Appendix 7-5

Crandall Creek Flow Calculations

I hereby certify that the design contained herein was prepared by myself and is true and correct to the best of my knowledge.

Richard B. White, P.E.

APPENDIX 7-5

Crandall Creek Flow Calculations

I hereby certify that the design contained herein was prepared by myself and is true and correct to the best of my knowledge.

Richard B. White

Richard B. White, P.E.

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
STATE OF UTAH

6/10/88

CRANDALL CREEK FLOOD FLOW
ADJACENT TO SED. POND

Watershed Characteristics

Area = 3480 ac (5.44 mi²) – see watershed area on page 2 of this calc.

$$\text{Avg. slope} = \left[\frac{(187{,}400\ ft)(400\ ft)}{(3480\ ac)(43{,}560\ ft^2/ac)}\right](100) = 49.4\%$$

Avg. CN = 69 (see sed. pond calcs.)

Time of concentration:

$$T_c = 1.67\,L$$

$$L = \frac{l^{0.8}\,(s+1)^{0.7}}{1900\,Y^{0.5}} \quad \left\{ \begin{array}{l} l = 17{,}000\ ft \\ s = \frac{1000}{CN} - 10 = 4.49 \\ Y = 49.4\% \end{array} \right.$$

$$L = \frac{(17{,}000)^{0.8}\,(5.49)^{0.7}}{(1900)(49.4)^{0.5}} = 0.60\ hr$$

$$T_c = (1.67)(0.60) = 1.00\ hr$$

Average basin elevation ⟶ determine at grid points on 1000-ft centers across basin. Grid points shown on page 3 of this calc. Avg. of 143 pts = 9330 ft

Return-Period / Peak-Flow Estimates

With an avg. basin elevation > 8000 ft, Crandall Cr. is in the High Plateau flood region of Thomas and Lindskov (1983). Flood peak flows in this region can be estimated from the equations:

$$Q_{10} = 680\,A^{0.706}\,E^{-1.30}$$

$$Q_{25} = 10{,}300\,A^{0.672}\,E^{-2.33}$$

$$Q_{50} = 64{,}200\,A^{0.651}\,E^{-3.03}$$

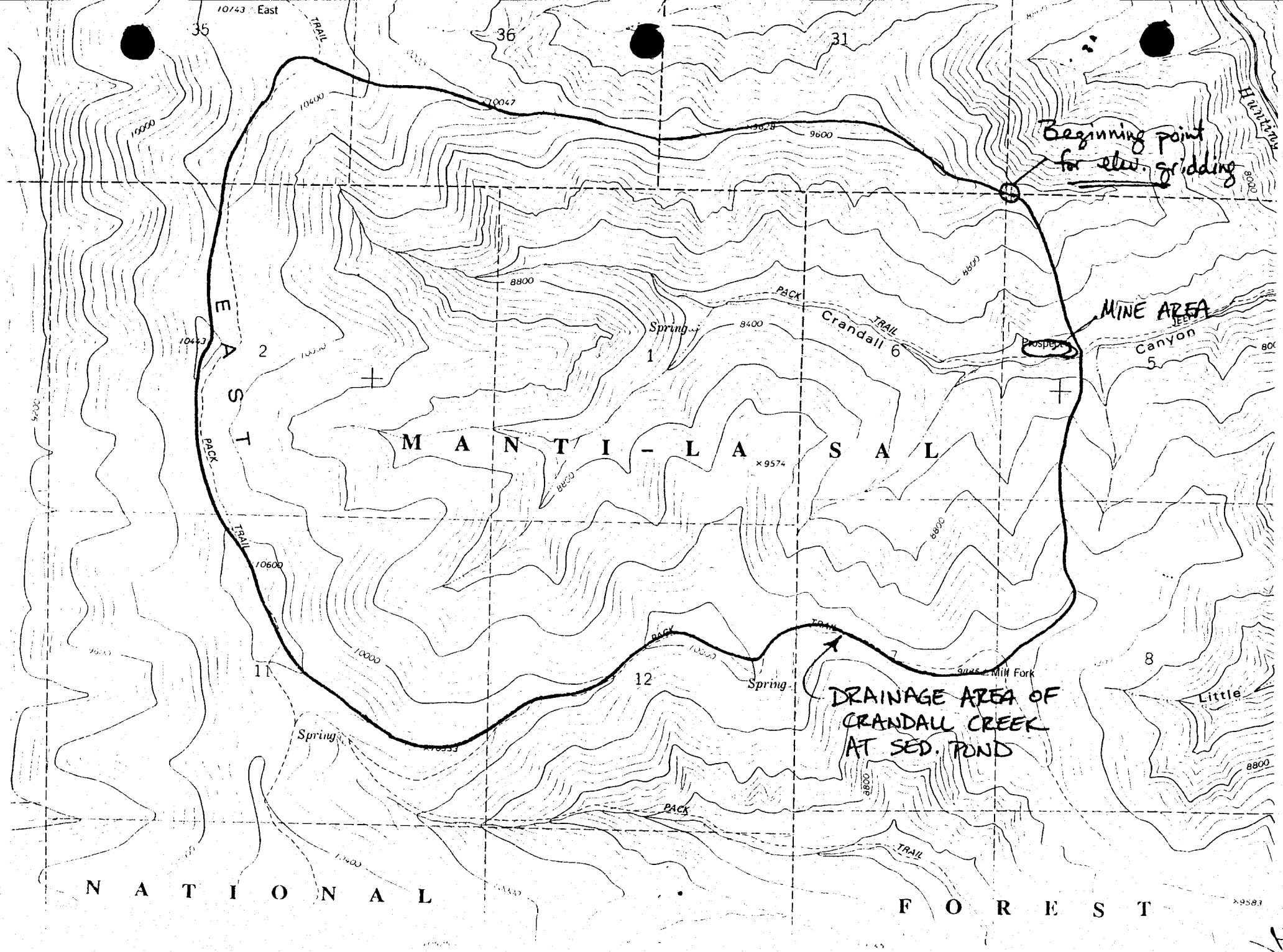
$$Q_{100} = 347{,}000\,A^{0.631}\,E^{-3.68}$$

Q_N = peak flow with a return period of N years (cfs)

A = drainage area (mi²)

E = avg. basin elev. (thousands of feet)

Equations from Thomas and Lindskov (1983)



Beginning point for elev. gridding
MINE AREA
DRAINAGE AREA OF CRANDALL CREEK AT SED. POND
MANTI-LA SAL
EAST
NATIONAL FOREST
Crandall
Canyon
Little
Mill Fork
Spring
PACK TRAIL
10743 East
35
36
31
2
1
6
5
11
12
7
8
10000
10400
10600
10443
9600
8800
8400
9574
9583

2/16

143 points → Mean elev. = 9330 ft

For the Crandell Cr. watershed → Q_{10} = 123 cfs

Q_{25} = 177 cfs

Q_{50} = 223 cfs

Q_{100} = 272 cfs

Design Storm

Examine effects of peak flow from 100-yr, 24-hr storm on Crandell Cr. adjacent to the sed. pond.

100-yr, 24-hr storm = 3.70 in (Miller et al., 1973)

Storm distribution → use Farmer-Fletcher, SCS Type B, and SCS Type II. Compare results with the return-period results above and determine most appropriate storm distribution.

Hydrograph Results

Printouts contained on pages 5-7 of this calc. for the three storm distributions. Peaks flows were:

Farmer-Fletcher → 487 cfs
Type B → 714 cfs
Type II → 1621 cfs

Comparison chart:

Storm Distribution	Peak Flow (cfs)	Return Period (yr)
Farmer/Fletcher	487	1000
Type B	714	7000
Type II	1621	>10,000

See probability plot on pg. 8 of this calc.

Although the above data indicate that all of the storm distributions yield conservative results, DOGM unequivocally requires the use of the Type II distribution for 24-hr events (ref. telecon with Dave Cline, 5 Jun 1986). Thus, the Type II data will be used.

```
*****************************
* EARTHFAX ENGINEERING, INC.  *
*                             *
* HYDROGRAPH GENERATION MODEL *
*   USING SCS CURVE NUMBER    *
*         METHODOLOGY         *
*****************************
```

IDENTIFICATION: CRANDALL CREEK - FARMER/FLETCHER

INPUT SUMMARY:

```
*************************************************************
     STORM:                    WATERSHED:
        DIST. = FARMER-FLETCHER      AREA =  5.440 SQ. MI.
        DEPTH =  3.70 IN.            CN = 69.0
        DURATION = 24.0 HR.          TIME OF CONC. =  1.00 HR.
*************************************************************
```

```
*************************************************************
```

OUTPUT SUMMARY:

```
*************************************************************
     TOTAL RUNOFF DEPTH =  1.0759 INCHES
     INITIAL ABSTRACTION =  0.8986 INCHES
     PEAK FLOW =   487.11 CFS  ( 0.1388 IN/HR)
     TIME TO PEAK =   5.04 HOURS
     RUNOFF VOLUME CHECK =  1.0781 INCHES
*************************************************************
```

```
*******************************
* EARTHFAX ENGINEERING, INC.  *
*                             *
* HYDROGRAPH GENERATION MODEL *
*   USING SCS CURVE NUMBER    *
*         METHODOLOGY         *
*******************************
```

IDENTIFICATION: CRANDALL CREEK - TYPE B

INPUT SUMMARY:

```
*************************************************************
     STORM:                    WATERSHED:
        DIST. = SCS TYPE B          AREA =  5.440 SQ. MI.
        DEPTH =  3.70 IN.           CN = 69.0
        DURATION = 24.0 HR.         TIME OF CONC. =  1.00 HR.
*************************************************************
```

```
*************************************************************
```

OUTPUT SUMMARY:

```
*************************************************************
     TOTAL RUNOFF DEPTH =  1.0759 INCHES
     INITIAL ABSTRACTION =  0.8986 INCHES
     PEAK FLOW =   714.38 CFS  ( 0.2035 IN/HR)
     TIME TO PEAK =  10.26 HOURS
     RUNOFF VOLUME CHECK =  1.0781 INCHES
*************************************************************
```

```
*******************************
* EARTHFAX ENGINEERING, INC.  *
*                             *
* HYDROGRAPH GENERATION MODEL *
*   USING SCS CURVE NUMBER    *
*         METHODOLOGY         *
*******************************
```

IDENTIFICATION: CRANDALL CREEK - TYPE II

INPUT SUMMARY:

```
*************************************************************
     STORM:                    WATERSHED:
        DIST. = SCS TYPE II          AREA =  5.440 SQ. MI.
        DEPTH =  3.70 IN.            CN = 69.0
        DURATION = 24.0 HR.          TIME OF CONC. =  1.00 HR.
*************************************************************
```

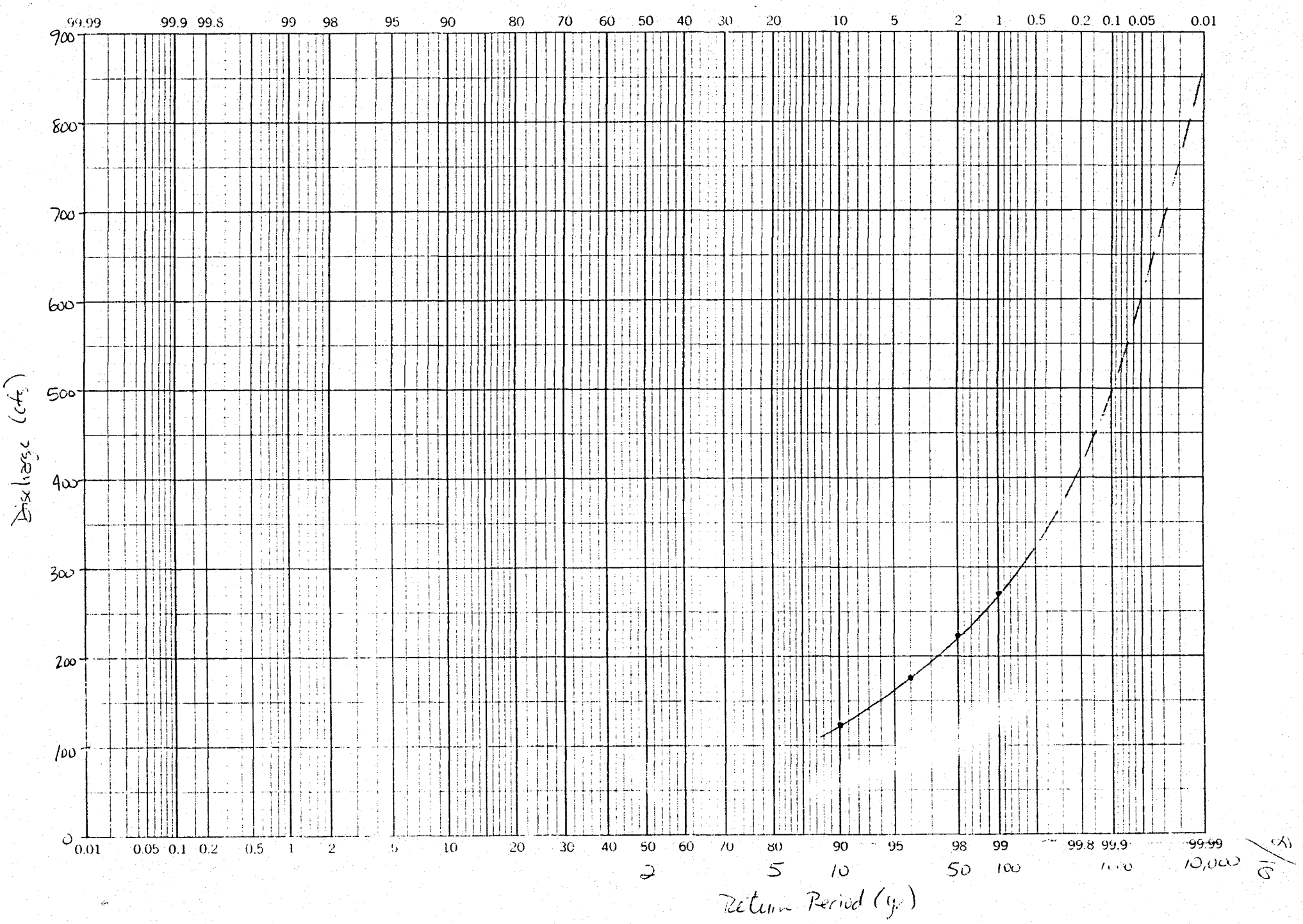
```
*************************************************************
```

OUTPUT SUMMARY:

```
*************************************************************
     TOTAL RUNOFF DEPTH =  1.0759 INCHES
     INITIAL ABSTRACTION =  0.8986 INCHES
     PEAK FLOW =  1620.90 CFS  ( 0.4617 IN/HR)
     TIME TO PEAK =  12.55 HOURS
     RUNOFF VOLUME CHECK =  1.0781 INCHES
*************************************************************
```

K+E PROBABILITY X 90 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 8000



Stage - Discharge Relations

Selection of "n" value — Based on methodology of U.S. SCS (1956).

① Basic n = 0.026 (coarse gravel / rock)

② Minor irregularity (slightly eroded side slopes)
Modifying value = 0.005

③ Only minor changes in cross section
Modifying value = 0.000

④ Negligible number of obstructions
Modifying value = 0.000

⑤ Minor amt of vegetation along banks
Modifying value = 0.005

⑥ Minor meandering
Modifying value = 0.000.

⑦ $n = 0.026 + 0.005 + 0.000 + 0.000 + 0.005 + 0.000$
$= \underline{\underline{0.036}}$

$$Q = \left[\frac{1.486}{n} R^{2/3} S^{\frac{1}{2}}\right](A)$$

$$S = \left(\frac{7760' - 7750'}{170\ ft}\right)(100) = 5.9\%$$ } From contours on plate 3-1

$$Q = \left(\frac{1.486}{0.036}\right)(0.059)^{\frac{1}{2}} R^{2/3} A$$

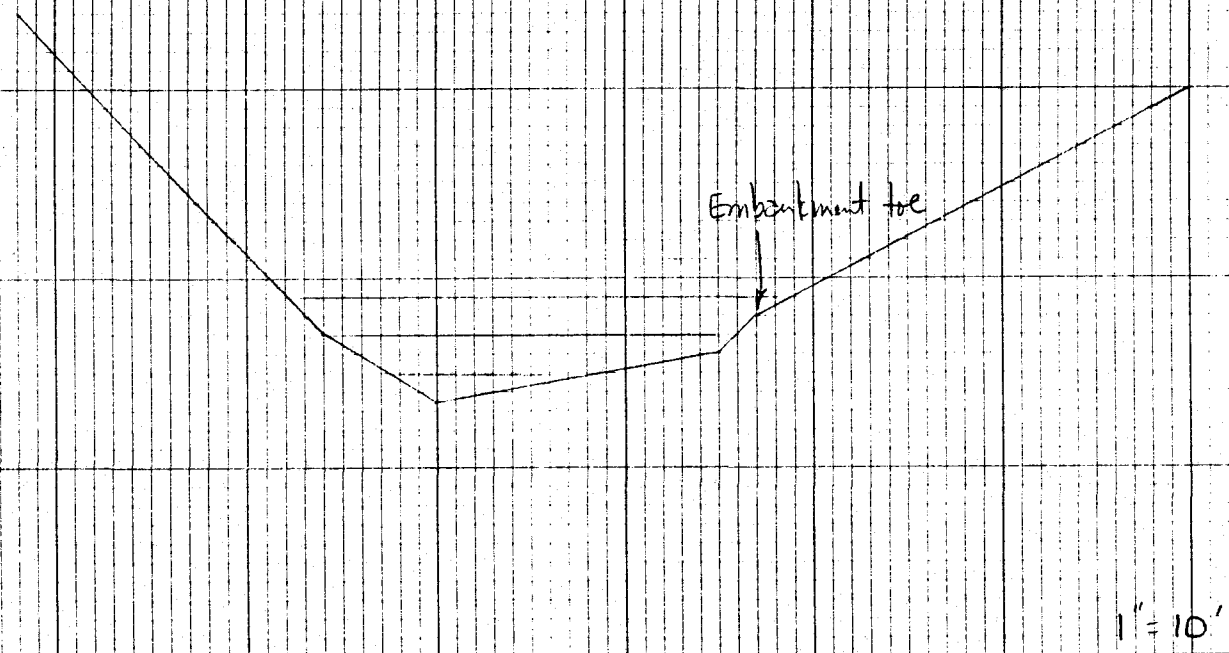
$$= 10.026\, A R^{2/3}$$

See cross section adjacent to sed. pond shown on page 10 of this calc.

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 0700

Channel Cross Section
Crandall Cr. at sed. pond
Cross Section B-B' on Plate 7-4 (Creek section)



For d = 1.5 ft :

$$\left.\begin{array}{l} A = 8.2\ ft^2 \\ P = 17.5\ ft \\ R = 0.47\ ft \end{array}\right\} Q = 50\ cfs$$

For d = 3.5 ft :

$$\left.\begin{array}{l} A = 44.8\ ft^2 \\ P = 23.1\ ft \\ R = 1.94\ ft \end{array}\right\} Q = 699\ cfs$$

For d = 5.5 ft

$$\left.\begin{array}{l} A = 92.8\ ft^2 \\ P = 29.5\ ft \\ R = 3.15\ ft \end{array}\right\} Q = 1999\ cfs$$

Flow depth at q = 1621 cfs ⟶ 5.1 ft (see stage-discharge curve on page 12 of this calc.). Needs riprap on toe (base of toe = 4.5 ft)

Stage-velocity curves ⟶ see page 13 of this calc. Design V = 20.8 ft/s

Maximum permissible velocity (see page 14 of this calc.):

Assume design d_{75} (riprap on toe) = 20 in

Basic V = 21.6 ft/s

D = 1.12 (flow depth = 5.5 ft)

A = 1.00

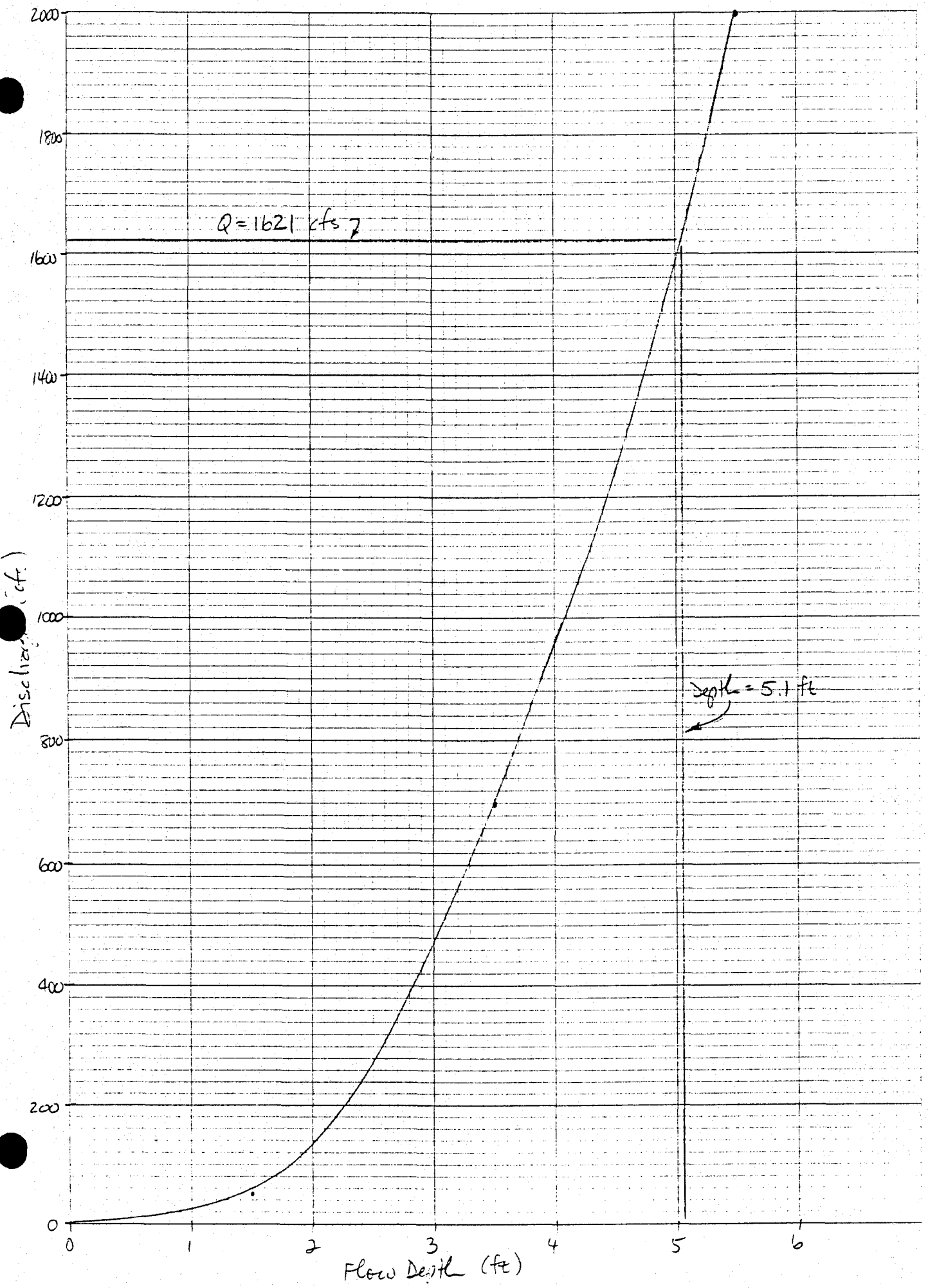
B = 0.86 (average cot. = 3.5)

Permissible velocity = (21.6)(1.12)(1.00)(0.86)

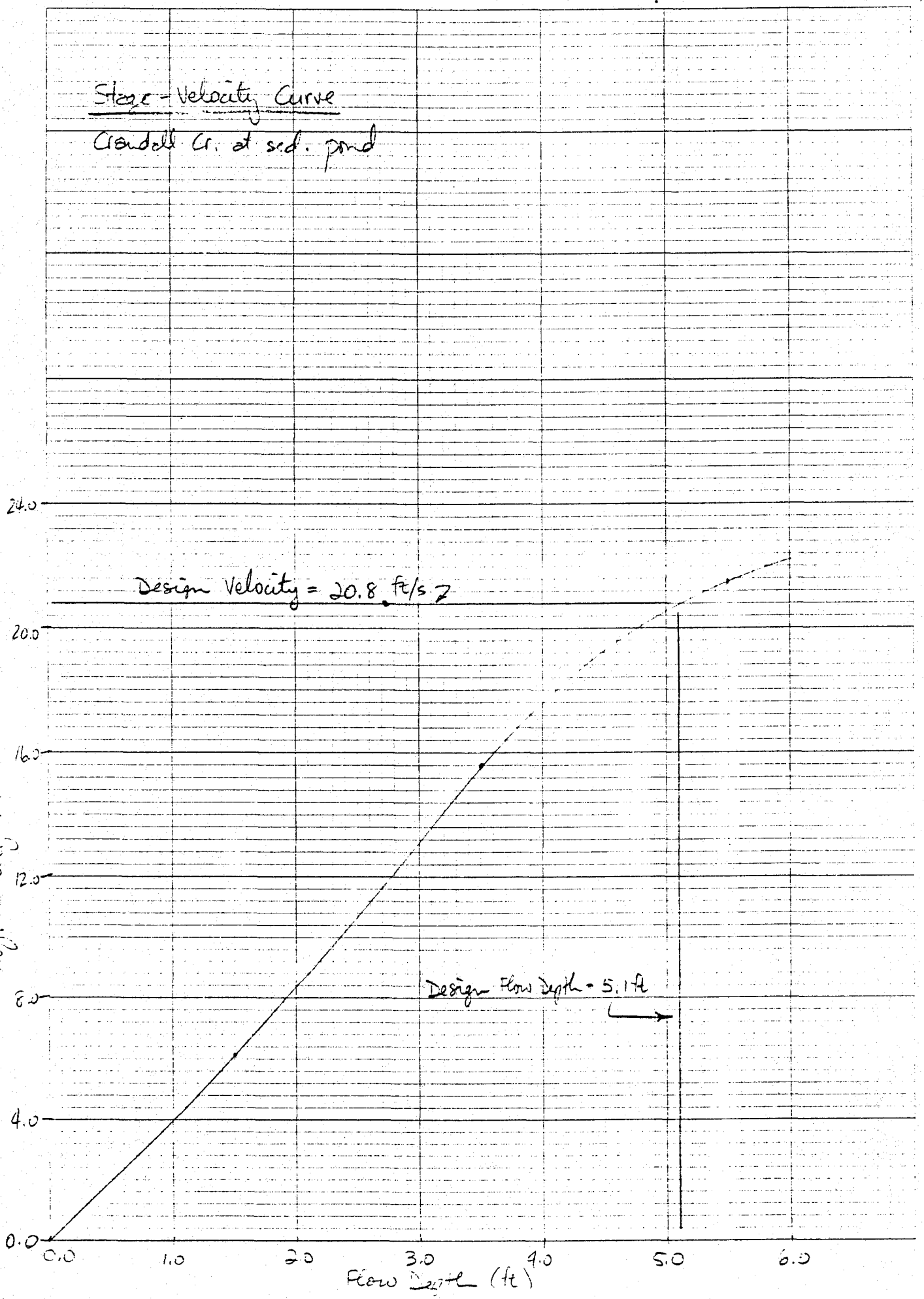
= 20.8 ft/s

= Design velocity ⟹ d_{75} <u>OK</u>

Riprap gradation ⟶ see page 15 of this calc (from Barfield et al. 1981 dimensionless curve). Place riprap along bottom 2.0 ft of embankment (0.6 ft flow depth + freeboard). Great amount of freeboard is provided incidentally due to large riprap size.

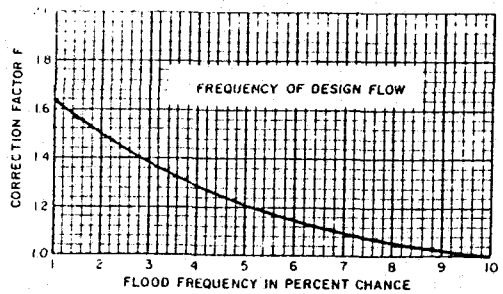


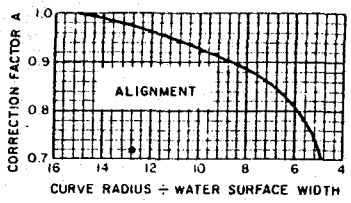
46 0700
10 X 10 TO THE INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.

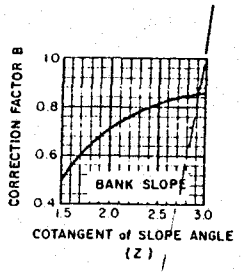


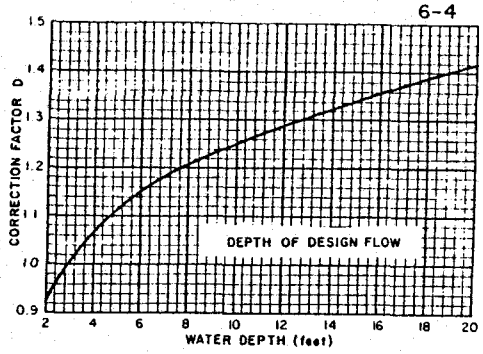
46 0700

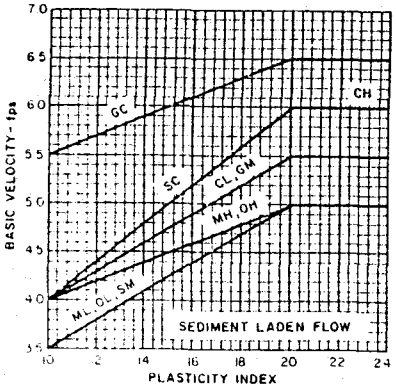
10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



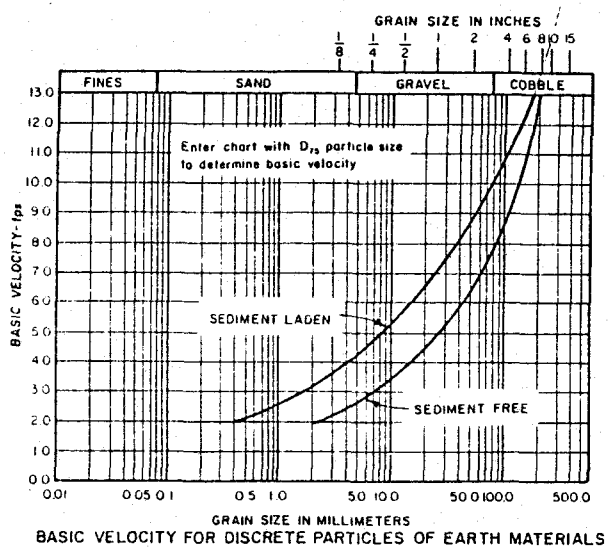




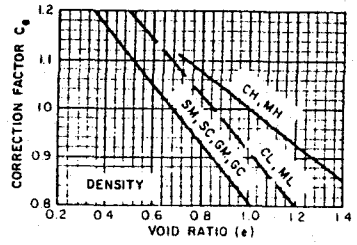




BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)

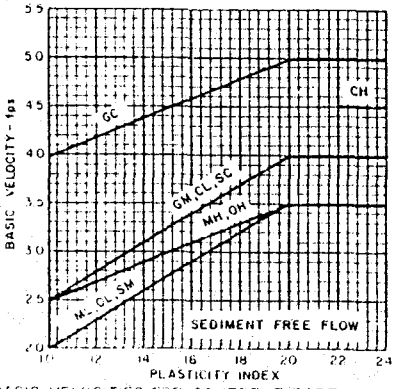


BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS (v_b)



NOTES:

1. In no case should the allowable velocity be exceeded when the 10% chance discharge occurs, regardless of the design flow frequency.



BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)

ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS	
CHANNEL BOUNDARY MATERIALS	ALLOWABLE VELOCITY
DISCRETE PARTICLES	
Sediment Laden Flow	
$D_{75} > 0.4$ mm	Basic velocity chart value x D x A x B
$D_{75} < 0.4$ mm	2.0 fps
Sediment Free Flow	
$D_{75} > 2.0$ mm	Basic velocity chart value x D x A x B
$D_{75} < 2.0$ mm	3.0 fps
COHERENT EARTH MATERIALS	
PI > 10	Basic velocity chart value x D x A x B x C_e
PI < 10	2.0 fps

FIGURE 6-2

ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS

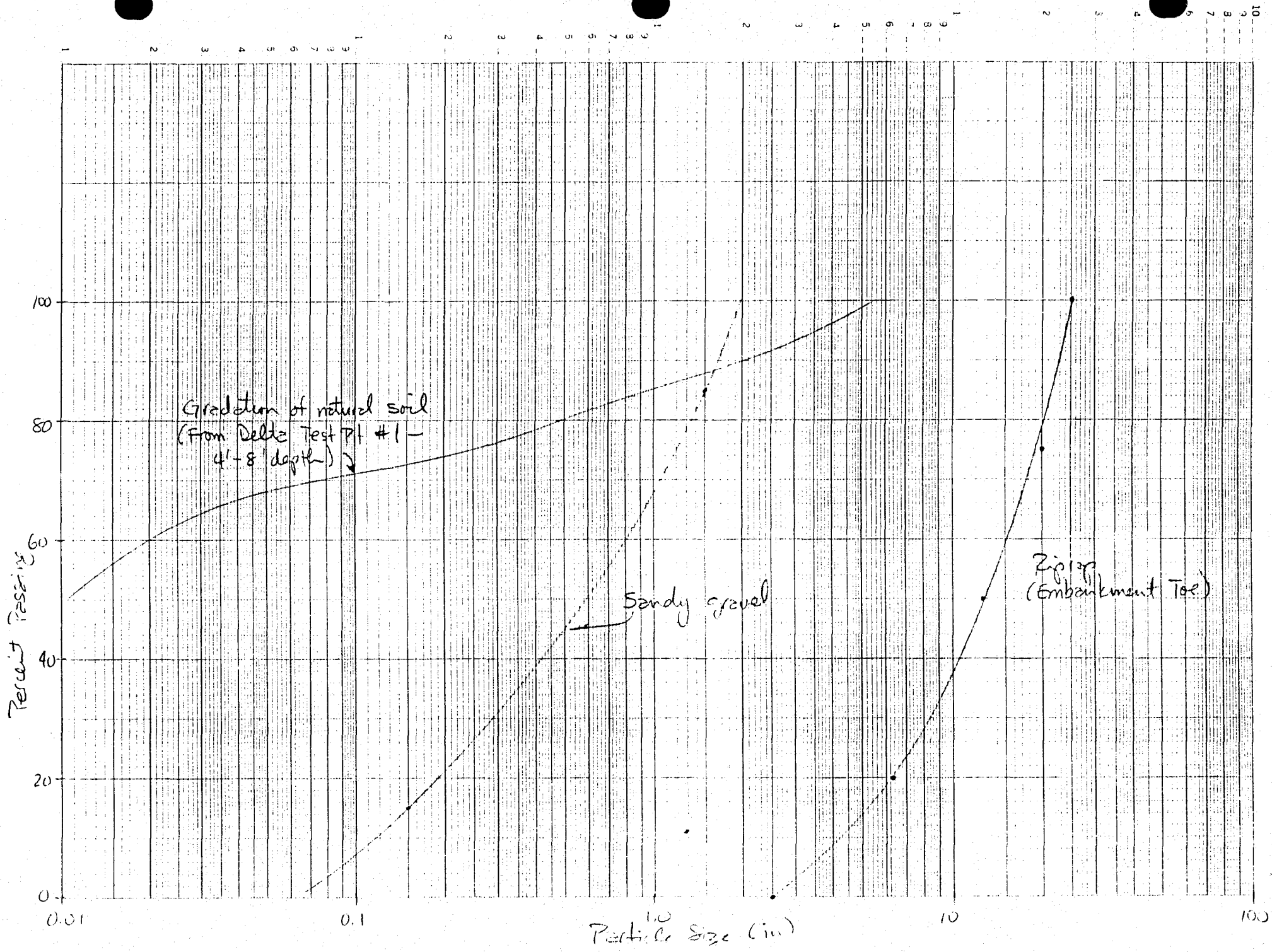
Revised -

Source: U.S. Soil Cons. Service (1975)

14/18

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6010



A filter blanket will be needed beneath the riprap to provide erosional stability. Check design of blanket shown on page 15 of this calc.

$$\frac{D_{15}\ (\text{riprap})}{D_{85}\ (\text{filter})} = \frac{5.2\ \text{in}}{1.5\ \text{in}} = 3.5 < 5 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\ (\text{riprap})}{D_{15}\ (\text{blanket})} = \frac{5.2\ \text{in}}{0.15\ \text{in}} = 34.7 < 40 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\ (\text{blanket})}{D_{85}\ (\text{soil})} = \frac{0.15\ \text{in}}{1.0\ \text{in}} = 0.15 < 5 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\ (\text{blanket})}{D_{15}\ (\text{soil})} = \frac{0.15\ \text{in}}{0.0021\ \text{in}} = 71.4 > 40$$

Although the last criterion indicates some erosional instability, this blanket will be used due to the unlikelihood of occurrence (RP > 10,000 yr) of the design event.

References

Barfield, B.J., R.C. Warner, and C.T. Haan. 1981. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. Stillwater, Oklahoma.

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-Frequency Atlas of the Western United States: Volume II - Utah. NOAA Atlas 2. National Weather Service. Silver Spring, Maryland.

Thomas, B.E. and K.L. Lindskov. 1983. Methods for Estimating Peak Discharge and Flood Boundaries of Streams in Utah. Water-Resources Inv. Rpt 83-4129. U.S.G.S. Salt Lake City, UT.

U.S. Soil Conservation Service. 1956. National Engineering Handbook: Section 5 - Hydraulics. Washington D.C.

U.S. Soil Conservation Service. 1975. Design of Open Channels. Technical Release No. 25. Washington, D.C.

Check on the adequacy of the sedimentation pond during reclamation:

Design volume:

Pond area (at design 10-yr, 24-hr level) ⟶ A = 0.2 ac
Undisturbed area ⟶ 0.9 + 3.3 + 2.0 + 0.2 = 6.2 ac
(WS-2) (WS-4) (WS-5) (site)
↳ See Plate 7-3
Reclaimed area = 4.7 ac (total of disturbed and reclaimed areas included on pg. 1 of this calc.).

Runoff storage volume:

Pond area ⟶ CN = 100; Q = 2.50 in = 0.04 AF
Undisturbed area ⟶ CN = 69; Q = 0.42 in = 0.22 AF
Reclaimed area ⟶ CN = 75; Q = 0.65 in = 0.25 AF
} Total = 0.51 AF

Sediment storage volume:

Reclaimed: A = 0.84 tons/ac/yr (see pg. 1c of this calc.)
= 0.002 AF/yr (assuming 90 lb/ft³)

Undisturbed: A = 0.84 tons/ac/yr (see pg. 1f of this calc.)
= 0.007 AF/yr

Design for 10-yr of sediment storage:
Total sed. storage = (0.002 + 0.007)(10) = 0.09 AF

Total required storage = 0.51 AF + 0.09 AF
= 0.60 AF

This value is less than the design storage (0.99 AF). Hence, the pond volume is acceptable as designed.

Check the pond hydraulics using SEDIMOT II.

Changes in SEDIMOT II entries:

No. of subwatersheds = 2 (undisturbed & reclaimed)

Data for subwatershed 1 (undisturbed):

A = 6.2 ac

CN = 69

T_c → use value for original subwatershed 2 (pg. 8 of this calc.)

T_c = 0.21 hr

Data for subwatershed 2 (reclaimed):

A = 4.7 ac

CN = 75

T_c → use upland method

1150 ft @ 7% ⟹ V = 5.3 ft/s (channel – see pg. 7 of this calc)

$$T_c = \frac{1150\ ft}{5.3\ ft/s} = 220s$$

$$= 0.06\ hr$$

All other values remain the same.

SEDIMOT II results → attached.

Peak inflow = 5.70 cfs
Peak outflow = 4.14 cfs
Peak stage = 5.80 ft

} Values all lower than design condition. OK

```
*****************************************************************
                        -- SEDPC --
              SEDIMOT II MODEL FOR THE IBM PC/XT
              CONVERTED BY TECH ENGINEERING INC.
                 VERSION 1.10 NOVEMBER 17,1983
*****************************************************************

*****************************************************************
*****************************************************************
       UNIVERSITY OF KENTUCKY COMPUTER MODEL
       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
       FOR MORE INFORMATION CONTACT THE AGRICULTURAL
       ENGINEERING DEPARTMENT
       THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
       THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)
       VERSION DATE 9-23-83
       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
       ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL
*****************************************************************
*****************************************************************
*****************************************************************
*                                                               *
*     THE FOLLOWING VALUES ARE NOW PREDICTED BY SEDIMOT II.     *
*     THEY CAN BE FOUND IN SUMMARY TABLES.                      *
*      1. PERIOD OF SIGNIFICANT CONCENTRATION                   *
*      2. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION      *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION            *
*      3. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION      *
*         DURING PEAK 24 HOUR PERIOD                            *
*      4. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION           *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION            *
*      5. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION           *
*         DURING PEAK 24 HOUR PERIOD                            *
*                                                               *
*     ALL CONCENTRATIONS ARE IN ML/L.                           *
*                                                               *
*****************************************************************
            *******************************************
                 WATERSHED IDENTIFICATION CODE
                 -----------------------------
 GENWAL SEDIMENTATIION POND - PHASE I RECLAMATION
            *******************************************
```

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	.250	.100	.050	.010	.005	.001
	.000					
PCT FINER NO. 1	100.000	50.000	35.000	19.000	15.000	6.000
	.000					

**********INPUT VALUES**********

STORM DURATION	=	24.00	HOURS
PRECIPATION DEPTH	=	2.92	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

* *

JUNCTION 1, BRANCH 1, STRUCTURE 1

* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	6.20	69.00	.210	.000	.000	.00	3.0
2	4.70	75.00	.060	.000	.000	.00	.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.00	.0	.00	.000	1.0	.0
2	1	.00	.0	.00	.000	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	1.71	.63	.00	.027	.580	1.000
2	4.72	.91	.00	.100	1.000	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	.6801	ACRE-FT
PEAK DISCHARGE	=	5.7002	CFS
AREA	=	10.9000	ACRES
TIME OF PEAK DISCHARGE	=	12.00	HRS
BETA	=	1.0000	
RAINFALL EROSITIVITY FACTOR	=	49.63	EI UNIT
PEAK CONCENTRATION	=	.00	MG/L
PEAK SETTLEABLE CONCENTRATION	=	.00	ML/L
PEAK SETTLEABLE CONCENTRATION	=	.00	MG/L
TOTAL SEDIMENT YIELD	=	.0000	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0001	MM
TIME OF PEAK CONCENTRATION	=	.00	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-26.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

***** GENERATED DATA FOR INPUT INTO STRUCTURE 1 *****

*** PARTICLE SIZE DISTRIBUTION OF SEDIMENT ***

SIZE,MM	.2500	.1000	.0500	.0100	.0050	.0010
PERCENT FINER	.0000	.0000	.0000	.0000	.0000	.0000
SIZE,MM	.0001					
PERCENT FINER	.0000					

*** HYDROGRAPH AND SEDIMENT GRAPH ***

(TWO CONSECUTIVE VALUES PER LINE)

TIME (HR)	DISCHARGE (CFS)	SED DISC (MG/L)	********	TIME (HR)	DISCHARGE (CFS)	SED DISC (MG/L)
.00	.000	.000	*	.10	.000	.000
.20	.000	.000	*	.30	.000	.000

.40	.000	.000	*	.50	.000	.000
.60	.000	.000	*	.70	.000	.000
.80	.000	.000	*	.90	.000	.000
1.00	.000	.000	*	1.10	.000	.000
1.20	.000	.000	*	1.30	.000	.000
1.40	.000	.000	*	1.50	.000	.000
1.60	.000	.000	*	1.70	.000	.000
1.80	.000	.000	*	1.90	.000	.000
2.00	.000	.000	*	2.10	.000	.000
2.20	.000	.000	*	2.30	.000	.000
2.40	.000	.000	*	2.50	.000	.000
2.60	.000	.000	*	2.70	.000	.000
2.80	.000	.000	*	2.90	.000	.000
3.00	.000	.000	*	3.10	.000	.000
3.20	.000	.000	*	3.30	.000	.000
3.40	.000	.000	*	3.50	.000	.000
3.60	.000	.000	*	3.70	.000	.000
3.80	.000	.000	*	3.90	.000	.000
4.00	.000	.000	*	4.10	.000	.000
4.20	.000	.000	*	4.30	.000	.000
4.40	.000	.000	*	4.50	.000	.000
4.60	.000	.000	*	4.70	.000	.000
4.80	.000	.000	*	4.90	.000	.000
5.00	.000	.000	*	5.10	.000	.000
5.20	.000	.000	*	5.30	.000	.000
5.40	.000	.000	*	5.50	.000	.000
5.60	.000	.000	*	5.70	.000	.000
5.80	.000	.000	*	5.90	.000	.000
6.00	.000	.000	*	6.10	.000	.000
6.20	.000	.000	*	6.30	.000	.000
6.40	.000	.000	*	6.50	.000	.000
6.60	.000	.000	*	6.70	.000	.000
6.80	.000	.000	*	6.90	.000	.000
7.00	.000	.000	*	7.10	.000	.000
7.20	.000	.000	*	7.30	.000	.000
7.40	.000	.000	*	7.50	.000	.000
7.60	.000	.000	*	7.70	.000	.000
7.80	.000	.000	*	7.90	.000	.000
8.00	.000	.000	*	8.10	.000	.000
8.20	.000	.000	*	8.30	.000	.000
8.40	.000	.000	*	8.50	.000	.000
8.60	.000	.000	*	8.70	.000	.000
8.80	.000	.000	*	8.90	.000	.000
9.00	.000	.000	*	9.10	.000	.000
9.20	.000	.000	*	9.30	.000	.000
9.40	.000	.000	*	9.50	.000	.000
9.60	.000	.000	*	9.70	.000	.000
9.80	.000	.000	*	9.90	.000	.000
10.00	.000	.000	*	10.10	.000	.000
10.20	.000	.000	*	10.30	.000	.000
10.40	.000	.000	*	10.50	.000	.000
10.60	.000	.000	*	10.70	.000	.000
10.80	.000	.000	*	10.90	.000	.000
11.00	.000	.000	*	11.10	.026	.000
11.20	.048	.000	*	11.30	.069	.000
11.40	.089	.000	*	11.50	.109	.000
11.60	1.512	.000	*	11.70	2.547	.000
11.80	3.556	.000	*	11.90	4.618	.000
12.00	5.700	.000	*	12.10	2.471	.000
12.20	2.688	.000	*	12.30	2.499	.000
12.40	2.313	.000	*	12.50	2.162	.000
12.60	1.564	.000	*	12.70	1.507	.000
12.80	1.451	.000	*	12.90	1.406	.000
13.00	1.373	.000	*	13.10	1.201	.000
13.20	1.178	.000	*	13.30	1.142	.000
13.40	[illegible]	.000	*	13.50	[illegible]	.000

13.60	.986	.000	*	13.70	.961	.000
13.80	.929	.000	*	13.90	.899	.000
14.00	.872	.000	*	14.10	.752	.000
14.20	.719	.000	*	14.30	.680	.000
14.40	.642	.000	*	14.50	.609	.000
14.60	.580	.000	*	14.70	.560	.000
14.80	.547	.000	*	14.90	.538	.000
15.00	.531	.000	*	15.10	.524	.000
15.20	.519	.000	*	15.30	.515	.000
15.40	.511	.000	*	15.50	.509	.000
15.60	.507	.000	*	15.70	.505	.000
15.80	.504	.000	*	15.90	.503	.000
16.00	.503	.000	*	16.10	.404	.000
16.20	.394	.000	*	16.30	.377	.000
16.40	.363	.000	*	16.50	.352	.000
16.60	.344	.000	*	16.70	.340	.000
16.80	.337	.000	*	16.90	.334	.000
17.00	.332	.000	*	17.10	.329	.000
17.20	.327	.000	*	17.30	.325	.000
17.40	.323	.000	*	17.50	.321	.000
17.60	.320	.000	*	17.70	.318	.000
17.80	.317	.000	*	17.90	.316	.000
18.00	.315	.000	*	18.10	.314	.000
18.20	.314	.000	*	18.30	.313	.000
18.40	.313	.000	*	18.50	.313	.000
18.60	.313	.000	*	18.70	.313	.000
18.80	.313	.000	*	18.90	.314	.000
19.00	.314	.000	*	19.10	.315	.000
19.20	.315	.000	*	19.30	.316	.000
19.40	.316	.000	*	19.50	.317	.000
19.60	.317	.000	*	19.70	.318	.000
19.80	.318	.000	*	19.90	.319	.000
20.00	.319	.000	*	20.10	.267	.000
20.20	.263	.000	*	20.30	.254	.000
20.40	.247	.000	*	20.50	.241	.000
20.60	.237	.000	*	20.70	.234	.000
20.80	.233	.000	*	20.90	.231	.000
21.00	.230	.000	*	21.10	.228	.000
21.20	.227	.000	*	21.30	.226	.000
21.40	.225	.000	*	21.50	.224	.000
21.60	.223	.000	*	21.70	.222	.000
21.80	.221	.000	*	21.90	.221	.000
22.00	.220	.000	*	22.10	.220	.000
22.20	.219	.000	*	22.30	.219	.000
22.40	.219	.000	*	22.50	.218	.000
22.60	.218	.000	*	22.70	.218	.000
22.80	.219	.000	*	22.90	.219	.000
23.00	.219	.000	*	23.10	.219	.000
23.20	.219	.000	*	23.30	.220	.000
23.40	.220	.000	*	23.50	.220	.000
23.60	.220	.000	*	23.70	.220	.000
23.80	.221	.000	*	23.90	.114	.000
24.00	.114	.000	*	24.10	.114	.000
24.20	.104	.000	*	24.30	.085	.000
24.40	.069	.000	*	24.50	.057	.000
24.60	.048	.000	*	24.70	.042	.000
24.80	.038	.000	*	24.90	.034	.000
25.00	.031	.000	*	25.10	.028	.000
25.20	.024	.000	*	25.30	.022	.000
25.40	.019	.000	*	25.50	.016	.000
25.60	.014	.000	*	25.70	.012	.000
25.80	.010	.000	*	25.90	.008	.000
26.00	.006	.000	*	26.10	.005	.000
26.20	.003	.000	*	26.30	.002	.000
26.40	.002	.000	*	26.50	.001	.000

POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	2	300	12	2

***** DROP SPILLWAY INPUTS *****

ENTRANCE LOSS COEFFICIENT	=	1.0000	
BEND LOSS COEFFICIENT	=	.5000	
WEIR COEFFICIENT	=	3.1000	
ORIFICE COEFFICIENT	=	.6000	
MANNING COEFFICIENT	=	.0240	
BARREL DIAMATER	=	18.00	INCHES
RISER DIAMETER	=	24.00	INCHES
LENGTH OF PIPE	=	92.00	FEET
VERTICAL HEAD DROP	=	16.00	FEET

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.083	.00	.00	.00
.50	.090	.49	.00	.04
1.00	.096	.97	.00	.09
1.50	.103	1.44	.00	.14
2.50	.117	2.35	.00	.25
3.50	.133	3.22	.00	.37
4.50	.149	4.06	.00	.52
5.50	.166	4.87	.00	.67
6.00	.175	5.27	6.89	.76
6.50	.183	5.66	13.13	.85
7.00	.192	6.04	18.53	.94
7.50	.201	6.42	20.99	1.04

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.673	ACRE-FT
DEAD STORAGE	=	20.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	.680	ACRE-FT
OUTFLOW ROUTED VOLUME	=	.680	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	.680	ACRE-FT
POND VOLUME AT PEAK STAGE	=	.724	ACRE-FT
PEAK STAGE	=	5.800	FT
PEAK INFLOW RATE	=	5.700	CFS
PEAK DISCHARGE RATE	=	4.137	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0000	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.00	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	.00	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
BASIN TRAP EFFICIENCY	=	**********	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	.15	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	.15	HRS
DETENTION TIME INCLUDING STORED FLOW	=	.15	HRS
SEDIMENT LOAD DISCHARGED	=	.00	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-26.90	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

VOLUME WEIGHTED AVERAGE SETTLEABLE

CONCENTRATION DURING PERIOD OF
SIGNIFICANT CONCENTRATION = .00 ML/L
ARITHMETIC AVERAGE SETTLEABLE
CONCENTRATION DURING PEAK 24 HOUR
PERIOD = .00 ML/L

*** PARTICLE SIZE DISTRIBUTION OF SEDIMENT ***

SIZE,MM	.2500	.1000	.0500	.0100	.0050	.0010
PERCENT FINER	.0000	.0000	.0000	.0000	.0000	.0000
SIZE,MM	.0001					
PERCENT FINER	.0000					

*** HYDROGRAPH AND SEDIMENT GRAPH ***
(TWO CONSECUTIVE VALUES PER LINE)

TIME (HR)	DISCHARGE (CFS)	SED DISC (MG/L)	******* *	TIME (HR)	DISCHARGE (CFS)	SED DISC (MG/L)
.00	.000	.000	*	.10	.000	.000
.20	.000	.000	*	.30	.000	.000
.40	.000	.000	*	.50	.000	.000
.60	.000	.000	*	.70	.000	.000
.80	.000	.000	*	.90	.000	.000
1.00	.000	.000	*	1.10	.000	.000
1.20	.000	.000	*	1.30	.000	.000
1.40	.000	.000	*	1.50	.000	.000
1.60	.000	.000	*	1.70	.000	.000
1.80	.000	.000	*	1.90	.000	.000
2.00	.000	.000	*	2.10	.000	.000
2.20	.000	.000	*	2.30	.000	.000
2.40	.000	.000	*	2.50	.000	.000
2.60	.000	.000	*	2.70	.000	.000
2.80	.000	.000	*	2.90	.000	.000
3.00	.000	.000	*	3.10	.000	.000
3.20	.000	.000	*	3.30	.000	.000
3.40	.000	.000	*	3.50	.000	.000
3.60	.000	.000	*	3.70	.000	.000
3.80	.000	.000	*	3.90	.000	.000
4.00	.000	.000	*	4.10	.000	.000
4.20	.000	.000	*	4.30	.000	.000
4.40	.000	.000	*	4.50	.000	.000
4.60	.000	.000	*	4.70	.000	.000
4.80	.000	.000	*	4.90	.000	.000
5.00	.000	.000	*	5.10	.000	.000
5.20	.000	.000	*	5.30	.000	.000
5.40	.000	.000	*	5.50	.000	.000
5.60	.000	.000	*	5.70	.000	.000
5.80	.000	.000	*	5.90	.000	.000
6.00	.000	.000	*	6.10	.000	.000
6.20	.000	.000	*	6.30	.000	.000
6.40	.000	.000	*	6.50	.000	.000
6.60	.000	.000	*	6.70	.000	.000
6.80	.000	.000	*	6.90	.000	.000
7.00	.000	.000	*	7.10	.000	.000
7.20	.000	.000	*	7.30	.000	.000
7.40	.000	.000	*	7.50	.000	.000
7.60	.000	.000	*	7.70	.000	.000
7.80	.000	.000	*	7.90	.000	.000
8.00	.000	.000	*	8.10	.000	.000
8.20	.000	.000	*	8.30	.000	.000
8.40	.000	.000	*	8.50	.000	.000
8.60	.000	.000	*	8.70	.000	.000
8.80	.000	.000	*	8.90	.000	.000
9.00	.000	.000	*	9.10	.000	.000
9.20	.000	.000	*	9.30	.000	.000
9.40	.000	.000	*	9.50	.000	.000
9.60	.000	.000	*	9.70	.000	.000
9.80	.000	.000	*	9.90	.000	.000
10.00	.000	.000	*	10.10	.000	.000

10.30	.000	.000	*	10.30	.000	.000
10.40	.000	.000	*	10.50	.000	.000
10.60	.000	.000	*	10.70	.000	.000
10.80	.000	.000	*	10.90	.000	.000
11.00	.000	.000	*	11.10	.007	.000
11.20	.022	.000	*	11.30	.040	.000
11.40	.059	.000	*	11.50	.079	.000
11.60	.445	.000	*	11.70	1.238	.000
11.80	2.145	.000	*	11.90	3.116	.000
12.00	4.137	.000	*	12.10	4.110	.000
12.20	3.344	.000	*	12.30	2.967	.000
12.40	2.686	.000	*	12.50	2.461	.000
12.60	2.161	.000	*	12.70	1.848	.000
12.80	1.663	.000	*	12.90	1.545	.000
13.00	1.467	.000	*	13.10	1.376	.000
13.20	1.283	.000	*	13.30	1.223	.000
13.40	1.178	.000	*	13.50	1.144	.000
13.60	1.093	.000	*	13.70	1.033	.000
13.80	.988	.000	*	13.90	.951	.000
14.00	.918	.000	*	14.10	.865	.000
14.20	.800	.000	*	14.30	.749	.000
14.40	.705	.000	*	14.50	.665	.000
14.60	.630	.000	*	14.70	.600	.000
14.80	.576	.000	*	14.90	.560	.000
15.00	.547	.000	*	15.10	.537	.000
15.20	.529	.000	*	15.30	.523	.000
15.40	.518	.000	*	15.50	.514	.000
15.60	.511	.000	*	15.70	.508	.000
15.80	.506	.000	*	15.90	.505	.000
16.00	.504	.000	*	16.10	.478	.000
16.20	.438	.000	*	16.30	.412	.000
16.40	.391	.000	*	16.50	.374	.000
16.60	.361	.000	*	16.70	.351	.000
16.80	.345	.000	*	16.90	.340	.000
17.00	.337	.000	*	17.10	.333	.000
17.20	.331	.000	*	17.30	.328	.000
17.40	.326	.000	*	17.50	.324	.000
17.60	.322	.000	*	17.70	.321	.000
17.80	.319	.000	*	17.90	.318	.000
18.00	.317	.000	*	18.10	.316	.000
18.20	.315	.000	*	18.30	.314	.000
18.40	.313	.000	*	18.50	.313	.000
18.60	.313	.000	*	18.70	.313	.000
18.80	.313	.000	*	18.90	.313	.000
19.00	.314	.000	*	19.10	.314	.000
19.20	.315	.000	*	19.30	.315	.000
19.40	.315	.000	*	19.50	.316	.000
19.60	.316	.000	*	19.70	.317	.000
19.80	.317	.000	*	19.90	.318	.000
20.00	.318	.000	*	20.10	.306	.000
20.20	.285	.000	*	20.30	.272	.000
20.40	.261	.000	*	20.50	.252	.000
20.60	.246	.000	*	20.70	.241	.000
20.80	.237	.000	*	20.90	.235	.000
21.00	.232	.000	*	21.10	.231	.000
21.20	.229	.000	*	21.30	.228	.000
21.40	.227	.000	*	21.50	.225	.000
21.60	.224	.000	*	21.70	.223	.000
21.80	.222	.000	*	21.90	.222	.000
22.00	.221	.000	*	22.10	.220	.000
22.20	.220	.000	*	22.30	.219	.000
22.40	.219	.000	*	22.50	.219	.000
22.60	.219	.000	*	22.70	.218	.000
22.80	.218	.000	*	22.90	.219	.000
23.00	.219	.000	*	23.10	.219	.000
23.20	.219	.000	*	23.30	.219	.000

[illegible]	.319	.000	*	23.60	.220	.000
23.80	.220	.000	*	23.70	.220	.000
23.90	.220	.000	*	23.90	.194	.000
24.00	.154	.000	*	24.10	.134	.000
24.20	.121	.000	*	24.30	.108	.000
24.40	.092	.000	*	24.50	.077	.000
24.60	.065	.000	*	24.70	.055	.000
24.80	.047	.000	*	24.90	.042	.000
25.00	.037	.000	*	25.10	.033	.000
25.20	.030	.000	*	25.30	.026	.000
25.40	.023	.000	*	25.50	.020	.000
25.60	.018	.000	*	25.70	.015	.000
25.80	.013	.000	*	25.90	.011	.000
26.00	.009	.000	*	26.10	.007	.000
26.20	.006	.000	*	26.30	.004	.000
26.40	.003	.000	*	26.50	.002	.000
26.60	.001	.000	*	26.70	.001	.000

*** RUN COMPLETED ****