RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA , SUITE 113
COLORADO SPRINGS, CO 80903
(719) 578-6212

MASTER DRAINAGE REPORT

for a portion of Area II

Cheyenne Mountain Ranch

Colorado Springs, Colorado

DREXEL, BARRELL & CO.

ENGINEERS — SURVEYORS

1700 38TH STREET BOULDER, COLORADO 80301 (303) 442-4338

MASTER DRAINAGE REPORT

for a portion of Area II

Cheyenne Mountain Ranch

Colorado Springs, Colorado

Prepared for:
Gates Land Development Co.

Prepared by:
Drexel, Barrell & Co.

E-2551

October 15, 1982

RECEIVED
NOV 17 1982
1100
PUBLIC WORKS
ENGINEERING

CERTIFICATIONS

The attached drainage plan and report for a portion of Area II, Cheyenne Mountain Ranch were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by the negligent acts, errors, or omissions on my part in preparing this report.

For: DREXEL, BARRELL & CO.

By: _____
John Common, P.E. 11956

The developer has read and will comply with all of the requirements specified in this drainage report as ~~approved~~ filed by the City Engineer. 11.12.84.

By: _____
Robert F. Svejkovsky
Director of Enginering

Filed: "As ammended on drawing"

_____, 1/11/85
City Engineer

Master Drainage Report for

a portion of Area II

Cheyenne Mountain Ranch

for Gates Land Development Company

The purpose of this report is to generate flows for areas in Cheyenne Mountain Ranch tributary to a point located just north of the intersection with Highway 85 and Interstate I-25. Drainage facilities adjacent to Highway 85 must be designed prior to development of the commercial area between I-25 and Highway 85. Specifically part of Section 31, 32 and 33, R66W and Section 36, R67W all in T14S, in the 6th P.M., Colorado Springs, El Paso County, were studied. This report updates a portion of a report entitled "Master Drainage Plan, Harrison Street - I-25 Vicinity, Cheyenne Mountain Ranch" prepared by Hartzell-Pfeiffenberger and Associates, Inc., on November 15, 1973. This report reflects as built conditions or proposed development according to the Gates Master Plan where development has not yet occurred. This report also utilized current City of Colorado Springs Criteria.

Drainage criteria used was taken from the City of Colorado Springs "Determination of Storms Runoff Criteria" manual and "Procedures for Determining Peak Flows in Colorado" prepared by the Soil Conservation Service in March 1980. The 6 hour 100 year frequency storm was analyzed. Soil types were determined by maps published by the S.C.S. Curve numbers for residential areas were verified by checking the average pervious/impervious area for existing subdivisions. The procedure used for hydrograph configuration was based on discussions with S. Glade Wilkes from the S.C.S. office in Denver. For each peak flow determination, runoff from a given area equals the volume under the hydrograph drawn for that area. The routing procedure used to determine outflow from detention ponds is based on a simple storage equation.

Peak flow determinations have been calculated at critical points, usually at a point above a detention ponding area. The routing procedure generates outflow hydrographs for the ponding area. Hydrographs downstream are combined to achieve a new peak flow at a required point.

Area and Basin designations were taken and updated from a Master drainage report entitled "Drainage Study, Broadmoor Mesa First Filing" prepared by Hartzell-Pfeiffenberger and Associates on August 18, 1969. Area II excepting Basin B, F and G are included in this report. The areas excepted from this report are to be directed to other outfalls.

Four concentration points contribute flow to Highway 85. The largest tributary area (called North Gully by Hartzell-Pfeiffenberger) flows to Highway 85 at concentration point E. Two detention ponds reduce flow in this area. The first exists west of Highway 115 and the second is west of Tenderfoot Hill Road. A third pond located at the junction of Basin N and K has not been built to date. A pond at this location called K2 is considered as an alternate. The second largest tributary area is tributary to concentration point C. Quail Lake, located west of Quail Lake Road, is a large detention ponding area that significantly reduces the quantity of flow to point C. Two additional areas, Basin D and Stratmoor Hills, are also tributary to Highway 85. No detention ponding

exists in these basins. The combined flow to Highway 85 is 972 cfs. The flow alternate, (with pond at K2) is 807 cfs. Drainage facilities adjacent to Highway 85 draining southeast to the existing box culvert at I-25 will be designed and built to contain this 100 year flow. The flow in the proposed drainage facilities and flow from basin area T are tributary to an existing 14' wide x 11'x 8" box culvert and a 48" R.C.P. under I-25 located north of the intersection with Highway 85. The capacity of this box culvert and pipe at a headwater depth of 9' equals the design flow of 1249 cfs. The design alternate is 1068 cfs.

This paragraph discusses the adequacy of the major culverts from State Highway 115 to State Highway 85-87. The upper tributary area of the North Gulley, basins Q and P, flows to a detention ponding area and 24" pipe under State Highway 115. As indicated in the original Hartzell-Pfeiffenberger report the 24" pipe is not adequate to convey flow to the east side of the highway. Both the 5 year and the 100 year storm will cause flow over the road embankment. The flow continues east thru the Myron Stratton Home Site which is not owned by Gates. A 72" pipe exists under Tenderfoot Hill Street. This pipe creates a small detention ponding area and will convey the 100 year storm. Basin N has been detailed in a previous report by Drexel, Barrell dated January 15, 1979 entitled "Drainage Report of Areas draining to a low point at State Highway 115 at the approximate center Section 31, T14S, R66W..." Capacities of the storm sewer under Highway 115 and pipe directed northeast past Cheyenne Meadows Boulevard are adequate for the 5 year storm. The North Gulley flows in a 5'x 20' box culvert under State Highway 85-87. Its capacity is adequate for the 100 year storm. Basin D is a relatively small basin where flow is concentrated in a 36" storm sewer in Cheyenne Meadows Boulevard. This sewer provides capacity for the 5 year storm and daylights on the northeast side of Highway 85-87. The bridge below Quail Lake for Basin C provides capacity in excess of the 100 year storm. Outflow and capacity from Stratmoor Hills was not analyzed and is not owned by Gates.

The following discussion outlines methods used to determine the 100 year flood plain for the North Gulley and channel below Quail Lake. The limit of the 100 year flood plain is approximate in nature. As adjacent properties are platted, detailed analysis should be performed. Cross-sections along each drainageway were plotted from a 100 scale aerial topo map. Mannings equation was used to determine flow levels. Flow in the North Gulley and two upper tributary legs is confined to the existing channel. Flow directly below Quail Lake is confined to a channel except that at about 1000' southwest of Highway 85-87 the ground flattens to the south causing flow to sheet across the fields to the highway. We propose to channel this flow to the bridge by means of grading.

The drainage facilities proposed adjacent to Highway 85-87 are preliminary in nature and are subject to change. Mannings equation was used to choose pipe and channel sizing. An increasingly larger pipe size is shown from the mouth of the North Gulley flowing southeast for a distance of approximately one half mile. From that point to the box under I-25 either a concrete lined channel or a pipe is proposed.

By agreement with the City of Colorado Springs no drainage basin fees are paid by Gates Land Company. The proposed drainage facilities north of State Highway 85-87 will be built and paid for by Gates Land Company.

In conclusion, this report generates 100 year flows for approximately 1040 acres that drain to I-25. Drainage facilities along Highway 85 will direct flow southeast to the existing box culvert and pipe north of the intersection of I-25 and Highway 85. The capacity of the two culverts is sufficient to carry the 100 year flow east under I-25.

Drainage plan, calculations, and other supporting information follow in the appendix.

Respectfully submitted,

Barbara Weiss

Barbara Weiss

CHEYENNE MOUNTAIN RANCH

INDEX

for

AREA II DRAINAGE STUDY

Project: Master Drainage Study | Job Nº: E-2551

Client: Gates | By: BNW | Date: 4/6/82

$\therefore$ area basin runoff $A \times Q$ = volume hydrograph $\frac{t_b}{2} \times q$

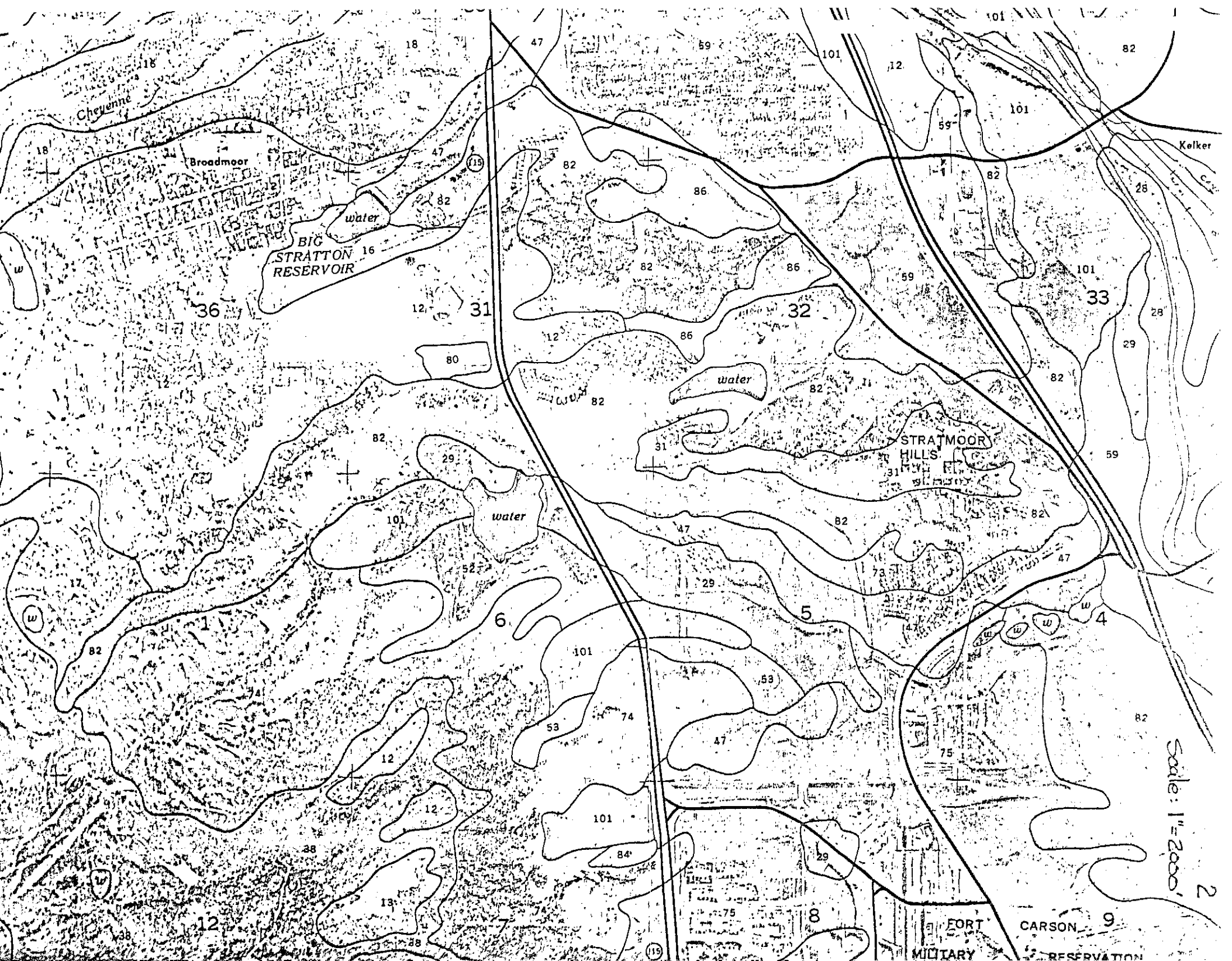
solve unknown $t_b = \frac{AQ2}{q}$

units $(hr) = sq\,mi\,(in) \div \frac{ft^3}{sec}$

$= \frac{mi^2 \cdot in \cdot sec}{ft^3} \times \left[\frac{43560 \frac{ft^2}{Ac} \times 640 \frac{Ac}{mi^2}}{12\,in/ft \times 3600\,sec/hr}\right]$

$\rightarrow \quad t_b = \frac{1290\,AQ}{q}$

let $D = .133\,T_c$


Cheyenne
Broadmoor
water
BIG
STRATTON
RESERVOIR
36
31
32
33
water
STRATMOOR
HILLS
water
6
5
4
1
12
7
8
9
FORT
CARSON
MILITARY
RESERVATION
Kelker
Scale: 1" = 2000'

Project: Master Drainage Study | Job No: E-2551

Client: Gates | By: BNW | Date: 4/15/82

Hydrological Soil Groups

12	Bresser	B
59	Nunn	C
82	Schamber/Razor	A/C
31	Fort Collins	B
86	Stonehdm	B
50	Satanta	B
16	Chaseville	A

Project: Master Drainage Cheyenne Mtn Ranch | Job No: E-[illegible]

Client: Gates | By: GS | Date: 1-6-87

Determination of Impervious Areas

Percentages of impervious areas were determined for subdivisions within Cheyenne Mtn Ranch. The percent of impervious areas within each subdivision include homes and out buildings, driveways, side walks, roads and anything else that could be determined to be impervious from an aerial photo. The percentages that were determined for Cheyenne Mtn Ranch were compare favorably to the percentage given in Table 2-2 of "Procedures for Determing Peak Flows in Colo"

Lot Size (Ac)	Table 2-2	Cheyenne Mtn Ranch.
1/8 (Multi Family)	65 %	70 %
1/5	47	50.5
1/4	38	33
1/3	30	27.5
1/2	25	25.5
Commercial	85	94

Project: Storm Drainage

Job Nº: E-2528

Client: State

By: SS

Date: 1-5-82

Broadmoor Bluffs Park #1

# of Lots = 51

Ave Lot Size = 21,632 = 0.496Ac
½Ac Lot

Ave House Size = 3900Ft²
& Drive

Ave Impervious Area
Per Lot = 3900Ft²

% Impervious area = 13 %

DREXEL, BARRELL & CO. LAND SURVEYORS CIVIL ENGINEERS

Project	Job No.
Martens Farm	

Client	By	Date
Gates		

Broadmoor Ridge #1

Total Area = 23.796 Ac

Total # of Lots = 4

Ave lot size = 3.42 - 4 Ac.

Ave House Size = 2750 sq ft

Ave Drive Size = 500 sq ft

Ave Impervious Area per lot = 3[illegible]

= .[illegible] Ac

Percent Impervious Area

Per Lot = 21 %

Project: Mountain Shadows | Job No: E2-28

Client: Gates | By: SS | Date: 1-4-82

MJ BROCK Unit #3
SW of Cheyenne Mtn BLVD

Total Area = 26.52 Ac

total Lots 100

Total Road Area = 190,469 ft² = 4.37Ac

Ave lot size = .22 Ac ≈ 1/5 Ac

AVE HOUSE SIZE = 2,425 ft²

AVE DRIVE SIZE = 450 ft²

242,500 + 4,500 = 247,000 ft² = 5.67Ac

total IMPERVIOUS Area = 10.04Ac

% IMPERVIOUS Area = 37.8 ≈ 38%

DREXEL, BARRELL & CO.
LAND SURVEYORS
CIVIL ENGINEERS

SD

Project	Job Nº
Master Drainage	1E-2123

Client	By	Date
Gates	SS	12-24-81

Multi Family Housing North of
Cheyenne Mtn Blvd & East of Colo 115

Area = 182,500 sf±

Approx Bldg Size = 10,000 sq ft (3) = 30,000 sf±

Total Approx bldg Area = 34,750 sf±

Walks ≈ 400' x 5 = 2000 sf±

Roads & Parking Lots = 45' x 905' ≈ 40,700

total impervious = 107,475

Impervious Area % = 59%

1700 38TH STREET (303) 442-4338
3405 N. EL PASO STREET (303) 633-5029

Project: [illegible] Job No: F-2528

Client: Gates By: SS Date: 12-28-81

Gentry Subdivision Sub-basin P

House size 45 x 30 = 1350 ft²

Drive way 20' x 13 = 260 ft²

Lot Area = 8200 ft² 1610 ft²

1/5 Ac ± Lots 16 Lots @ 1/5 Ac

55' x 50 = 2750 ft² = 139,400 ± ft²

=

HOUSE SIZES

1350
2750
1500
1600
1700
1350
2000
1850
1250
2100
1650
1400
1500
1800
1800
2100

AVE 1731.25 ft²

½ = 27,700 ft²

DRIVES & Impervious Areas, Rds

240 (7) = 1680
420 (5 = 2100
360 (4) = 1440
30 x 320 = 9600
10,354
25,174

Houses & DRIVES

~~52,874~~
87,674.0

63 % ± IMPERVIOUS

Project	Job No.
Master Drainage	

Client	By	Date
Gates		12-29-81

BroadMoor Mesa

Single Family Filing #3 (20373)

West and S.W. of E. & Stratton Rd.

# of lots 35 Area = 21.76 Ac.

Rd Area = 5.15 Ac ±

Total Area of Lots = 16.61

Ave Area per Lot ≃ .40 Ac ≃ 1/2 Ac Lots

Ave House size ≃ 2600 Sq Ft

2600 (35) = 91000 Sq Ft = 2.09 Ac

Houses & Rds = 7.24 Acs

% of impervious Area = 33 %

Project	Job No
Master Drainage	E-2528
Client	**By** / **Date**
Gates	SS / 12-29-81

SPRING RUN (20-414)
So of Big Stratton Res.

# of Lots = 113 Total Area = 44.88Ac

Area of Rds ≈ 5.8Ac

Ave lot size = 0.35 Ac = 1/3 Ac Lots

Ave House Size = 2550 Sq = .059Ac(113) = 6.67Ac

Ave DR Way = 15 x 18 = 270(113) = 30,5100 Sq

Total IMPERVIOUS Area = 12.6 Ac ±

% impervious Area = 28% ±

Project: Master Drainage
Job No: [illegible]
Client: Gates
By: SS
Date: 1-[illegible]

Spring Lake #1

Total Area = 21.763 Ac

Ave Lot Size = 0.422 Ac

Ave house size = 3500 Ft²

Ave Drive Size = 870 Ft²

Ave Impervious Area = 4370 Ft²
= 0.10 Ac

Percentage Impervious
Area = 24%

Project: Morton Estates | Job Nº: E-2528

Client: Gates | By: | Date: 1-5-82

The Falls

Total Area = 26.9 Ac

Developed Area = 11.5 Ac ±

Bldg Area = 7500 Ft²(14) = 105,000 Ft²

Rd Area = 77,000 Ft²

Garages, Walks, Etc. = 45,000

Σ Impervious Area = 227,000 = 5.22 Ac.

% impervious for developed Area = 45%

Project	Job No
Master Drainage	E-2128

Client	By	Date
Gates	SS	1-4-82

Commercial Broodmoor Mesa

total Area = 7.94 Acres

Σ Green Areas (pervious) = 22,175 Ft^2 ± = 0.509 Ac

% Impervious = 93.6 %

Project	Job No
Master Drainage	E-2529

Client	By	Date
Gates	SS	1-5-82

Country Club Estates #2

total Area 12.2.

total Road Area = 1.7 Ac

total Lots = 30

Ave Lot Size = 0.35 Ac ≈ 1/3 Ac

Ave House Size = 3700 ft^2 = 0.084 Ac

Ave Drive Size = 500 ft^2 = 0.011 Ac

Ave Impervious Area = 0.095 Ac

% Impervious Area = 27 %

Country Club Estates #1

Ave Lot Size .25 Ac

Ave House Size 3200 ft^2

Ave Drive 500 ft^2

Ave Impervious Area = 0.085 Ac

% Impervious Area = 33 %

DREXEL, BARRELL & CO. LAND SURVEYORS CIVIL ENGINEERS

Project: MASTER DRAINAGE STUDY | Job Nº E 2551

Client: GATES | By: MH | Date: 19 MAY 82

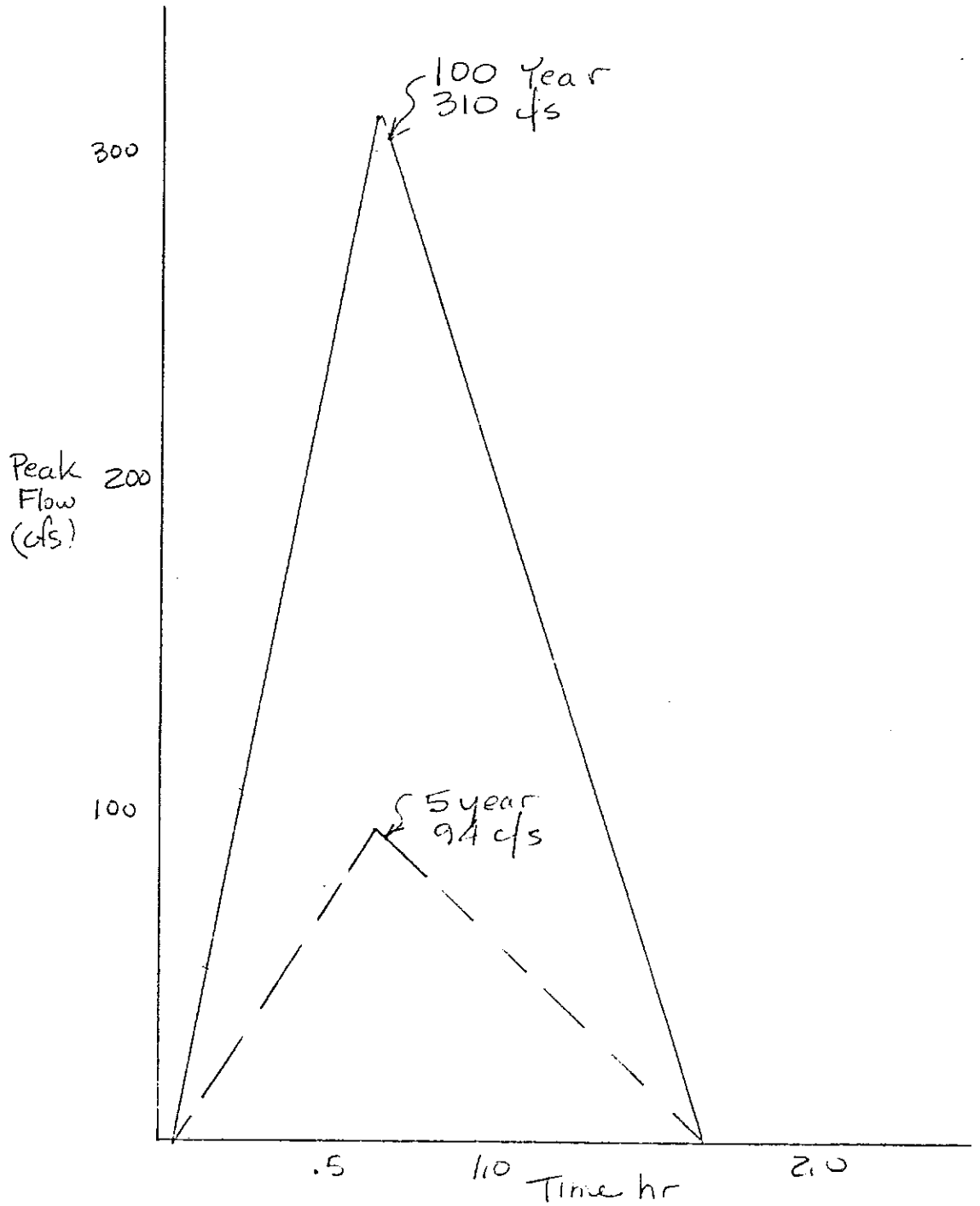
MASTER CHART FOR AREA II BASINS

CONCEN. POINT	BASIN	AREA/Ac	Tc/hr	CN	100yr FLOW	FLOW @ CONCEN. PT
E	O&P	218.9	0.4	71.8	310	451 cfs (323 cfs) ALTERNATE
	N&J	163	0.52	75.7	247	
	K1	62	0.15	73	131	
	K2	25	0.17	71.4	45	
	E	50	0.26	76	105	
C	I,M&L	177	0.28	79.0	430	220 cfs
	C	123	0.47	77.5	194	
D	D	51	0.25	83.4	150	150 cfs
STRATMOOR HILLS		214	0.25	70	338	338 cfs
T	T	111	0.48	89	303	1249 cfs (1068 cfs) ALTERNATE

Project: Master Drainage Study | Job No: E-2551

Client: Gates | By: BWW | Date: 4/19/82

Area II Basin O & P



Project: MASTER DRAINAGE STUDY — Job No. E 2551

Client: GATES — By: SS — Date: 8 JAN 82

AREA II

BASIN O

SOIL GROUP	AREA	USE	CN	%	PRODUCT
B	6.5	1/3 Ac lot	58	5	292
B	9.9	MULTI	77	7.7	591
B	88	1/3 Ac	72	68	4915
B	21	MULTI	84	16.3	1368
B	3.5	COMM.	93	2.7	252
	128.9 Ac			100	74.2

CN = 74.2

BASIN P

B	56 Ac	1 Ac lot	68	62%	42.2
B	34	1/2 Ac lot	70	38	26.6
					68.8

CN = 68.8

Project: Master Drainage Area II — Job No: 1257.B

Client: Gates West - 5 CSH II — By: JS — Date: 4-12-92

Area II Sub-basin Off P 6hr 100yr

Basin	Area	Wted CN	%	Product
O	128.9 Ac	74.2	58.9	43.6
P	90 Ac	68.8	41.1	28.2
	218.9 Ac		100	71.8

Wted CN = 71.8

Q = 1.12

t_c = 0.3 hrs

L = 5000

H = 200

Plus 6 mins of pipe flow

q_p = 810 csm/in

D = 0.066 hrs

T_p = .27 hrs

T_b = .73 hrs

t_c = .3 + .1 = 0.4 hrs

t_c = 0.4 hrs

$$q = 810\left(\frac{218.9}{640}\right) 1.12 = 310 \text{ cfs } 100yr$$

$$t_b = \frac{1290}{640} \times \frac{219(1.12)}{310} = 1.6 \text{ hr}$$

D = .05 hr

t_p = .6

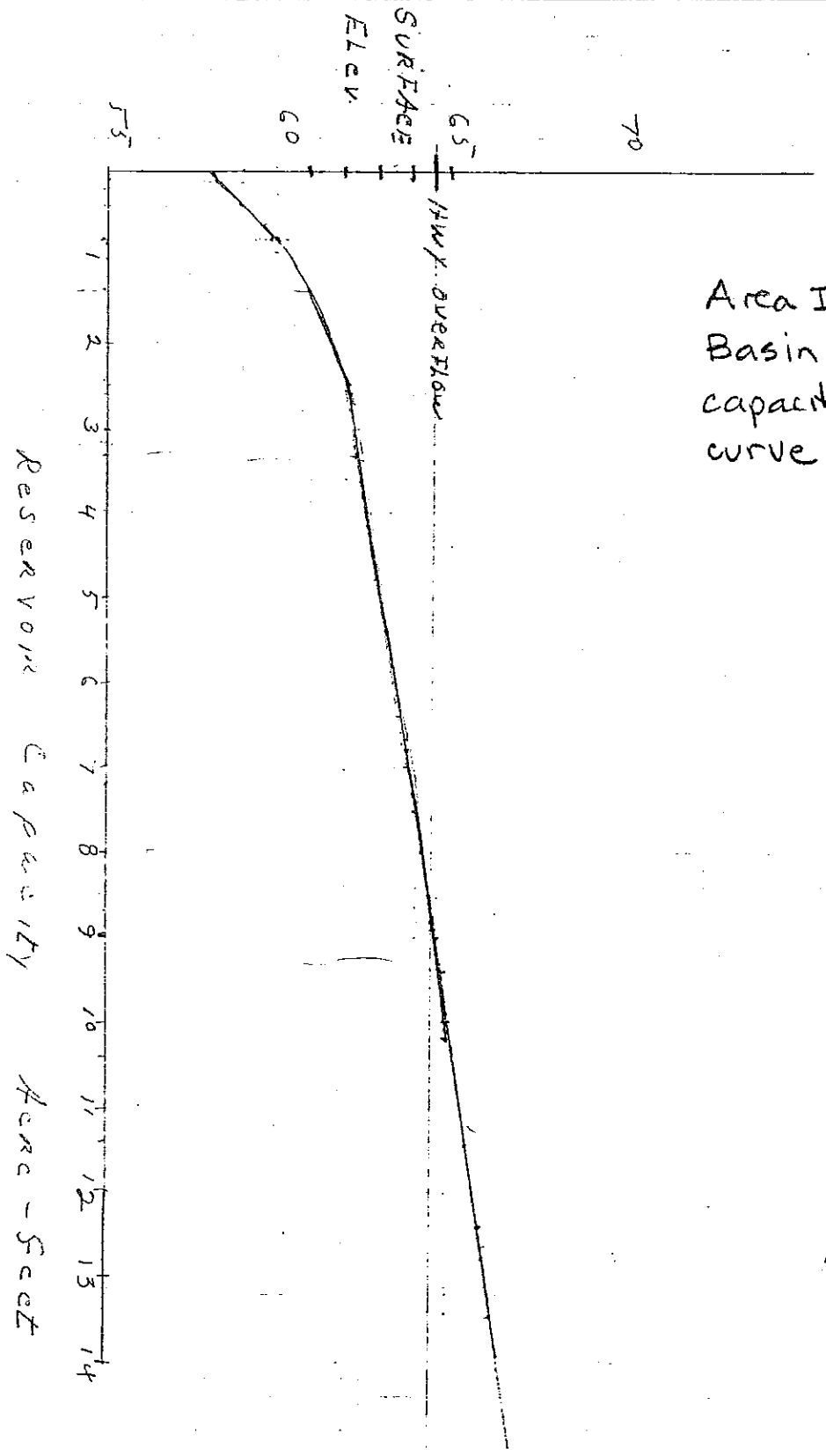
5yr Q = .34

$$q = 810\left(\frac{218.9}{640}\right) .34 = 94 \text{ cfs}$$

$$t_b = \frac{1290}{640} \times \frac{218.9(.34)}{94} \; 1.6$$

Project | Job No

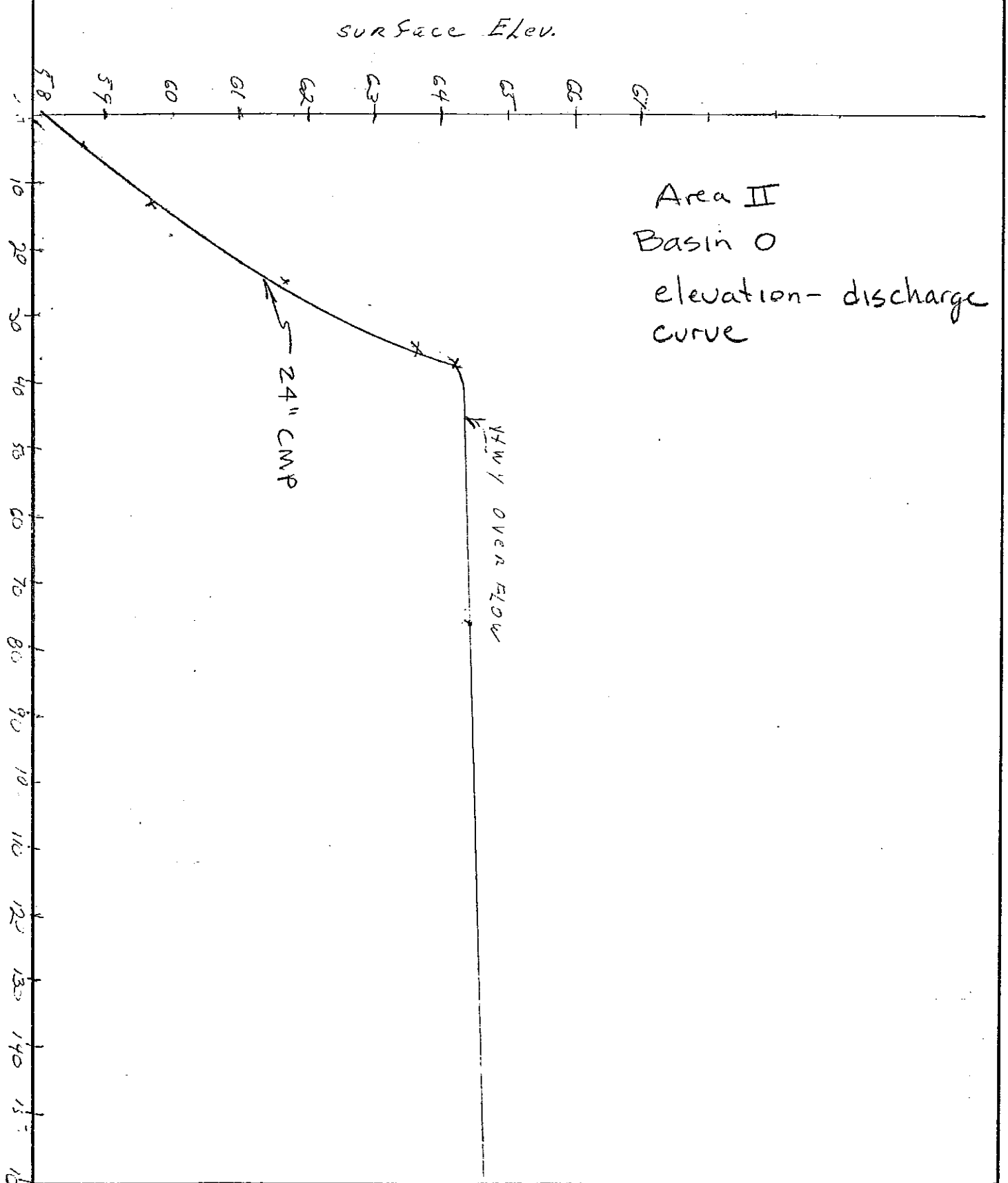
Client | By | Date



Area II
Basin O
capacity-elev.
curve

Project | Job Nº

Client | By | Date



Area II
Basin O
elevation- discharge curve

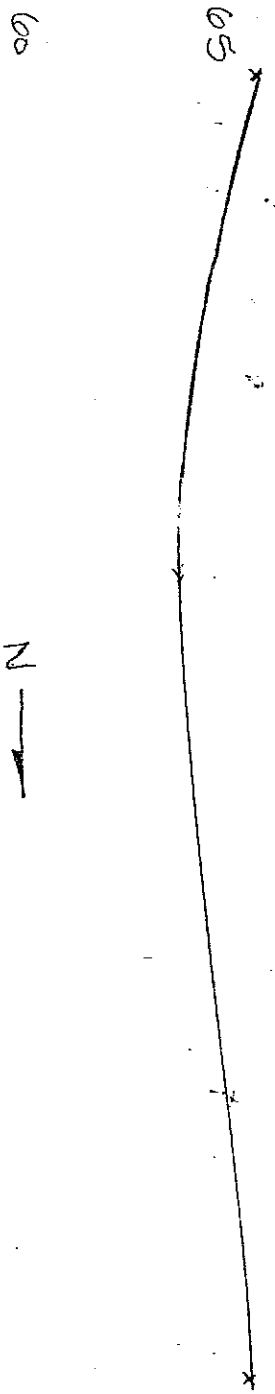
discharge

35

Project: Master Drainage study | Job No: E-2551

Client: Gates | By: BNW | Date: 4/30/82

Area II
Basin O



Profile along Hwy 115

Scale 1"=100' horiz
1" = 5' vert

N

Project: Master Drainage Study | Job No: [illegible]551

Client: Gates | By: DMW | Date: 5/3/82

Area II - Basin O

outlet from detention pond

at el 65.0

$Q = 456$ (over road) $+ 39$ c/s (pipe) $= 495$ c/s

at el 64.7

over road $Q = C L H^{3/2} + C Z H^{5/2}$ $C = 2.6$

$Q_{Total} = 137 + 37 = 174$ c/s

at el 64.5

$Q_{Total} = 24 + 13 + 37 = 74$ c/s

Project: [illegible] drainage plan

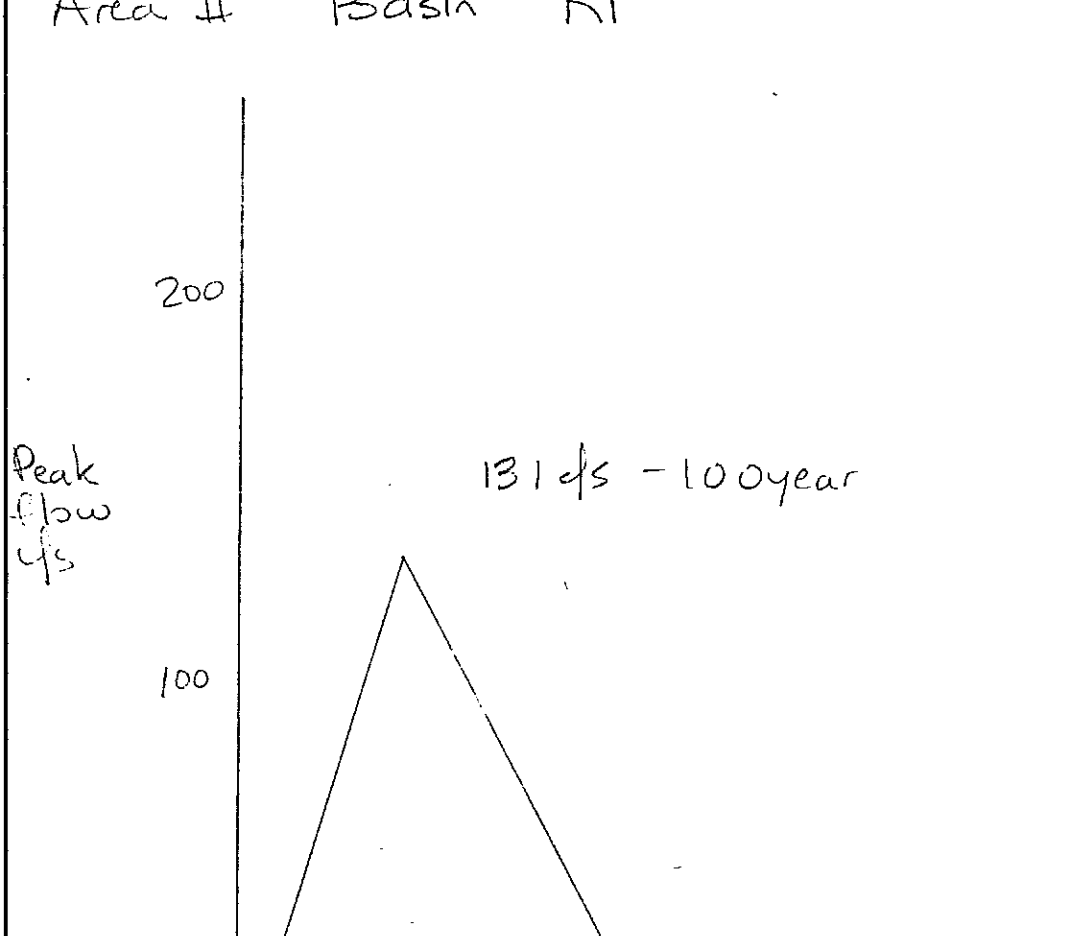
Job Nº: E-2551

Client: Gates

By: BNW

Date: 4/28/82

Area II Basin K1



Project: Master Drainage Plan | Job No: E-251

Client: Gates | By: BNW | Date:

Area K1 to Tenderfoot Hill Rd

62 Ac

Soil Group	Ac Acre	Use	CN	%	Product
B	24	Open Space	65	39	25.4
B	38	mixed (use)	78	61	47.6
	62				73.0

Q = .37-5yr Q = 1.18-100yr

T_c = .15 hr

L = 9500' S = 10%

H = 100'

T_c = .07 hr - travel time add 5min flow to channel

q_p = 1150 csm

$q = \frac{1150(62)}{640} 1.18 = 131$ cfs

$t_b = \frac{1290(1.18)62}{640(131)} = 1.1$ hr

t_p = .42 hr

D = .02 hr

Project: Master Drainage Study | Job No: E-2551

Client: Gates | By: BNW | Date: 5/5/82

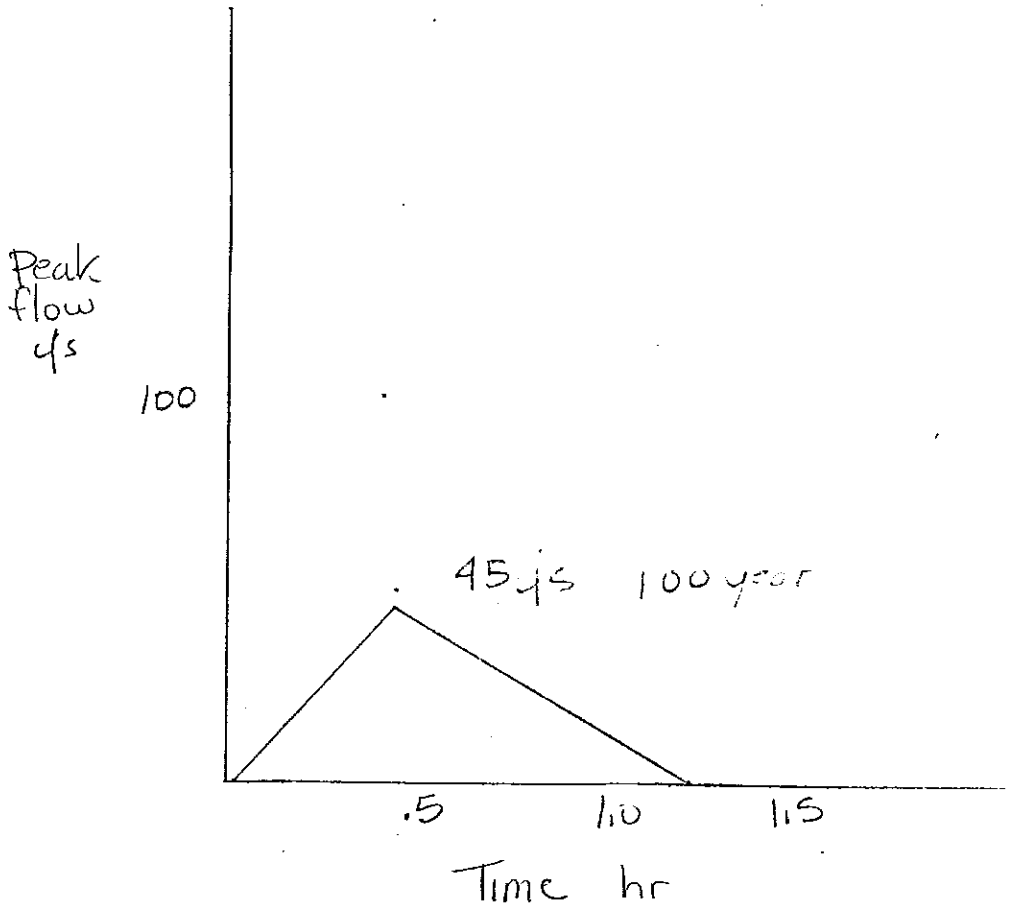
Area II Basin K1
Pond uphill of Tenderfoot Hill Road

Contour el	Area Ac	Volume Ac ft	Outflow cfs 72" CMP
5980	0	0	0
5984	.5	0.67	100
5986	.751	1.17	195
5988	1.11	1.91	290
5990	1.40	2.64	350
5992	1.76	4.01	400
5994	2.23	5.50	450
5996	2.52	7.38	500

Project: Master Drainage Study | Job No.

Client: Gates | By: BNW | Date: 4/29/82

Area II Basin K2



Project: Master ... Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/28/82

Area II Basin K2

A = 25 Ac

Soil Group	Ac Acre	Use	CN	%	Product
B	17	Open Space	65	68	44.2
B	8	Multi F.	85	32	27.2
	25				71.4

Q 5 year = .30" Q 100yr = 1.05"

Tc = .17 hr

qp = 1100 cfm/in

$q = \frac{25}{640}(1100)1.05 = 45$ cfs

$t_L = \frac{1200(25)1.05}{640(45)} = 1.2$ hr

tp = .44 hr

D = .02 hr

L = 1350'

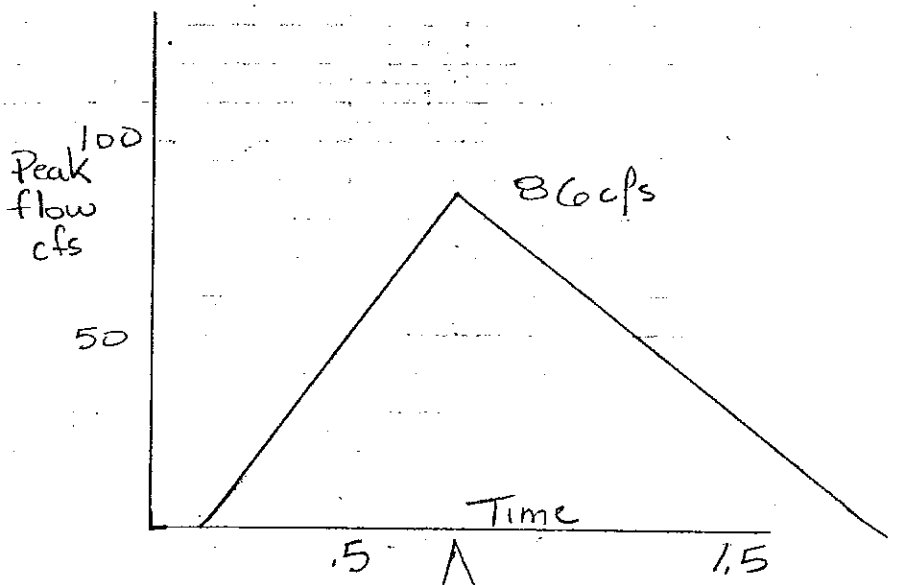
H = 5886 − 5837 = 51

travel time Tc = .12 hr

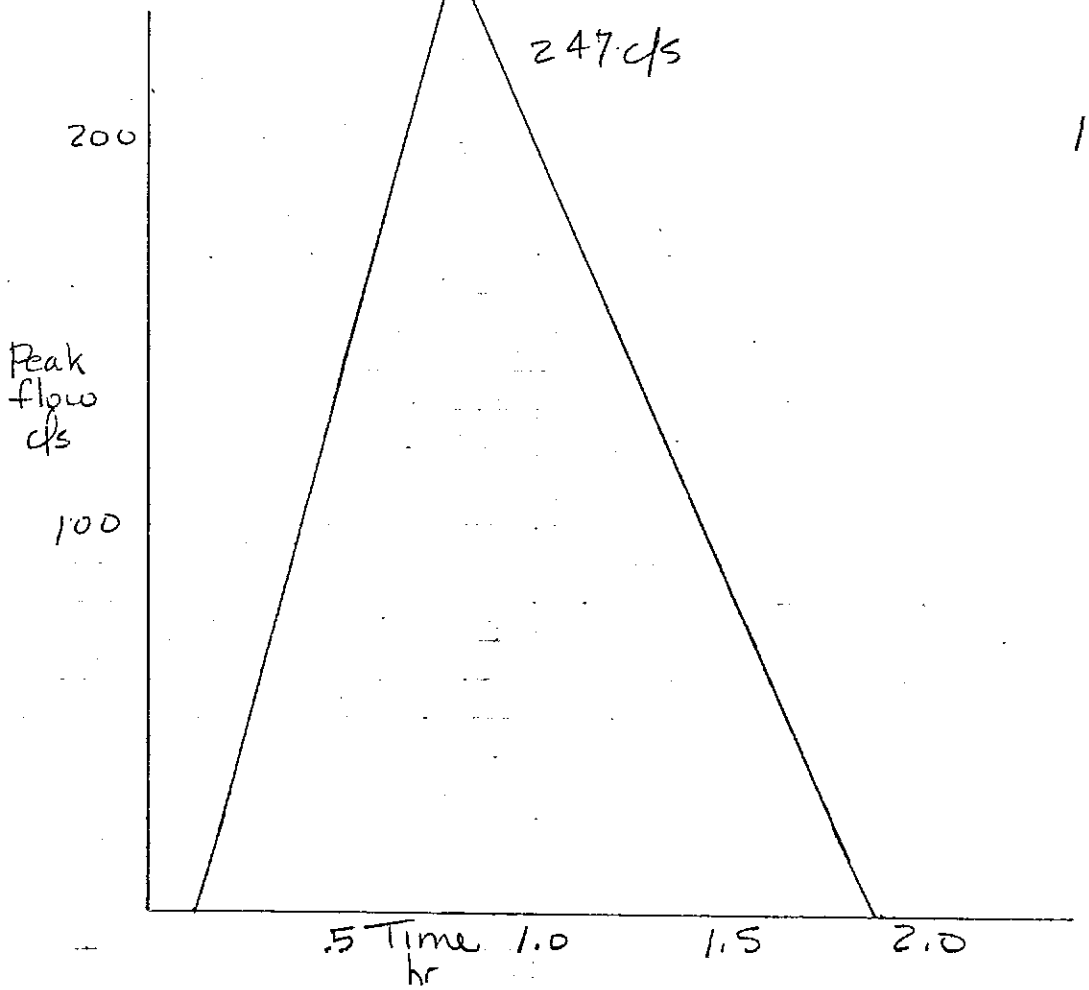
time to main channel 400' @ 2.5 fps = 3 min

Project: Master Drainage Study — Job No: E-25[illegible]1

Client: Gates - Area II N & J — By: BNW — Date: 4/14/82



5yr



100 year

Project: Master Drainage Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/13/82

Area II

Peak flow for Basin N + J

$A = 163$ Ac

$CN = 75.7$

$Tc = 31$ min $= .52$ hr $\Rightarrow P = 720$ csm/in

$Q = .47$ in 5yr storm

$Q = 1.35$ in 100 yr storm

$q_{p_{5yr}} = \frac{163}{640}(.47)(720) = 86$ cfs

$q_{p_{100yr}} = \frac{163}{640}(1.35)720 = 247$ cfs

$5yr\ tb = \frac{163(.47)1290}{(640)\ 86} = 1.8$ hr 5yr

$tp = .7$ hr $\quad D = .07$ hr

$100yr\ tb = \frac{163(1.35)1290}{640 \times 2.47} = 1.8$ hr

Project: Master Drainage Study | Job No: E-2551

Client: Gates | By: BNW | Date: 4/13/82

Area II Basin N

Total A = 77 Ac

Soil Group	(Ac.) Area	Use	CN	%	Product
B	5.8	Comm.	92	8	7.4
B	8.8	Multi Family	85	11	9.4
B	62.4	1/2 Ac	70	81	56.7
Total	77				73.5

T_c = 800' sheet Flow @ 2% (1.5 fps) + st 3% (4 fps) 1100' + inlet/pipe
9 + 5 + 2

+ 700' st. 2% (4 fps) + pipe/inlet 700' 2% (10 fps) = 21 min = .35 hr
+ 3 + 2

Q = 870 csm/in

P 5yr = .38 in
P 100yr = 1.21 in

q_p 5yr = .38 (870) 77/640 = 40 c/s

q_p 100yr = 1.21 (870) 77/640 = 126 c/s

Project: Master Drainage Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/13/82

Area II Basin J

A = 86 Ac

Soil Group	Ac Acre	Use	CN	%	Product
B	9.2	Comm	92	11	10.1
B	11	Multi Family	85	13	11.1
B	13	Multi Family	85	15	12.8
B	26.7	Open Space	65	31	20.2
B	18.4	1/8 Ac S.F.	78	21	16.4
B	7.7	1/8 Ac SF	78	9	7
					77.6

T_c = 700' 54" RCP @ 2.6% (fps) / inlet + + 3 min

3405' @ (8 fps)
7 min

T_c = 10 min

5:1

S = 3.6%
S 1/2 = .19
n = 0.035
@ D = 2'
Q = 176 cfs
V = 8

Project: Master Drainage Study

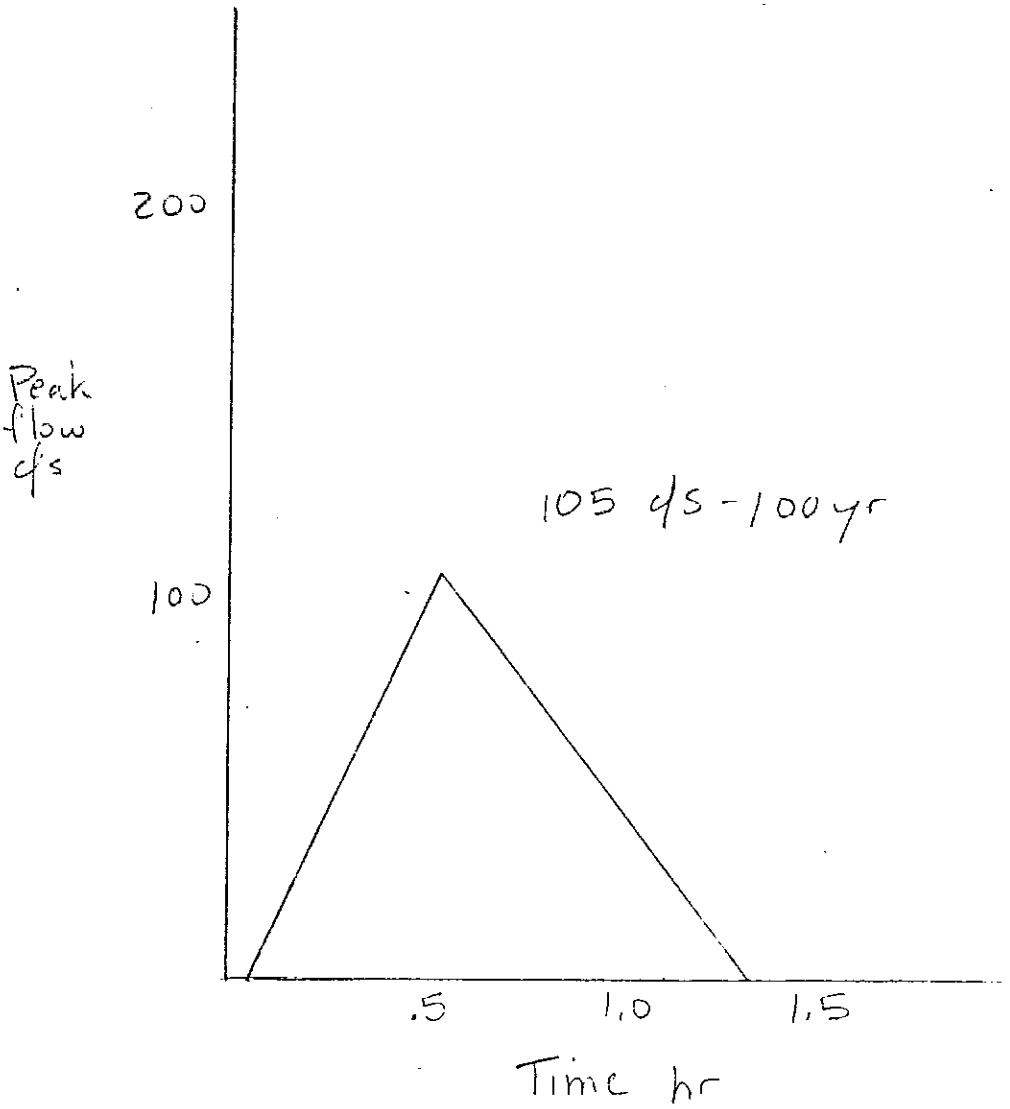
Job No:

Client: Gates

By: BNW

Date: 4/28/92

Area II Basin E



Project: [illegible] Drainage Study — Job No. E-255 1

Client: Gates — By: BNW — Date: 4/20/82

Area II Basin E

A = 50 Ac

Soil Group	Ac Acre	Use	CN	%	Product
B	10.2	Comm.	92	.21	19.3
B	9.9	Multi Family	85	.20	17.0
B	2.0	misc. bldg	98	.04	3.9
B	27.8	open space	65	.55	35.8
	50				76

Q = (100 YR) = 1.36 "

T_c = .26

q_p = 990 csm/in

$Q = \frac{1.36(50)\ 990}{640} = 105$ cfs

$t_c = \frac{1290(1.36)50}{105(640)} = 1.3$ hr

t_p = .49 hr

D = .03 hr

L = 1800'

H = 40'

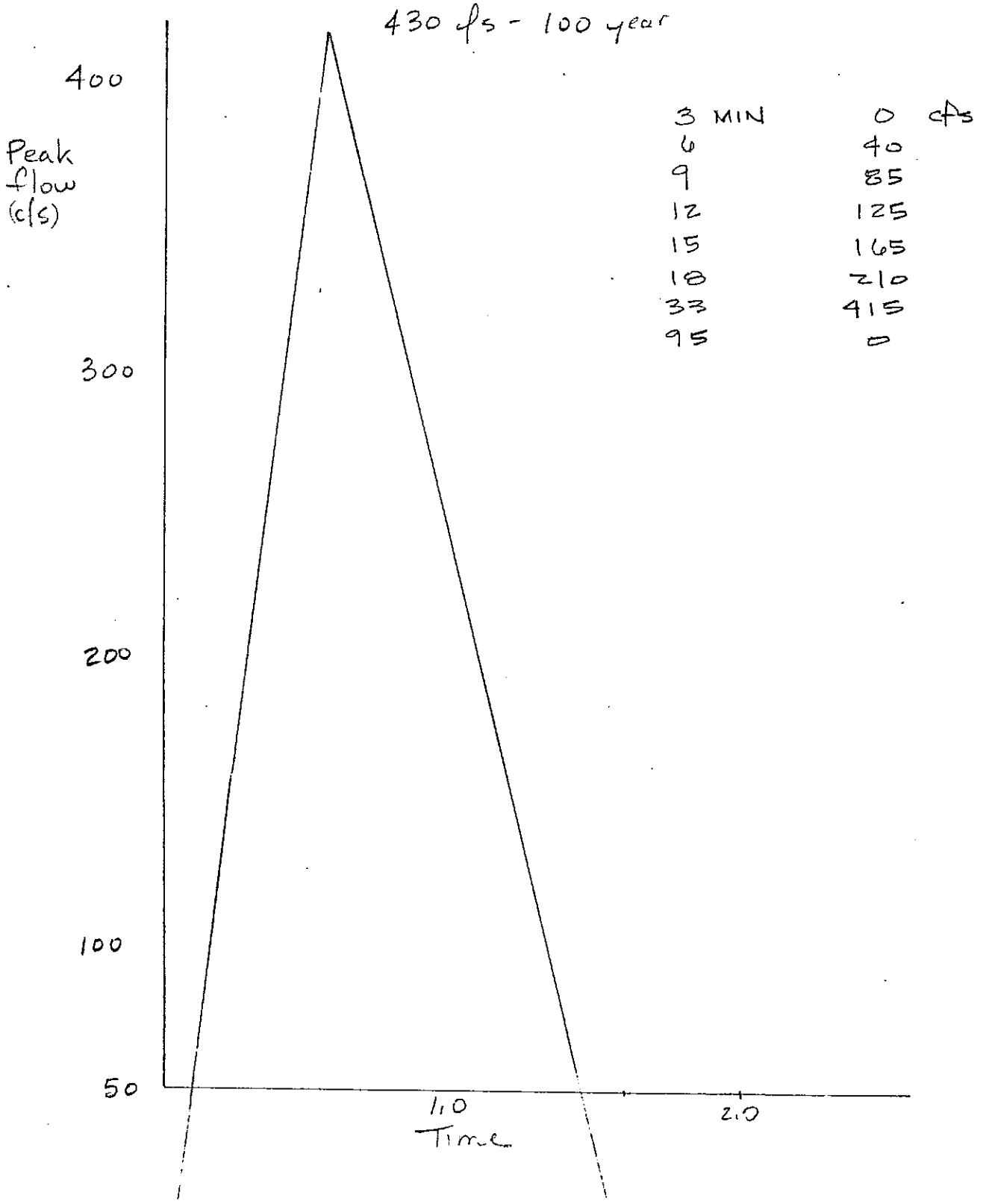
T_{travel} = .18 hr

800' - 10% = 5 min time to channel

DREXEL, BARRELL & CO. LAND SURVEYORS CIVIL ENGINEERS

Project: Master Drainage Study — Job No: E-2[illegible]

Client: Gates — Area II, Basin J, M, L — By: BNW — Date: 4/29/82



3 MIN	0 cfs
6	40
9	85
12	125
15	165
18	210
33	415
95	0

Project: Master Drainage Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/20/82

Area II Basin I, M, L Quail Lake

Area = 177 Ac

Soil Group	Area Ac	Use	CN	%	Product
B	18.3	Quail Lake	98	10	9.8
B	115.	1/5 Ac S.F	78	65	50.7
B	23.5	Multi Family	85	13	11.1
B	20.2	Park	69	12	8.3
					79.9

$Q = (100\%)\ 1.64$ csm/in

$T_c = 17$ min $= .28$ hr

$q_p = 950$ csm/in

$q = \frac{1.64(950)177}{640}$

$q = 430$ cfs

$t_b = \frac{1290(177)1.64}{640(430)}$

$t_b = 1.4$ hr

$t_p = .5$

$I = .04$

650 c/ 21"-27" RCP @ 6%
ref HP File No. 53 B5
chey. mnt Blvd
260' c/ 33" RCP @ 3.3%

560 c/ 45" RCP @ 1.3%
1470 @ 15 fps ⇒ 2 min

1600' = L H = 40'
st. flow @ 6 fps ⇒ 5 min
add 1 min inlet time
5 min flow to st

Project: Master Drainage Study

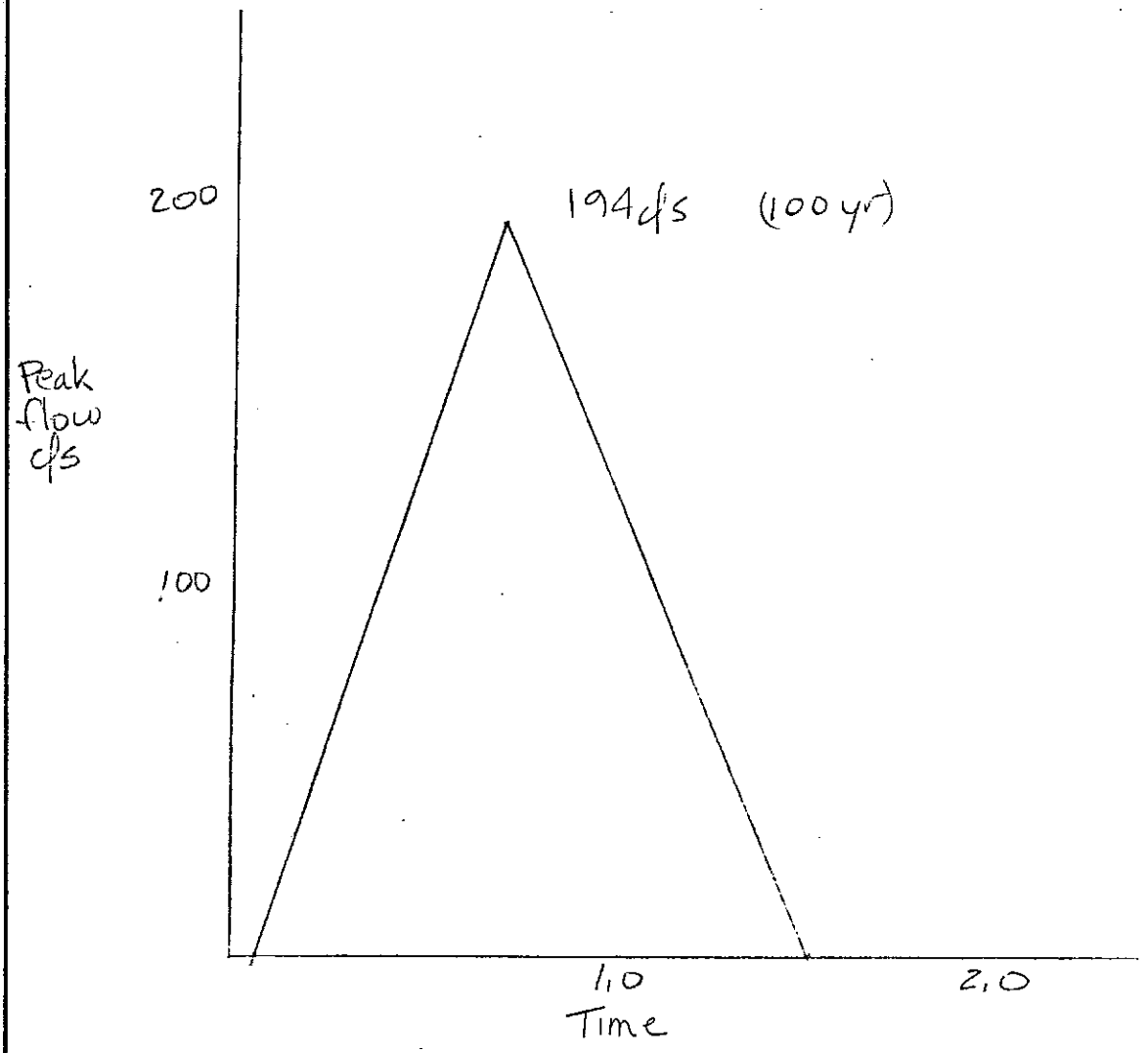
Job No: [illegible]

Client: Gates

By: BNW

Date: 4/30/82

Area II Basin C



Project: Master Drainage Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/20/81

Area II Basin C

A = 123

Soil Group	(Ac) Area	Use	CN	%	Product
B	34	office	92	27.6	25.4
B	15	1/5 Ac. S.F	78	12.2	9.5
A	4.4	1/5 Ac S.F	65	3.6.	2.3
A	7.7	multi family	77	6.3	4.9
B	14.3	multi Family	85	11.6	9.9
A	7.3	Park	49	5.9	2.9
B	40.3	Park	69	32.8	22.6
					77.5

Q = 100 yr 1.33 "

Tc = .47 hr

qp = 760 cfs/in

$Q = \frac{1.33(123)760}{640}$

Q = 194 cfs

$t_b = \frac{1290}{640}\frac{(123)}{(194)}(1.33)$

t_b = 1.7 hr

t_p = .64 hr

D = .06

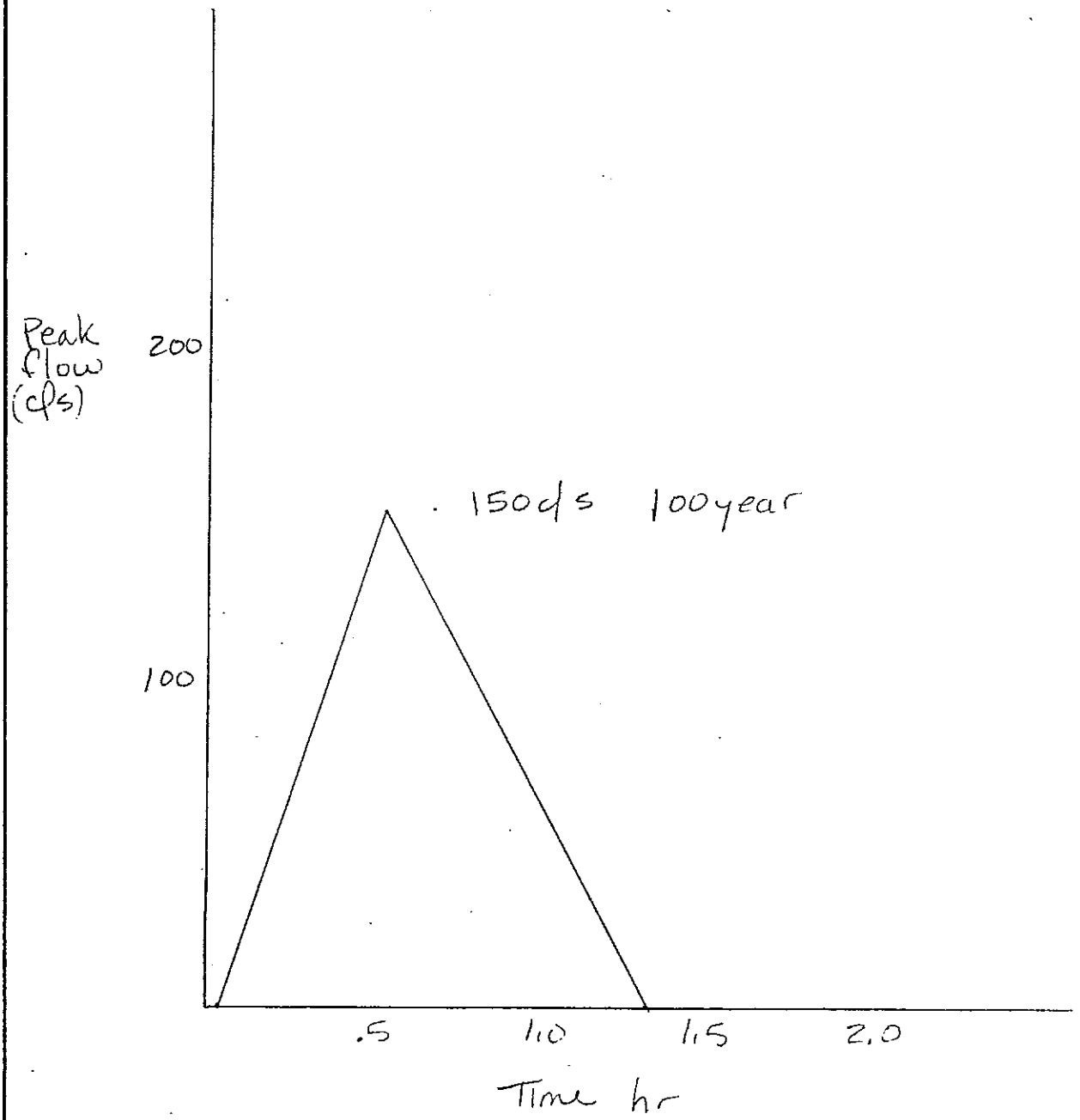
H = 5912 - 5883 = 29'
L = 2000' ⇒ .2hr

H = 5960 - 5912 = 48'
L = 1000' ⇒ .09 hr
+ 2min pipe: inlet to swale
+ t. flow
L = 1100' @ 6%
12 fps 2min
L = 650' @ 2.5%
6 fps 2min
overland 300' @ 3%
5min

*Travel time to Quail Lake
.2 hr from above
+ [6'=H L=300] .05
= .25 hr

Project: Master Drainage Study
Job No.:
Client: Gates
By: BNW
Date: 4/27/82

Area II Basin D



Project: Master Drainage Study — Job No: E-2551

Client: Gates — By: BNW — Date: 4/27/82

Area II Basin D

Area = 51 Ac

Soil Group	Ac Area	Use	CN	%	Product
B	41	office industrial	88	80	70.4
B	10	Open	65	20	13
					83.4

Q_{100yr} = 1.88 in

Tc = .25 hr

C_p = 1000 cfs/in

$q = \frac{1000(51)1.88}{640(10)}$

q = 150 cfs

ck Tc for 100 yr - OK

$t_b = \frac{1290(51)1.88}{640(150)} = 1.3$ hr

D = .03 hr

t_p = .5

el 6030 - 5990 = 40' } natural channel
L = 1200
Tc = .12 hr

5yr 12 fps } 24" RCP avg S = 2.5% 900' = L
Tc = .02 hr

5yr 15 fps } 24" RCP avg S = 5% 1127 = L
Tc = .02 hr
add 5 min - inlet, bends

100yr el 5990 - 5964 = 26'
L = 550'
Tc = .06 hr

100yr 7 fps } paved road 3.5%
L = 400'
Tc = .02 hr

100yr 12 fps } Chey. Mnt 1127' = L 5%
Tc = .03

Tc = .23 hr (100 Yr)

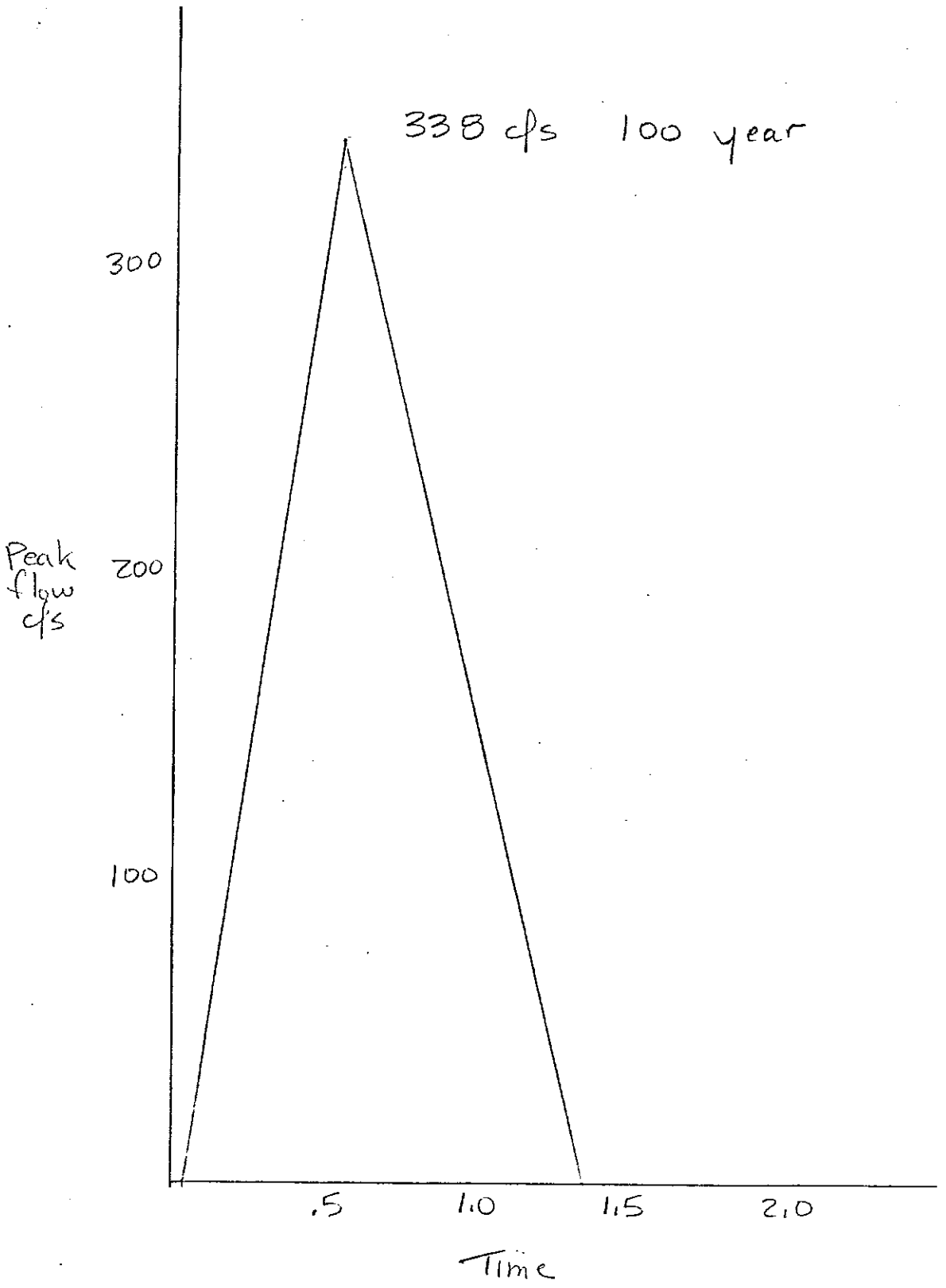
Project: Master Drainage Study

Job No

Client: Gates Area II Stratmoor Hills

By: BIII

Date: 4/27/82



Project	Job N°
Master Drainage Study	E-2551

Client	By	Date
Gates	BNW	4/23/82

Area II Basin "Stratmoor Hills"

A = 214 Ac - Soil group B

½ Ac lots CN = 70

Q = 1.01 100 year storm

Tc = .25 hr L = 3500' H = 160' natural channel flow

q_p = 1000 csm/in

$q = 1000\ (1.01)\ \frac{214}{640} = 338$ cfs

$t_b = \frac{214(1290)(1.01)}{640\ (335)} = 1.3$

$t_p = .48$

D = .03

DREXEL, BARRELL & CO.

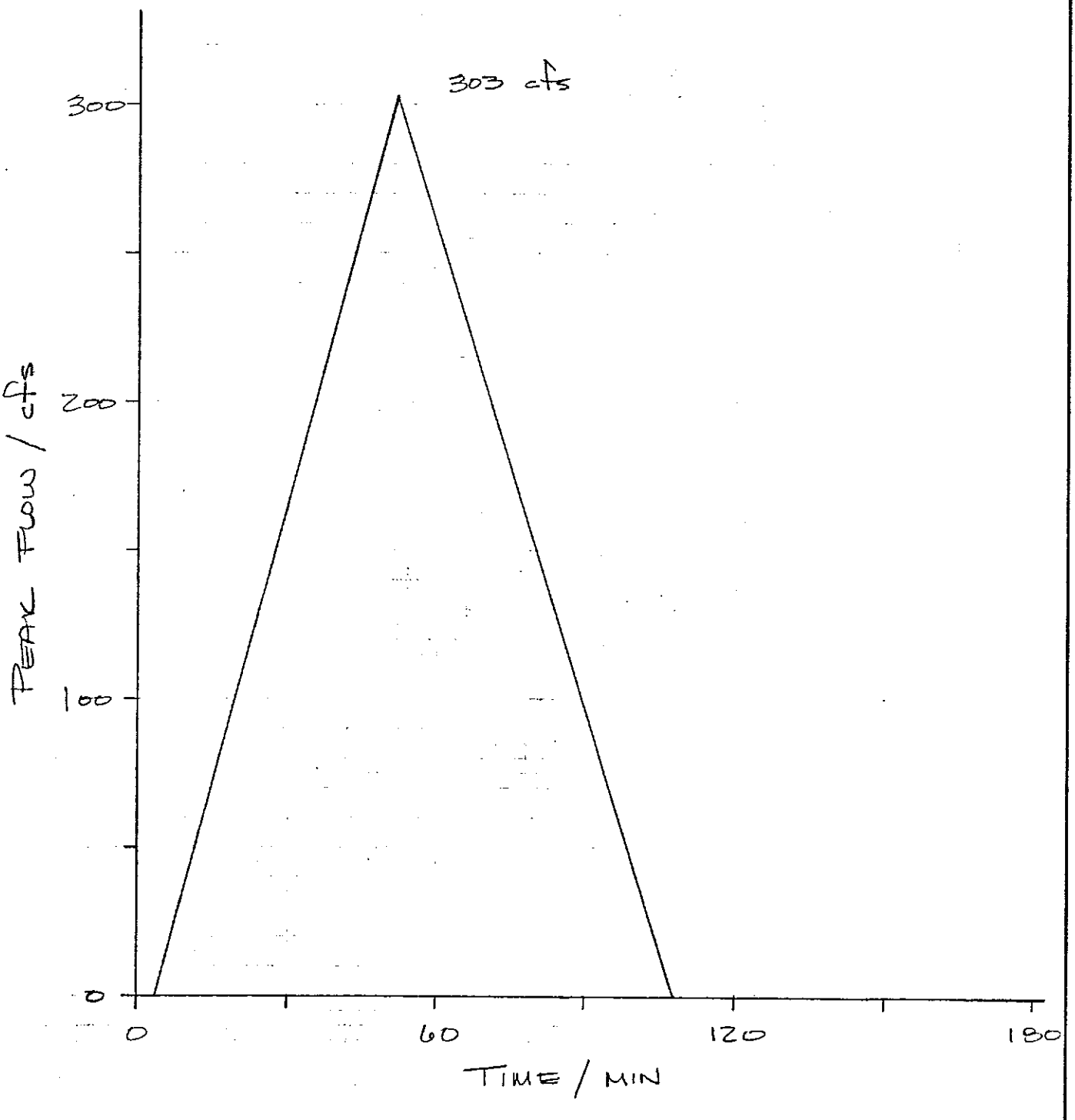
LAND SURVEYORS
CIVIL ENGINEERS

Project	Job No
MASTER DRAINAGE STUDY	E 2551

Client	By	Date
GATES	MH	7 MAY, 82

AREA II BASIN T

100 YR



Project	Job No
MASTER DRAINAGE STUDY	E 2551

Client	By	Date
GATES	MH	7 MAY 82

AREA II BASIN T

$A = 111$ Ac

$C_N = 89$

$T_c = 29$ MIN $\longrightarrow$ P = 740 csm/in

$Q_5 = 1.12$ in $Q_{100} = 2.36$ in

$$q_5 = 740\left(\frac{111}{640}\right)1.12 = 144 \text{ cfs}$$

$$q_{100} = 740\left(\frac{111}{640}\right)2.36 = 303 \text{ cfs}$$

$$t_{b_5} = \frac{111\,(1.12)\,1290}{(640)(144)} = 1.74 \text{ hr} = 104 \text{ min}$$

$$t_{b_{100}} = \frac{111\,(2.36)\,1290}{(640)(303)} = 1.74 \text{ hr} = 104 \text{ min}$$

$D = 0.06$ hr $\quad t_p = 0.7$

DREXEL, BARRELL & CO. LAND SURVEYORS CIVIL ENGINEERS

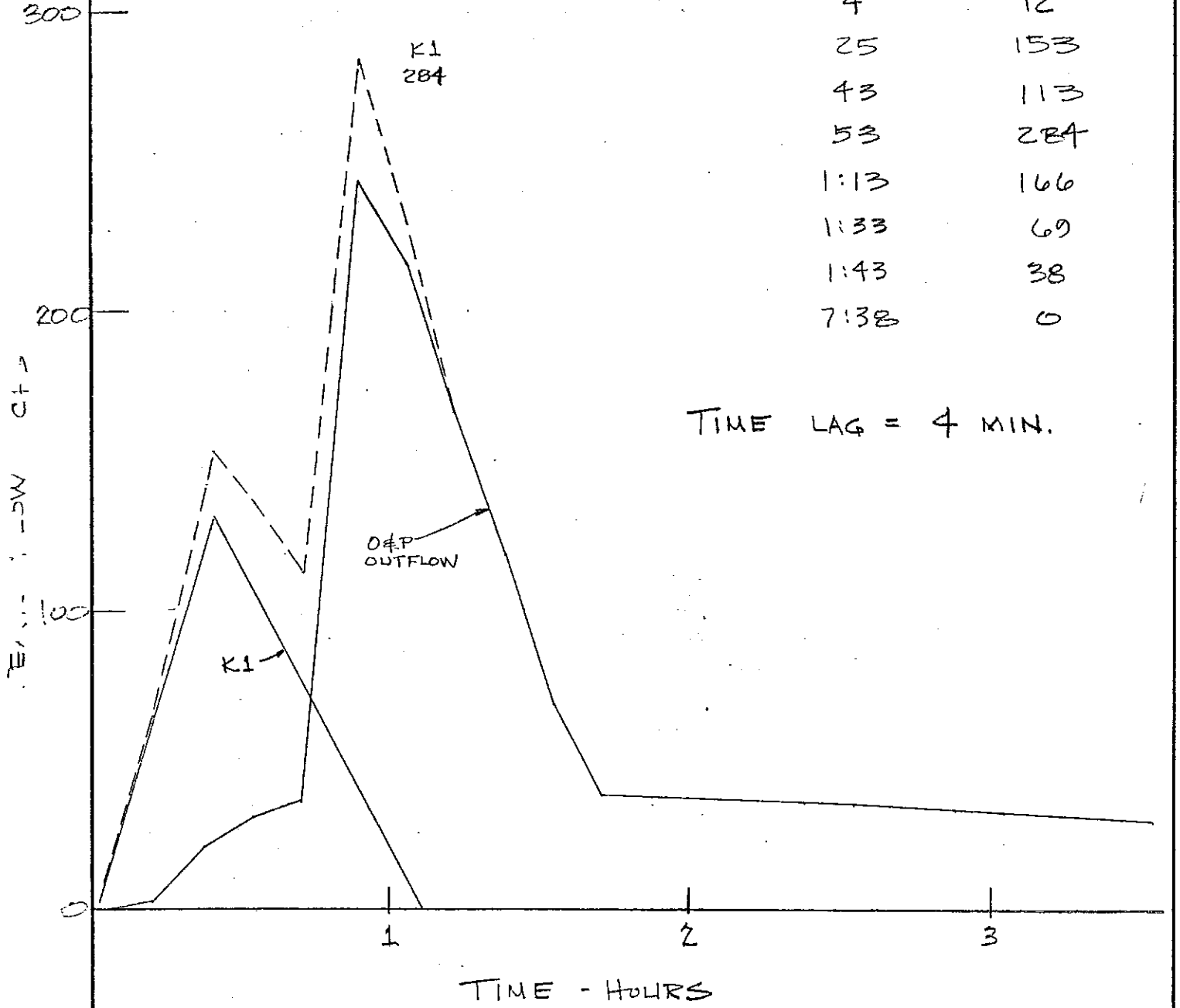
Project	Job No.
MASTER DRAINAGE STUDY	E 2551

Client	By	Date
GATES	MH	5 MAY 82

COMBINED INFLOW HYDROGRAPH FOR AREA II CONCENTRATION POINT K1 PLUS BASINS O&P

0 MIN	0 cfs
1	0
4	12
25	153
43	113
53	284
1:13	166
1:33	69
1:43	38
7:38	0

TIME LAG = 4 MIN.



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3405 N. EL PASO STREET (303) 633-5029

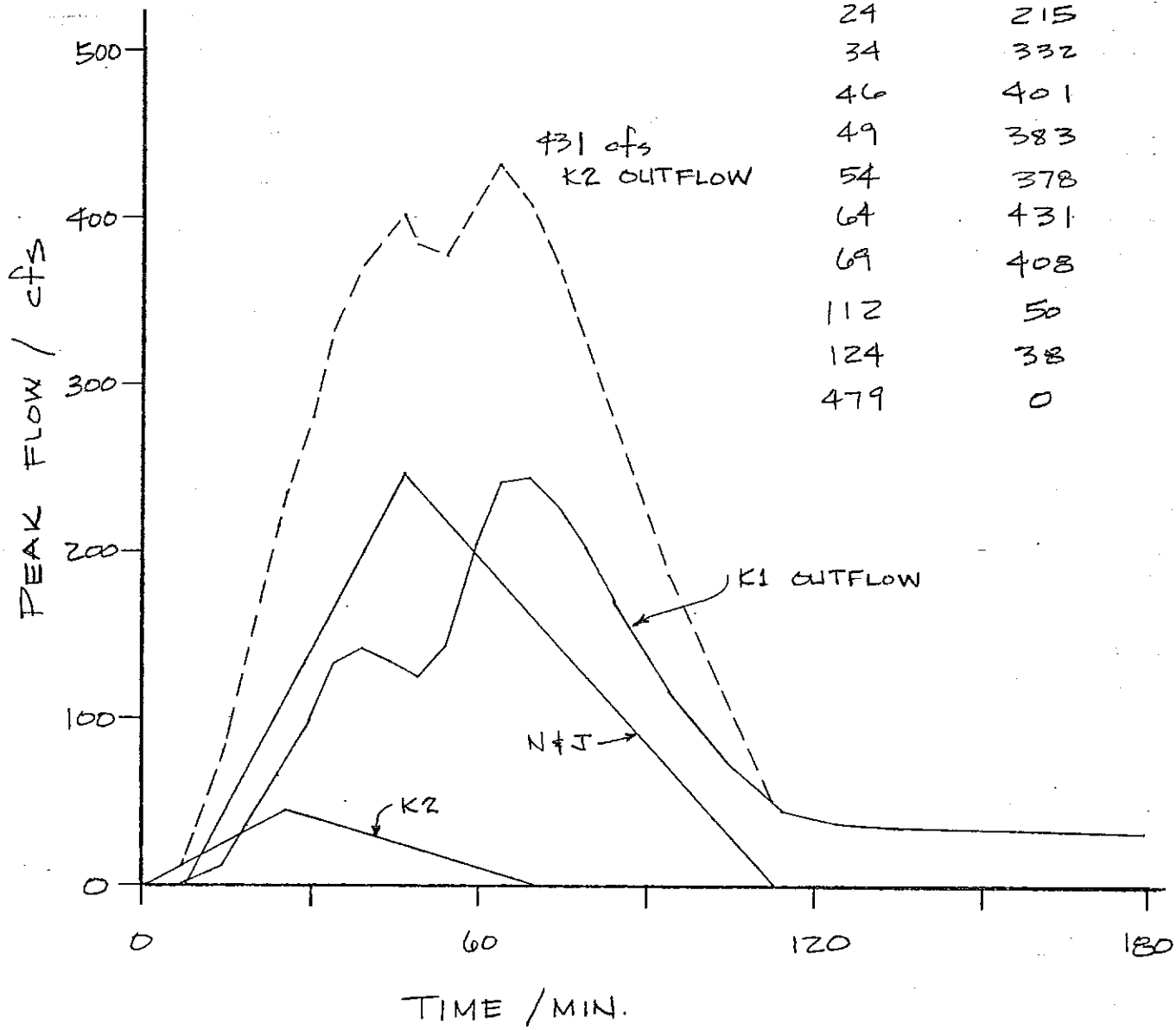
DREXEL, BARRELL & CO. LAND SURVEYORS CIVIL ENGINEERS

Project	Job Nº
MASTER DRAINAGE STUDY	E 2551

Client	By	Date
GATES	MH	6 MAY 82

AREA II BASINS K2, K1, N&J

1 MIN	0 cfs
7	11
9	30
12	58
15	88
18	130
24	215
34	332
46	401
49	383
54	378
64	431
69	408
112	50
124	38
479	0



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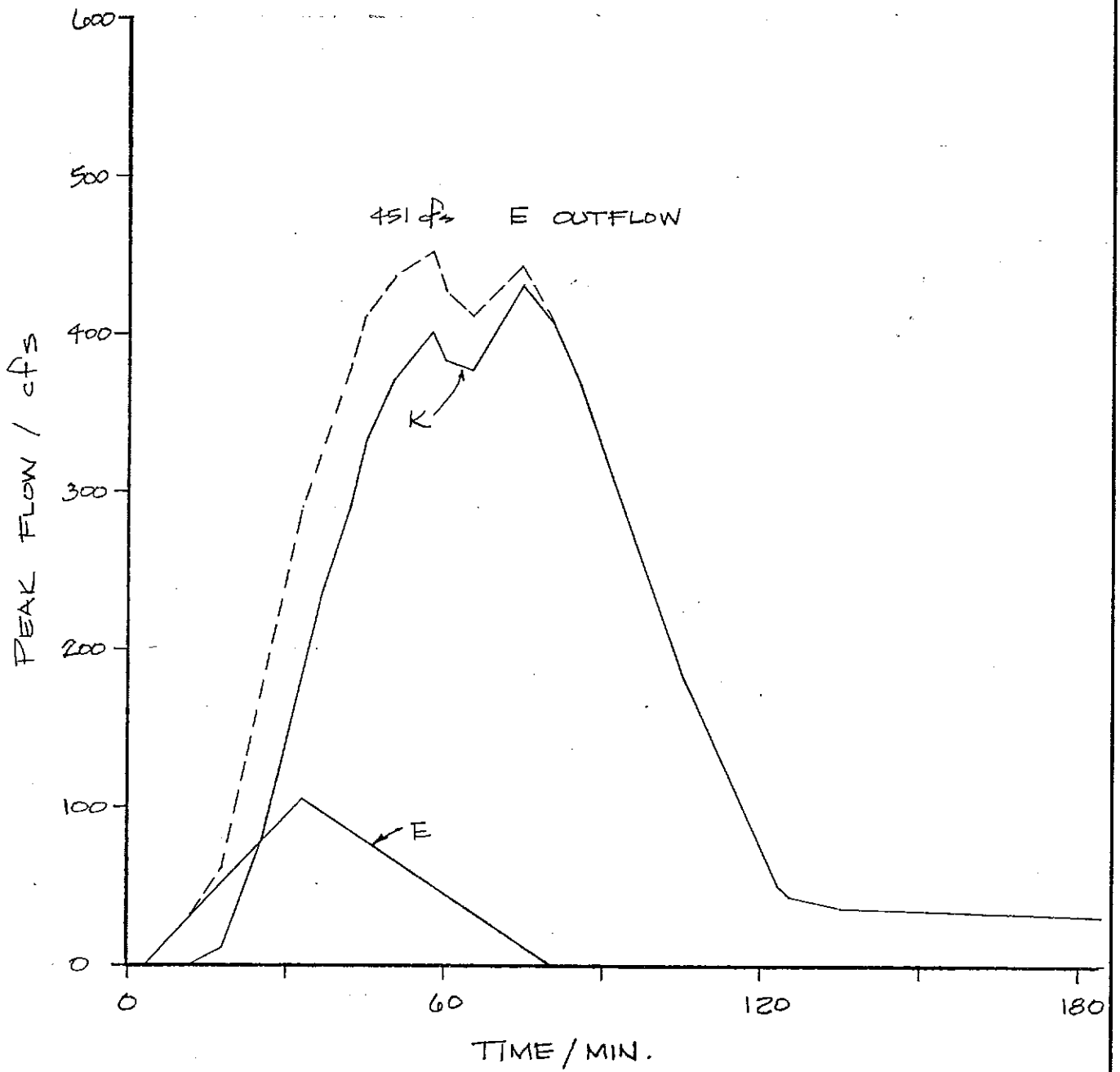
Project	Job Nº
MASTER DRAINAGE PLAN	E 2551

Client	By	Date
GATES	MH	7 MAY 82

AREA II BASINS K & E



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BOULDER, COLORADO 80301

3405 N. EL PASO STREET (303) 633-5029
COLORADO SPRINGS, COLORADO 80907

DREXEL, BARRELL & CO.
LAND SURVEYORS
CIVIL ENGINEERS

Project: MASTER DRAINAGE PLAN

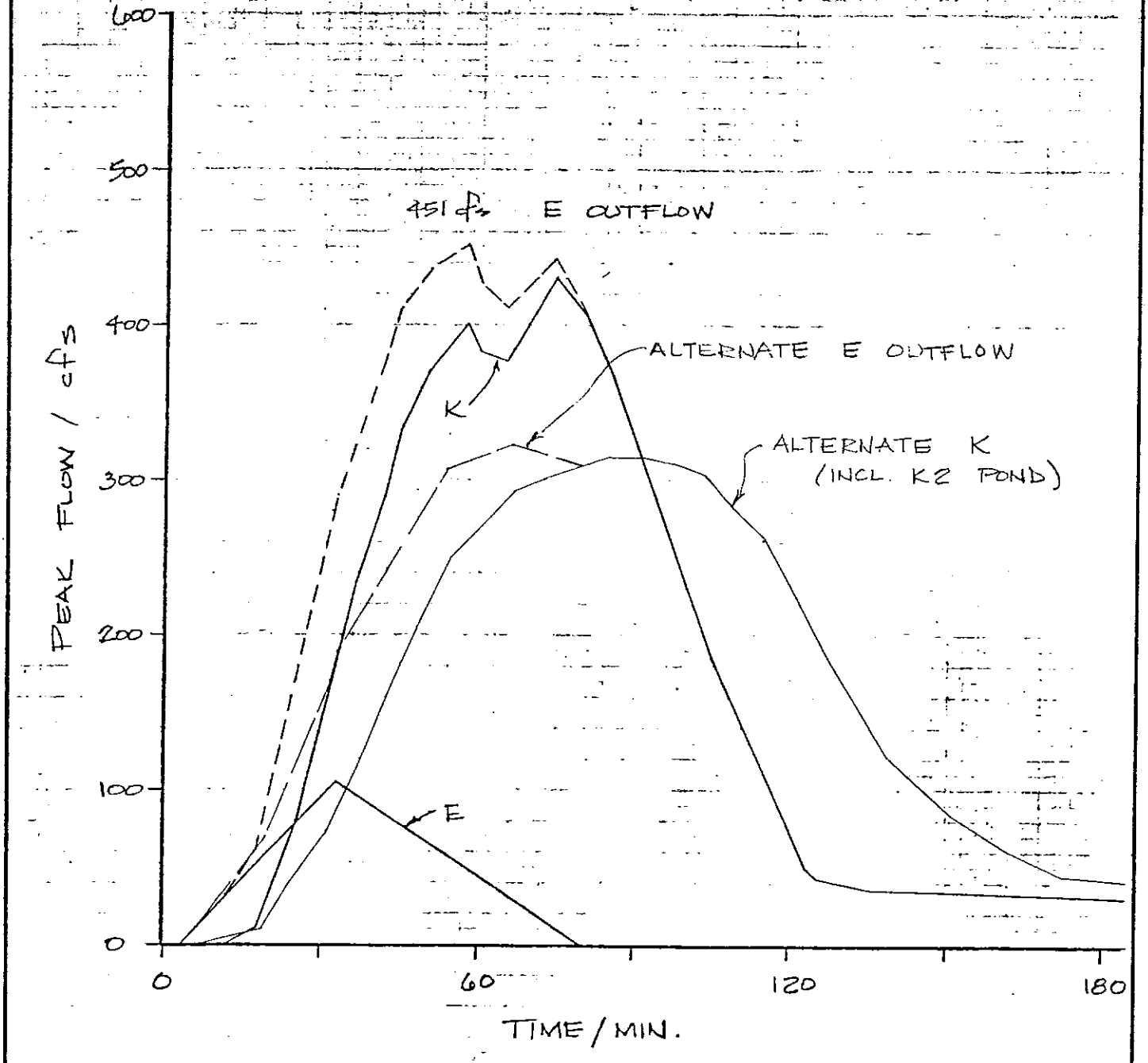
Job No: E 2551

Client: GATES

By: MH

Date: 7 May 82

AREA II BASINS K & E



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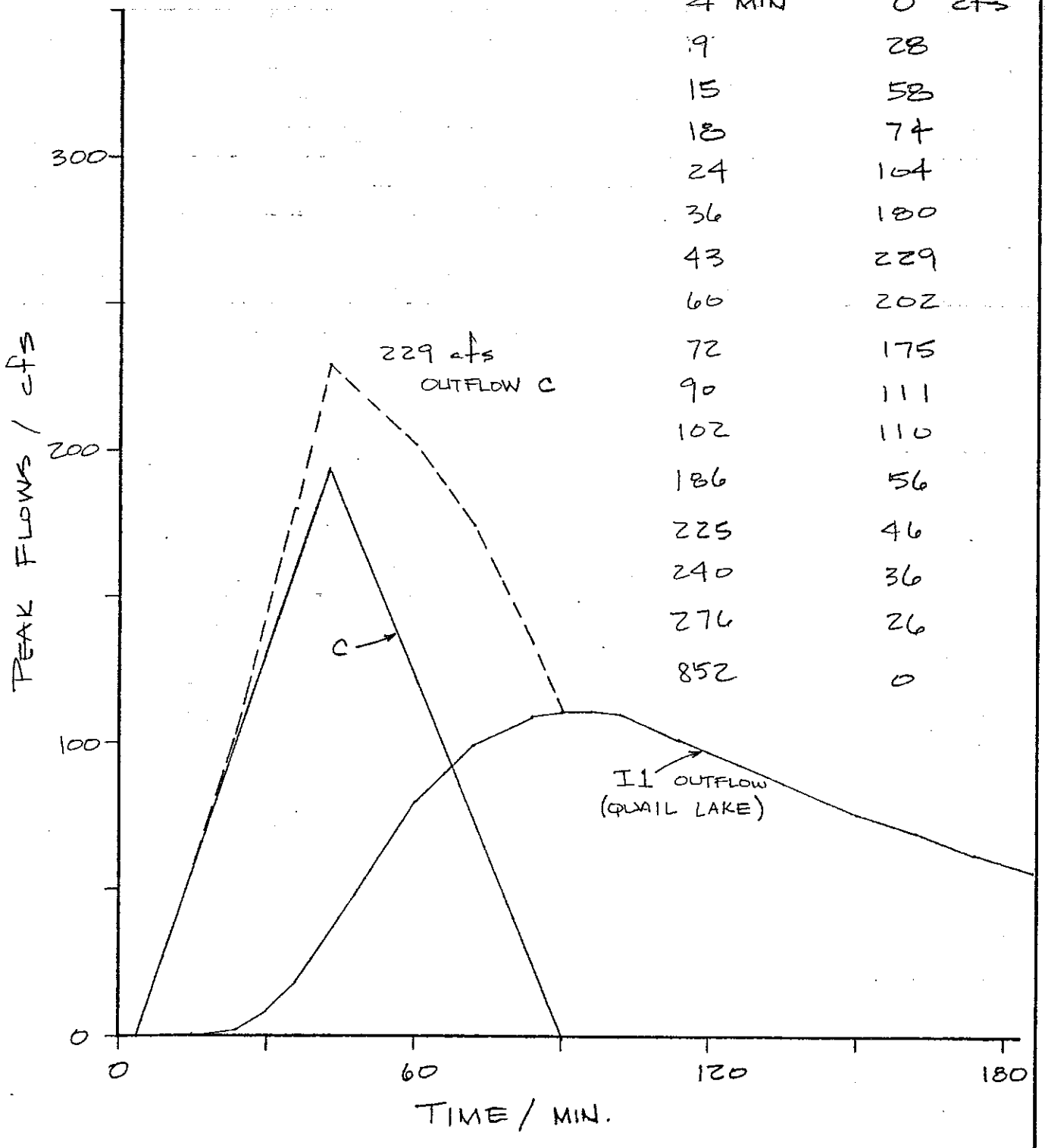
Project: MASTER DRAINAGE STUDY — Job No. E 2551

Client: GATES — By: MH — Date: 6 MAY 82

AREA II BASIN C & I1 (QUAIL LAKE)

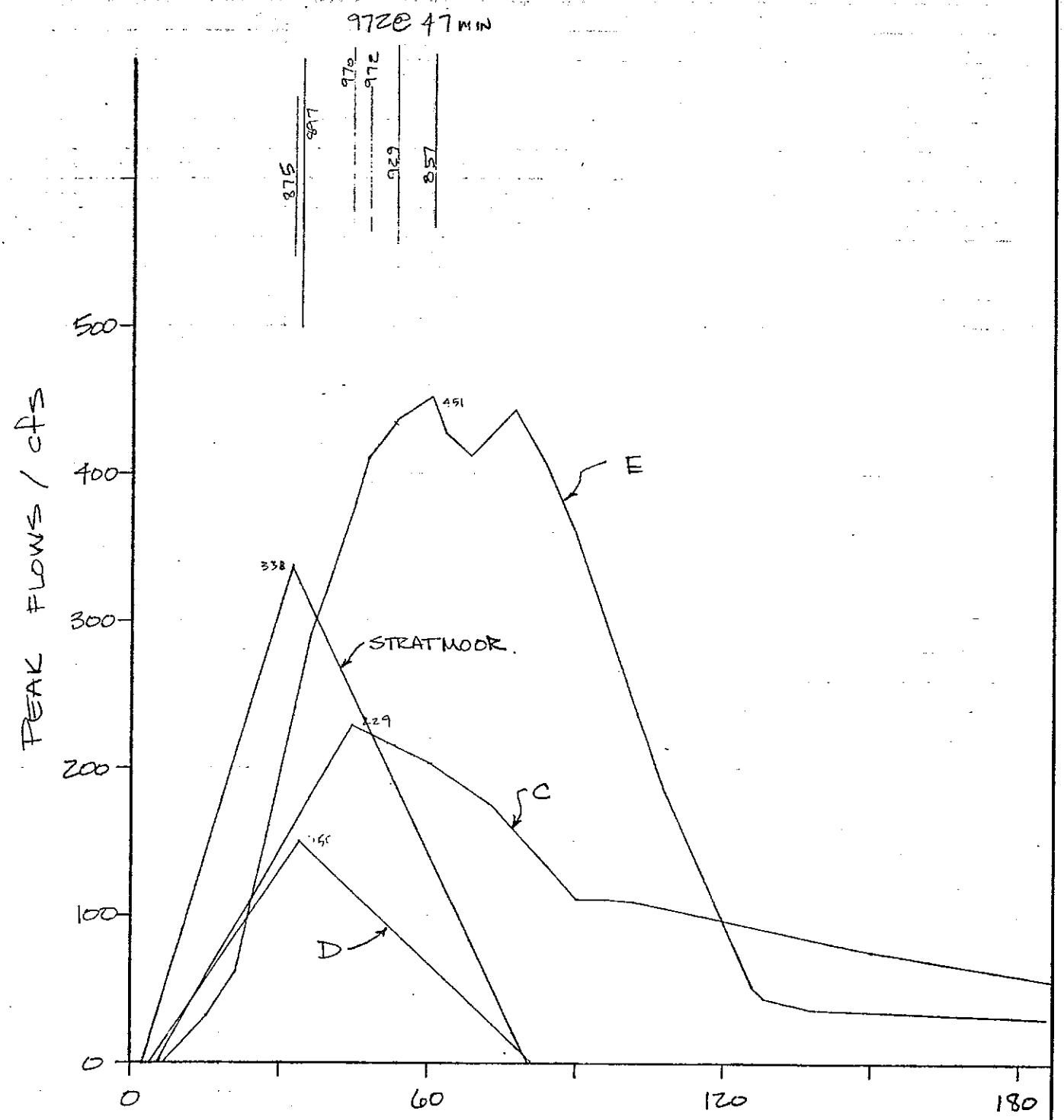


4 MIN	0 cfs
9	28
15	58
18	74
24	104
36	180
43	229
60	202
72	175
90	111
102	110
186	56
225	46
240	36
276	26
852	0

Project: MASTER DRAINAGE STUDY | Job No E 2551

Client: GATES | By: MH | Date: 7 MAY 82

AREA II BASINS - STRATMOOR HILLS, C, D & E.



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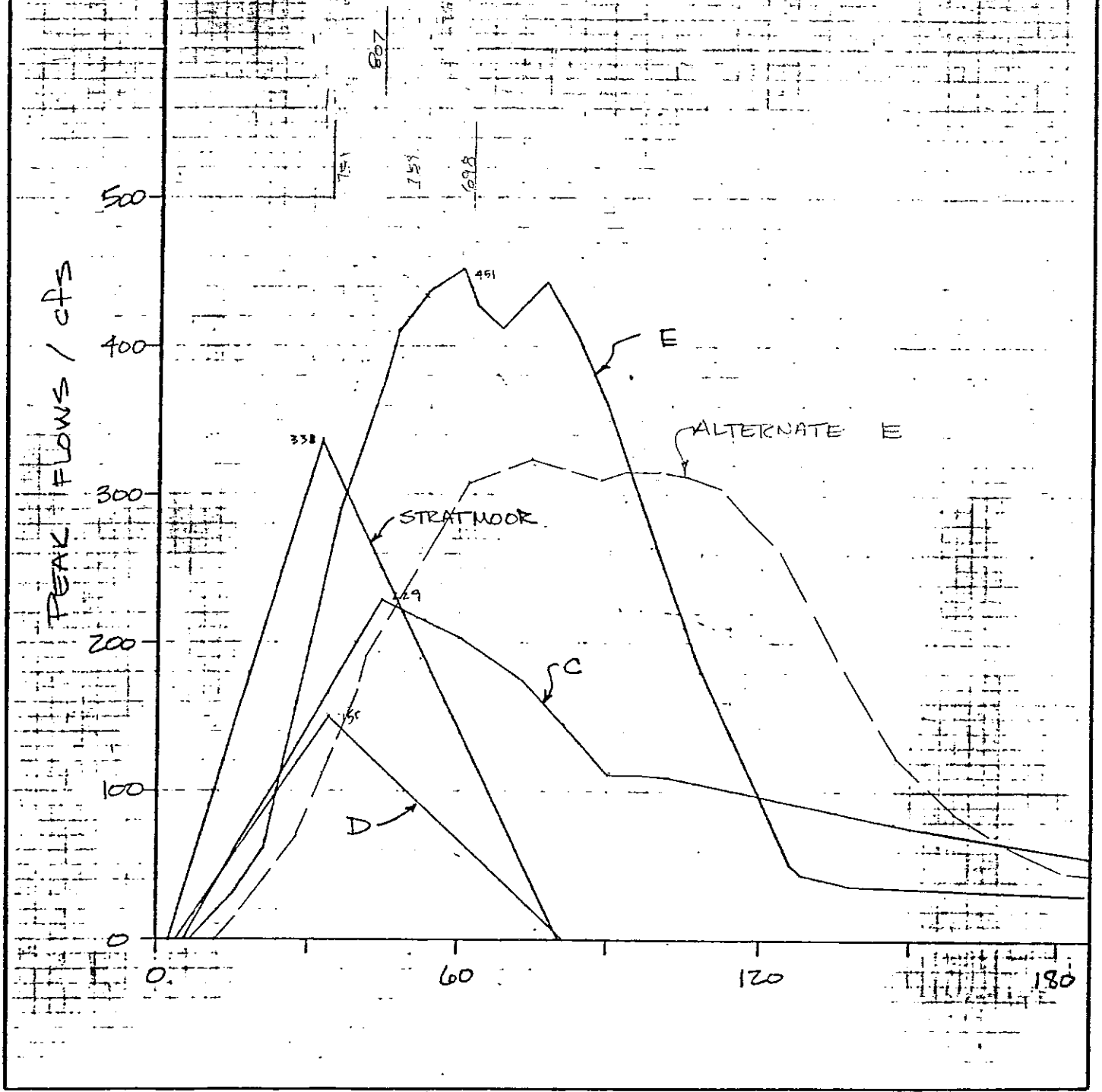
LAND SURVEYORS
CIVIL ENGINEERS

Project: MASTER DRAINAGE STUDY
Job No: E 2551
Client: GATES
By: MH
Date: 7 MAY 82

AREA II BASINS - STRATMOOR HILLS, C, D & E (ALTERNATE)

807 @ 44 MIN



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Project: MASTER DRAINAGE STUDY

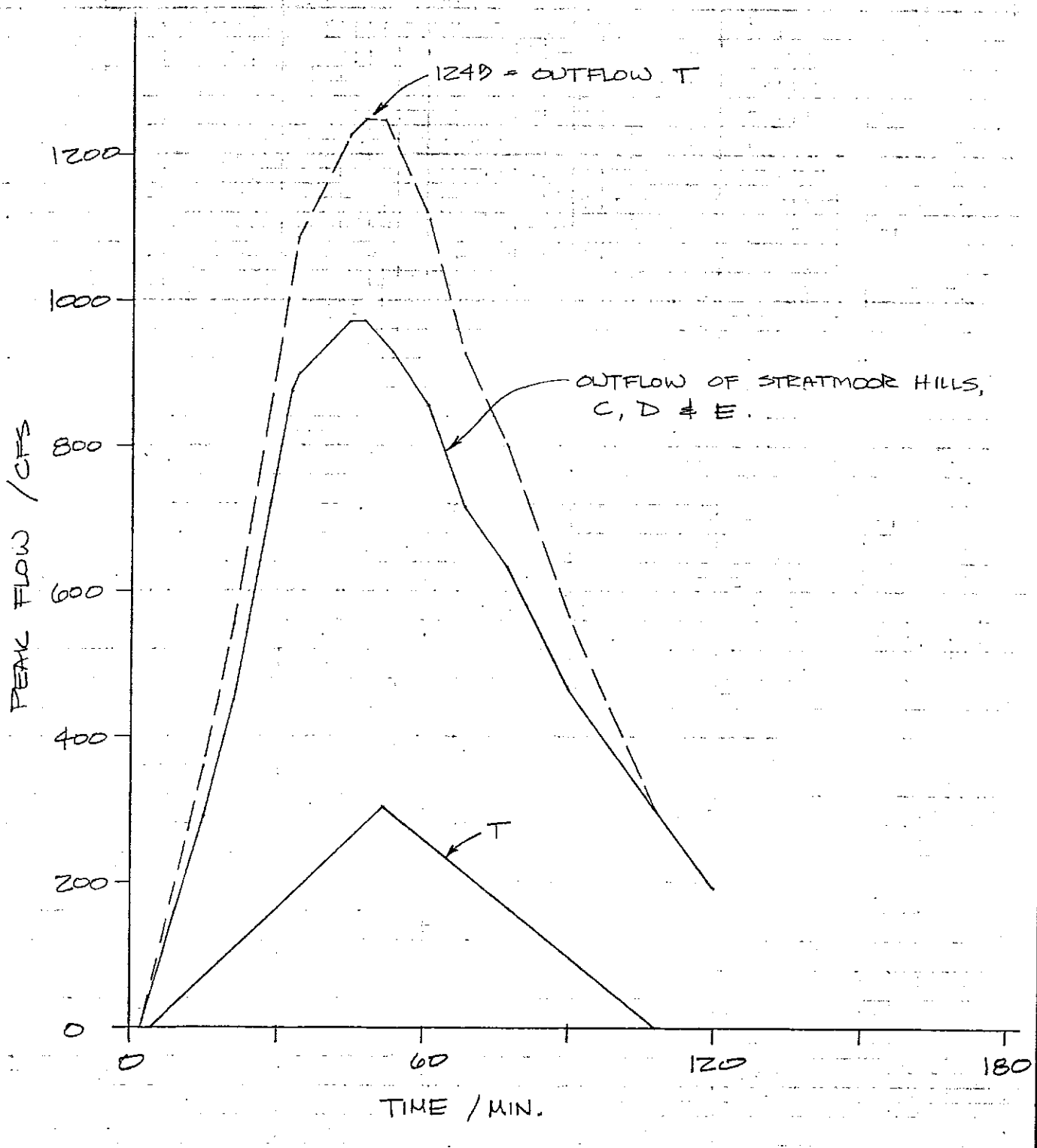
Job No: E 2551

Client:

By: MH

Date: 7 MAY 82

AREA II COMBINED OUTFLOW



Project: MASTER DRAINAGE STUDY

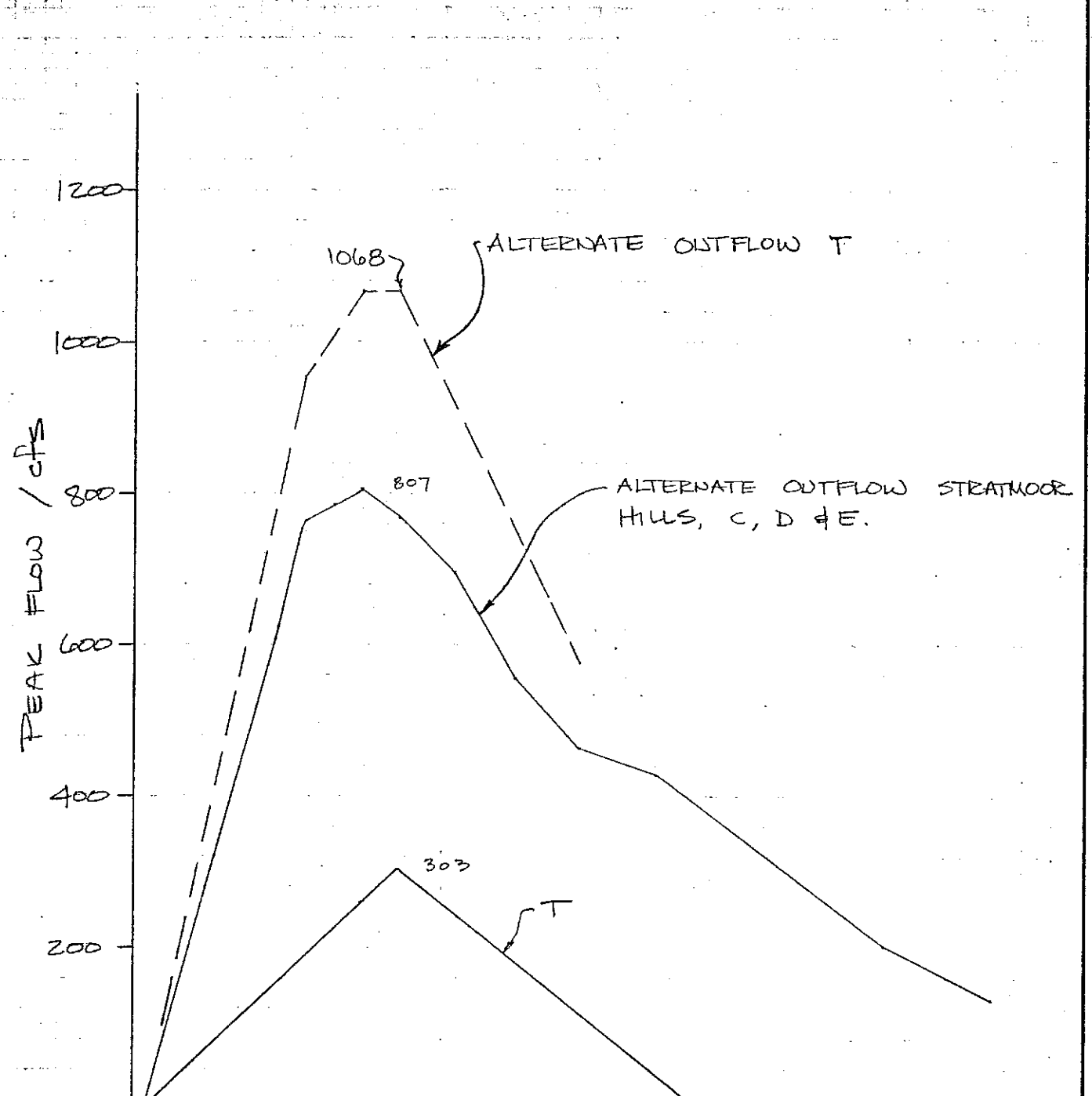
Job No. E 2551

Client:

By: MH

Date: 18 JUNE 82

AREA ALTERNATE COMBINED OUTFLOW



ROUTING OF HYDROGRAPH # 1

Date 5/6/82

Pond File : AREA2I1P

Description :

QUAIL LAKE

Number	Elevation	Storage	Outflow
1	970.00	0.000	0.00
2	971.00	15.000	92.00
3	972.00	40.000	227.00
4	973.00	69.000	360.00
5	974.00	90.000	520.00
6	975.00	127.000	915.00
7	975.50	147.000	1160.00

Routing of Hydrograph # 1

Description of hydrograph : Page 1

Area = 1.00 ac. Rational 'C' = .## Time of Concent. = 1 min.
Storm frequency, years = 0

Hydrograph # 6 - total outflow hydrograph
Description :
QUAIL LAKE

Date 5/6/82

Inflow H'graph:

Time hr:min	Inflow cfs	Storage ac ft	Elevation feet	Outflow cfs (Tot)
4:51.0	0.00	3.3318	970.22	20.44
4:57.0	0.00	3.1671	970.21	19.43
5:03.0	0.00	3.0106	970.20	18.46
5:09.0	0.00	2.8617	970.19	17.55
5:15.0	0.00	2.7203	970.18	16.68
5:21.0	0.00	2.5858	970.17	15.86
5:27.0	0.00	2.4580	970.16	15.08
5:33.0	0.00	2.3364	970.16	14.33
5:39.0	0.00	2.2209	970.15	13.62
5:45.0	0.00	2.1111	970.14	12.95
5:51.0	0.00	2.0068	970.13	12.31
5:57.0	0.00	1.9076	970.13	11.70
6:03.0	0.00	1.8133	970.12	11.12
6:09.0	0.00	1.7236	970.11	10.57
6:15.0	0.00	1.6384	970.11	10.05
6:21.0	0.00	1.5574	970.10	9.55
6:27.0	0.00	1.4804	970.10	9.08
6:33.0	0.00	1.4072	970.09	8.63
6:39.0	0.00	1.3377	970.09	8.20
6:45.0	0.00	1.2715	970.08	7.80
6:51.0	0.00	1.2087	970.08	7.41
6:57.0	0.00	1.1489	970.08	7.05
7:03.0	0.00	1.0921	970.07	6.70
7:09.0	0.00	1.0381	970.07	6.37
7:15.0	0.00	0.9868	970.07	6.05
7:21.0	0.00	0.9380	970.06	5.75
7:27.0	0.00	0.8917	970.06	5.47
7:33.0	0.00	0.8476	970.06	5.20
7:39.0	0.00	0.8057	970.05	4.94
7:45.0	0.00	0.7659	970.05	4.70
7:51.0	0.00	0.7280	970.05	4.47
7:57.0	0.00	0.6920	970.05	4.24
8:03.0	0.00	0.6578	970.04	4.03
8:09.0	0.00	0.6253	970.04	3.84
8:15.0	0.00	0.5944	970.04	3.65
8:21.0	0.00	0.5650	970.04	3.47
8:27.0	0.00	0.5371	970.04	3.29
8:33.0	0.00	0.5105	970.03	3.13
8:39.0	0.00	0.4853	970.03	2.98
8:45.0	0.00	0.4613	970.03	2.83
8:51.0	0.00	0.4385	970.03	2.69
8:57.0	0.00	0.4168	970.03	2.56
9:03.0	0.00	0.3962	970.03	2.43
9:09.0	0.00	0.3766	970.03	2.31
9:15.0	0.00	0.3580	970.02	2.20
9:21.0	0.00	0.3403	970.02	2.09
9:27.0	0.00	0.3235	970.02	1.98
9:33.0	0.00	0.3075	970.02	1.89

3	986.00	1.170	195.00
4	988.00	1.910	290.00
5	990.00	2.840	350.00
6	992.00	4.010	400.00
7	994.00	5.500	450.00
8	996.00	7.380	500.00

Routing of Hydrograph # 1 K1

Description of hydrograph : Page 1

Area = 1.00 ac. Rational 'C' = .## Time of Concent. = 1 min.
Storm frequency, years = 0

K1

Date 5/6/82 Page 2

Inflow H'graph:

Time hr:min	Inflow cfs	Storage ac ft	Elevation feet	Outflow cfs (Tot)
0:00.0	0.00	0.0000	980.00	0.00
0:07.0	33.00	0.0751	980.45	11.20
0:12.0	63.00	0.2425	981.45	36.19
0:17.0	97.67	0.4433	982.65	66.16
0:22.0	132.00	0.6647	983.97	99.21
0:27.0	148.56	0.8361	984.66	131.56
0:32.0	137.44	0.8837	984.85	140.61
0:37.0	126.33	0.8474	984.71	133.71
0:42.0	115.22	0.7936	984.49	123.48
0:47.0	181.40	0.8970	984.91	143.12
0:52.0	266.90	1.2438	986.20	204.47
0:57.0	260.40	1.5264	986.96	240.75
1:02.0	230.90	1.5498	987.03	243.76
1:07.0	201.40	1.4179	986.67	226.83
1:12.0	171.90	1.2260	986.15	202.20
1:17.0	146.60	1.0401	985.48	170.31
1:22.0	122.35	0.8909	984.88	141.96
1:27.0	98.10	0.7587	984.35	116.86
1:32.0	73.85	0.6265	983.74	93.50
1:37.0	56.60	0.4978	982.97	74.30
1:42.0	41.10	0.3820	982.28	57.02
1:47.0	37.57	0.3016	981.80	45.01
1:52.0	37.04	0.2665	981.59	39.78
1:57.0	36.50	0.2528	981.51	37.74
2:02.0	35.97	0.2460	981.47	36.72
2:07.0	35.43	0.2414	981.44	36.03
2:12.0	34.90	0.2374	981.42	35.44
2:17.0	34.36	0.2338	981.40	34.89
2:22.0	33.83	0.2301	981.37	34.35
2:27.0	33.29	0.2265	981.35	33.81
2:32.0	32.75	0.2229	981.33	33.28
2:37.0	32.22	0.2194	981.31	32.74
2:42.0	31.68	0.2158	981.29	32.21
2:47.0	31.15	0.2122	981.27	31.67
2:52.0	30.61	0.2086	981.25	31.13
2:57.0	30.08	0.2050	981.22	30.60
3:02.0	29.54	0.2014	981.20	30.06
3:07.0	29.01	0.1978	981.18	29.53
3:12.0	28.47	0.1943	981.16	28.99
3:17.0	27.94	0.1907	981.14	28.46
3:22.0	27.40	0.1871	981.12	27.92
3:27.0	26.87	0.1835	981.10	27.39
3:32.0	26.33	0.1799	981.07	26.85
3:37.0	25.80	0.1763	981.05	26.32
3:42.0	25.26	0.1727	981.03	25.78
3:47.0	24.73	0.1692	981.01	25.25
3:52.0	24.19	0.1656	980.99	24.71
3:57.0	23.66	0.1620	980.97	24.18

Date 5/6/82

Inflow H'graph:

Time hr:min	Inflow cfs	Storage ac ft	Elevation feet	Outflow cfs (Tot)
4:02.0	23.12	0.1584	980.95	23.64
4:07.0	22.59	0.1548	980.92	23.11
4:12.0	22.05	0.1512	980.90	22.57
4:17.0	21.52	0.1476	980.88	22.04
4:22.0	20.98	0.1441	980.86	21.50
4:27.0	20.45	0.1405	980.84	20.97
4:32.0	19.91	0.1369	980.82	20.43
4:37.0	19.37	0.1333	980.80	19.90
4:42.0	18.84	0.1297	980.77	19.36
4:47.0	18.30	0.1261	980.75	18.82
4:52.0	17.77	0.1225	980.73	18.29
4:57.0	17.23	0.1190	980.71	17.75
5:02.0	16.70	0.1154	980.69	17.22
5:07.0	16.16	0.1118	980.67	16.68
5:12.0	15.63	0.1082	980.65	16.15
5:17.0	15.09	0.1046	980.62	15.61
5:22.0	14.56	0.1010	980.60	15.08
5:27.0	14.02	0.0974	980.58	14.54
5:32.0	13.49	0.0939	980.56	14.01
5:37.0	12.95	0.0903	980.54	13.47
5:42.0	12.42	0.0867	980.52	12.94
5:47.0	11.88	0.0831	980.50	12.40
5:52.0	11.35	0.0795	980.47	11.87
5:57.0	10.81	0.0759	980.45	11.33
6:02.0	10.28	0.0723	980.43	10.80
6:07.0	9.74	0.0688	980.41	10.26
6:12.0	9.21	0.0652	980.39	9.73
6:17.0	8.67	0.0616	980.37	9.19
6:22.0	8.14	0.0580	980.35	8.66
6:27.0	7.60	0.0544	980.32	8.12
6:32.0	7.06	0.0508	980.30	7.59
6:37.0	6.53	0.0472	980.28	7.05
6:42.0	5.99	0.0437	980.26	6.52
6:47.0	5.46	0.0401	980.24	5.98
6:52.0	4.92	0.0365	980.22	5.44
6:57.0	4.39	0.0329	980.20	4.91
7:02.0	3.85	0.0293	980.17	4.37
7:07.0	3.32	0.0257	980.15	3.84
7:12.0	2.78	0.0221	980.13	3.30
7:17.0	2.25	0.0185	980.11	2.77
7:22.0	1.71	0.0150	980.09	2.23
7:27.0	1.18	0.0114	980.07	1.70
7:32.0	0.64	0.0078	980.05	1.16
7:37.0	0.11	0.0042	980.03	0.63
7:42.0	0.00	0.0016	980.01	0.24
7:47.0	0.00	0.0008	980.00	0.12
7:52.0	0.00	0.0000	980.00	0.00

E2550

*** ROUTING OF HYDROGRAPH # 1 ***

Date 6/17/82

Pond File : PONDO

POND FOR BASINS O&P

Number	Elevation	Storage	Outflow
1	57.70	0.000	0.00
2	60.00	0.800	14.50
3	62.00	1.400	27.00
4	64.00	7.300	35.00
5	64.50	8.700	74.00
6	64.70	9.000	174.00
7	65.00	10.000	495.00

Routing of Hydrograph # 1

Description of hydrograph : Page 1

O & P OUTFLOW

Area = 1.00 ac. Rational 'C' = .## Time of Concent. = 1 min.

Storm frequency, years = 0

Hydrograph # 6 - total outflow hydrograph

Description :

O&P OUTFLOW

Date 6/17/82

Inflow Hydrograph: O & P OUTFLOW

Time hr:min	Inflow cfs	Storage ac ft	Elevation feet	Outflow cfs (Tot)
0:00.0	0.00	0.0000	57.70	0.00
0:08.0	40.00	0.1538	58.14	2.79
0:14.0	96.67	0.6577	59.59	11.92
0:20.0	148.67	1.5101	62.04	27.15
0:26.0	199.93	2.7194	62.45	28.79
0:32.0	250.73	4.3347	62.99	30.98
0:38.0	301.53	6.3495	63.68	33.71
0:44.0	285.00	8.3665	64.38	64.71
0:50.0	255.00	9.2628	64.78	256.37
0:56.0	225.00	9.1976	64.76	237.42
1:02.0	194.50	9.0993	64.73	205.87
1:08.0	163.00	9.0029	64.70	174.94
1:14.0	131.48	8.9066	64.64	142.86
1:20.0	99.93	8.8122	64.57	111.39
1:26.0	68.37	8.7175	64.51	79.82
1:32.0	36.81	8.5354	64.44	69.42
1:38.0	5.26	8.1769	64.31	59.43
1:44.0	0.00	7.7559	64.16	47.70
1:50.0	0.00	7.4024	64.04	37.85
1:56.0	0.00	7.1025	63.93	34.73
2:02.0	0.00	6.8170	63.84	34.35
2:08.0	0.00	6.5348	63.74	33.96
2:14.0	0.00	6.2556	63.65	33.58
2:20.0	0.00	5.9796	63.55	33.21
2:26.0	0.00	5.7067	63.46	32.84
2:32.0	0.00	5.4368	63.37	32.47
2:38.0	0.00	5.1699	63.28	32.11
2:44.0	0.00	4.9060	63.19	31.75
2:50.0	0.00	4.6451	63.10	31.40
2:56.0	0.00	4.3870	63.01	31.05
3:02.0	0.00	4.1318	62.93	30.70
3:08.0	0.00	3.8795	62.84	30.36
3:14.0	0.00	3.6300	62.76	30.02
3:20.0	0.00	3.3832	62.67	29.69
3:26.0	0.00	3.1392	62.59	29.36
3:32.0	0.00	2.8979	62.51	29.03
3:38.0	0.00	2.6593	62.43	28.71
3:44.0	0.00	2.4234	62.35	28.39
3:50.0	0.00	2.1901	62.27	28.07
3:56.0	0.00	1.9594	62.19	27.76
4:02.0	0.00	1.7313	62.11	27.45
4:08.0	0.00	1.5057	62.04	27.14
4:14.0	0.00	1.2913	61.64	24.74
4:20.0	0.00	1.1031	61.01	20.81
4:26.0	0.00	0.9447	60.48	17.51
4:32.0	0.00	0.8114	60.04	14.74
4:38.0	0.00	0.6982	59.71	12.66
4:44.0	0.00	0.6009	59.43	10.89

Date 6/17/82 Page 3

Inflow H'graph: O & P OUTFLOW

Time hr:min	Inflow cfs	Storage ac ft	Elevation feet	Outflow cfs (Tot)
4:50.0	0.00	0.5172	59.19	9.37
4:56.0	0.00	0.4451	58.98	6.07
5:02.0	0.00	0.3831	58.80	6.94
5:08.0	0.00	0.3297	58.65	5.98
5:14.0	0.00	0.2838	58.52	5.14
5:20.0	0.00	0.2442	58.40	4.43
5:26.0	0.00	0.2102	58.30	3.81
5:32.0	0.00	0.1809	58.22	3.28
5:38.0	0.00	0.1680	58.18	3.04
5:44.0	0.00	0.1550	58.15	2.81
5:50.0	0.00	0.1421	58.11	2.58
5:56.0	0.00	0.1292	58.07	2.34
6:02.0	0.00	0.1163	58.03	2.11
6:08.0	0.00	0.1034	58.00	1.87
6:14.0	0.00	0.0904	57.96	1.64
6:20.0	0.00	0.0775	57.92	1.41
6:26.0	0.00	0.0646	57.89	1.17
6:32.0	0.00	0.0517	57.85	0.94
6:38.0	0.00	0.0388	57.81	0.70
6:44.0	0.00	0.0258	57.77	0.47
6:50.0	0.00	0.0129	57.74	0.23
6:56.0	0.00	- 0.0000	57.70	- 0.00

Project: MASTER DRAINAGE STUDY | Job No: E 2551

Client: GATES | By: MH | Date: 21 MAY 82

AREA II

CHECK CAPACITY FOR EXIST. 48" PIPE @ I-25 & U.S. 85

HW = 5' D = 4' ASSUME TYPE 1 INLET

HW/D = 2.25 Q = 158 cfs

CAPACITIES FROM H.E.C. N° 5

CHECK CAPACITY FOR EXISTING 14' WIDE × 11'-8" BOX CULVERT @ I-25 & US 85

HW = 9' ASSUME TYPE 1 INLET

HW/D = 0.77 Q/B = 80

Q = B(80) = 14(80) = 1120 cfs

TOTAL CAPACITY - BOTH CULVERTS

= 158 + 1120

= 1278 cfs > 1249 cfs OUTFLOW

Project: Part Area II - Master Drainage | Job No: E-2551

Client: Gates | By: BMW | Date: 10/14/82

Capacities of exist. pipes

Basin N

pipes under Hwy 115

from D&B report entitled Drainage "Report of Areas draining to a low point [etc]" Jan. 15 1979

Q_5 = 53 c/s - pipes sized accordingly

Basin E

5 x 20 box culvert @ Hwy 85-87

@ HW/D = 1 Q = 6660 cfs w/ wingwalls

5600 cfs w/o ww.

Project: Part Area II - Master Drainage | Job No: E-2551

Client: Gates | By: BNW | Date: 10/14/82

Capacities of exist pipes

Basin O exist 24" RCP @ Hwy 115

see 5B-E

outflow is shown on p. 15
because flow exceeds 35 cfs flow occurs in road for 100 year storm & 5 year storm

@ K1 72" RCP

outflow peak = 240° cfs (100 yr)
p22 capacity @ el 988 exceeds this value @ 2' above inside top pipe or $\frac{Hw}{D} = 1.3$

Basin D - 5 year storm only
36" RCP storm sewer in Cheyenne Mead. Bo.
@ 1.16% min Q = 110 cfs OK for 5 year

Basin C

the bridge center span only
20' x 6' provides Q = 740 cfs capacity @ HW/D = 1

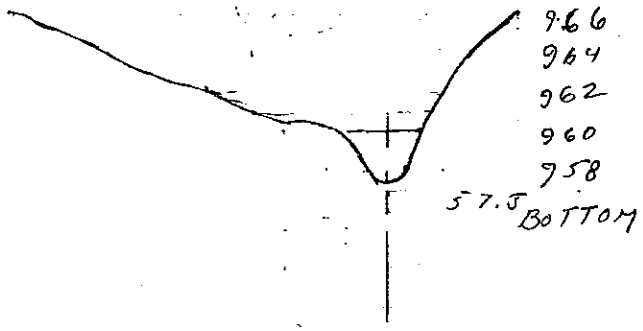
Project: Part Area II - Master Drainage
Job No: E-2551
Client: Gates - Flood Plain
By:
Date: 10-12-82

Cross-Section A-A North Gully

$N = 0.07$ $Q_{100} = 244$ cfs

$S = 3.6\%$ Reach = 500 ft

Scale
1" = 50' H
1" = 10' V



Depth = 2 ft
Area = 40 ft²
P_w = 22 ft
Q = 240 cfs

High Water Elev = ~59 ± ft

Distance From Hwy 85-87 2700 ± ft

1700 38TH STREET (303) 442-4338
BOULDER, COLORADO 80301

3405 N. EL PASO STREET (303) 633-5029
COLORADO SPRINGS, COLORADO 80907

Project: Part Area II - Master Drainage

Job No: E-2551

Client: Gates

By:

Date:

CROSS-SECTION B-B NORTH GULLY

Q_{100} = 244 cfs

N = 0.05

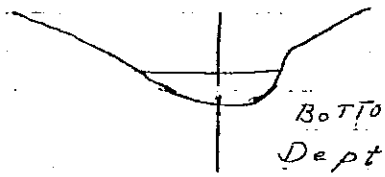
Scale 1" = 50' H
1" = 10' V

Reach = 500 ft S = 3.2 %

Depth = 1.5 ft

Area = 43 ft²

P_W = 38 ft



Depth = 945.5 ± ft

Q = 249 cfs

Elev = 947 ± ft

Distance from Hwy 85-87 2150 ± ft

1700 38TH STREET (303) 442-4338
BOULDER, COLORADO 80301

3405 N. EL PASO STREET (303) 633-5029
COLORADO SPRINGS, COLORADO 80907

Project: Part Area II – Master Drainage | Job Nº: E-2551

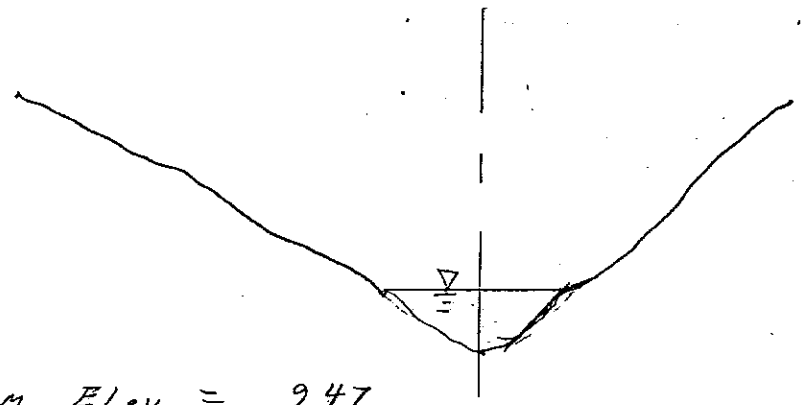
Client: Gates | By: SS | Date: 10/12/82

Cross-Section C-C

Scale 1" = 10' V
1" = 30' H

Q_{100} = 247 cfs North Gully

N = 0.07



Bottom Elev = 947

Reach = 400 ft

S = 1.5%

Top Elev = 950.0 to 950.1

Depth = 3.0 to 3.1

Area = 70 +/- SF

PW = 4.4 Q = 248 cfs

Distance to Hwy 87-85

2090 +/- ft

Project: Part Area II - Master Drainage

Job No: E2551

Client: Gates

By: SS

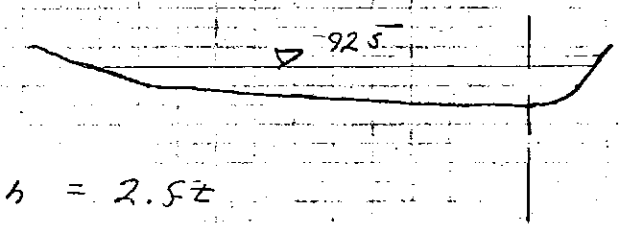
Date: 10/12/82

CROSS SECTION D-D NORTH GULLY

Q_{100} = 431 cfs N = .07

Reach = 500 ft S = 1.8 %

Scale
1" = 50' H
1" = 10' V



Bottom Elev
923 +/- ft

Depth = 2.5 ft

A = 195 ft²

P_W = 190

Q = 566 cfs

Top Elev 925 ft

Distance to Highway 85-87
1080 +/- ft

Project: Part Area II - Master Drainage | Job No: 2-2551

Client: Gates | By: | Date: 10/12/82

CROSS-SECTION E-E ✓ Scale 1" = 10 V, 1" = 50 H

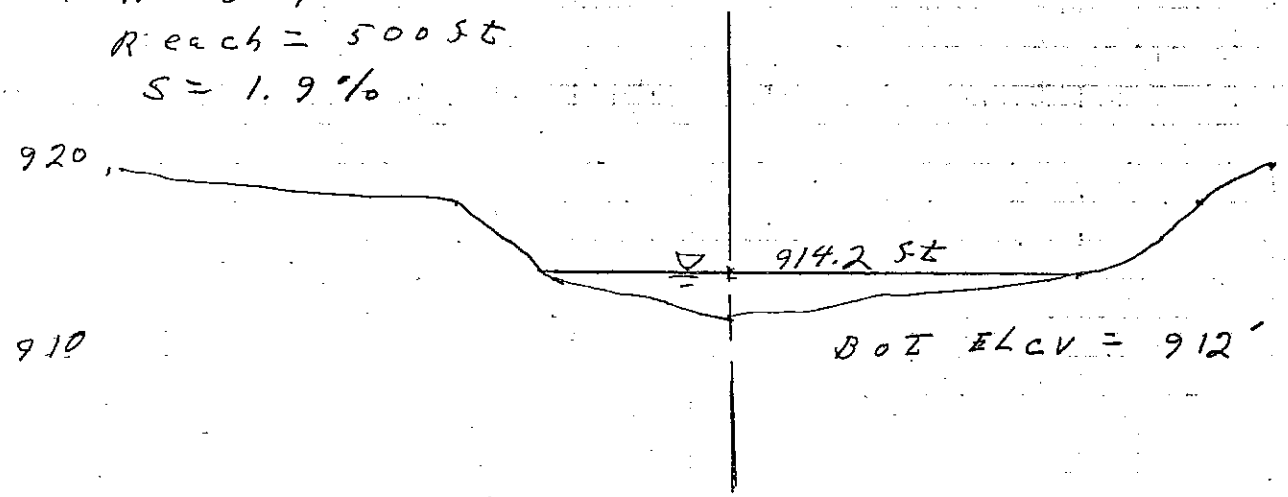
Q_{100} = 451 cfs

NORTH Gully

n = 0.07

Reach = 500 ft

S = 1.9 %



Depth = 2.2 ft Top Elev = 914.2

Area = 146 S.F. ✓

P_W = 133 ft

Q = 455

Distance to Highway 85-87

550 +/- ft

Project: Pt. Area II - Master Drainage | Job No: E-2551

Client: Gates | By: | Date: 10/12/82

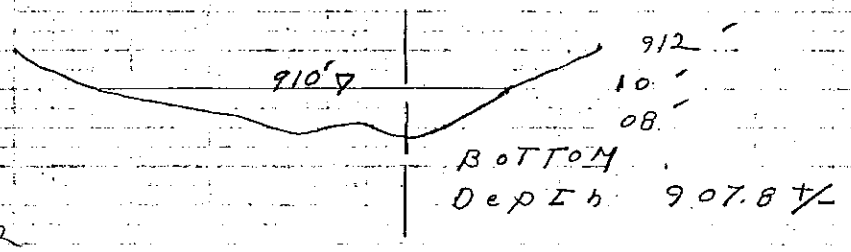
Cross-Section F-F North Gully

Q_{100} = 451 cfs

S = 1.1% N = 0.07

Reach 500 ft

Scale
1" = 50' H
1" = 10' V



Depth = 2.2

Area = 180 S.F.

P_w = 140 ft

Q = 475 Top Elev = 910 ft

Distance to Hwy 85-87
250 +/- ft

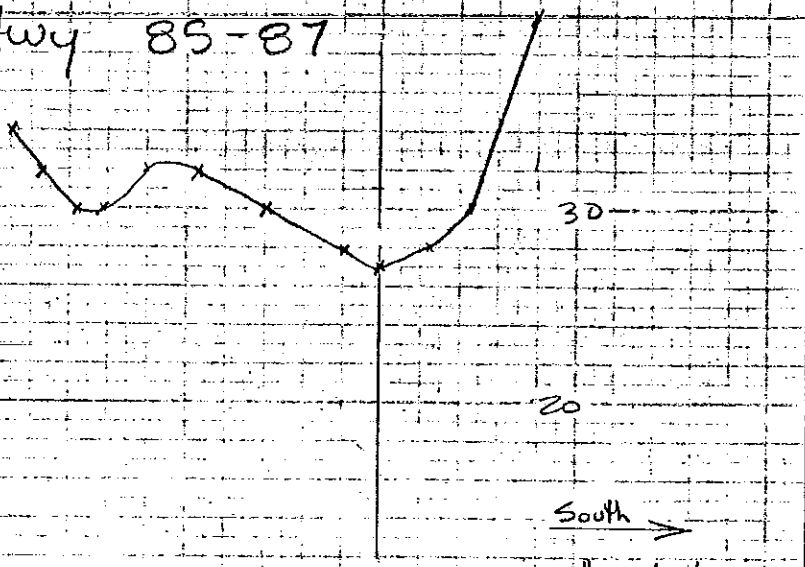
Project: Part Area II - Master Drainage | Job NR: E-2551

Client: Gates | By: | Date: 10/12/82

North Gully @ Q = 431 cfs

13+40' West of Hwy 85-87

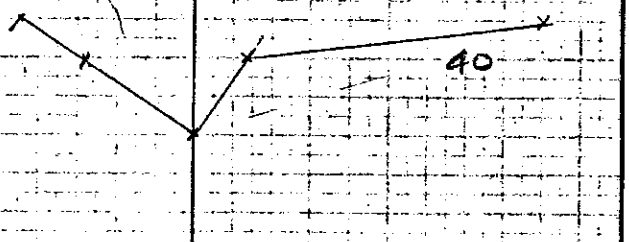
$n = 0.07$
$S = 2\%$
$Q = 3 A R^{2/3}$



@ el 31.0
$A = 160$ P = 65
$Q = 875$ cfs

@ el 30.0
$A = 103$ P = 52
$Q = 487$ cfs

14+70' West of Hwy 85-87



@ el 40
$n = 0.05$
$S = 1\%$
$Q = 3 A R^{2/3}$

@ el 41
$A = 154$ P = 87
$Q = 674$ cfs

@ el 40.7
$A = 130$ P = 80
$Q = 539$ cfs

Project: Part Area II - Master Drainage | Job Nº: E-2551

Client: Gates | By: | Date: 10/12/82

North Leg North Gulley
1100' west of confluence @ old dam

Q = 244 cfs
n = 0.07
S = 1.7% $S^{1/2}$ = .13
B = 60'
Z = 8'
D = 1.2'

@ B = 40' D = 1.5'

Project: Part Area II - Master Drainage | Job No: E-2551

Client: Gates | By: | Date: 10/12/82

South leg North Gulley -
1000' West of confluence @ old dam
Q = 247 c/s

S = 2.9% $S^{1/2}$ = .17
n = 0.07
$Q = 3.6 AR^{2/3}$
Z = 2 D < 5'
D = 4.6'

@ Z = 4
D = 3.4'

Project: Part Area II - Master Drainage | Job No: E2551

Client: Gates | By: SS | Date: 10-12-82

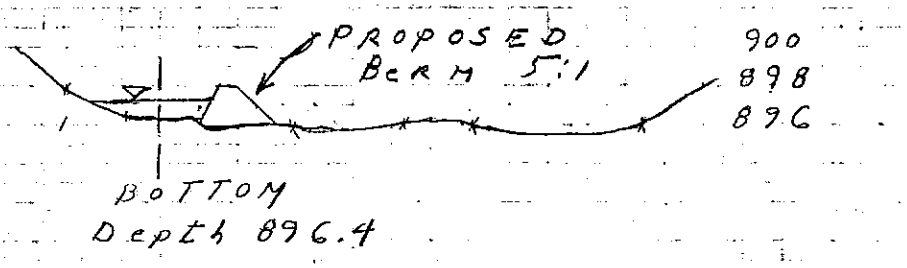
PROPOSED
CROSS-SECTION D-D Below Quail Lake

Q_{100} = 229 cfs

N = 0.0 S = 1.0%

Scale 1" = 10' V
1" = 100' H

Reach = 500 ft



Bottom Width = 42'

N = 0.05 Side Slope = ~5:1

Depth = 1.24'

Q = 239 cfs

V = 4 fps Top Elev 97.64 ft

Distance to Hwy 85-87 600 +/- ft

Project: Part Area II - Master Drainage | Job No: E-2551

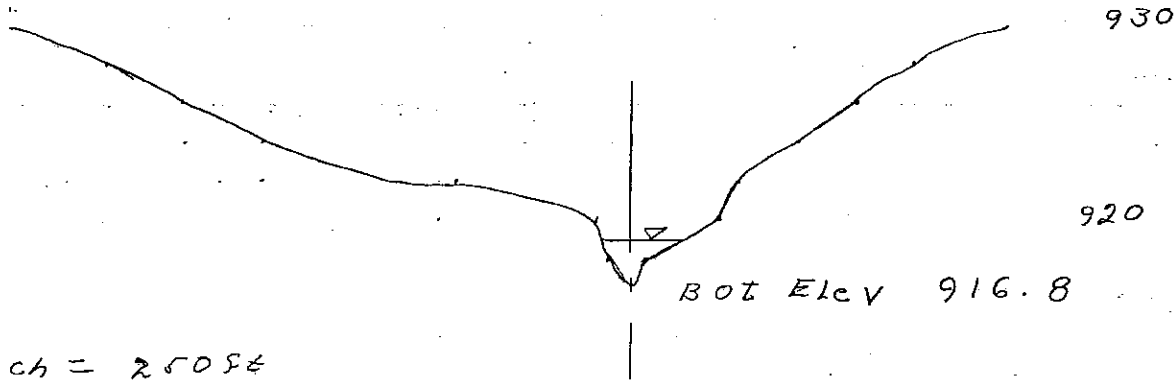
Client: Gates | By: SS | Date: 10/12/82

Cross-section C-C

Q_{100} = 111 cfs

Scale 1" = 10' V
1" = 50' H

N = 0.05 Below Quail Lake



Reach = 250 ft

S = 3.4 %

Top Elev 919 ft

Depth = 2.2 ft
P_W = 28 ft
Area = 23 S.F
Q = 111 cfs

Distance to HWY 85 - 87

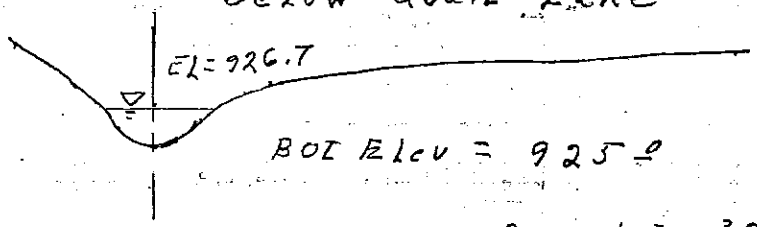
2300 +/- ft

Project: Part Area II - Master Drainage
Job No: 5-2551
Client: Gates
By: SS
Date: 10/12/82

Cross-Section B-B
Scale 1" = 10' V
1" = 50' H

Q_{100} = 111 cfs
n = 0.05

Below Quail Lake



BOI Elev = 925.0

Reach = 300 ft
S = 1%

TOP ELEV = 926.7
Depth = 1.75 ft
P_W = 35' Area = 37 S.F
Q = 114

Distance to HWY 85-87
2600 +/- ft

Project: Part Area II - Master Drainage | Job No: E-2501

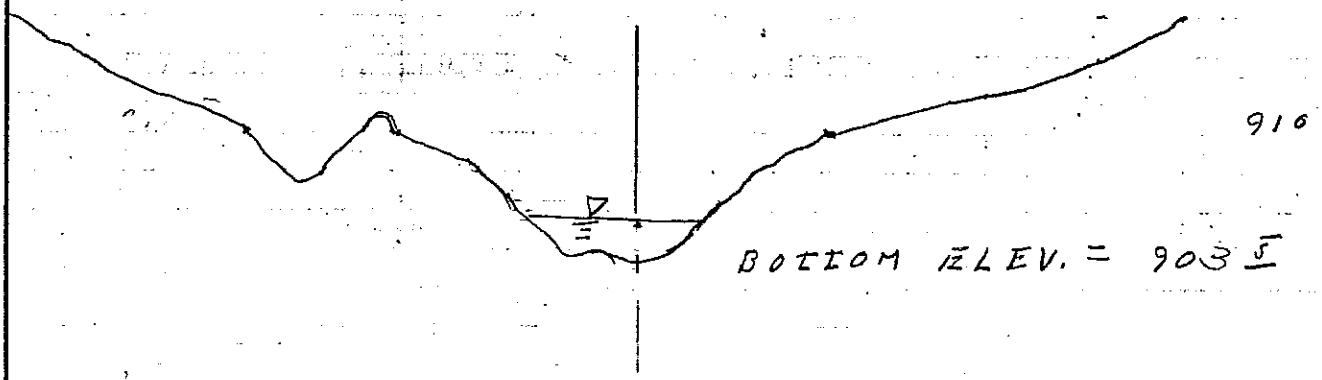
Client: Gates | By: | Date: 10/12/82

CROSS-SECTION A-A

SCALE
1" = 50' H
1" = 10' V

$Q_{100} = 229$ cfs
$n = 0.05$
$S = 1\%$

Below Quail Lake



BOTTOM ELEV. = 903.5

Top Elev = 904.9 to 905.0

Depth = 1.4' to 1.5'

$P_w = 40$ Area = 57

Distance to
HWY 85-87
1210 +/- ft