0006

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771

M E M O R A N D U M

* * * * * * * * * * * *

TO: Ronald W. Daniels,
Coordinator of Mined Land Development

FROM: Mike Thompson,
Engineering Geologist

SUBJECT: Swisher Coal Company (G.E.X.)
Huntington Canyon #4 Coal Mine
Sediment Pond Design
ACT/015/004

DATE: July 31, 1979

Enclosed with this memo is a copy of the hydrology I feel should be required for the design of the Swisher #4 sediment pond. The design requirements I propose vary somewhat from the Office of Surface Mining's. The difference being only that emergency overflow spillway structures should be designed for the 25 year - 6 hour event, not the 25 year - 24 hour event. I feel the 6 hour storm design criteria is more applicable to the mountainous area. Twenty-four hour storms occur in the area in the winter as snowfall. The six hour storm is more applicable to summer rainfall events.

The following data is a summary of my findings:

1. Required sediment pond volume

10 year - 24 hour storm runoff	=	0.58 acre-feet
Sediment storage	=	0.09 acre-feet
Direct precipitation	=	0.04 acre-feet
Total required volume	=	0.71 acre-feet

2. Required peakflow capacity for emergency spillway

Assuming diversions are constructed to pass the peak flow resulting from the 10 year - 24 hour storm (8.4 cfs), the peak flow from within the diversion system and the diversion system overflow resulting from the 25 year - 6 hour storm is 4 cfs. Therefore the spillway should be capable of passing 4 cfs.

In regards to the Office of Surface Mining's stipulations concerning the sediment pond I offer the following comments. 1. The sediment pond design as proposed in Exhibit 19 is approved in item 1 of the July 6, 1979 list of stipulations. 2. A map of the scale of 1" = 400' is in the application; a copy is in the enclosed hydrologic study. 3. Of most importance, I would like to point out that the State has determined that diversion structures should be designed and constructed between the highwall, composed of bedrock, and the surface facility pad. Construction of diversions above the highwall is dangerous to workers and existing facilities, will create more disturbance and will probably function no better than the diversion proposed. I also feel that we can obtain written concurrence from the U.S. Forest Service, the land management agency.

K. MICHAEL THOMPSON
ENGINEERING GEOLOGIST

KMT/te

HYDROLOGIC REQUIREMENTS

Swisher #4 Mine
Sediment Pond
ACT/015/004

K. Michael Thompson
Engineering Geologist
July 31, 1979

REQUIRED POND CAPACITY

Assumptions

1. Diversions above mine site will pass the peak flow from the 10 year - 24 hour precipitation event.

10 year - 24 hour precipitation *2.1 inches
Curve Number *from NOAA Atlas

Undisturbed Watershed

*cn = 75 14.08 acres
*based on U.S. Forest Service estimate

Disturbed Area

cn = 90 0.92 acres

Weighted Curve Number

$$\frac{14.08}{15}(75) + \frac{0.92}{15}(90) = 75.92 = 76$$

Area Runoff

$Q(in) = (P-0.2S)^2/(P+0.8S)$ where $S = (1,000/cn)-10$ $P \geq 0.2S$

Q = 0.47in = 0.039ft
Volume = 15 acres (0.039ft) = 0.58 acre-feet direct runoff

Sediment Storage Volume

0.92 acres disturbed area * 0.1 acre-feet/acre
= 0.09 acre-feet

Direct Precipitation into Pond

Area of ponds = 0.217 acres
0.217 acres * 2.1 inches * 1/12 ft/in = 0.04 acre-feet

Total Required Pond Volume

Direct runoff + additional sediment storage + direct precipitation
0.58 acre-feet + 0.09 acre-feet + 0.04 acre-feet = <u>0.71 acre-feet</u>

Pond Overflow Discharge Capacity

1. CASE 1 - Diversions sized to pass 25 year - 6 hour storm peak

Assumptions:

1. Diversions above mine site will pass peak flow resulting from design storm, (25 yr. - 6 hr.), thereby limiting watershed draining into pond to approximately 15 acres.

2. Assume pond at full capacity.

Design:

1. Pass peak flow from 25 year - 6 hour storm.

2. Emergency Spillway Hydrograph as developed by the Soil Conservation Service (N.E.H. - 4, pages 21.49 to 21.53).

Given:

Area = 15 acres
Fall of watershed = (7820 - 7410 feet) = 410 feet
Length of longest watercourse = 0.229 mile = 1200 feet
25 Year - 6 hour storm = 1.8 inches
Weighted watershed curve number = 76
SCS design storm

Find:

Area Runoff

$Q(in) = (P-0.2S)^2/(P+0.8S)$ where $S = (1,000/cn)-10$
$Q = 0.32in = 0.026$ ft $P \geq 0.2S$

Hydrograph Family:

No. 5 - See Figure 21-3

Duration of Excess Rainfall (To)

To = Storm duration - period of time required to satisfy Ia
= 6 hours - period of time required to accumulate 0.63 inches (2.2 hours)
= 3.8 hours
See figures 21.2 and 21.4

Time of Concentration (Tc)

Reference: Kent, K.M. 1973. A method of Estimating Volume and Rate of Runoff in Small Watersheds. U.S.D.A., SCS-TP-149 (Revised April, 1973) ca. 80 pp.

Te = 1/0.6
L = Watershed lag in hours

$$L = \frac{1^{0.8}\ (5 + 1)^{\ 0.7}}{1900\ y^{0.5}}$$

where:

l = length of longest stream channel, ft.
S = (1,000/cn)-10, inches
y = average watershed slope in percent

$$Tc = \left[\frac{(1200^{0.8})((3.1579 + 1)^{0.7})}{(1900)(34.17^{0.5})}\right] \div 0.6 = 0.118 \text{ hours} = 7.1 \text{ minute}$$

Check Velocity:

1200 feet of stream channel/(7.1 min x 60 sec/min) = 2.8 feet/second

Time to peak:

Tp = 0.7(Tc)
= 0.7(0.1182577153) = 0.083 hours = 4.97 minutes

To/Tp ratio
3.8 hours/0.083 hours = 45.78

Revised To/Tp = 50.0

Revised Tp:

3.8/Tp = 50
Tp = 3.8/50
Tp = 0.076 (revised)

HYDROGRAPH COMPUTATION FORM

STREAM AND STATION Drainage into Sediment Pond - Swisher #4

REMARKS CASE -1, Assumes Diversions can pass 25 year - 6 hour peak

DR. AREA 15 Ac., 0.023 **SQ. MI.** T_c 0.118 **HR.** **RUNOFF CONDITION NO.** II

RUNOFF CURVE NO. 76 **STORM DISTRIB CURVE** SCS . **HYDRO. FAM. NO.** 5

STORM DURATION 6 **HR.** **RAINFALL:** **POINT** 1.8 **IN.** **AREAL** 1.8 **IN.**

Q 0.32 **IN.** **COMPUTED** T_p 0.083 **HR.** T_o 3.8 **HR.**

(T_o/T_p): **COMPUTED** 45.78 : **USED** 50.0 . **REVISED** T_p 0.076

$q_p = \frac{484\ A}{\text{REV. } T_p} =$ 149.26 **CFS.** $Qq_p =$ 47.10 **CFS.**

$t(\text{COLUMN}) = (t/T_p)\ \text{REV. } T_p$ $q(\text{COLUMN}) = (qc/q_p)\ Qq_p$

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	3.04	1.71	41		
2	0.15	0.79	22	3.09	1.84	42		
3	0.30	0.96	23	3.34	1.94	43		
4	0.46	1.01	24	3.50	1.99	44		
5	0.61	1.02	25	3.65	2.03	45		
6	0.76	1.02	26	3.80	2.04	46		
7	0.91	1.02	27	3.95	0.27	47		
8	1.06	1.02	28	4.10	0.01	48		
9	1.22	1.02	29	4.26	0	49		
10	1.37	1.02	30			50		
11	1.52	1.02	31			51		
12	1.67	1.02	32			52		
13	1.82	1.02	33			53		
14	1.98	1.02	34			54		
15	2.13	1.02	35			55		
16	2.28	1.02	36			56		
17	2.43	1.02	37			57		
18	2.58	1.14	38			58		
19	2.74	1.35	39			59		
20	2.89	1.55	40			60		

qp = (484 A /rev. Tp) , where A = mi^2
(484 (15 acre * 1/640 mi 2/acre)) /0.076 = 149.26

Qqp = 0.316 inches (149.26) = 47.10 cfs

Peak Flow = 2 cfs

2. CASE 2 - Diversions above mine-site designed to pass 10 year - 24 hour peak flow.

Assumptions:

1. Diversions will pass peak flow from 10 year - 24 hour storm. Therefore, Diversions will overflow when flow resulting from design storm (25 year - 6 hour) is greater than design flow.

2. Assume pond at full capacity.

Design:

1. Calculate flow from area between diversions and pond, construct runoff hydrograph (see previous case). Calculate flow from undisturbed watershed and construct runoff hydrographs for the 10 year - 24 hour storm for the diversion design and 25 year - 6 hour storms. Subtrack peak flow resulting from 10 year - 24 hour storm from that resulting from 25 year - 6 hour storm from the undisturbed watershed and combine with 25 year - 6 hour runoff hydrograph from the area between the diversions and the pond. This results in flow from area normally draining into pond plus overflow from diversions.

2. Utilize ESH as in Case 1.

Find:

1. Peak flow from 10 year - 24 hour storm for watershed above diversions. This is the required diversion flow capacity.

   Given:

   Area = 81.5 acre
   Fall of watershed = 9175 - 7800 = 1375 feet
   Length of watershed = 2200 feet
   Slope = 62.5%
   10 year - 24 hour storm = 2.1 inches
   Watershed curve number = 75
   SCS design storm

Calculate:

Area Runoff

$Q = (P-0.25)^2/(P+0.85)$ where $S = (1{,}000/cn)-10$
$Q =$ $P = 0.25$

Peak runoff determined by Utah State University computer facilities utilizing SCS technology.
Peak Flow = 8.4 cfs.

2. Peak flow from 25 year - 6 hour storm for watershed above diversions.

Given:

Area = 81.5 acre
Fall of watershed = 1375 feet
Length of watershed = 2200 feet
Slope = 62.5%
P = 25 year - 6 hour storm = 1.8 inches
$Q = (P-0.25)^2/(P+0.85) = 0.29$

Hydrograph Family:

No. 5 - See figure 21-3.

Duration of Excess Rainfall (To):

3.8 hours

Time of Concentration (Tc):

$$Tc = \frac{1^{0.8}\ (s+1)^{0.7}}{1900\ \ y^{0.5}} \div 0.6 = 0.146 \text{ hours}$$

Time to Peak = 0.7Tc
0.102 hours

To/Tp

3.8/0.102 = 37.25

Revised To/Tp = 36

Revised Tp = 0.106 hours

qp = (484 A/rev. Tp) = 581.46
$Qqp = (P-0.25)^2/(P+0.85)\ qp = 167$

Peak flow = 10.4 cfs

HYDROGRAPH COMPUTATION FORM

STREAM AND STATION Watershed above diversions - CASE II

REMARKS 25 year - 6 hour storm

DR. AREA 81.5 acre SQ. MI. T_c 0.146 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 75 STORM DISTRIB CURVE SCS . HYDRO. FAM. NO. 5

STORM DURATION 6 HR. RAINFALL: POINT 1.8 IN. AREAL 1.8 IN.

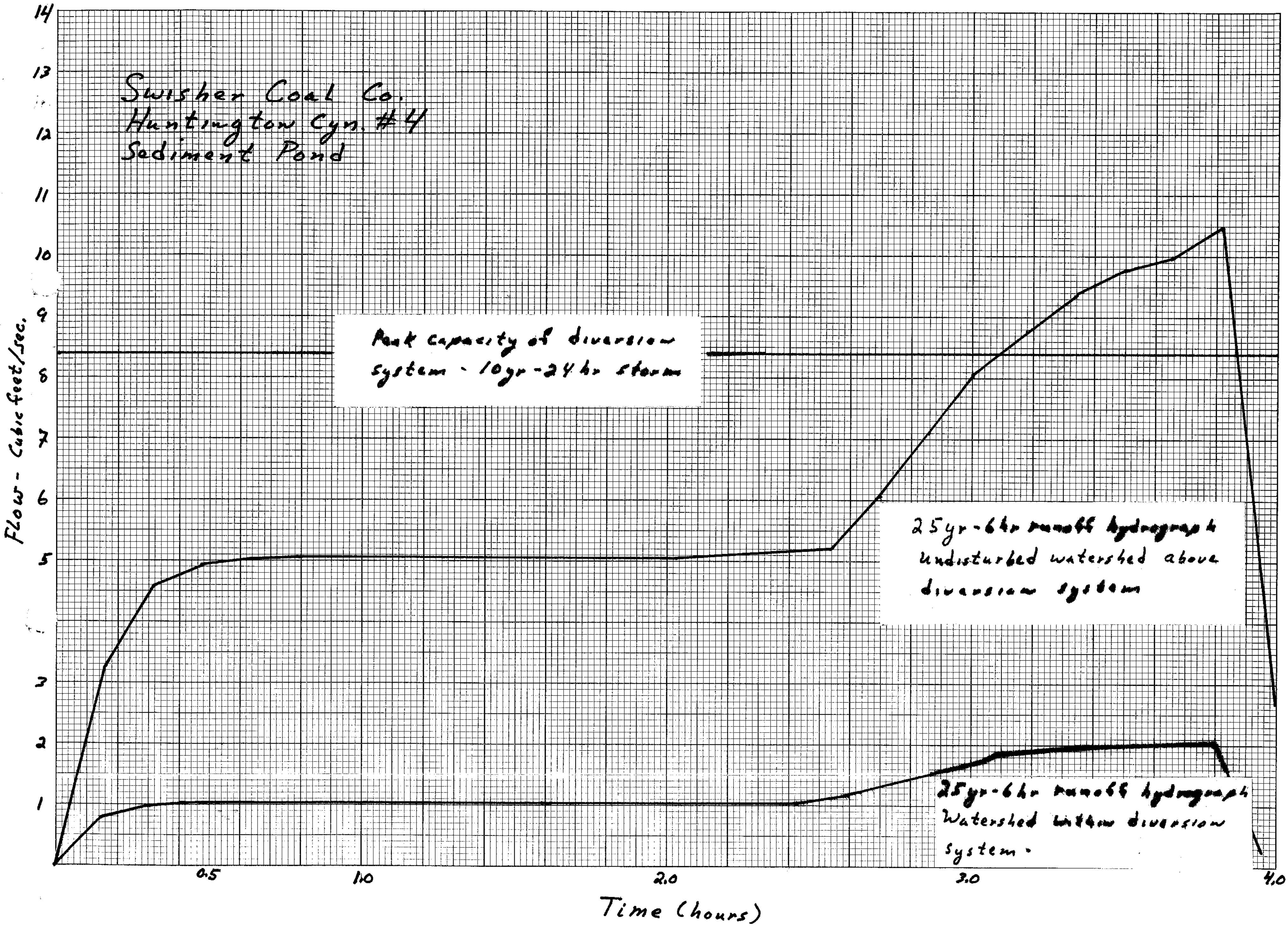
Q 0.29 IN. COMPUTED T_p 0.102 HR. T_o 3.8 HR.

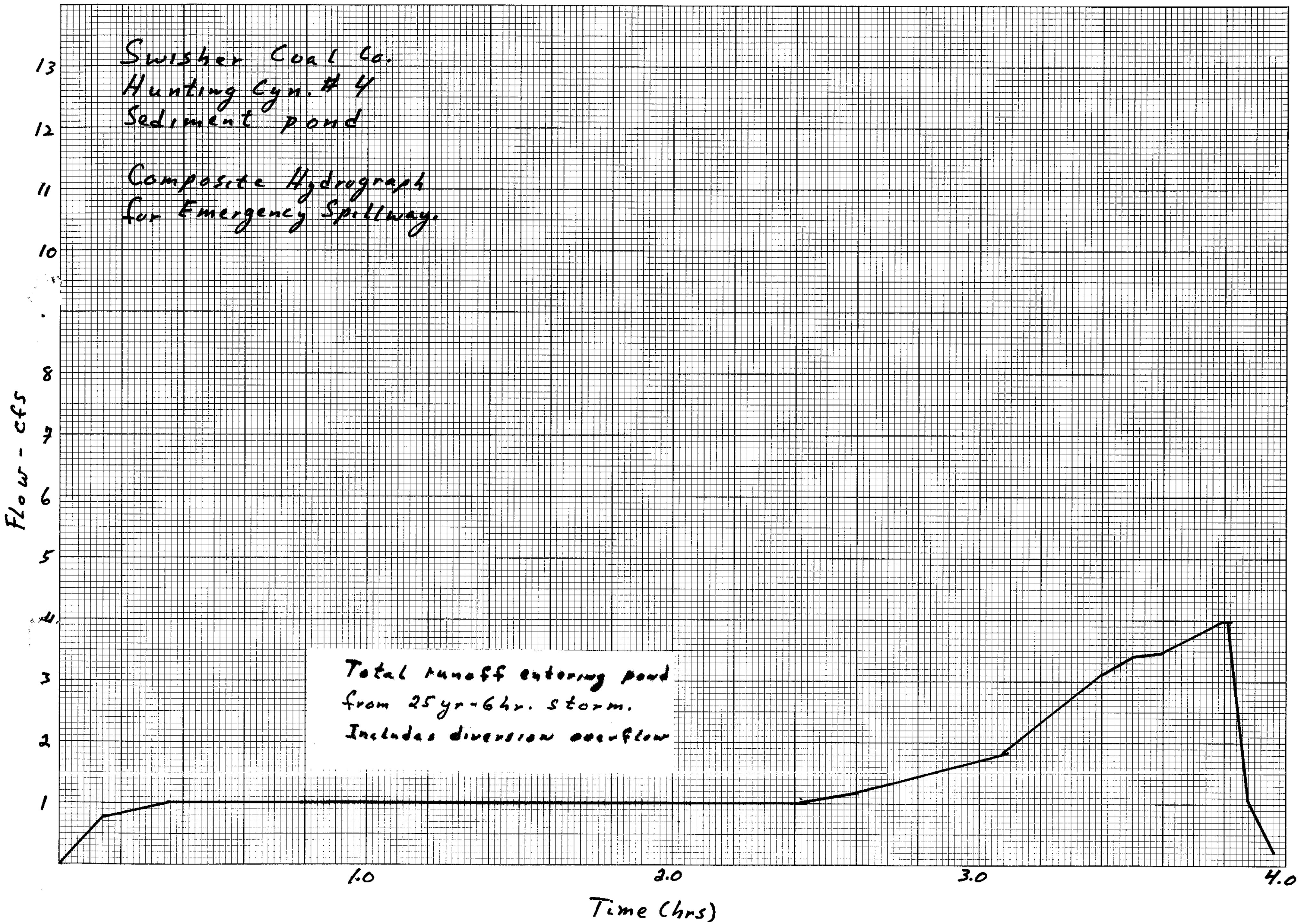
(T_o/T_p): COMPUTED 37.25 : USED 36 . REVISED T_p 0.106

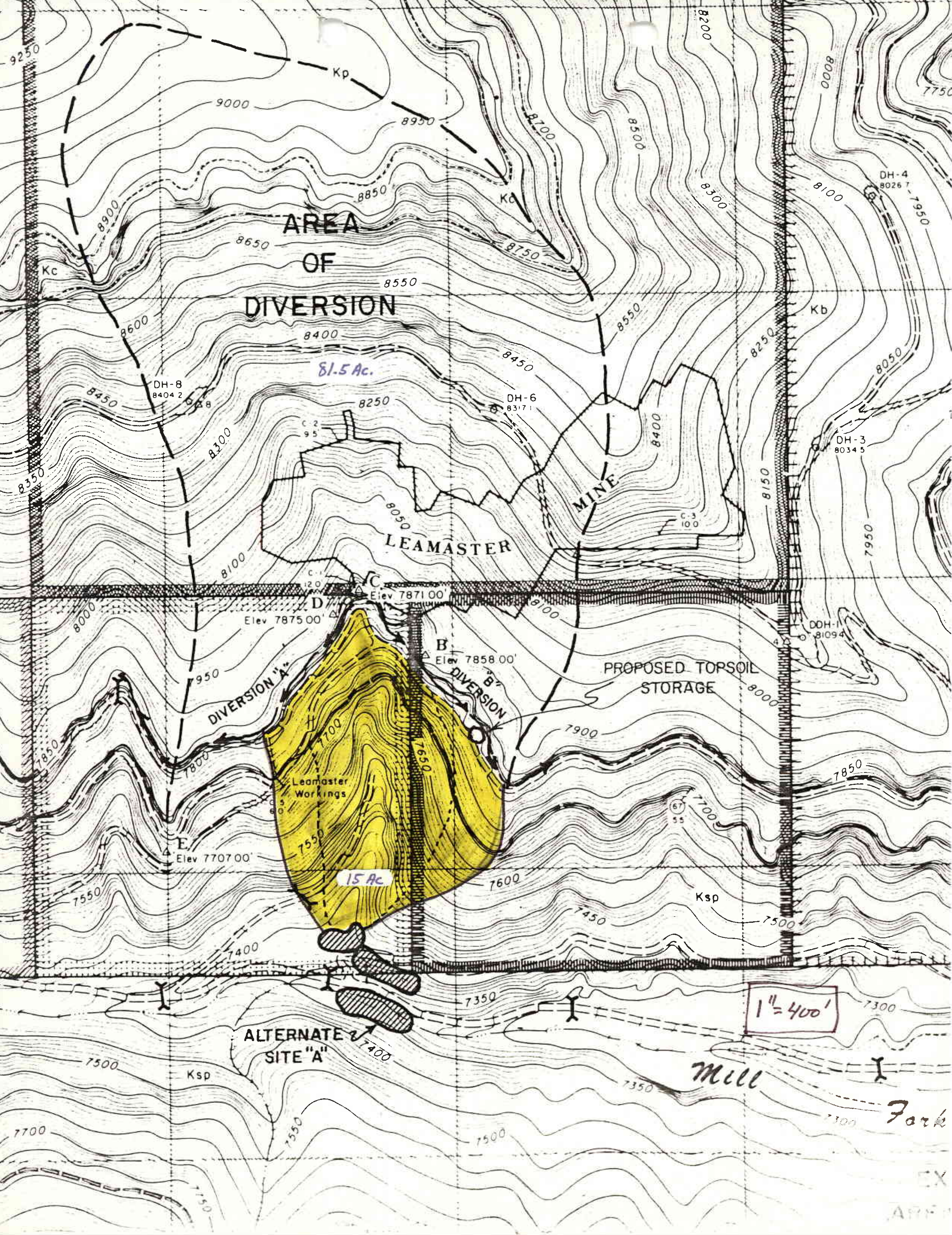
$q_p = \frac{484\ A}{REV.\ T_p}$ = 581.46 CFS. Qq_p = 167 CFS.

t(COLUMN) = (t/T_p) REV. T_p q(COLUMN) = $(qc/q_p)\ Qq_p$

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	3.18	8.77	41		
2	0.16	3.26	22	3.34	9.37	42		
3	0.32	4.59	23	3.50	9.76	43		
4	0.48	4.91	24	3.66	9.99	44		
5	0.64	5.01	25	3.82	10.44	45		
6	0.80	5.03	26	3.98	2.79	46		
7	0.95	5.03	27	4.13	0.30	47		
8	1.11	5.03	28	4.29	0	48		
9	1.27	5.03	29			49		
10	1.43	5.03	30			50		
11	1.59	5.03	31			51		
12	1.75	5.03	32			52		
13	1.91	5.03	33			53		
14	2.07	5.03	34			54		
15	2.23	5.03	35			55		
16	2.39	5.03	36			56		
17	2.54	5.20	37			57		
18	2.70	6.08	38			58		
19	2.86	7.10	39			59		
20	3.02	8.02	40			60		


Swisher Coal Co.
Huntington Cyn. #4
Sediment Pond
Peak capacity of diversion system - 10yr-24hr storm
25yr-6hr runoff hydrograph undisturbed watershed above diversion system
25yr-6hr runoff hydrograph Watershed within diversion system.
Flow - Cubic feet/sec.
Time (hours)
14
13
12
11
10
9
8
7
6
5
3
2
1
0.5
1.0
2.0
3.0
4.0


Swisher Coal Co.
Hunting Cyn. # 4
Sediment pond
Composite Hydrograph
for Emergency Spillway.
Total runoff entering pond
from 25yr-6hr. storm.
Includes diversion overflow
Flow - cfs
13
12
11
10
8
7
6
5
3
2
1
1.0
2.0
3.0
4.0
Time (hrs)


AREA
OF
DIVERSION
81.5 Ac.
LEAMASTER
MINE
Leamaster Workings
15 Ac.
DIVERSION "A"
"B" DIVERSION
PROPOSED TOPSOIL
STORAGE
C
Elev 7871.00'
D
Elev 7875.00'
B
Elev 7858.00'
E
Elev 7707.00'
DH-8
DH-6
DH-4
DH-3
DDH-1
ALTERNATE
SITE "A"
1" = 400'
Mill
Fork
Kp
Kc
Kb
Ksp

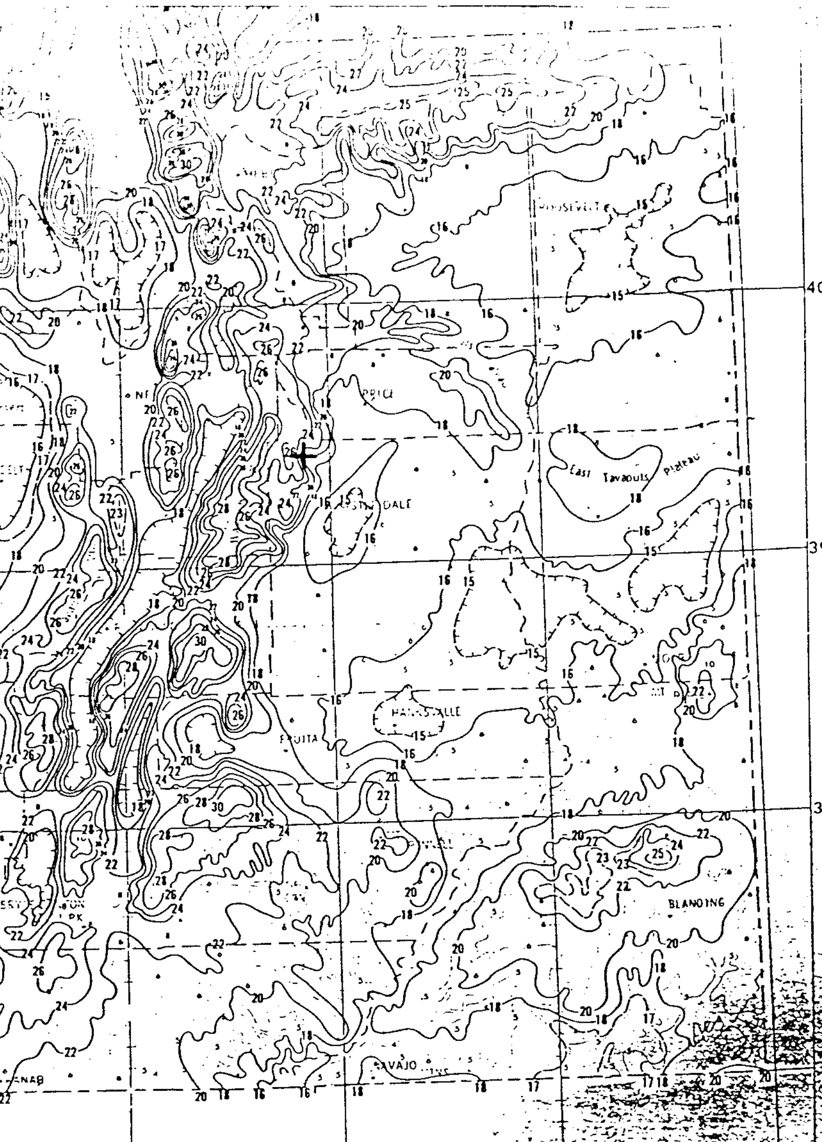


Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

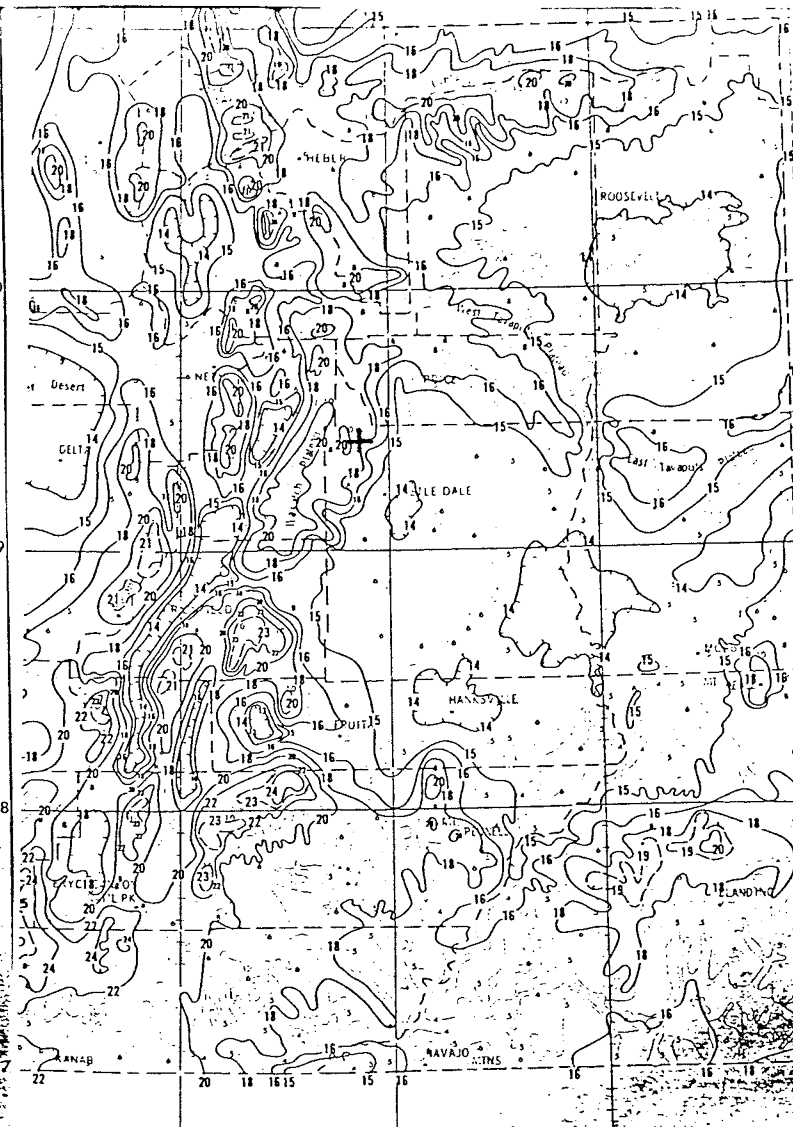
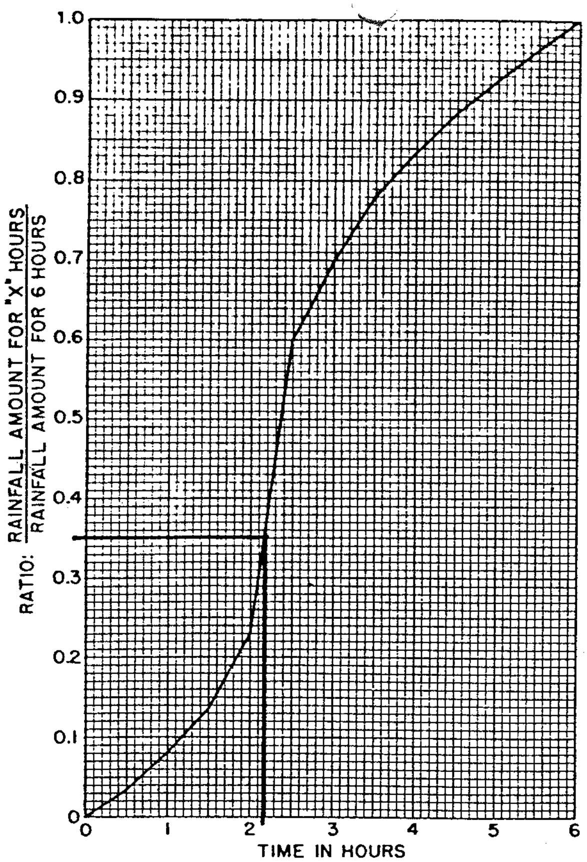


Figure 22

ISOPLUVIALS OF 25-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH



(b) SIX HOUR DESIGN STORM DISTRIBUTION

Hydrograph Family 5

T_o/T_p = 50

t/T_p	Q_c/q_p	Q_t/Q
0	0	0
2.00	.0167	.012
4.00	.0204	.040
6.00	.0214	.071
8.00	.0216	.102
10.00	.0216	.134
12.00	.0216	.166
14.00	.0216	.198
16.00	.0216	.230
18.00	.0216	.262
20.00	.0216	.294
22.00	.0216	.326
24.00	.0216	.358
26.00	.0216	.390
28.00	.0216	.422
30.00	.0216	.454
32.00	.0217	.486
34.00	.0243	.520
36.00	.0287	.559
38.00	.0329	.604
40.00	.0363	.656
42.00	.0391	.711
44.00	.0411	.771
46.00	.0423	.832
48.00	.0430	.895
50.00	.0433	.959
52.00	.0058	.995
54.00	.0002	1.000
56.00	0	1.000

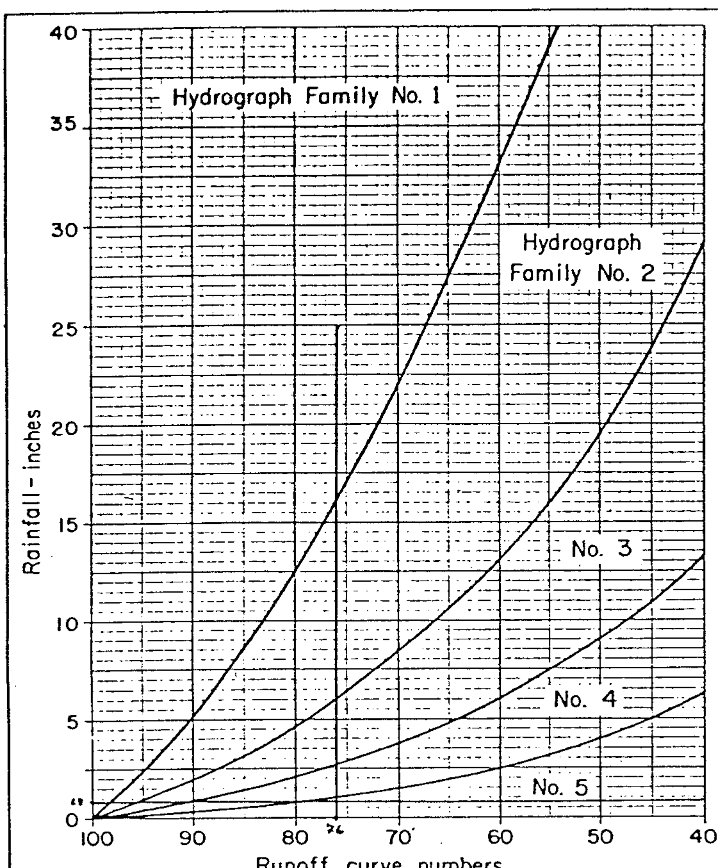


Figure 21-3. Chart for selecting a hydrograph family for a given rainfall and runoff curve number.

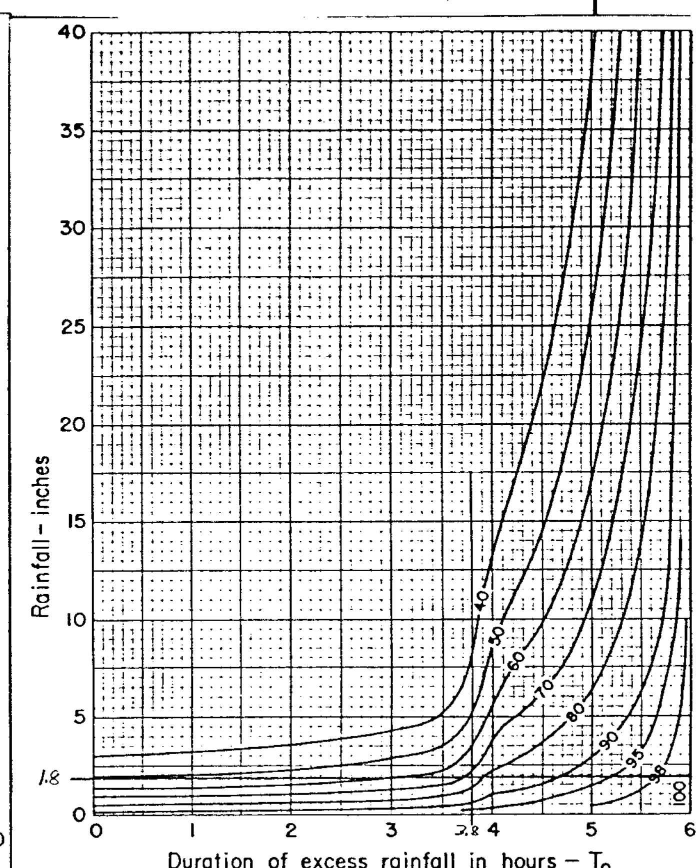


Figure 21-4. Duration of excess rainfall for a 6-hour rainfall and for runoff curve numbers 40 to 100.