .         .
    48. .         .         .       X .     E   .         .         .         .         .         .
8   50. .         .         .         X     E   .         .         .         .         .     BANK.
    52. .         .         .         .X    E   .         .         .         .         .         .
    54. .         .         .         . X   E   .         .         .         .         .         .
    56. .         .         .         .  X  E   .         .         .         .         .         .
    58. .         .         .         .   X E   .         .         .         .         .         .
    60. .         .         .         .     X   .         .         .         .         .         .
    62. .         .         .         .      X  .         .         .         .         .         .
    64. .         .         .         .       X .         .         .         .         .         .
    66. .         .         .         .        X.         .         .         .         .         .
9   68. .         .         .         .         X         .         .         .         .         .
```

100 YEAR- 24 HOUR EVENT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	3.000	0.00	0.00	0.00	257.00	1579.00	264.15	264.15	266.10	168.24	11.23	140.58	121.74
	2.000	1200.00	0.00	0.00	276.00	1579.00	282.16	281.77	283.90	132.33	10.60	148.91	137.26
*	1.000	350.00	0.00	0.00	289.00	1579.00	298.49	298.49	301.07	194.22	12.89	122.54	113.30

100 YEAR- 24 HOUR EVENT

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	3.000	1579.00	264.15	0.00	0.00	0.00	35.90	0.00
	2.000	1579.00	282.16	0.00	18.01	0.00	34.04	1200.00
*	1.000	1579.00	298.49	0.00	16.34	0.00	24.38	350.00

```
HEC1 S/N: 1343001323        HMVersion: 6.33    Data File: hummer.hc1

****************************************                ****************************************
*                                      *                *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                *   U.S. ARMY CORPS OF ENGINEERS       *
*              MAY  1991               *                *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0.1E             *                *        609 SECOND STREET             *
*                                      *                *      DAVIS, CALIFORNIA 95616         *
* RUN DATE  09/06/1996  TIME  15:18:49 *                *          (916) 756-1104              *
*                                      *                *                                      *
****************************************                ****************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X        XXXXX   X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX


                 :::::::::::::::::::::::::::::::::::::::::
                 :::::::::::::::::::::::::::::::::::::::::
                 :::                                   :::
                 :::  Full Microcomputer Implementation :::
                 :::                 by                 :::
                 :::        Haestad Methods, Inc.       :::
                 :::                                   :::
                 :::::::::::::::::::::::::::::::::::::::::
                 :::::::::::::::::::::::::::::::::::::::::
      37 Brookside Road * Waterbury, Connecticut  06708 * (203) 755-1666


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID  PRECIP DEPTH- AREA SIMULATION FOR HUMMER WATERSHED - MT. TAYLOR MINE
ID  100 YEAR, 24 HOUR STORM EVENT
IT      15       0       0      96
IO       1
JD     3.2     .54
PH                     1.2    1.70    2.00     2.1     2.3     2.5     2.7     3.2

KK      10 RUNOFF FROM EAST HUMMER
KO       0
BA     .40       0
BF       0       0       1
LS       0      71       0
UD     .22

KK    1030  ROUTE EAST HUMMER RUNOFF TO JUNCTION 30
RD    9513    0.10     .06            TRAP      14     4.0

KK      20  RUNOFF FROM WEST HUMMER
KO       0
BA     .14       0
BF       0       0       1
LS       0      71       0
UD    0.15

KK    2030  ROUTE WEST HUMMER RUNOFF TO JUNCTION 30
RD    5644   0.088     .06            TRAP      14     4.0

KK      30 COMBINE 10 AND 20 RUNOFF
KM  COMBINE RUNOFF FROM EAST AND WEST HUMMER
HC       2       0
KO       0

KK    3040 ROUTE COMBINED 10 AND 20 RUNOFF TO WEST SIDE OF MINE PROPERTY
RD     968    .036     .03            TRAP      14       4
ZZ
```

r1 S/N: 1343001323 HMVersion: 6.33 Data File: hummer.hc1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	10	226.	12.00	31.	9.	9.	0.40		
ROUTED TO	1030	254.	12.25	35.	10.	10.	0.40		
HYDROGRAPH AT	20	118.	12.00	11.	3.	3.	0.14		
ROUTED TO	2030	107.	12.25	11.	3.	3.	0.14		
2 COMBINED AT	30	361.	12.25	46.	14.	14.	0.54		
ROUTED TO	3040	334.	12.25	46.	14.	14.	0.54		

```
*****************************************
 HEC-2 WATER SURFACE PROFILES           *
                                        *
 Version    4.6.2;  May 1991            *
                                        *
 JN DATE      6SEP96     TIME   16:05:18 *
*****************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS      *
*  HYDROLOGIC ENGINEERING CENTER     *
*  609 SECOND STREET, SUITE D        *
*  DAVIS, CALIFORNIA 95616-4687      *
*        (916) 756-1104              *
*************************************
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X      X  XXXXXXX   XXXXX             XXXXX
X      X  X        X     X           X     X
X      X  X        X                       X
XXXXXXX   XXXX     X          XXXXX   XXXXX
X      X  X        X                 X
X      X  X        X     X           X
X      X  XXXXXXX   XXXXX            XXXXXXX
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:::::::::::::::::::::::::::::::::::::::::::
:::                                     :::
:::  FULL MICRO-COMPUTER IMPLEMENTATION :::
:::                                     :::
:::::::::::::::::::::::::::::::::::::::::::
```


===========================
H A E S T A D   M E T H O D S
===========================

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS RUN EXECUTED 6SEP96 16:05:18

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************************************
HEC-2 WATER SURFACE PROFILES

Version   4.6.2;  May 1991
************************************
```

WATER PROFILE ANALYSES FOR HUMMER WATERSHED WITHOUT IMPROVEMENTS
MT. TAYLOR MINE
100 YEAR- 24 HOUR EVENT

ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	0	0	-1	0	0	361		0

NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
-1	1	0	0	0	0	-1	0	0	1

VARIABLE CODES FOR SUMMARY PRINTOUT

150

LPRNT	NUMSEC	********REQUESTED SECTION NUMBERS********
-1	-10	

IHLEQ	ICOPY	SUBDIV	STRTDS	RMILE
1	1	0	0	0

```
   .03      .03     .040      .1       .3
     3        7      110     186                                  0          0        1
   325        0      321      80      321      110     318.5     142      318.5      158
   321      186    323.7     280

     2        7       85     159      820      790       800       0          0        1
   340        0      336      60      336       85    331.75     115     331.75      129
   336      159    338.2     280

     1        7       60     130      900      900       900       0          0        1
   350        0      352      30      350       60       344      93        344      107
   350      130      360     180
```

CROSS SECTION 1.00
STREAM 100 YEAR- 24 HOUR EVENT
DISCHARGE= 361.

PLOTTED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL

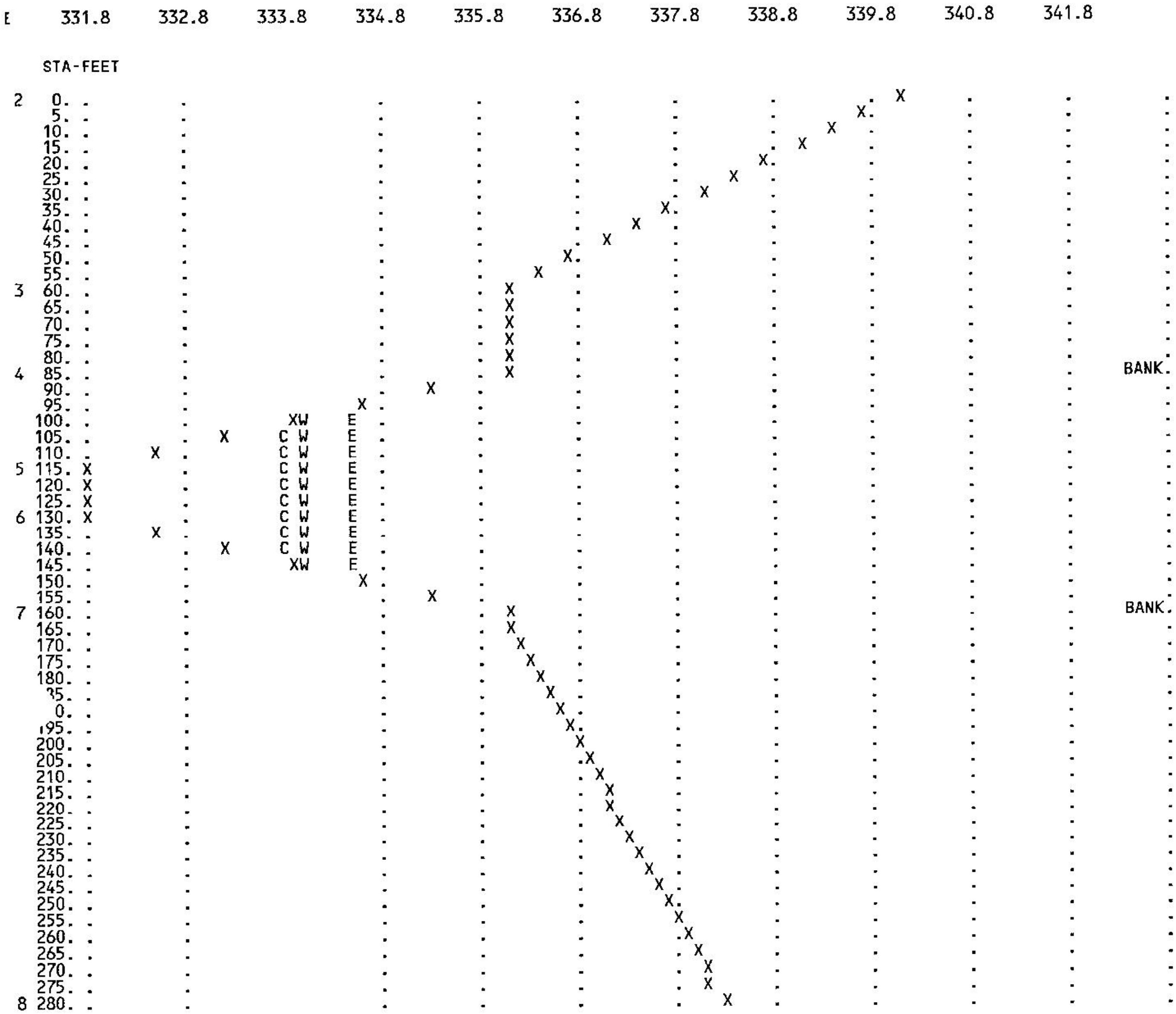
```
E     344.0     346.0     348.0     350.0     352.0     354.0     356.0     358.0     360.0     362.0     364.0

   STA-FEET

 2   0. .         .         .         X         .         .         .         .         .         .         .         .
     5. .         .         .         . X       .         .         .         .         .         .         .         .
    10. .         .         .         .  X      .         .         .         .         .         .         .         .
    15. .         .         .         .    X    .         .         .         .         .         .         .         .
    20. .         .         .         .      X  .         .         .         .         .         .         .         .
    25. .         .         .         .       X .         .         .         .         .         .         .         .
 3  30. .         .         .         .         X         .         .         .         .         .         .         .
    35. .         .         .         .       X .         .         .         .         .         .         .         .
    40. .         .         .         .      X  .         .         .         .         .         .         .         .
    45. .         .         .         .    X    .         .         .         .         .         .         .         .
    50. .         .         .         .  X      .         .         .         .         .         .         .         .
    55. .         .         .         . X       .         .         .         .         .         .         .         .
 4  60. .         .         .         X         .         .         .         .         .         .         .     BANK.
    65. .         .         .    X    .         .         .         .         .         .         .         .         .
    70. .         .         .X        .         .         .         .         .         .         .         .         .
    75. .         .     X   .         .         .         .         .         .         .         .         .         .
    80. .         . X  E    .         .         .         .         .         .         .         .         .         .
    85. .     X   .CW  E    .         .         .         .         .         .         .         .         .         .
    90. .  X      .CW  E    .         .         .         .         .         .         .         .         .         .
 5  95. X         .CW  E    .         .         .         .         .         .         .         .         .         .
   100. X         .CW  E    .         .         .         .         .         .         .         .         .         .
 6 105. X         .CW  E    .         .         .         .         .         .         .         .         .         .
   110. .     X   .CW  E    .         .         .         .         .         .         .         .         .         .
   115. .         .  X E    .         .         .         .         .         .         .         .         .         .
   120. .         .         X         .         .         .         .         .         .         .         .         .
   125. .         .         .     X   .         .         .         .         .         .         .         .         .
 7 130. .         .         .         X         .         .         .         .         .         .         .     BANK.
   135. .         .         .         .    X    .         .         .         .         .         .         .         .
   140. .         .         .         .         X         .         .         .         .         .         .         .
   145. .         .         .         .         .    X    .         .         .         .         .         .         .
   150. .         .         .         .         .         X         .         .         .         .         .         .
   155. .         .         .         .         .         .    X    .         .         .         .         .         .
   160. .         .         .         .         .         .         X         .         .         .         .         .
   165. .         .         .         .         .         .         .    X    .         .         .         .         .
   170. .         .         .         .         .         .         .         X         .         .         .         .
   175. .         .         .         .         .         .         .         .    X    .         .         .         .
 8 180. .         .         .         .         .         .         .         .         X         .         .         .
```

CROSS SECTION 2.00
STREAM 100 YEAR- 24 HOUR EVENT
DISCHARGE= 361.

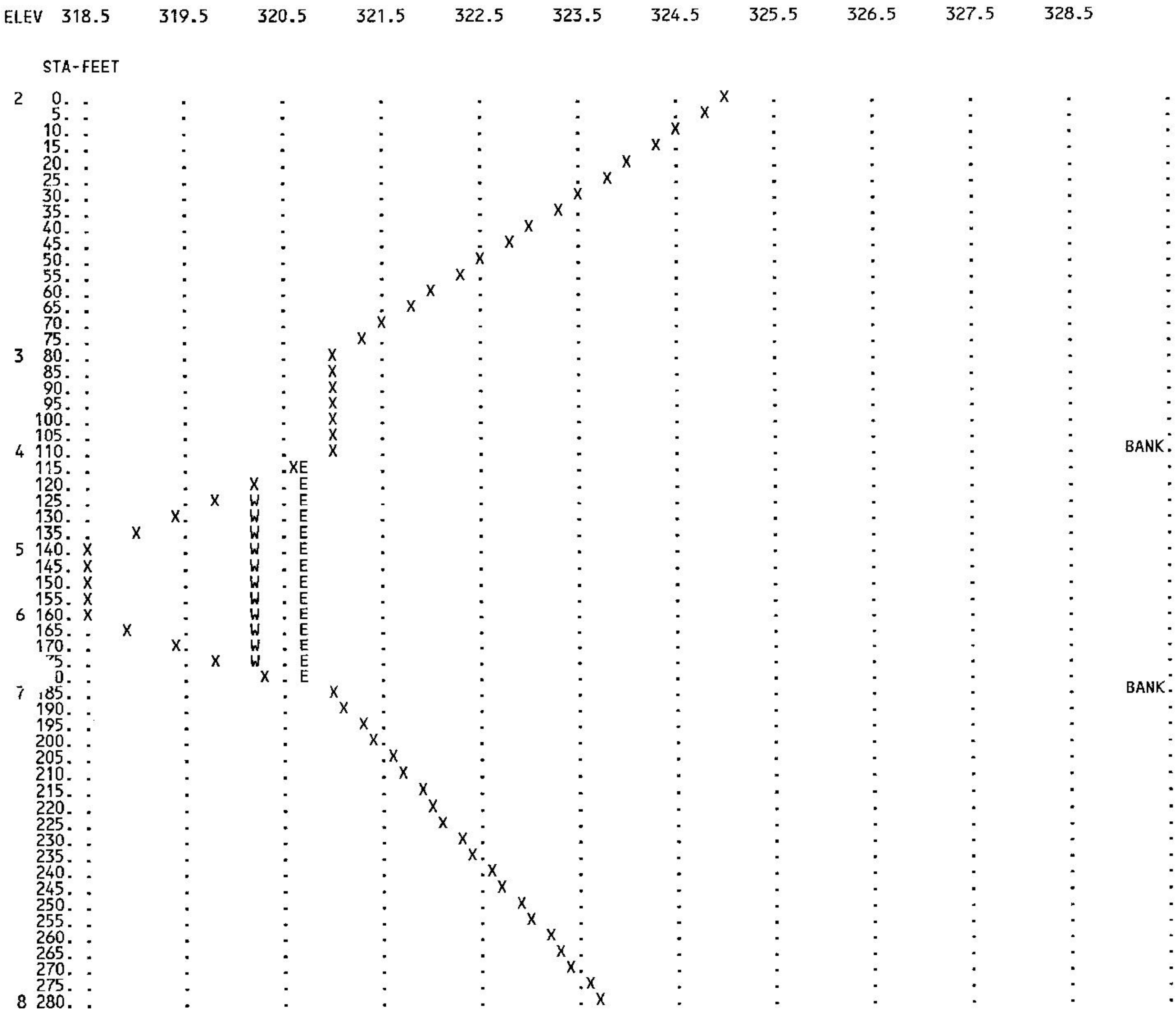
PLOTTED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL



Run Date: 6SEP96 Run Time: 16:05:18 HMVersion: 6.52 Data File: HUMMER.HC2 Page 2

CROSS SECTION 3.00
STREAM 100 YEAR- 24 HOUR EVENT
DISCHARGE= 361.

F 'ED POINTS (BY PRIORITY)-B=BOTTOM BRIDGE,T=TOP BRIDGE,X=GROUND,W=WATER SUR,E=ENERGY GRADIENT,C=CRITICAL WSEL



SURFACE WATER RUNOFF HYDROLOGIC ANALYSIS

GENERAL PARAMETRIC EVALUATION AND MODEL INPUT DATA SELECTION FOR HEC-1 (WATERSHED RUNOFF) AND HEC-2 (FLOOD ROUTING)

Design Storm Precipitation (Inches) for Various Frequency Intervals and Durations

Interval years	Duration in Hours					
	1	2	3	6	12	24
2	0.89	1.00	1.07	1.20	1.30	1.50
5	1.03	1.17	1.27	1.45	1.60	1.90
10	1.15	1.32	1.44	1.65	1.83	2.20
25	1.38	1.59	1.73	2.00	2.23	2.70
50	1.71	1.91	2.04	2.30	2.50	2.90
100	1.97	2.15	2.27	2.50	2.73	3.20

** Duration selected must be => time of concentration, Tc

Unit Duration ~= Lg/5.5

Time of Concentration, tc
For watersheds < or = 10 sq. mi.
tc = 0.00013*(L^0.77/S^0.385)
where S = gradient
For watersheds > 10 sq. mi.
tc = 0.385*(11.9*L^3)/H
where H = elevation difference

Curve Number, CN
CN = 71 for P-J uplands (Group D) = 78 for Group B/C soils

Time to Peak Discharge, Tp, hours
Tp = 0.5*dt+Tlag
where dt = duration of excess, or computation interval
Tlag = time between center of rainfall excess and time of peak discharge

Peak flow of unit hydrograph, Qp, cfs/in
Qp = 484*Area*/Tp where Area = subbasin area in sq mi

Average Manning's Coefficient, Kn =
0.26 for uplands, general storm
0.13 for PMF and well-developed drainage courses
0.05 for uplands thunderstorm
0.073 for thunderstorm in well-developed drainage courses
For Southwest region
0.07 for coniferous forest areas
0.042 for desert terrain

WEATHER DATA FOR THE MT. TAYLOR AREA

from National Weather Service Annual Climatological Summaries

1986-1995

Grants Airport (1986-1995) and San Mateo (1986-1987) Stations

GRANTS AIRPORT

AVERAGE MONTHLY PRECIPITATION, INCHES

	J	F	M	A	M	J	JL	A	S	O	N	D	Annual
1986	0.00	0.55	0.32	0.47	1.29	1.94	1.75	1.53	1.10	1.55	2.25	1.35	14.10
1987	1.60	1.24	0.54	0.28	0.89	0.26	2.61	3.05	0.72	0.50	0.82	1.25	13.76
1988	0.19	0.09	0.07	1.74	0.20	1.06	1.22	2.30	1.46	0.85	0.15	0.13	9.46
1989	0.77	0.45	0.16	0.00	0.08	0.10	0.98	0.90	1.64	1.07	0.05	0.11	6.31
1990	0.35	0.17	0.88	1.54	1.02	0.37	1.96	3.99	2.13	1.27	0.62	1.59	15.89
1991	0.66	0.05	1.04	0.65	0.26	0.99	1.05	1.66	1.83	0.27	1.33	1.76	11.55
1992	0.72	0.27	0.93	0.67	2.68	0.46	1.68	1.86	1.23	0.90	0.90	1.26	13.56
1993	1.91	1.15	1.94	0.25	1.10	0.00	0.43	4.23	0.35	0.60	0.43	0.18	12.57
1994	0.10	0.38	0.77	0.52	2.02	0.18	0.84	1.50	1.42	1.82	1.84	0.30	11.69
1995	0.49	0.30	0.38	0.09	0.29	0.49	0.45	1.92	0.86	0.00	0.30	0.37	5.94
AVE	0.68	0.47	0.70	0.62	0.98	0.59	1.30	2.29	1.27	0.88	0.87	0.83	**11.48**

	FREEZE-FREE DAYS	ANNUAL TEMP., F LOW	HIGH
1986	141	0	96
1987	132	-18	NA
1988	120	-6	94
1989	167	-15	101
1990	159	-33	99
1991	154	-7	98
1992	183	-9	99
1993	138	-4	98
1994	140	-3	101
1995	129	2	102
AVE	**146.3**	**-9.3**	**98.7**

SAN MATEO

	J	F	M	A	M	J	JL	A	S	O	N	D	Annual
1986	0.04	0.13	0.45	0.38	0.73	0.84	3.45	1.78	1.90	1.91	3.88	0.57	16.06
1987	0.92	2.81	0.84	0.14	0.78	0.73	0.39	3.97	0.23	0.72	0.54	2.00	14.07
1988	2.64												*10.22*
1989													*6.82*
1990													*17.17*
1991													*12.48*
1992													*14.66*
1993													*13.59*
1994													*12.63*
1995													*6.42*
AVE	1.20	1.47	0.65	0.26	0.76	0.79	1.92	2.88	1.07	1.32	2.21	1.29	**12.41**

	FREEZE-FREE DAYS	ANNUAL TEMP., F LOW	HIGH
1986	155	4	89
1987	181	0	89
1988	*146*	*5*	*87*
1989	*204*	*-4*	*94*
1990	*194*	*-22*	*92*
1991	*188*	*4*	*91*
1992	*223*	*2*	*92*
1993	*168*	*7*	*91*
1994	*171*	*8*	*94*
1995	*157*	*13*	*95*
AVE	***179***	**2**	***91***

CORRECTION FACTORS

F-F DAYS	LOW	HIGH
0.9097	4	-7
0.7293	18	
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7
0.8195	11	-7

RAINFALL PARAMETERS

Design Storm Precipitation (Inches) for Various Frequency Intervals and Durations

Interval years	Duration in Hours					
	1	2	3	6	12	24
2	0.9	1.0	1.1	1.2	1.3	1.5
5	1.0	1.2	1.3	1.45	1.6	1.9
10	1.2	1.3	1.4	1.65	1.8	2.2
25	1.4	1.6	1.7	2.0	2.2	2.7
50	1.7	1.9	2.0	2.3	2.5	2.9
100	2.0	2.1	2.3	2.5	2.7	3.2

** Duration selected must be => time of concentration, Tc

Fraction of one hour

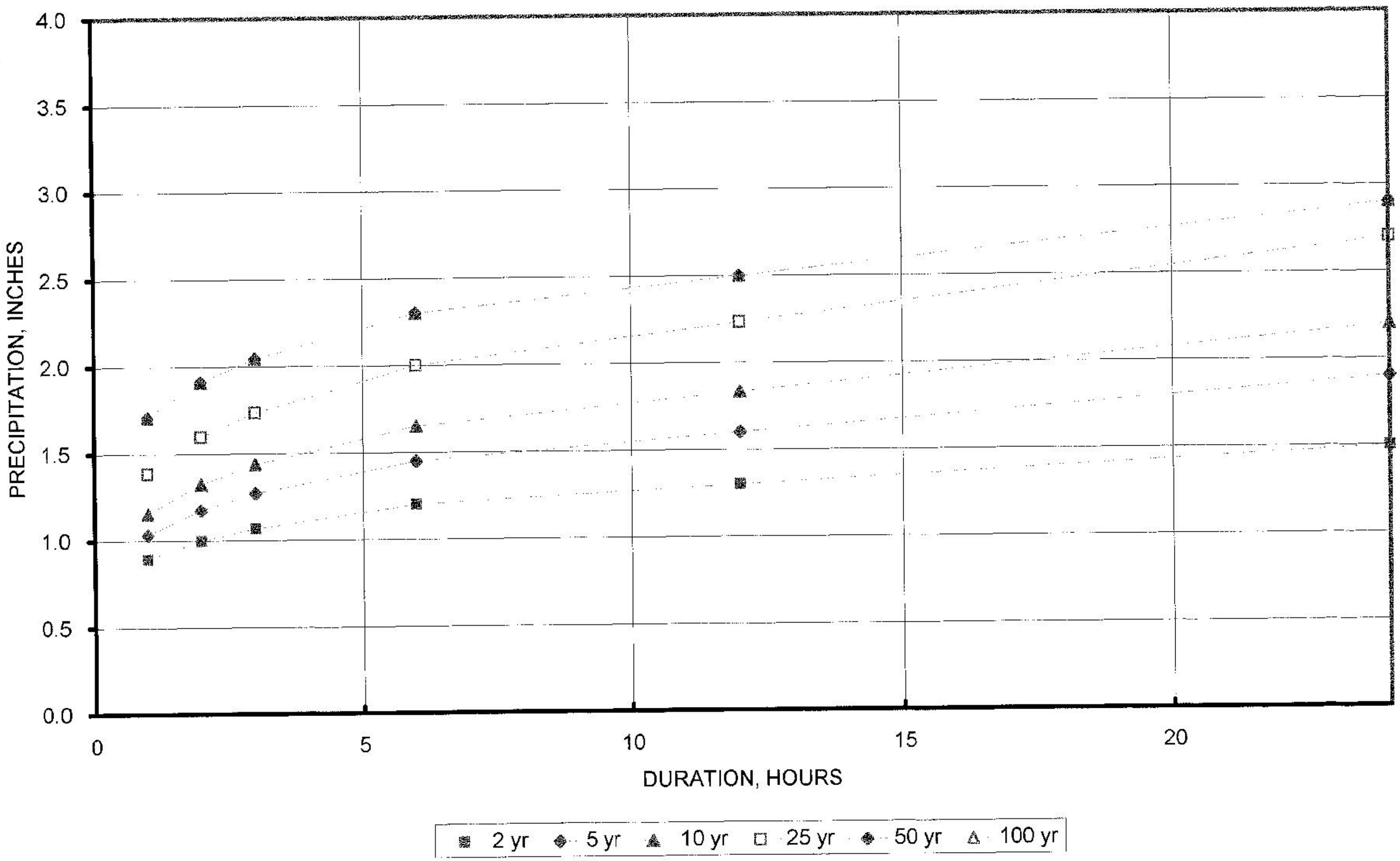
depth10 = 0.59 depth15 + 0.41 depth5
depth30 = 0.49 depth60 + 0.51 depth15

Minutes	Hours	Fraction of 1-Hr Depth inches
0	0	0.00
5	0.08	0.60
10	0.17	0.75
15	0.25	0.85
30	0.50	0.93
45	0.75	0.97
60	1.00	1.00

Triangular Precipitation Distribution for 24 hr/100 yr Event

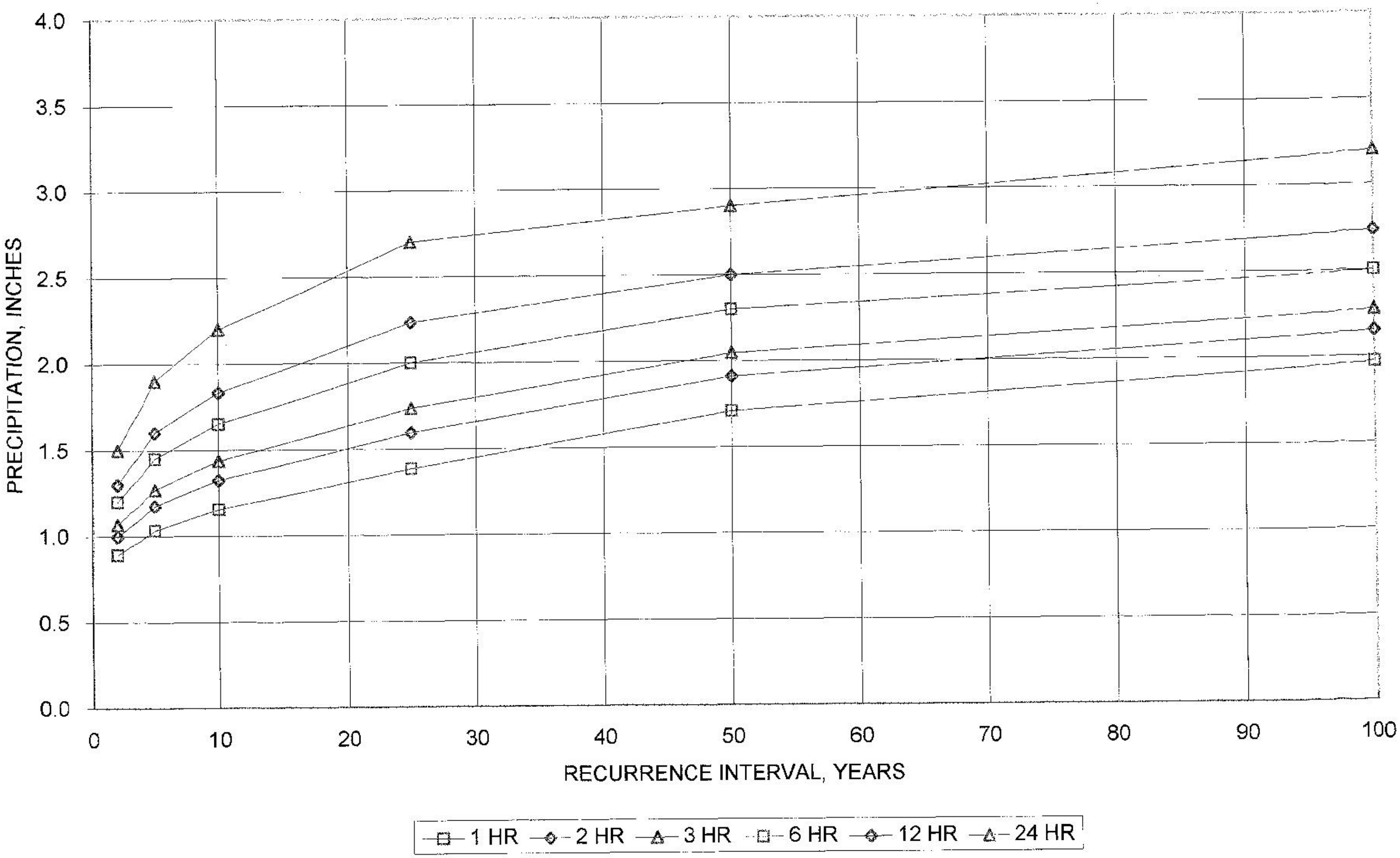
Time Step hours	Cum Precip	Interval Depth	Balanced Storm Hyetograph
0	0	0	0
1	1.97	1.9686	0.0300
2	2.15	0.1812	0.0367
3	2.27	0.1212	0.0400
4	2.35	0.0790	0.0400
5	2.42	0.0700	0.0400
6	2.50	0.0800	0.0400
7	2.54	0.0400	0.0400
8	2.58	0.0400	0.0400
9	2.62	0.0400	0.0400
10	2.66	0.0400	0.0700
11	2.69	0.0300	0.0800
12	2.73	0.0433	0.1812
13	2.77	0.0367	1.9686
14	2.81	0.0400	0.1212
15	2.85	0.0400	0.0790
16	2.89	0.0400	0.0433
17	2.93	0.0400	0.0400
18	2.97	0.0400	0.0400
19	3.00	0.0300	0.0400
20	3.04	0.0400	0.0400
21	3.08	0.0400	0.0400
22	3.12	0.0400	0.0400
23	3.16	0.0400	0.0400
24	3.20	0.0400	0.0300

PRECIPITATION DEPTH VS DURATION
MT TAYLOR MINE WATERSHED



9431HYD.XLS

PRECIPITATION VS INTERVAL AND DURATION
MT TAYLOR MINE WATERSHED



9431HYD.XLS

SURFACE WATER RUNOFF HYDROLOGIC ANALYSIS - MT. TAYLOR MINE
WATERSHED PARAMETERS

A73.K145

PARAMETERS	Marquez/ Maruca Basin				Hummer Basin		
	Total Basin	Marquez Canyon above junction	Maruca Canyon	Lower Marquez Canyon	Total Basin	East Hummer	West Hummer
L, length of longest watercourse, ft =	32312	26805	26214	7000	10481	9513	5644
Maximum elevation	9250	9250	9380	7928	8300	8300	7810
Minimum elevation	7260	7450	7450	7450	7315	7350	7315
H, difference in elevation	1990	1800	1930	478	985	950	495
S, slope gradient =	0.062	0.067	0.074	0.068	0.094	0.100	0.088
in ft/mi =	325	355	389	361	496	527	463
Time of Concentration, tc, hrs (watersheds < 10 sq. mi.) = 0.00013*(L^0.77/S^0.385) =	1.13	0.94	0.90	0.33	0.40	0.37	0.26
Area, sq. mi.	5.02	2.76	1.63	0.63	0.54	0.4	0.14
Lag Time, Lg, hrs							
USBR method, Lg = C*(L*Lc/S^.5)^N =	1.58	1.38	1.34	0.57	0.70	0.65	0.47
Constant, C = 26*Kn =	1.56	1.56	1.56	1.56	1.56	1.56	1.56
Constant, N =	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Length of Longest Watercourse, L, mi =	6.12	5.08	4.96	1.33	1.99	1.80	1.07
Length Along L to Point Opposite Watershed Centroid, Lc, mi =	3.06	2.54	2.48	0.66	0.99	0.90	0.53
Overall Slope of L, S, ft/mi =	325	355	389	361	496	527	463
Average Manning's Coefficient, Kn = 0.06 average based on: For Southwest region 0.07 for coniferous forest 0.042 for desert terrain	0.06	0.06	0.06	0.06	0.06	0.06	0.06
SCS Method, Lg = 0.6 Tc	0.68	0.57	0.54	0.20	0.24	0.22	0.15
Unit Duration, dt, hours ~= Lg/5.5	0.12	0.10	0.10	0.04	0.04	0.04	0.03
rounded to	0.1	0.1	0.1	0.04	0.04	0.04	0.03
Time to Peak Discharge, Tp, hours							
Tp = 0.5*dt+Lg	0.73	0.62	0.59	0.22	0.26	0.24	0.17
Peak flow of unit hydrograph, Qp, cfs/in							
Qp = 484*Area*/Tp	3344	2166	1342	1384	999	810	401
Vol. = volume of runoff, cfs-day from 1 inch rainfall	134.99	74.22	43.83	16.94	14.52	10.76	3.76
Curve Number, CN							
CN = 71 for P-J upland (Group D) = 78 for Group B/C soils							

Temporal Distribution - Dimensionless Unit Hydrograph

** % of (Lg+D/2)	** q	q*(Lg+D/2)/V	differential q*(Lg+D/2)/Vol.
5	0.19	0.0016	
10	0.32	0.0027	0.0011
15	0.48	0.0040	0.0013
20	0.74	0.0061	0.0022
25	1.21	0.0101	0.0039
30	1.81	0.0150	0.0050
35	2.63	0.0219	0.0068
40	3.68	0.0306	0.0087
45	5.47	0.0455	0.0149
50	8.41	0.0699	0.0244
55	12.61	0.1048	0.0349
60	16.5	0.1371	0.0323
65	20.5	0.1704	0.0332
70	23.97	0.1992	0.0288
75	27.75	0.2306	0.0314
80	28.91	0.2403	0.0096
85	28.07	0.2333	-0.0070
90	26.38	0.2192	-0.0140
95	24.18	0.2009	-0.0183
100	21.55	0.1791	-0.0219
105	18.92	0.1572	-0.0219
110	16.08	0.1336	-0.0236
115	14.19	0.1179	-0.0157
120	12.61	0.1048	-0.0131
125	11.04	0.0917	-0.0130
130	9.99	0.0830	-0.0087
135	9.04	0.0751	-0.0079
140	8.2	0.0681	-0.0070
145	7.36	0.0612	-0.0070
150	6.78	0.0563	-0.0048
155	6.2	0.0515	-0.0048
160	5.83	0.0484	-0.0031
165	5.47	0.0455	-0.0030
170	5.15	0.0428	-0.0027
175	4.84	0.0402	-0.0026
180	4.57	0.0380	-0.0022
185	4.31	0.0358	-0.0022
190	4.1	0.0341	-0.0017
195	3.87	0.0322	-0.0019
200	3.68	0.0306	-0.0016
205	3.47	0.0288	-0.0017
210	3.28	0.0273	-0.0016
215	3.1	0.0258	-0.0015
220	2.93	0.0243	-0.0014
225	2.75	0.0229	-0.0015
230	2.63	0.0219	-0.0010
235	2.47	0.0205	-0.0013
240	2.33	0.0194	-0.0012
245	2.22	0.0184	-0.0009
250	2.1	0.0175	-0.0010
255	1.99	0.0165	-0.0009
260	1.88	0.0156	-0.0009
265	1.78	0.0148	-0.0008
270	1.68	0.0140	-0.0008
275	1.59	0.0132	-0.0007
280	1.5	0.0125	-0.0007
285	1.43	0.0119	-0.0006
290	1.36	0.0113	-0.0006
295	1.28	0.0106	-0.0007
300	1.21	0.0101	-0.0006
305	1.15	0.0096	-0.0005

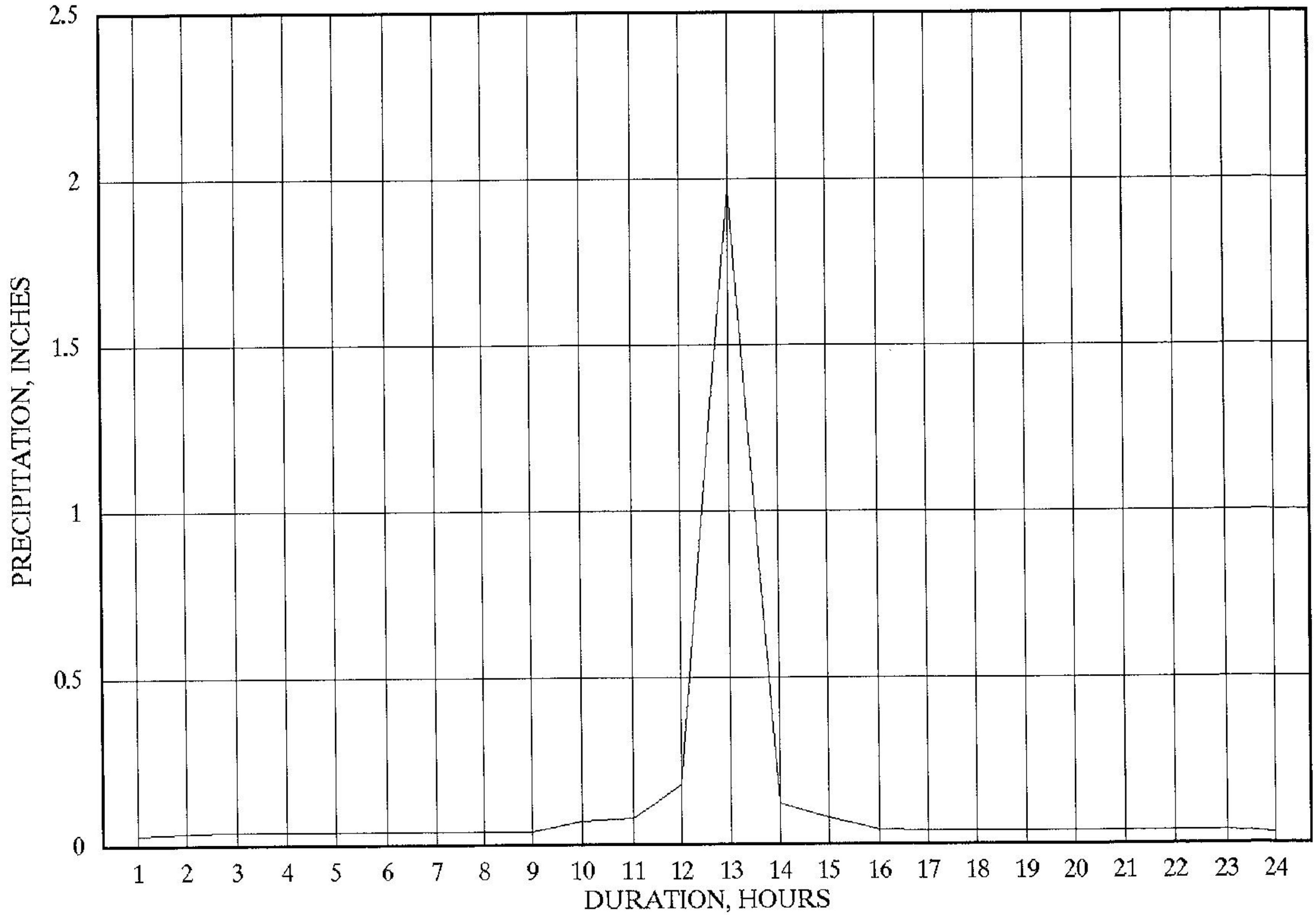
Time hours	% of (Lg+D/2)	Ordinate	Unit q cfs
0.25	40.5	0.032	3.86
0.50	81.1	0.239	28.73
0.75	121.6	0.101	12.11
1.00	162.1	0.129	15.49
1.25	202.7	0.220	26.46
1.50	243.2	0.225	27.06
1.75	283.7	0.167	20.13
2.00	324.3	0.112	13.46
2.25	364.8	0.080	9.61
2.50	405.3	0.060	7.16
2.75	445.9	0.048	5.74
3.00	486.4	0.040	4.79
3.25	526.9	0.034	4.07
3.50	567.5	0.029	3.46
3.75	608.0	0.024	2.93
4.00	648.5	0.021	2.48
4.25	689.1	0.018	2.12
4.50	729.6	0.015	1.80
4.75	770.1	0.013	1.52
5.00	810.7	0.011	1.31
5.25	851.2	0.009	1.11
5.50	891.7	0.008	0.94
5.75	932.3	0.007	0.80
6.00	972.8	0.006	0.68
6.25	1013.3	0.005	0.58
6.50	1053.9	0.004	0.49
6.75	1094.4	0.003	0.42
7.00	1135.0	0.003	0.36
7.25	1175.5	0.002	0.30

Lg =	0.57	0.54	0.20
D =	0.1	0.1	0.04
Lg+D/2 =	0.62	0.59	0.22
Vol. =	74.22	43.83	16.94

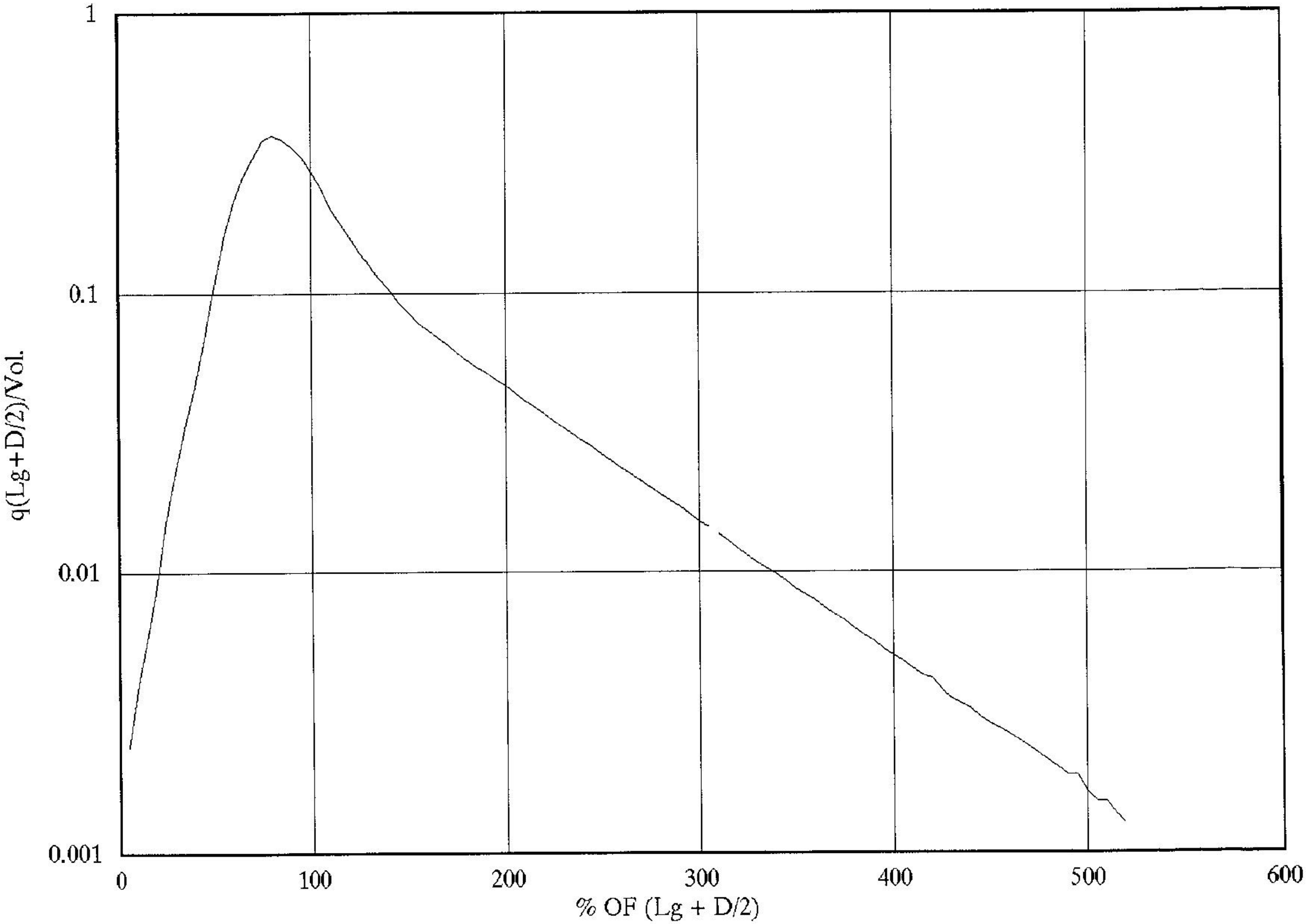
** from Table 3-13, USBR 1987

BALANCED STORM HYETOGRAPH – 24 HR/100YR

MT TAYLOR MINE WATERSHED

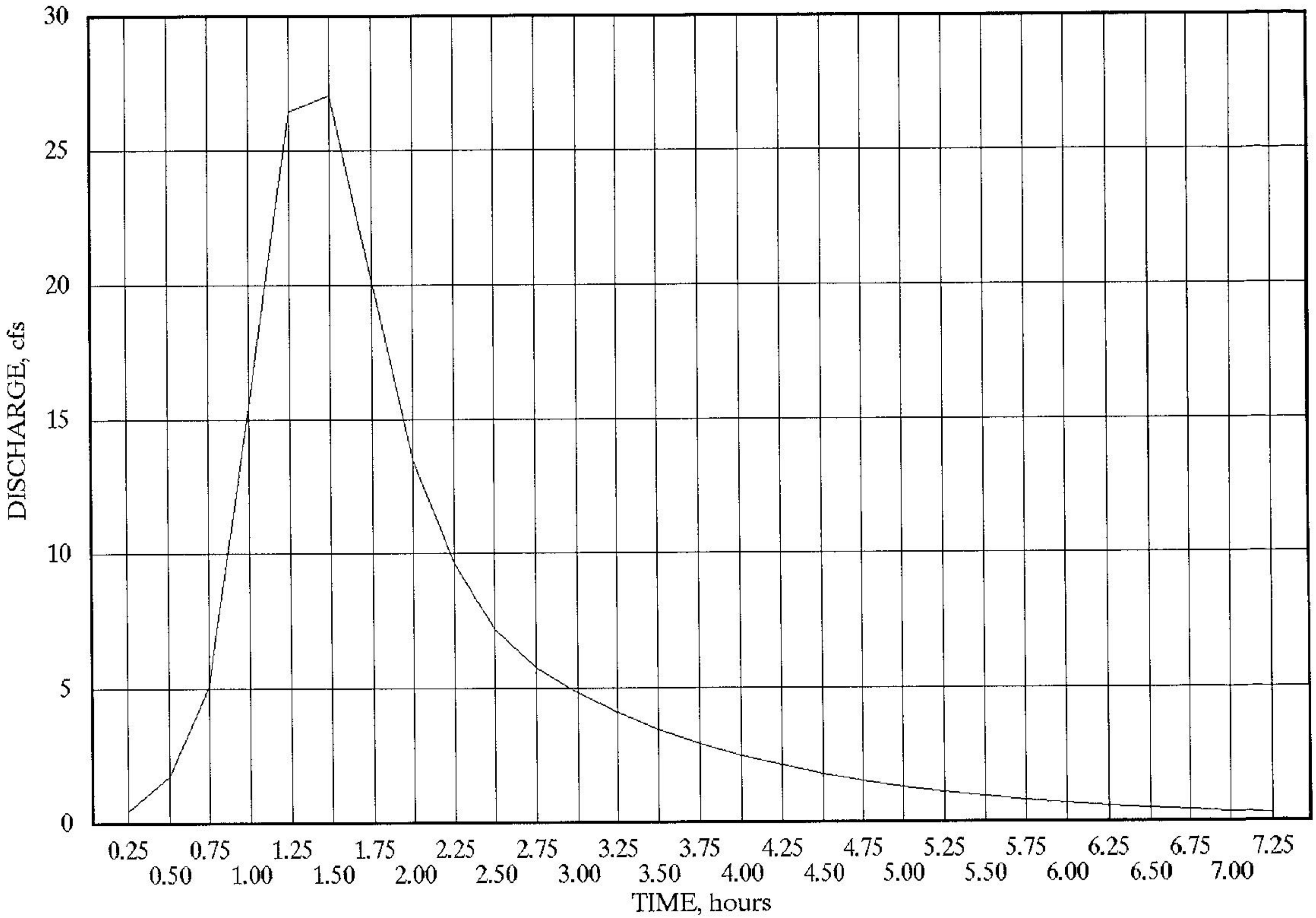


DIMENSIONLESS UNIT HYDROGRAPH FOR MARQUEZ WATERSHED
MT TAYLOR MINE

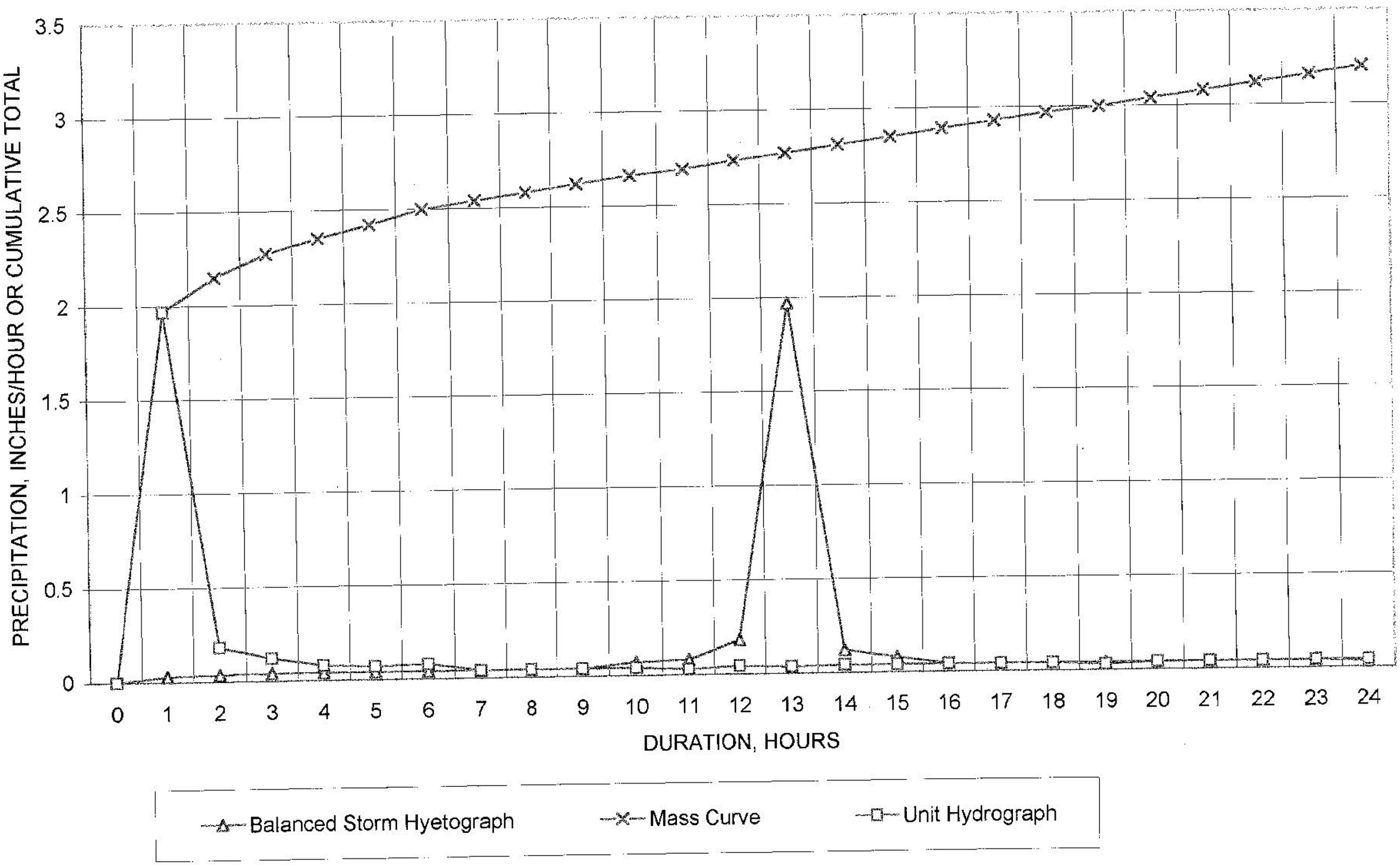


UNIT HYDROGRAPH AT SITE WEST BOUNDARY

MT. TAYLOR MINE – MARQUEZ CANYON WATERSHED



24 HR/100YR RAINFALL DISTRIBUTION
MT TAYLOR MINE - MARQUEZ CANYON WATERSHED



SWHYDATA.XLS