Appendix H

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY SJM DATE 11/81
CHECKED BY _____ DATE _____
SCALE WLT#3

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO ____ OF ____
CALCULATED BY ____ DATE 11/81
CHECKED BY ____ DATE ____
SCALE WLT#3

TUNNEL #3 DESIGN IS COMPLEX:

1. ACCESS TO SITE IS DIFFICULT
2. TREATMENT OF TUNNEL ALONE LEAVES STREAM ACIDIC
3. TREATMENT BENEFITS TEND TO BE MARGINAL
4. MANY ALTERNATIVES REQUIRE CONSIDERATION

(a) NO TREATMENT - ASSUME DILUTION FROM AUDENRIED WILL ADEQUATELY TREAT STREAM & TUNNEL 3 - VALID BUT WRITES OFF SEVERAL MILES OF SALVAGABLE STREAM

(b) BLOCK TUNNEL & ALLOW OVERFLOW TO GOTO WLT-2 TO BE TREATED - LEAVES STREAM UNTREATED & ACIDIC

(c) TREAT TUNNEL DISCHARGE ONLY - LEAVES STREAM ACIDIC & PARTICULARLY AT LOW FLOW
- (C1) TREAT AT SITE
- (C2) FLUME TO AUDENRIED SITE

(d) TREAT COMBINED FLOW AT SITE - ACCESS PROBLEMS

(e) TREAT STREAM ABOVE SITE & TUNNEL FLOW AT SITE - INCREASED COST & LOW FLOW PROBLEMS
(ADVANTAGE - INCREASES STREAM MILES ABATED)

(f) PIPE TUNNEL FLOW TO AUDENRIED

Of the alternatives available only a, d & e are viable as if the stream is not treated there is little point in treating the tunnel as the Andesined discharge will mask results.

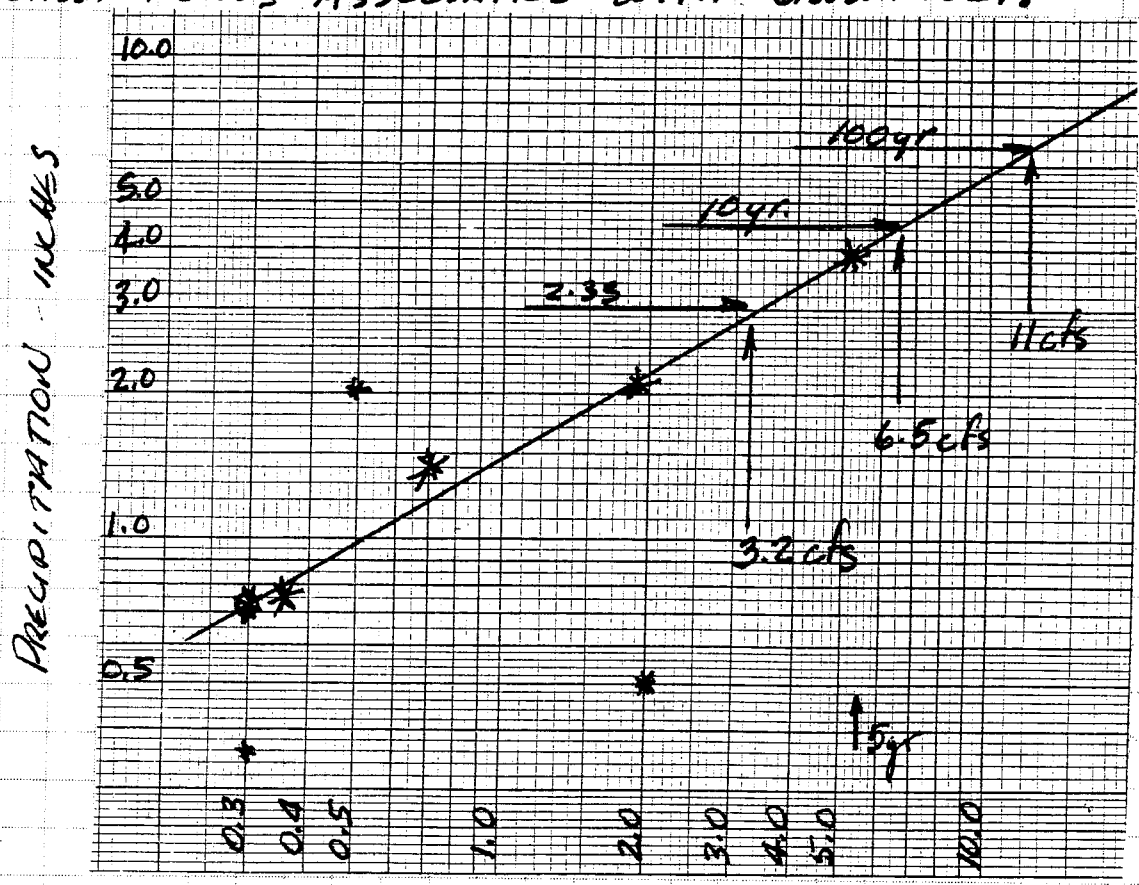
Alternate (a) has the obvious advantage of cost.

IF RECLAMATION OF THE STREAM IS TO BE CONSIDERED THEN A COMBINATION OF (d/e) is appropriate.

1. Combining of the stream & tunnel flow will be required for low flow treatment of the tunnel
2. At low flow additional acidity will probably be pickup particularly during low flow
3. Treatment at CC-2 or futher upstream will maximize stream reclamation

IN OTHERWORDS a "WHOLE-HOG" OR "NOTHING" APPROACH IS RECOMMENDED

- PLOT PEAK DISCHARGE VS. PRECIPITATION (96 hr.)
- RECORDS POOR HOWEVER 8 of 10 RECORDED EVENTS HAVE LAG TIMES GREATER THAN 40 hrs.
- HIGHEST FLOWS ASSOCIATED WITH SNOWMELT.



FREQUENCY ESTIMATE SHOULD BE ADJUSTED FOR HIGH FLOWS CAUSED BY SNOWMELT

ASSUME 5 CFS = $Q_{2.33}$

CATAWISSA CREEK

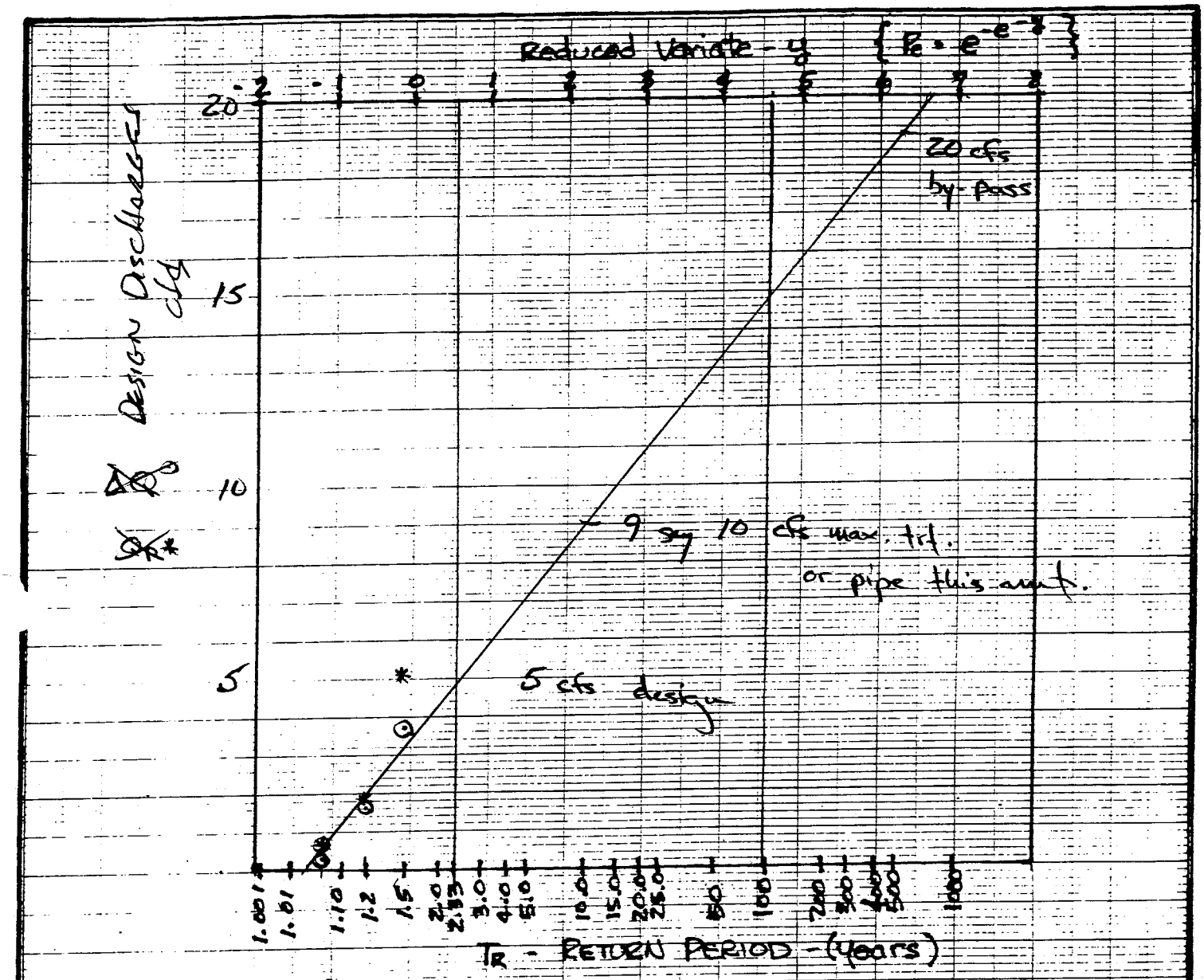
GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

SHEET NO _____ OF _____

CALCULATED BY TAG & SAM DATE 11/81

CHECKED BY _____ DATE _____

WLT-3



JOB CATAWISSA CREEK

SHEET NO. _____ OF _____

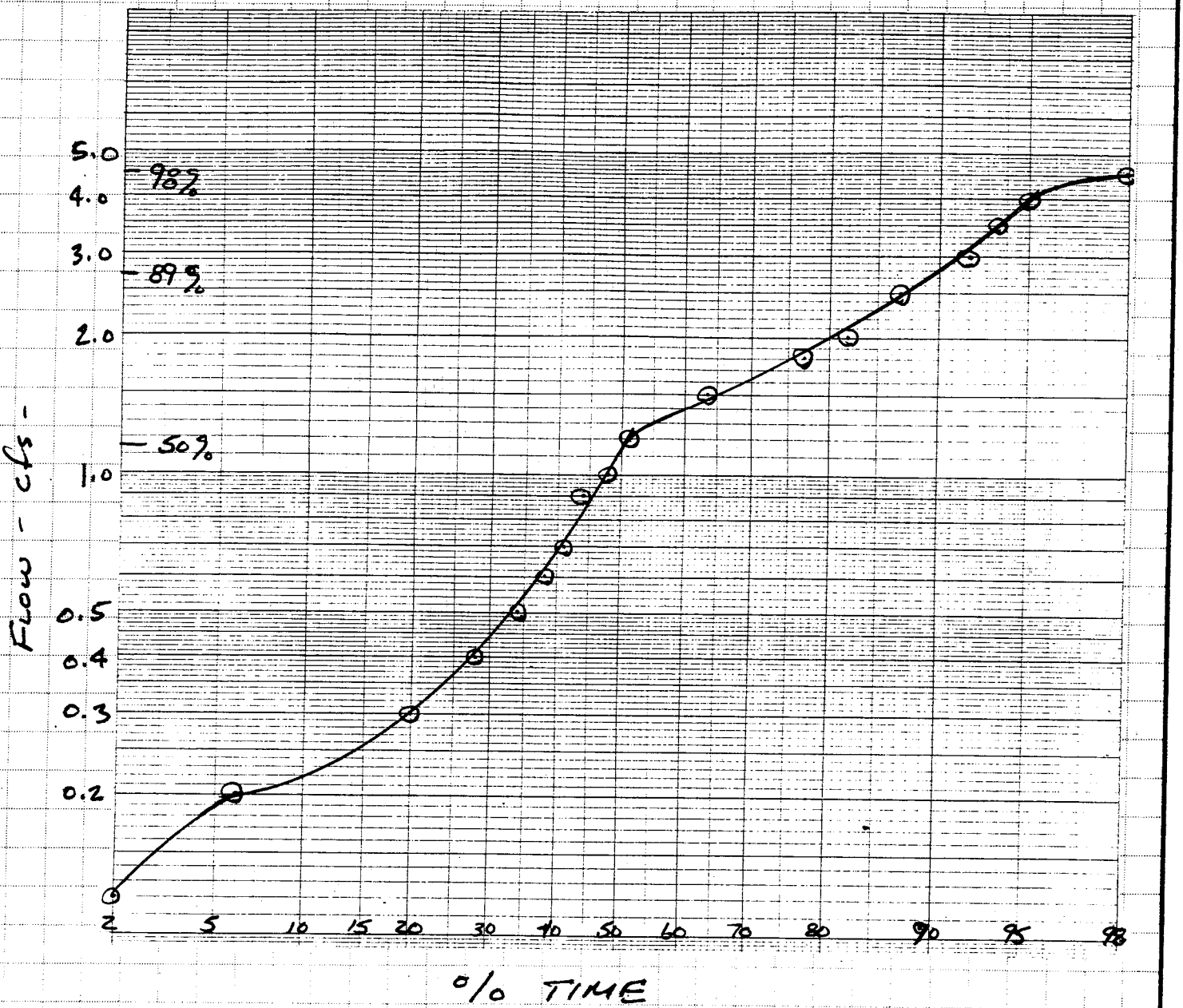
CALCULATED BY SJM DATE 11/81

CHECKED BY _____ DATE _____

WLT-3

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

PLOT FLOW DURATION CURVE



GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY TAG DATE 11/81
CHECKED BY _____ DATE _____
SCALE WLT-3 TREATMENT DESIGN

CHEMICAL PARAMETERS FOR TREATMENT DESIGN

FLOW -cfs-	pH	ACIDITY mg/l	ALK* mg/l	CT*
.2	3.56	65	-30	35
.4	3.59	60	-26	34
.6	3.62	57	-25	32
.8	3.67	54	-24	30
1.0	3.74	50	-16	34
2	3.93	42	-10	32
4	3.95	36	-10	26
6	3.97	35	-10	25

ESTIMATE REQUIRED HEADS FOR DRUM TREATMENT

Q	Δ Alk	H
0.2	70	17.9
0.4	66	16.9
0.6	65	16.7
0.8	64	16.4
1.0	56	14.4
2.0	50	12.8
4.0	50	12.8
6.0	50	12.8

USE SAME APPROACH AS WLT-2
ie - Downflow Beds followed by single drum

* ESTIMATED FROM EQUILIBRIUM CONDITIONS

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY S/m DATE 11/81
CHECKED BY ____ DATE ____
SCALE WLT#3

DUE TO THE POSSIBILITY OF DIFFICULT ACCESS FOR SHORT TO MOD. PERIODS OF TIME - USE A MODIFIED DOWNFLOW APPROACH.

1. USE ½" SIZE STONE
2. BEDS TO BE LINEAR BARRIER WITH BACKWASH CAPABILITY
3. DESIGN FOR R = 0.2 TO ALLOW FOR LONGER BACKWASH PERIODS @ WEEKLY OR MORE
4. PROVIDE STANDBY BEDS TO OPERATE BY OVERFLOW AND/OR MANUAL SWITCHING TO EXTEND BACKWASH CYCLE

PROVIDE BED TREATMENT TO 1.0 CFS ±
TREAT REMAINDER WITH DRUMS

FLOW	pH	CI	LF	SURFACE AREA *
0.2	3.56	35	90	72
0.4	3.59	34	85	136
0.6	3.62	32	80	192
1.0	3.67	30	75	300
2.0	3.74	28	70	560

* 3' deep beds
Assumed final pH = 5.2

PROVIDE 3 - 5' WIDE BY 60' LONG BEDS

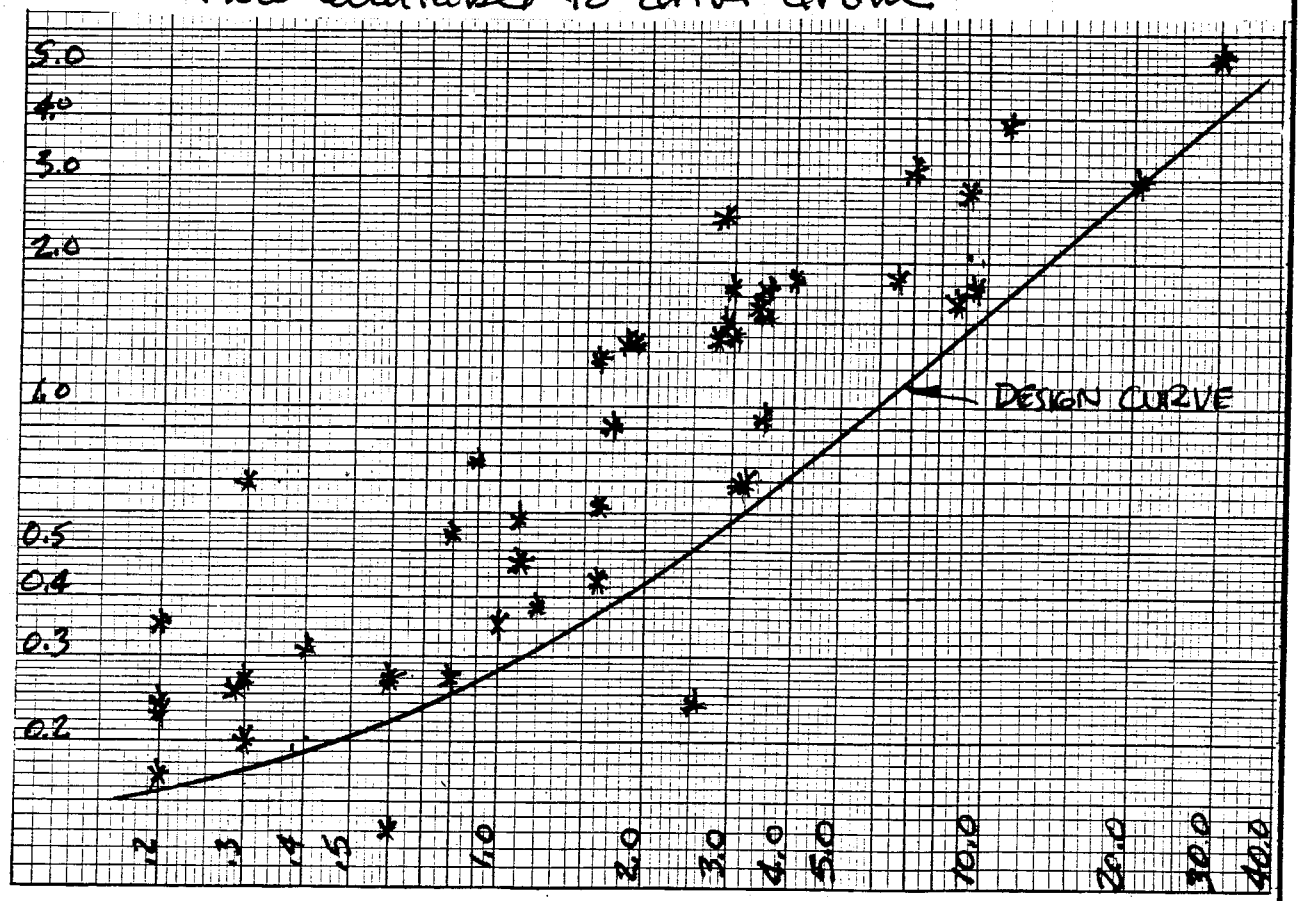
GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY SJM DATE 11/81
CHECKED BY _____ DATE _____
SCALE WLT#3

ESTIMATE DRUM REQUIREMENTS

Flow	Δalk	H
0.2 → 1.0	40	10.25
1.0 → 10.0	50	12.8

PLOT WLT-3 vs. CC3 to estimate low flow available to drive drum.



FLOW - WLT 3

FLOW - CC3

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY sjm DATE 11/81
CHECKED BY ____ DATE ____
SCALE WLT # 3

ASSUME DRUMS AT CC-2 WILL PROVIDE ADEQUATE TREATMENT AT FLOWS > 2 cfs

WLT 3 FLOW	CC-3 FLOW
.2	.5
.4	2.0
.6	3.5
1.0	6.0
2.0	13.0

ASSUME ONLY 2 cfs DIVERTED FROM STREAM

PRODUCTION REQUIRED.

WLT 3 FLOW	DRIVING FLOW	REQ'D * PROD.	FINES ** PRODUCED
.2	0.7	2.6	7
.4	2.4	5.3	26
.6	2.6	7.9	28
1.0	3.0	13.2	33
2.0	4.0	33.0	44
4.0	6.0	66.0	74
6.0	8.0	99.0	90

* .33 * Δalk * Q

** ASSUMING SAME DRUM ARRANGEMENT AS WLT-2

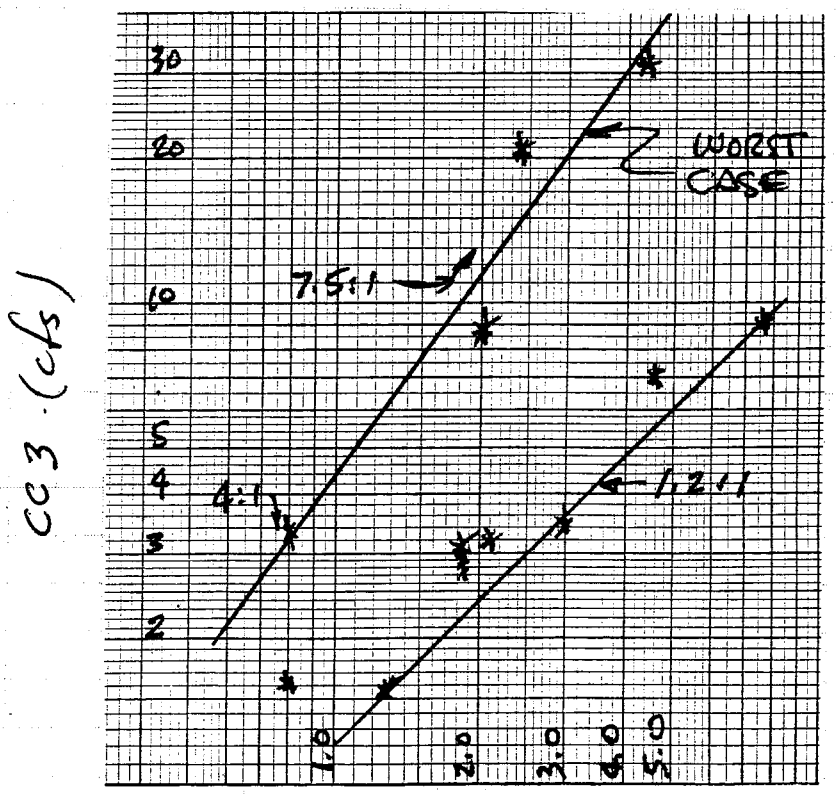
GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. ____ OF ____
CALCULATED BY SPM DATE 11/81
CHECKED BY ____ DATE ____
SCALE WLT #3

STREAM TREATMENT

DRAINAGE AREA · CC-2 1.1 sq mi
CC-3 1.7 sq mi

DESPITE THE SMALL INCREASE IN DRAINAGE AREAS A 7.5 TO 1 FLOW RATIO BETWEEN CC2 & CC3 WAS OBSERVED AT HIGH FLOWS AND 1.2 TO 1 AT MED. FLOWS



IT IS PROPOSED THAT OVERTREATMENT AT CC-2 BE PROVIDED & HIGH FLOW DRUMS BE INSTALLED AT CC-3/WLT-3 ONLY IF PROVEN NECESSARY

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY gm DATE 11/81
CHECKED BY _____ DATE _____
SCALE WLT#3

COSTS & DRUM SIZE SELECTION ARE SITE-SPECIFIC & TOPO OTHER THAN USGS IS NOT AVAILABLE FOR AN INSTALLATION AT CC-2

IT IS ESTIMATED THAT THE FOLLOWING ITEMS WOULD BE REQUIRED:

2 tiers of 3 drums (1 LOW FLOW 2 HIGH FLOW)
ACCESS ROAD.
10' HIGH DAM
STOCK PILE STORAGE.

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY TAG DATE 11/19/81
CHECKED BY _____ DATE _____
~~SCALE~~ WLT-3

ANNUAL LIMESTONE USE:

DURATION %	DAYS /yr	FLOW cfs (Of / Drum)	-DRUMS- FINES lbs/hr.	TOT. FINES lbs	-DOWNFLOW- ACID mg/l	LBS NEUT. lbs	TOTAL TONS
0-2	7.2	.18/.7	7	1361	65	167	5.8
2-5	11	.15/.7	7	1848	65	318	1.1
5-10	18.3	.20/.7	7	3074	65	705	1.9
10-20	36.5	.25/1.1	12	10512	60	1623	6.1
20-30	36.5	.35/2.4	26	22776	56	2121	12.5
30-40	36.5	.50/2.5	27	23652	54	2922	13.3
40-50	36.5	1.0/3.0	33	28908	50	5410	17.2
50-60	36.5	1.3/3.3	37	32418	46	6471	19.4
60-70	36.5	1.5/3.5	40	35040	42	6817	20.9
70-80	36.5	2.0/4.0	44	38544	36	7791	23.2
80-90	36.5	2.0/4.5	52	45552	36	7791	26.7
90-95	18.3	2.0/6.0	74	32500	35	3798	18.2
95-98	11	2.0/6.5	78	20592	35	2283	11.4
98-100	7.2	2.0/8.0	90	15552	35	1494	8.5

ANNUAL LIMESTONE CONSUMPTION (TONS) : 181.2

USE RATE FORMULAS *

DRUMS TOT. FINES:

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

DOWNFLOW LBS. NEUT:

$$\text{LBS. ACID NEUTRALIZED} = 1.1\left[\frac{\text{ACIDITY}^{**}\text{(mg/l)} \times \text{FLOW (cfs)} \times 5.3901 \times \text{days}}{2}\right]$$

* Developed from experimental results at Quakake.
** Assumes Complete Acid Removal (conservative limestone use estimate)

GEO-TECHNICAL SERVICES
Consulting Engineers & Geologists

JOB CATAWISSA CREEK
SHEET NO. _____ OF _____
CALCULATED BY TAG DATE 11/19/81
CHECKED BY _____ DATE _____
~~SCALE~~ CC-2

ANNUAL LIMESTONE USE:

DURATION %	DAYS /yr	FLOW cfs	DRUMS FINES lbs/hr.	DRUMS TOT. FINES lbs	DOWNFLOW ACID mg/l	DOWNFLOW LBS NEUT. lbs	TOTAL TONS
0-2	7.2	.5	6.4	1106			0.6
2-5	11	.5	6.4	1690			0.9
5-10	18.3	1.0	14.3	6281			3.1
10-20	36.5	1.0	14.3	12527			6.3
20-30	36.5	2.0	32.2	28207			14.1
30-40	36.5	2.0	32.2	28207			14.1
40-50	36.5	2.5	39.2	34339			17.2
50-60	36.5	3.0	46.1	40384			20.2
60-70	36.5	4	60.0	52560			26.3
70-80	36.5	6	90.0	78840			39.4
80-90	36.5	8	120.0	105120			52.6
90-95	18.3	12	150	65880			32.9
95-98	11	16	180	47520			23.8
98-100	7.2	30	300	51840			25.9

NO DOWNFLOW TREATMENT UNITS

ANNUAL LIMESTONE CONSUMPTION (TONS) : 277.4

USE RATE FORMULAS *

DRUMS TOT. FINES:

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

DOWNFLOW LBS. NEUT:

$$\text{LBS. ACID NEUTRALIZED} = 1.1\left[\frac{\text{ACIDITY}^{**}(\text{mg/l}) \times \text{FLOW (cfs)} \times 5.3901 \times \text{days}}{2}\right]$$

* Developed from experimental results at Quakake.
** Assumes Complete Acid Removal (conservative limestone use estimate)