Appendix E

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK

SHEET NO. _____ OF _____

CALCULATED BY SJM DATE 11/81

CHECKED BY _____ DATE _____

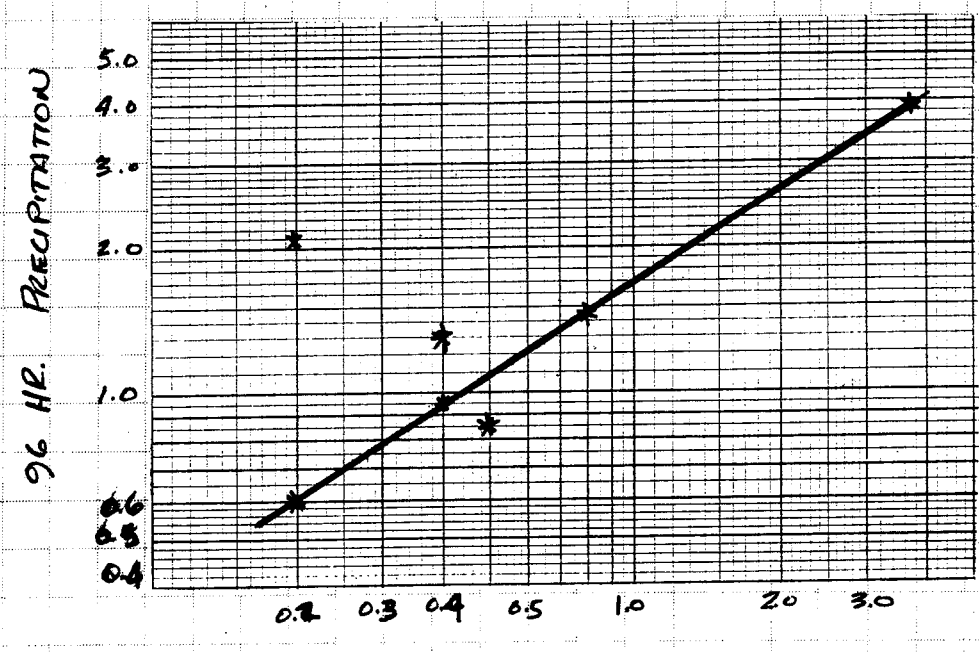
SUBJECT ONEIDA TUNNEL

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY SPM DATE 11/81
CHECKED BY ____ DATE ____
SCALE OWEGA TUNNEL

HYDROGRAPH EVALUATION

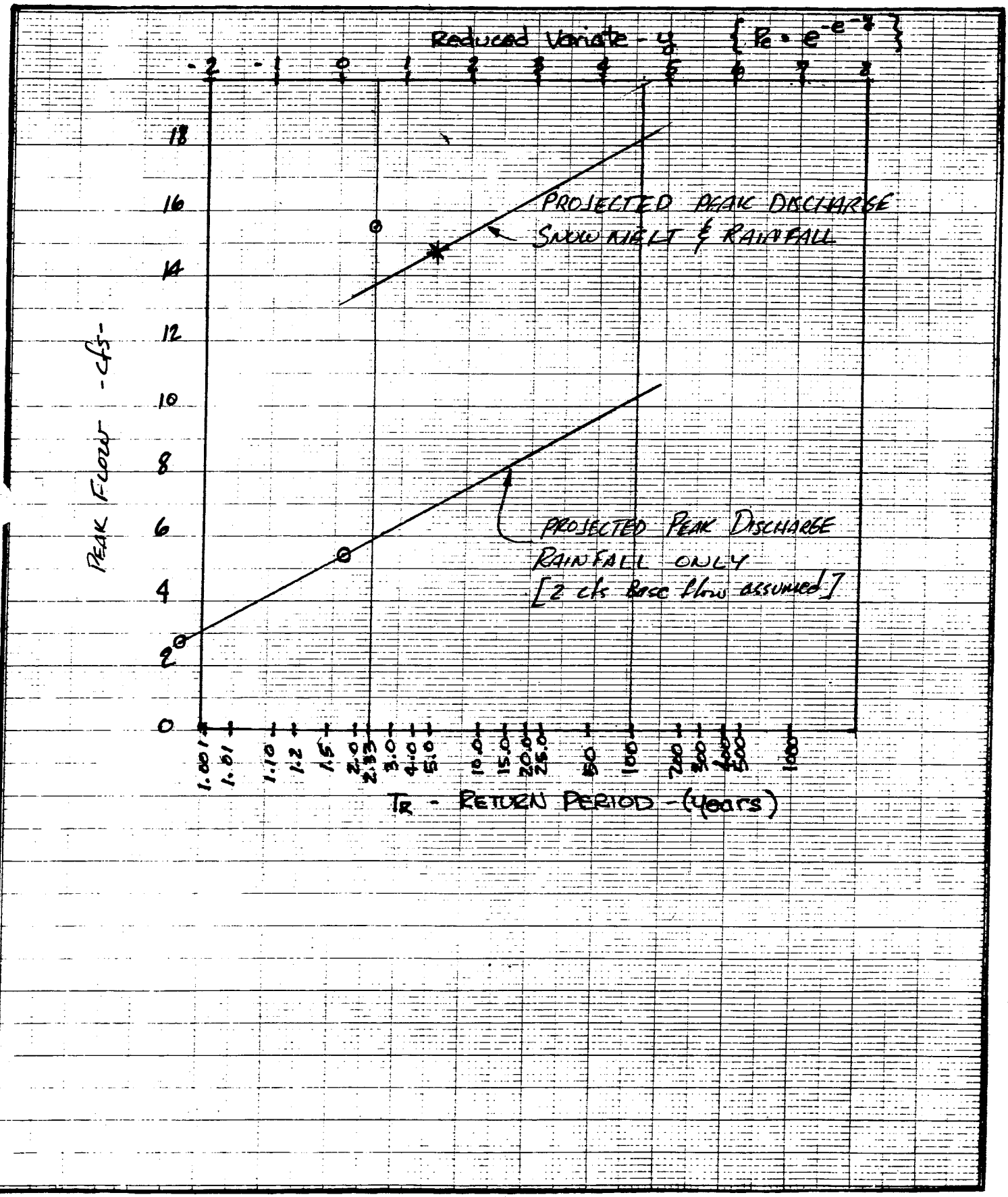
	DATE	Q_P	Q_B	ΔQ	PRECIP (inch)	LAG TIME (HR)	96 HR PRECIP	REMARKS
		— cfs —						
1)	3/23	2.9	2.5	0.4	0.95	60	0.95	24 hr. storm
2)	5/23	5.5	1.8	3.7	2.60	74	3.95	44 hr. "
3)	4/27	2.4	2.0	0.4	1.00	70	1.30	5 hr. "
4)	4/13	2.5	2.3	0.2	0.45	81	0.60	6 hr. (snow melt.?)
	8/12				0.35			
5)	8/13	2.5	2.0	0.5	0.50	46	0.85	8 & 18 hr.
6)	8/25	2.0	1.8	0.2	0.90	11	2.1	1/2 hr. (localized.?)
7)	9/19	2.0	1.2	0.8	1.20	15	1.45	9 hr.



OBSERVED PEAK = 14.8 CF 1/24/79 TR = 5yr

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

SHEET NO _____ OF _____
CALCULATED BY TAG & JPM DATE 10/81
CHECKED BY _____ DATE _____
ONEIDA TUNNEL



JOB LUTHERWOOD CREEK

SHEET NO. _____ OF _____

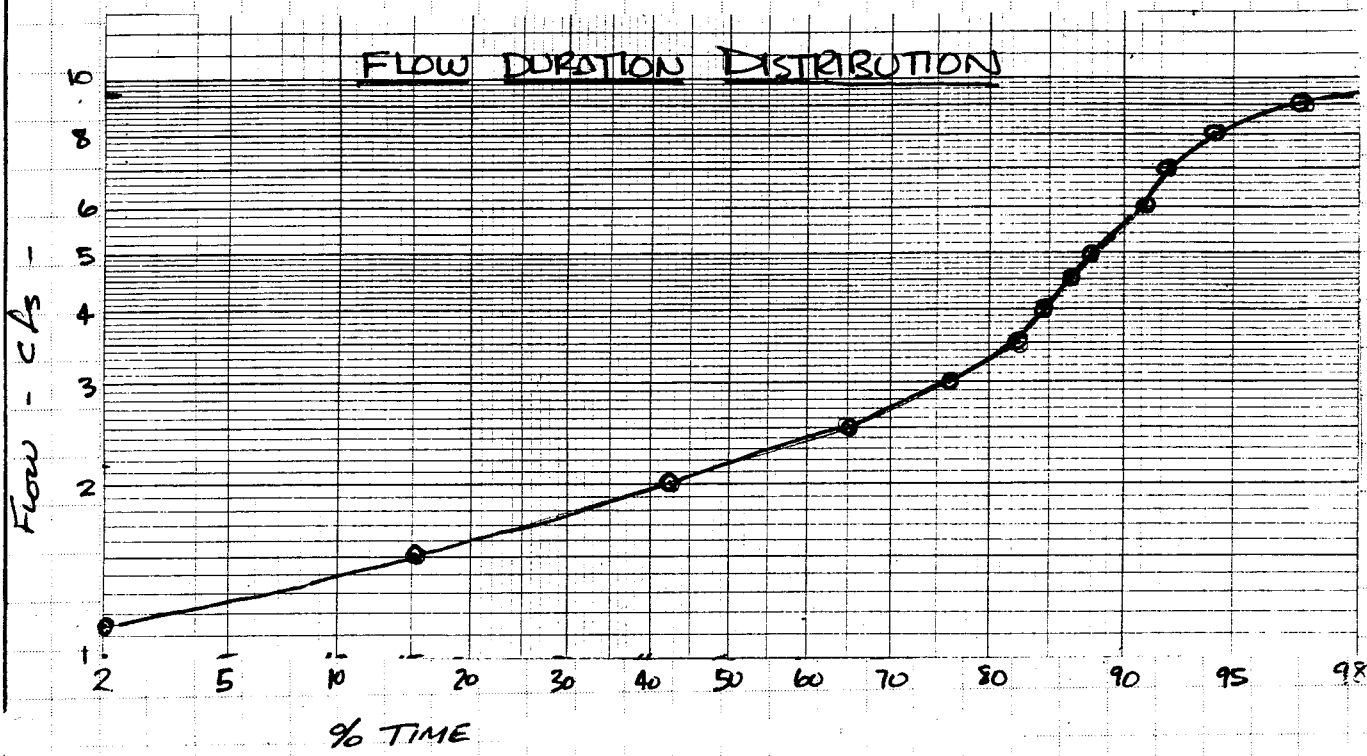
CALCULATED BY JPK DATE 11/81

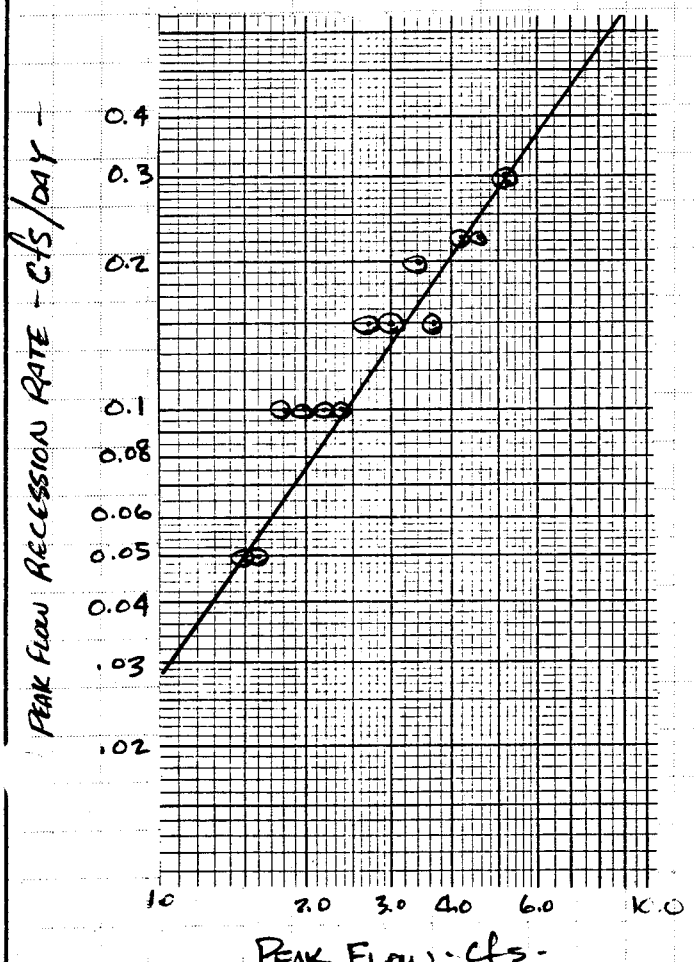
CHECKED BY _____ DATE _____

ONEDA TUNNEL

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

FLOW DURATION DISTRIBUTION





SET :

DESIGN FLOW - 10 cfs
MAX TREATMENT - 20 cfs
EMERGENCY BYPASS - 30 cfs

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

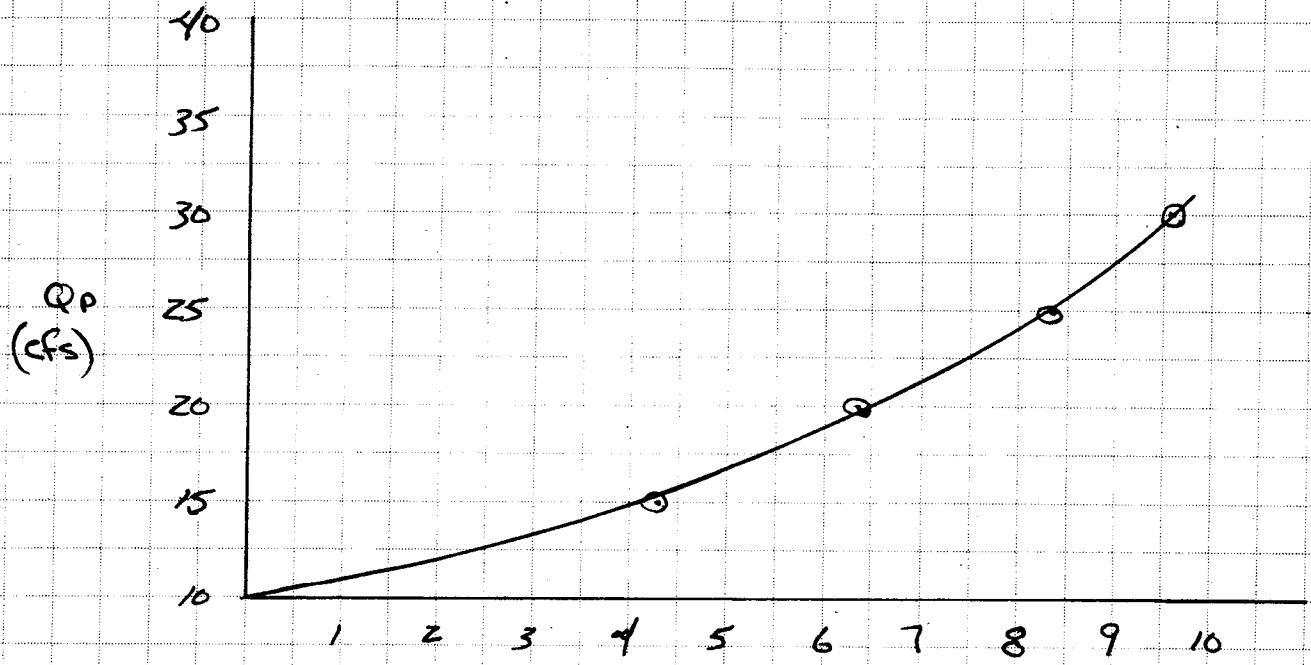
JOB CATAWISSA CREEK

SHEET NO. _____ OF _____

CALCULATED BY TG DATE 10/9

CHECKED BY _____ DATE _____

SCALE ONIEDA TUNNEL



TIME DURATION FLOW EXCEEDS DESIGN FLOW (10 cfs)

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY JPM DATE 11/81
CHECKED BY ____ DATE ____
ONEIDA TREATMENT DESIGN

CHEMICAL PARAMETERS FOR TREATMENT DESIGN

Flow -cfs-	pH	Acidity -mgl-	Alk * mgl	C_T *
1	3.30	150	-~~50~~ 40	100
2	3.50	140	-	100
4	3.60	110	-26	84
6	3.62	90	-24	66
10	3.65	80	-22	58
20	3.70	70	-20	50

* ESTIMATED FROM EQUILIBRIUM CONDITIONS

STATIC BED - REQUIRED LOAD FACTORS R = 0.5

Flow	pHf 5.0	5.25	5.5	5.75	6.0
1	34	64	152	380	1160
2	31	58	140	360	1120
4	30	53	120	320	880
6	28	46	104	240	800
10	27	44	92	226	640
20	26	42	88	216	520

(from Rpt. Table)

[PLOT NEXT SHEET]

REQUIRED STONE AREA = SAME AS ~~AUDUBON~~ = 2·Q·LF

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

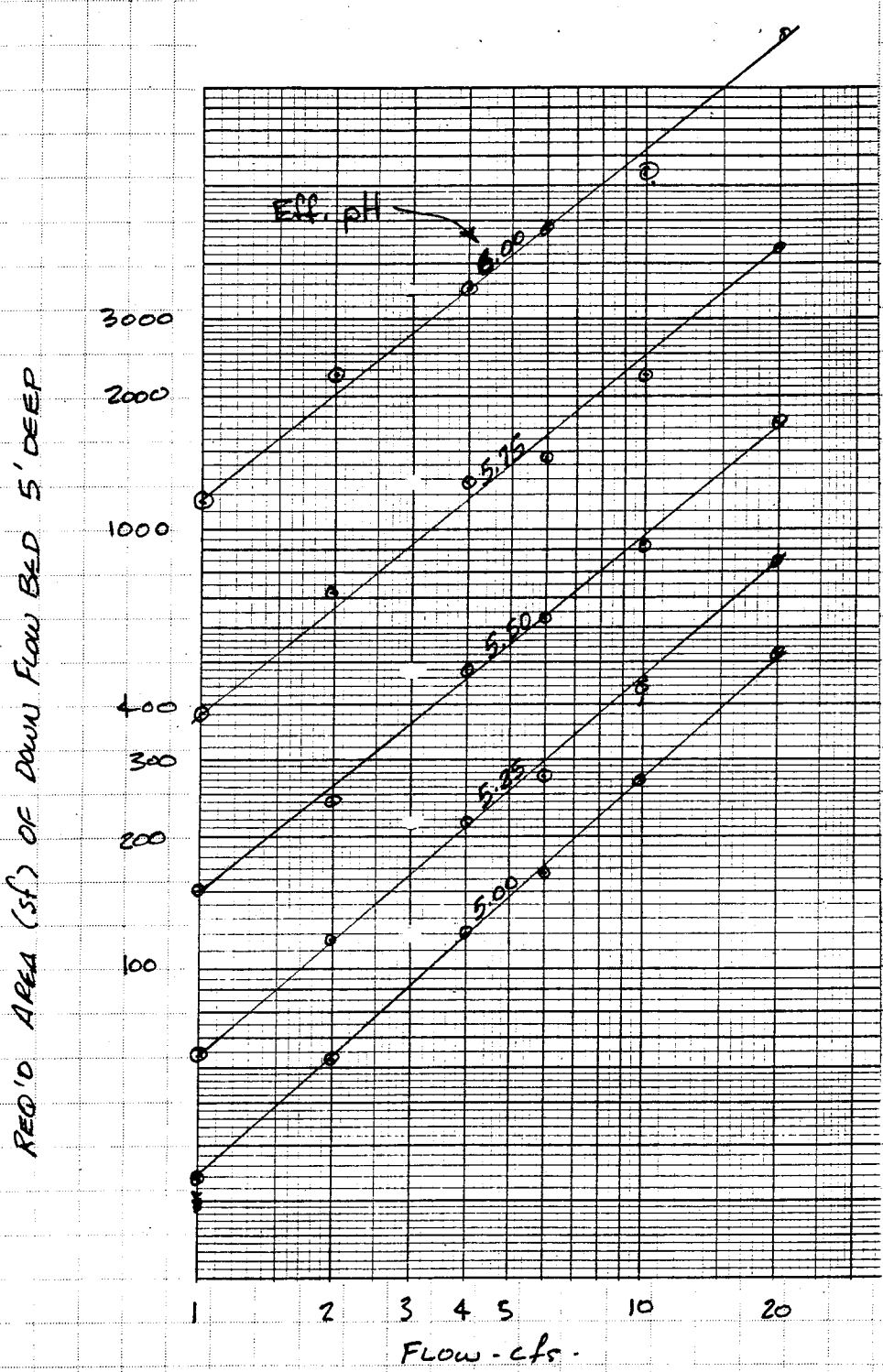
JOB CATTAURAUGUS CREEK

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE 11/81

CHECKED BY _____ DATE _____

ONEIDA TUNNEL



GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY SJM DATE 11/81
CHECKED BY ____ DATE ____
SCALE ____

ESTIMATE REQUIRED HEADS FOR DRUM TREATMENT

DRUMS ALONE

Q	Δ ALK	H
1	90	23
2	80	21
4	66	17
6	64	16
10	62	16
20	60	15

DRUMS & 1000 SF DOWNFLOW

Q	$ ALK$_f$	H	pH$_f$	
1	20	5.1	5.95	BED EFFLUENT
2	18	5.6	5.85	
4	16	6.2	5.70	
6	13	7.0	5.60	
10	12	7.2	5.55	
20	10	7.7	5.30	

DRUMS & 2000 SF DOWN FLOW

Q	ALK_f$	H	pH$_f$
1	25	3.8	6.1
2	22	4.6	6.0
4	20	5.1	5.95
6	17	5.3	5.80
10	16	6.2	5.70
20	12	7.2	5.6

ASSUMES REQ'D ALK @ pH: 6.5 = 40 mgl

$$H = \frac{\Delta alk}{0.13\, A_{(A)}}$$

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY ____ DATE 11/81
CHECKED BY ____ DATE ____
~~DONE~~ ONEIDA TUNNEL

DESIGN

USE: 2000 SF DOWNFLOW BEDS
1000 SF REDUNDANT SYSTEM *
W/ 2 DRUM TIERS

PROPORTION BACKWASH FLOW BASED ON ACQUIRED VOLUME = $\frac{2000}{5000} \times 100,267 = 40,100$ cf
PROVIDE 2x

* ie system to work w/ 1/2 BED & 2 SETS OF DRUMS OR FULL BED & 1 DRUM

SET OPT. CRITERIA - DRUM TO WORK AT 1 cfs

TRY 6'Φ = KD
D = 4'
L = 2'

$P_{in} = .67(1)(6)\delta 2 = 502$ ft-lb./sec

$M_R = 580$ ft-lb/ft (Rpt. Fig. 57)

$\frac{M_T}{L} = 614.4$ $\quad L = 2$

Clz. RPM: $RPM = \frac{60}{2\pi} \times \frac{P_I}{2} \times \frac{1}{M_t} = 3.9$ RPM

GRINDING RATE @ 3.9 RPM ≈ 4.5 lbs/Hr./ft

REQ'D RATE = $U_R = .33 \Delta alk\ Q$ $\quad U_R = 30$ lbs/Hr no beds
$= 6.6$ lbs/Hr 1 bed.
$= 5.0$ lbs/Hr 2 beds

PRODUCTION RATE = 9 lbs/HR for L = 2'

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK

SHEET NO. _____ OF _____

CALCULATED BY SJM DATE 11/81

CHECKED BY _____ DATE _____

SCALE ONEIDA TUNNEL

CHECK OPERATION AT 2 cfs.

RPM = 7.8

PRODUCTION = $E_T \frac{23.5}{550} P_I$ $\quad E_T = \frac{470}{580} = .81$

U = 17.4 lbs/HR PER DRUM (34.8 TOTAL)

U_R = 53 w/ no beds > 34.8

= 14.5 lbs/HR w/ 1000 sf. < 17.4

= 11.9 lbs/HR w/ 2000 sf < 17.4

CHECK OTHER FLOWS

Q	Req'd Production: No Bed	1000 sf Bed	2000 sf Bed	Production: 1 Drum	2 Drums (6'φ x 2)
1	30	7	5	9	18
2	53	15	12	17.4	35
4	87	52	27	33.	66
6	127	53	46	≷	≷
8	161	71	64	≷	≷
10	205	92 -	80 -	≷	≷
20	396	198	168	≷	≷

2 - 6φ x 2 DRUMS WILL TREAT BETWEEN 6 & 8 cfs

TRY ADDITIONAL DRUMS 6'φ x 4' FOR HIGH FLOWS
RUN ON EXCESS FLOW ABOVE 4 cfs

Q	U (1 drum)	Total Production (4 Drums - 2small)
6	- 0 -	66
8	25	116 (91)
10	50	166 (116)
12	63	192 (129)

2small & 1 large
2nd large drum could be set to run at flows > 12 cfs

JOB CATAWISSA CREEK

SHEET NO. _____ OF _____

CALCULATED BY TAG DATE 11/19/81

CHECKED BY _____ DATE _____

SCALE ONEIDA TUNNEL

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

ANNUAL LIMESTONE USE:

DURATION %	DAYS /yr	FLOW cfs	-DRUMS- FINES lbs/hr.	TOT. FINES lbs	-DOWNFLOW- ACID mg/l	LBS NEUT. lbs	TOTAL TONS
0-2	7.2	1	18	3110	150	3201	3.2
2-5	11	1.2	22	5808	148	5265	5.5
5-10	18.3	1.3	25	10980	147	10367	10.7
10-20	36.5	1.5	27	23652	145	23535	23.6
20-30	36.5	1.7	31	27156	143	26305	26.7
30-40	36.5	1.9	35	30660	140	28783	29.7
40-50	36.5	2.1	37	32412	138	31358	31.9
50-60	36.5	2.3	42	36792	134	33349	35.1
60-70	36.5	2.6	46	40296	131	36855	38.6
70-80	36.5	3.0	51	44676	125	40576	42.6
80-90	36.5	5.0	66	57816	100	54103	56.0
90-95	18.3	7.0	91	39967	86	32657	36.3
95-98	11	9.0	141	37224	83	24360	30.8
98-100	7.2	30 (USE 20)	192	33178	70	29883	31.5

ANNUAL LIMESTONE CONSUMPTION (TONS) 402.2

USE RATE FORMULAS *

DRUMS TOT. FINES:

$$\text{TOTAL FINES} = \text{FINES (lbs/hr)} \times 24 \text{ hr/day} \times \text{days}$$

DOWNFLOW LBS. NEUT:

$$\text{LBS. ACID NEUTRALIZED} = 1.1\left[\frac{\text{ACIDITY}^{**}\text{(mg/l)} \times \text{FLOW (cfs)} \times 5.390 \times \text{days}}{2}\right]$$

* Developed from experimental results at Quakake.

** Assumes Complete Acid Removal (conservative limestone use estimate)