MASTER DEVELOPMENT DRAINAGE PLAN
FOR
TRAIL RIDGE AT NORTHGATE

May 1997

JR Engineering, Ltd.

JR Engineering, Ltd.
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May 1997

Prepared For:

MASTER BILT HOMES
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Colorado Springs, CO 80906
(719) 579-7630

AND
RMC CORPORATION
P.O. Box 908
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(719) 576-1070

Prepared By:

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4935 North 30th Street
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Job No. 8639.25

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DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:
The attached drainage plan and report 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 any negligent acts, errors, or omissions on my part in preparing this report.

Kyle R. Campbell, Colorado P.E. #29794 — 8/14/97
For and On Behalf of JR Engineering, Ltd. — Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name:	Master Bilt Homes	RMC Corporation
By:	John B. Wiepking	Robert P. Osborne
Title:	President	President
Address:	740 Elk Glen Court	P.O. Box 908
	Colorado Springs, CO 80906	Colorado Springs, CO 80906

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer — Aug 16, 1997
Date

Conditions:

Recycled

MASTER DEVELOPMENT DRAINAGE PLAN FOR TRAIL RIDGE AT NORTHGATE

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APPENDIX

MASTER DEVELOPMENT DRAINAGE PLAN FOR TRAIL RIDGE AT NORTHGATE

PURPOSE

This document is the Master Development Drainage Plan for Trail Ridge at Northgate. The purpose of this report is to analyze the phased development and create the foundation for each final drainage report which will be filed with the subdivision plats. This report will estimate peak rates of storm water runoff, recommend solutions for drainage problems resulting from development, and identify necessary improvements to safely route storm water runoff to adequate outfall facilities.

GENERAL DESCRIPTION

Trail Ridge at Northgate is located in the northeast quarter of Section 17, Township 12 South, Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso. The site is bounded to the north by unplatted county land, to the west by a branch of the middle tributary, to the south by Voyager Parkway, and to the east by Liberty Heights Filing No. 1 and a City of Colorado Springs tank site. Zoning of this 70.62 acre site is R1-6000. Proposed use is single family residential development, containing 239 lots.

Trail Ridge at Northgate is located on an existing ridge which slopes from northeast to southwest at a 12.0% grade. Vegetation is native grass. There is an existing gravel access road from Voyager Parkway to an existing water tank and pump station at the northeast corner of the site. The soil condition reflects Hydrologic Group "B" (Crowfoot, Cruckton) and "C" (Kutch) soils as determined by the "Soil Survey of El Paso County Area," prepared by S.C.S. (See Appendix).

EXISTING DRAINAGE CONDITIONS

Trail Ridge at Northgate is located within the Middle Tributary Drainage Basin and Black Squirrel Creek Drainage Basin. In the analysis of this site, JR Engineering, Ltd. used the "Middle Tributary

Drainage Basin Planning Study" by URS Consultants, 1987 in combination with the "Northgate Filing No. 3 (Voyager Parkway - Phase 2A) Preliminary and Final Drainage Report, " by URS Consultants, 1988, "Northgate Filing No. 5 (Voyager and Black Squirrel Parkways Phase 2B) Preliminary and Final Drainage Report," by URS Consultants, 1989, as well as the "Northgate Master Development Drainage Plan," by URS Consultants, 1989. Currently the site drains to both basins.

PROPOSED DRAINAGE CHARACTERISTICS

After construction of Trail Ridge at Northgate, on-site and off-site runoff will be split into several outfall locations (see drainage map). The northeast corner of this site drains into unplatted county land (Basin A). Per the Drainage Basin Planning Study prepared by URS this basin discharges into the adjacent county property which will be conveyed via a future improved channel into a 22 acre-foot detention facility which will be located on stream and near the existing city/county border. Since developed flows discharge into this channel, a temporary detention pond on an adjacent lot is proposed to release developed flows at historic levels of $Q_5 = 6$ cfs and $Q_{100} = 15$ cfs. Based upon field reconnaissance it appears that this system can be routed into an existing CMP pipe located under the existing asphalt mat. The preliminary pond routing calculations shown in the appendix requires a .182 acre foot detention facility which will adequately detain these flows to a historic rate. A more detailed grading and pond design will be included in the Final Drainage Report for this phase of development.

Basins B and D outfall as unconcentrated sheet flow onto adjacent property, and currently discharge into historic drainage patterns. These basins are consistent with the drainage studies for the tank site and Liberty Heights. A portion of flows from Basin's C and E (6.8 acres and 16.4 acres respectively) will be collected in a proposed inlet system (2-8 foot D-10-R's) and discharge into the existing system in Voyager Parkway and travel southeast into a previously approved outfall (Black Squirrel Creek). This basin transfer was identified in the Drainage Reports for "Northgate Filing No. 5", Voyager Parkway Phase 2A and 2B. The existing system has capacity for 30 cfs, but the basin transfer per the DBPS will be $Q_5 = 11$ cfs and $Q_{100} = 16$ cfs. Flowby from these inlets will turn into

Voyager Parkway and travel northwest ($Q_5 = 18$ cfs, $Q_{100} = 42$ cfs). The street capacity for Voyager Parkway at this section is $Q_5 = 20$ cfs and $Q_{100} = 44$ cfs. Therefore there will be no adverse effect on Voyager Parkway.

The system in Voyager Parkway has been constructed only under the existing asphalt mat (half section). The Voyager Parkway ultimate system does not need to be constructed at this time with the development of Trail Ridge. The system will need to be completed with the ultimate section of Voyager Parkway, or when additional development discharges flows into Voyager Parkway. This flow in Voyager Parkway combines with Basin M and will be intercepted by a proposed 20-foot D-10-R inlet at Design Point 4 which will route a majority of this discharge into the proposed detention facility ($Q_5 = 21$ cfs, $Q_{100} = 46$ cfs) (see drainage plan). The street capacity of Voyager Parkway (see Appendix) is $Q_5 = 34$ cfs and $Q_{100} = 80$ cfs. Therefore there will be no adverse effects on Voyager Parkway. This inlet system will be designed and detailed in the Final Drainage Report for Trail Ridge at Northgate Filing No. 2 and the report for the Northgate detention Pond 1. The construction of the 20-foot D-10-R will be part of the ultimate system in Voyager Parkway, the Voyager system will need to be redesigned to incorporate the 20-foot D-10-R inlet into the ultimate design of the Voyager Parkway system.

Design Point 5 consists of runoff from Basins I and G, $Q_5 = 4$ cfs and $Q_{100} = 8$ cfs. A proposed 4-foot D-10-R sump inlet will be constructed on this down draining cul-de-sac with an outfall system connecting this outfall to the improved channel. An 18-inch RCP at 1% with adequately convey this discharge. Since this developed discharge will be released directly into the proposed channel, the detention pond will "over detain" to ensure that the outfall release rate will remain at historic flows. Basins H and J will remain discharging in there historic patterns. These basins consist of mostly rear yards and discharge flows similar to historic rates.

Design Point 6 consists of surface runoff from Basin K, $Q_5 = 7$ cfs and $Q_{100} = 14$ cfs. A proposed 4-foot D-10-R sump inlet will be constructed to intercept these flows and discharge directly into the proposed detention pond via an 18-inch RCP at 1%.

Design Point 7 consists of surface flows from Basins L and F, (Q_5 = 41 cfs, Q_{100} = 84 cfs). An inlet structure will be constructed at this sump location in the cul-de-sac. At this time it appears that a system will be designed to pick-up the 5-year event and a rip-rap overflow will convey the 100 year event into the detention pond. This facility will be detailed in the Final Drainage Report for this portion of the site.

The flows in the Middle Tributary Creek are shown at Design Point OSDP-1 (Q_5 = 177 cfs, Q_{100} = 560 cfs) and Design Point OSDP-2 (Q_5 = 142 cfs, Q_{100} = 445 cfs) (see Drainage Plan). These discharge rates represent the historic flows with detention. The channel improvements for Middle Tributary Creek consist of drop structures and revised alignment (see drainage plan). The channel improvements and detention pond plans will be detailed in future reports and construction plans. The detention pond needs to be constructed with the first filing of Trail Ridge, but the channel improvements will be required only when development flows discharge directly into the channel, or subdivision platting abutts the channel. Both the detention facility and channel improvements are the responsibility of the owner of Northgate, and additional reports and financial obligations will be provided by the Northgate Development.

HYDROLOGIC/HYDRAULIC CRITERIA

This report has been prepared in accordance with the 1991 City/County Drainage Criteria Manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with a 5-year and 100-year recurrence interval. (Current Criteria dated October 12, 1994). The inlets for this site were sized based on a 5-year ponding depth not exceeding the crown of the street (6" max depth at flowline) and a 100-year ponding depth not to exceed the right-of-way assuming a 2% grade from top back of curb to the right-of-way (12" max depth at flowline). Street capacity is based on 5-year flows not exceeding the crown (6" max depth at flowline), 20 cfs max flow (34 cfs max flow collector streets) and the 100-year flows not exceeding a 12" depth at flowline with no adjacent flooding. (Current criteria dated October 12, 1994).

FLOODPLAIN STATEMENT

No portion of this site is located within the floodplain as determined by the Flood Insurance Rate Map (F. I .R .M.) Community Panel Number 080060 0040B, dated December 18, 1986.

SUMMARY

Construction of this subdivision will not adversely affect the surrounding developments. All drainage facilities were sized using the 1991 City of Colorado Springs Drainage Criteria and will safely discharge storm water runoff to adequate outfalls.

PREPARED BY:

Aaron B. Egbert, E.I.
Project Manager
For and On Behalf of JR Engineering, Ltd.

/vb/863925/mddp.rpt

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated October, 1991.

2. Northgate Filing No. 3 (Voyager Parkway - Phase 2A) Preliminary and Final Drainage Report, URS Consultants, 1988.

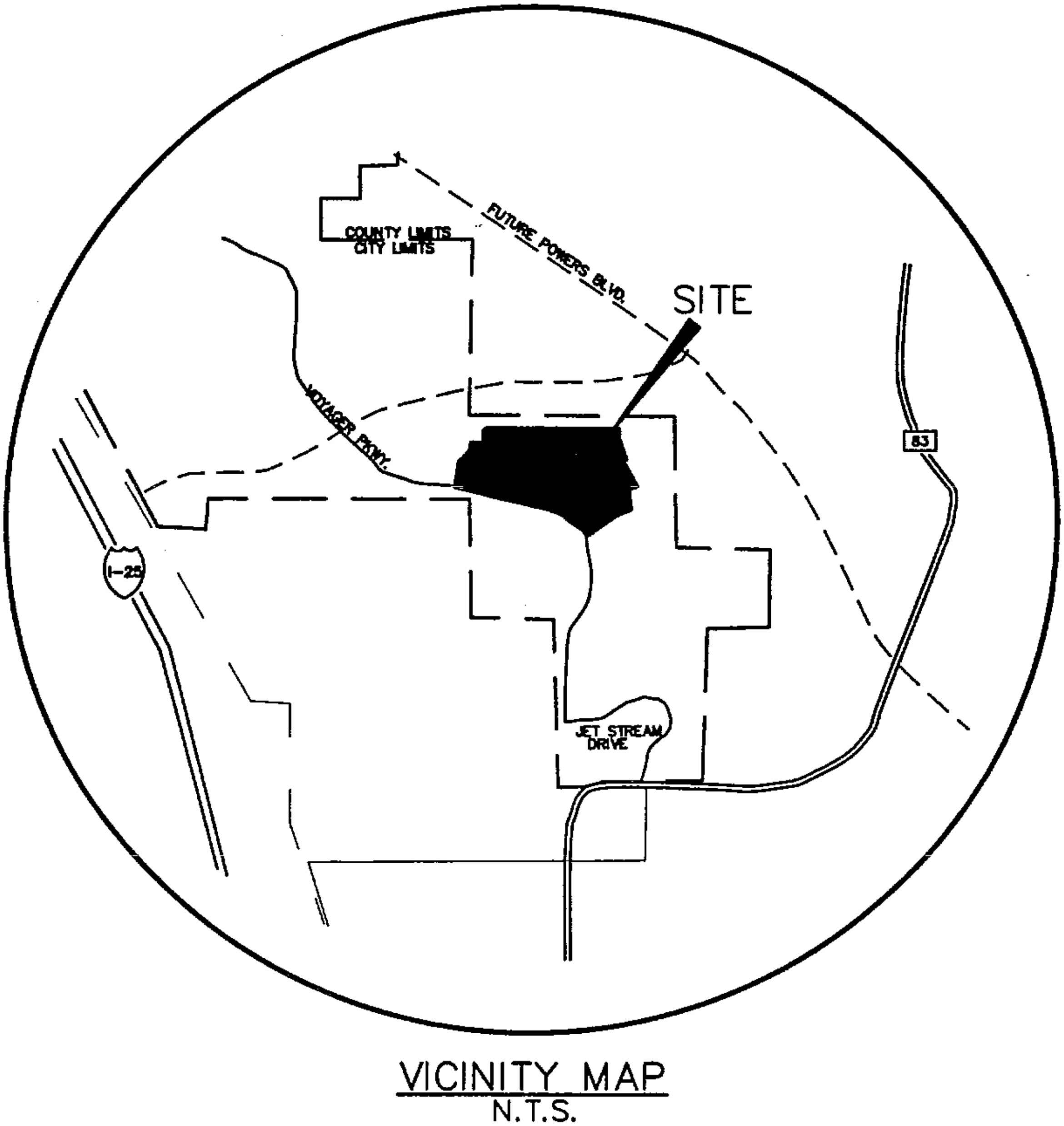
3. Northgate Filing No. 5 (Voyager and Black Squirrel Parkways - Phase 2B) Preliminary and Final Drainage Report, URS Consultants, 1989.

4. Middle Tributary Drainage Basin Planning Study, URS Consultants, 1987.

5. Northgate Master Development Drainage Plan, URS Consultants, 1989.

APPENDIX

VICINITY MAP

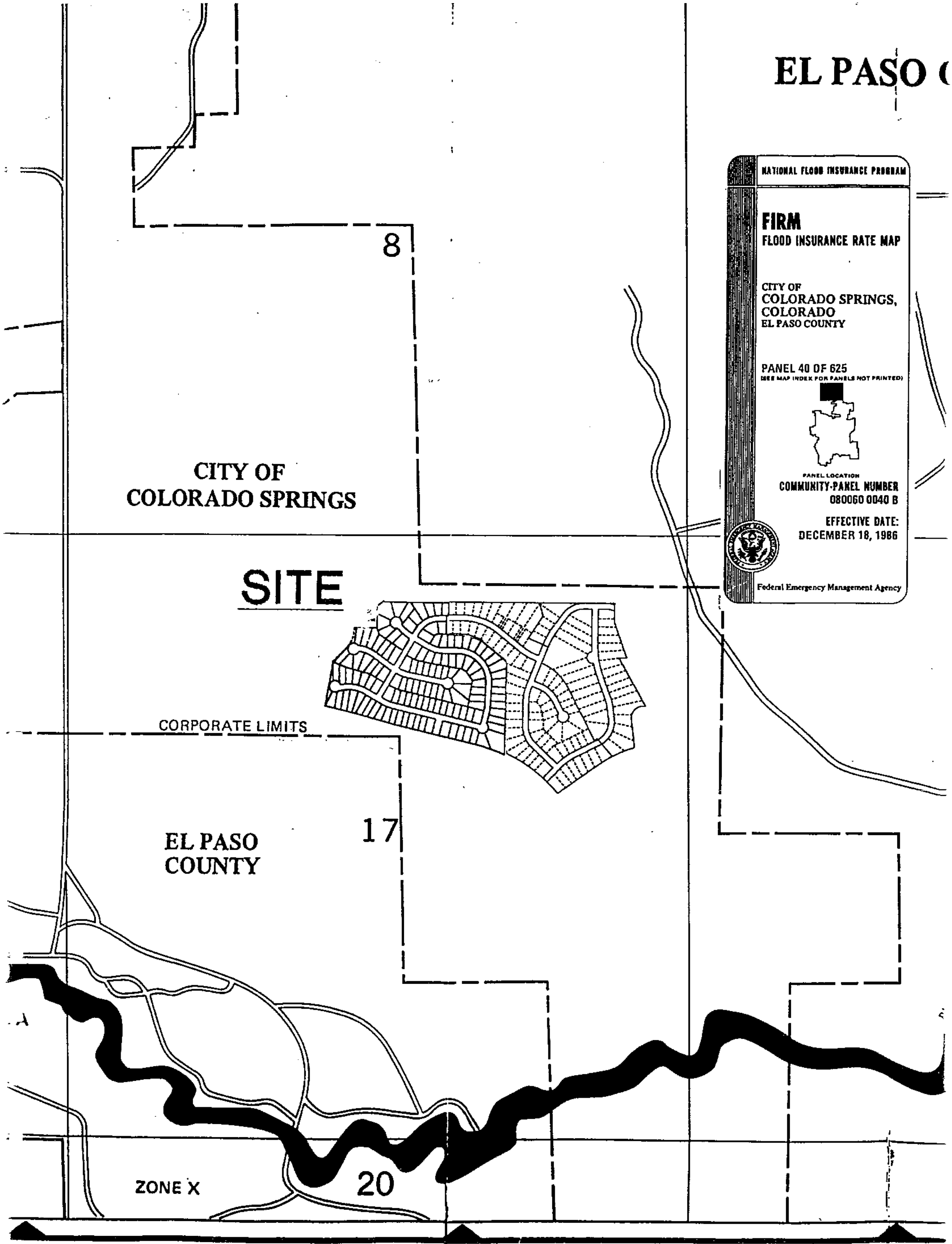


VICINITY MAP
N.T.S.

S. C. S. SOIL MAP


SHEET NO. 1
EL PASO COUNTY AREA, COLORADO
(MONUMENT QUADRANGLE)
FOREST
SITE
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SHEET NO. 1 OF 37
(Joins sheet 8)

F. E. M. A. FLOODPLAIN MAP


EL PASO
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
CITY OF
COLORADO SPRINGS,
COLORADO
EL PASO COUNTY
PANEL 40 OF 625
(SEE MAP INDEX FOR PANELS NOT PRINTED)
PANEL LOCATION
COMMUNITY-PANEL NUMBER
080060 0040 B
EFFECTIVE DATE:
DECEMBER 18, 1986
Federal Emergency Management Agency
8
CITY OF
COLORADO SPRINGS
SITE
CORPORATE LIMITS
17
EL PASO
COUNTY
ZONE X
20

HYDROLOGIC CALCULATIONS

RATIONAL METHOD: Q = CIA OR CA (EQUIVALENT)

BASIN	AREA (acres)	L (ft)	H (ft)	S (%)	V (fps)	Tc (min)	I5	I100	SOIL GROUP	LAND USE	C5	C100	FLOW Q5	Q100
A	5.6	See Basin Parameters				12.9	3.7	6.3	C	Res.	0.50	0.60	10	21
												CA =	2.82	3.38
A (Hist.)	5.6	See Basin Parameters				14.9	3.4	5.9	C	Mead.	0.30	0.45	6	15
B	0.3	See Basin Parameters				7.2	4.8	8.2	C	Res.	0.50	0.60	1	2
												CA =	0.15	0.18
C	6.8	See Basin Parameters				19.2	3.0	5.3	B	Res.	0.38	0.53	8	19
												CA =	2.58	3.61
D	1.0	See Basin Parameters				6.2	5.0	8.6	B	Res.	0.48	0.59	2	5
												CA =	0.48	0.59
E	16.4	See Basin Parameters				16.3	3.3	5.7	B/C	Res.	0.46	0.57	25	53
												CA =	7.54	9.35
F	5.3	See Basin Parameters				18.0	3.1	5.4	B/C	Res.	0.48	0.60	8	17
												CA =	2.54	3.18

JR ENGINEERING, LTD.

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Project: Trail Ridge at Northgate M.D.D.P.

Engineer: ABE **Date:** March 22, 1997

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/ew/863925/rational.wb2

G	6.1	See Basin Parameters				10.9	4.0	6.8	C	Res.	0.52	0.63	13	26
												CA =	3.18	3.83
H	0.2	See Basin Parameters				8.4	4.4	7.6	C	Res.	0.66	0.76	1	1
												CA =	0.13	0.15
I	1.9	See Basin Parameters				9.7	4.1	7.0	B	Res.	0.51	0.61	4	8
												CA =	0.97	1.16
J	1.3	See Basin Parameters				8.3	4.5	7.8	B	Res.	0.51	0.61	3	6
												CA =	0.66	0.79
K	3.4	See Basin Parameters				11.9	3.8	6.6	B	Res.	0.52	0.62	7	14
												CA =	1.77	2.11
L	22.4	See Basin Parameters				16.0	3.3	5.7	B	Res.	0.56	0.66	41	84
												CA =	12.46	14.71
M	2.4	See Basin Parameters				9.0	4.3	7.4	B	Res.	0.55	0.65	6	12
												CA =	1.32	1.56

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4935 NORTH 30TH STREET

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Project: Trail Ridge at Northgate M.D.D.P.

Engineer: ABE **Date:** March 21, 1997

Job No.: 8639.25 **Page:** 2 of 2

HYDROLOGIC CALCULATIONS

Basin Parameters

Basin A:

100' of Overland flow @ 2%

$T_{Co} = 1.87(1.1\text{-}0.30)(100)^{0.5}(2)^{-0.33}$

$T_{Co} = 11.9$ Min

550' of Street flow @ 7%

$T_{Cs} = \frac{550}{9.3(60)} = 1.0$ Min

Total $= T_{Co} + T_{Cs}$

$= 11.9 + 1.0$

$T_C = 12.9$ Min

Basin A: (Historic)

480' of Overland flow @ 11%

$T_{Co} = 1.87(1.1\text{-}0.30)(480)^{0.5}(11)^{-0.33}$

$T_{Co} = 14.9$ Min

Basin B:

120' of Overland flow @ 12%

$T_{Co} = 1.87(1.1\text{-}0.30)(120)^{0.5}(12)^{-0.33}$

$T_{Co} = 7.2$ Min

Basin C:

250' of Overland flow @ 3.0%

$T_{Co} = 1.87(1.1\text{-}0.25)(250)^{0.5}(3.0)^{-0.33}$

$T_{Co} = 17.4$ Min

1000' of Street flow @ 8.1%

$T_{Cs} = \frac{1000}{10(60)} = 1.7$ Min

Total $= T_{Co} + T_{Cs}$

$= 17.4 + 1.7$

$T_C = 19.1$Min

Basin D:

50' of Overland flow @ 6%

$T_{Co} = 1.87(1.1\text{-}0.25)(50)^{0.5}(6)^{-0.33}$

$T_{Co} = 6.2$ Min

Basin E:

100' of Overland flow @ 2%

$T_{Co} = 1.87(1.1\text{-}0.25)(100)^{0.5}(2)^{-0.33}$

$T_{Co} = 12.6$ Min

1050' of Street flow @ 4.4%

$T_{cs} = \frac{1050}{7.3(60)} = 2.4$Min

390' of Street flow @ 2%

$T_{Cs} = \frac{390}{4.9(60)} = 1.3$ Min

Total $= T_{Co} + T_{Cs} + T_{Cs}$

$= 12.6 + 1.3 + 2.4$

$T_C = 16.3$Min

Basin Parameters Continued

Basin F:

180' of Overland flow @ 2.0%

$T_C = 1.87(1.1\text{-}0.25)(180)^{0.5}(2.0)^{-0.33}$

$T_C = 17.0$ Min

60' of Swale Flow @ 2%

$T_{CSW} = \frac{60}{3(60)} = 0.3$ Min

400' of Street flow @ 7.3%

$T_{Cs} = \frac{400}{9.5(60)} = 0.7$ Min

Total $= T_{Co} + T_{Cs} + T_{CSW}$

$= 17.0 + 0.3 + 0.7$

$T_C = 18.0$ Min

Basin G:

90' of Overland flow @ 3%

$T_{Co} = 1.87(1.1\text{-}0.30)(90)^{0.5}(3)^{-0.33}$

$T_{Co} = 9.3$ Min

920' of Street flow @ 7.8%

$T_{Cs} = \frac{920}{9.8(60)} = 1.6$ Min

Total $= T_{Co} + T_{Cs}$

$= 9.3 + 1.6$

$T_C = 10.9$ Min

Basin H:

100' of Overland flow @ 8%

$T_{Co} = 1.87(1.1\text{-}0.25)(100)^{0.5}(8)^{-0.33}$

$T_{Co} = 8.1$ Min

60' of Swale Flow @ 2%

$T_{CSW} = \frac{60}{3(60)} = 0.3$ Min

Total $= T_{Co} + T_{CSW}$

$= 8.0 + 0.3$

$T_C = 8.4$ Min

Basin I:

60' of Overland flow @ 4%

$T_{Co} = 1.87(1.1\text{-}0.30)(60)^{0.5}(4)^{-0.33}$

$T_{Co} = 7.3$ Min

65' of Swale flow @ 2%

$T_{Csw} = \frac{65}{3(60)} = 0.4$ Min

440' of Street flow @ 4.4%

$T_{Cs} = \frac{440}{7.3(60)} = 1.0$ Min

Total $= T_{Co} + T_{Csw} + T_{Cs}$

$= 8.4 + 0.4 + 1.0$

$T_C = 9.7$ Min

Basin J:

50' of Overland flow @ 2%

$T_{Co} = 1.87(1.1\text{-}0.25)(50)^{0.5}(2)^{-0.33}$

$T_{Co} = 8.3$ Min

Basin Parameters Continued

Basin K:

80' of Overland flow @ 2%

$T_C = 1.87(1.1\text{-}0.25)(80)^{0.5}(2)^{-0.33}$

$T_C = 11.3$ Min

140' of Swale Flow @ 6%

$T_{CSW} = \dfrac{140}{4(60)} = 0.6$ Min

Total $= T_{Co} + T_{CSW}$

$= 11.0 + 0.6$

$T_C = 11.9$ Min

Basin L:

130' of Overland flow @ 2%

$T_C = 1.87(1.1\text{-}0.25)(130)^{0.5}(2)^{-0.33}$

$T_C = 14.4$ Min

110' of Swale Flow @ 2%

$T_{CSW} = \dfrac{110}{3(60)} = 0.6$ Min

420' of Street flow @ 4%

$T_{Cs} = \dfrac{420}{7(60)} = 0.4$ Min

Total $= T_{Co} + T_{Cs} + T_{CSW}$

$= 14.4 + 0.6 + 1.0$

$T_C = 16.0$ Min

Basin M:

80' of Overland flow @ 4%

$T_{Co} = 1.87(1.1\text{-}0.25)(80)^{0.5}(4)^{-0.33}$

$T_{Co} = 9.0$ Min

TRAIL RIDGE AT NORTHGATE M.D.D.P.
SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent) CA(5)	CA(100)	Tc (min.)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	Q(100) (cfs)
TEMP DRAINAGE FACILITY (NE COR.)	A	2.82	3.38					
		2.82	3.38	12.9	3.7	6.3	10	21
1	E	7.54	9.35					
		7.54	9.35	16.3	3.3	5.7	25	53
2	C	0.38	0.53					
		0.38	0.53	19.2	3.0	5.3	8	19
3	DP-1 FLOWBY	5.34	7.26					
	DP-2 FLOWBY	1.20	1.24					
		6.34	8.50	21.9	2.8	4.9	18	42
4	DP-3 FLOWBY	6.34	8.50					
	M	1.32	1.56					
		7.66	10.06	24.5	2.7	4.6	21	46
5	I	0.97	1.16					
		0.97	1.16	9.7	4.1	7.0	4	8
6	K	1.77	2.11					
		1.77	2.11	11.9	3.8	6.6	7	14
7	L	12.46	14.71					
	F	2.54	3.18					
		15.00	17.89	20.2	2.9	5.1	43	91

HYDRAULIC CALCULATIONS

TRAIL RIDGE AT NORTHGATE M.D.D.P.
INLET CALCULATIONS

DP-1
AT GRADE INLET
100-YR. FLOW

Q(100)	50	I(100)	5.7	Inlet size	8
DEPTH	0.45	Fr	3.25	Qi =	9
				CA(eqv.)	1.51
SPREAD	18.6	L(1)	46.5		
				FB =	41
CROSS SLOPE	2.0%	L(2)	27.9		
				CA(eqv.)	7.26
STREET SLOPE	5.7%	L(3)	99.5		

5-YR. FLOW

Q(5)	24	I(5)	3.3	Inlet size	8
DEPTH	0.34	Fr	3.03	Qi =	6
				CA(eqv.)	1.94
SPREAD	12.9	L(1)	30.0		
				FB =	18
CROSS SLOPE	2.0%	L(2)	18.0		
				CA(eqv.)	5.34
STREET SLOPE	5.7%	L(3)	64.7		

DP-2
AT GRADE INLET
100-YR. FLOW

Q(100)	19	I(100)	5.3	Inlet size	8
DEPTH	0.31	Fr	2.97	Qi =	6
				CA(eqv.)	1.08
SPREAD	11.6	L(1)	26.5		
				FB =	13
CROSS SLOPE	2.0%	L(2)	15.9		
				CA(eqv.)	2.50
STREET SLOPE	5.7%	L(3)	56.7		

5-YR. FLOW

Q(5)	8	I(5)	3.0	Inlet size	8
DEPTH	0.23	Fr	2.67	Qi =	4
				CA(eqv.)	1.47
SPREAD	7.1	L(1)	14.5		
				FB =	4
CROSS SLOPE	2.0%	L(2)	8.7		
				CA(eqv.)	1.20
STREET SLOPE	5.7%	L(3)	31.3		

TRAIL RIDGE AT NORTHGATE M.D.D.P.
SUMP INLET CALCULATIONS

Total Flow: Q(5) = 4 cfs
(Design Point 5) Q(100) = 8 cfs

Maximum allowable ponding depth at sump:

d(5) = 0.50 (dmax)
d(100) = 1.00 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

USE 1 -4 D-10-R SUMP INLET

TRAIL RIDGE AT NORTHGATE M.D.D.P.
SUMP INLET CALCULATIONS

Total Flow:	Q(5) =	7 cfs
(Design Point 6)	Q(100) =	**14** cfs

Maximum allowable ponding depth at sump:

d(5) = 0.50 (dmax)
d(100) = 1.00 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

USE 1 -4' D-10-R SUMP INLET

TRAIL RIDGE AT NORTHGATE M.D.D.P.
SUMP INLET CALCULATIONS

Total Flow: Q(5) = **43** cfs
(Design Point 7) Q(100) = **91** cfs

Maximum allowable ponding depth at sump:

d(5) = 0.50 (dmax)
d(100) = 1.00 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

5-Year Event: **47** foot inlet required

100-Year Event: **38** foot inlet required

USE 20' SUMP INLET TO PICK-UP Q5 = 25 CFS & Q100 = 65CFS
Q5 = 18 CFS & Q100 = 26CFS FLOWBY

TRAPEZOIDAL CHANNEL
Worksheet for Trapezoidal Channel

Project Description	
Project File	x:\863925\fm\project4.fm2
Worksheet	HYDRAULIC CALCULATIONS
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.010000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	25.00	ft
Discharge	445.00	cfs

Results		
Depth	2.00	ft
Flow Area	65.95	ft^2
Wetted Perimeter	41.48	ft
Top Width	40.99	ft
Critical Depth	1.92	ft
Critical Slope	0.011493	ft/ft
Velocity	6.75	ft/s
Velocity Head	0.71	ft
Specific Energy	2.71	ft
Froude Number	0.94	
Flow is subcritical.		

Quick TR-55 Ver.5.46 S/N:
Executed: 10:13:30 05-22-1997

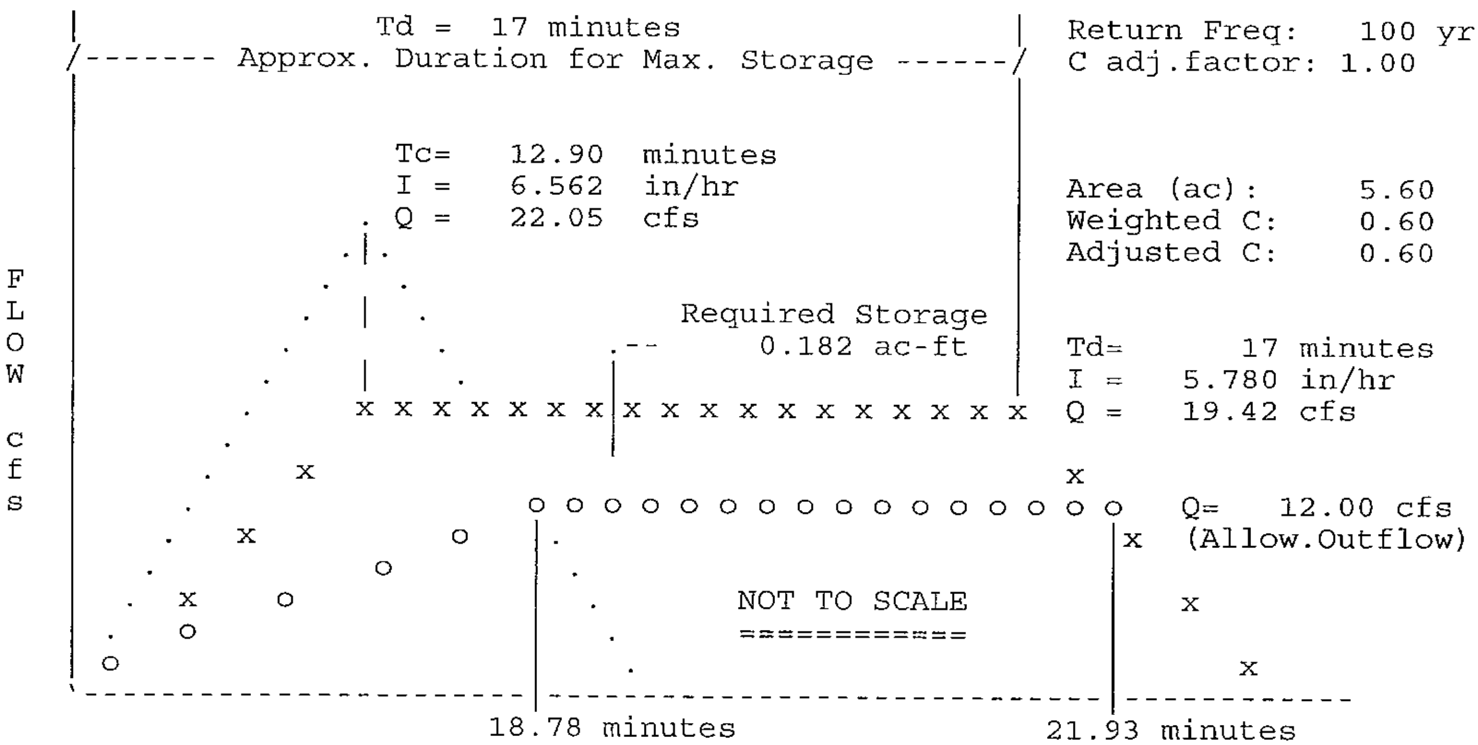
MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

TEMPORARY HISTORIC DETENTION FACILITY

RETURN FREQUENCY: 100 yr	Allowable Outflow: 12.00 cfs
'C' Adjustment: 1.000	Required Storage: 0.182 ac-ft
Peak Inflow: 19.42 cfs	Inflow .HYD stored: NONE STORED



Quick TR-55 Ver.5.46 S/N:
Executed: 10:13:30 05-22-1997

TEMPORARY HISTORIC DETENTION FACILITY

**** Modified Rational Hydrograph *****

Weighted C = 0.600 Area= 5.600 acres Tc = 12.90 minutes

Adjusted C = 0.600 Td= 17.00 min. I= 5.78 in/hr Qp= 19.42 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time increment = 0.017 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.015	1.35	2.86	4.37	5.87	7.38	8.88	10.39
0.132	11.89	13.40	14.90	16.41	17.92	19.42	19.42
0.248	19.42	19.42	19.42	18.07	16.56	15.05	13.55
0.365	12.04	10.54	9.03	7.53	6.02	4.52	3.01
0.482	1.51	0.00					

Quick TR-55 Ver.5.46 S/N:
Executed: 10:13:30 05-22-1997

TEMPORARY HISTORIC DETENTION FACILITY

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
A	0.600	5.60						
			12.90	0.600	0.600	6.562	5.60	22.05

Quick TR-55 Ver.5.46 S/N:
Executed: 10:13:30 05-22-1997

```
***********************************************************************
***********************************************************************
*                                                                     *
*                                                                     *
*                     MODIFIED RATIONAL METHOD                        *
*          ---- Grand Summary For All Storm Frequencies ----          *
*                                                                     *
*                                                                     *
***********************************************************************
***********************************************************************
```

First peak outflow point assumed to occur at Tc hydrograph recession leg.

TEMPORARY HISTORIC DETENTION FACILITY

Area = 5.60 acres Tc = 12.90 minutes

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES Inflow (ac-ft)	Storage (ac-ft)
100	0.600	17	5.780	19.42	12.00	0.455	0.182

Quick TR-55 Ver.5.46 S/N:
Executed: 10:13:30 05-22-1997

MODIFIED RATIONAL METHOD

---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

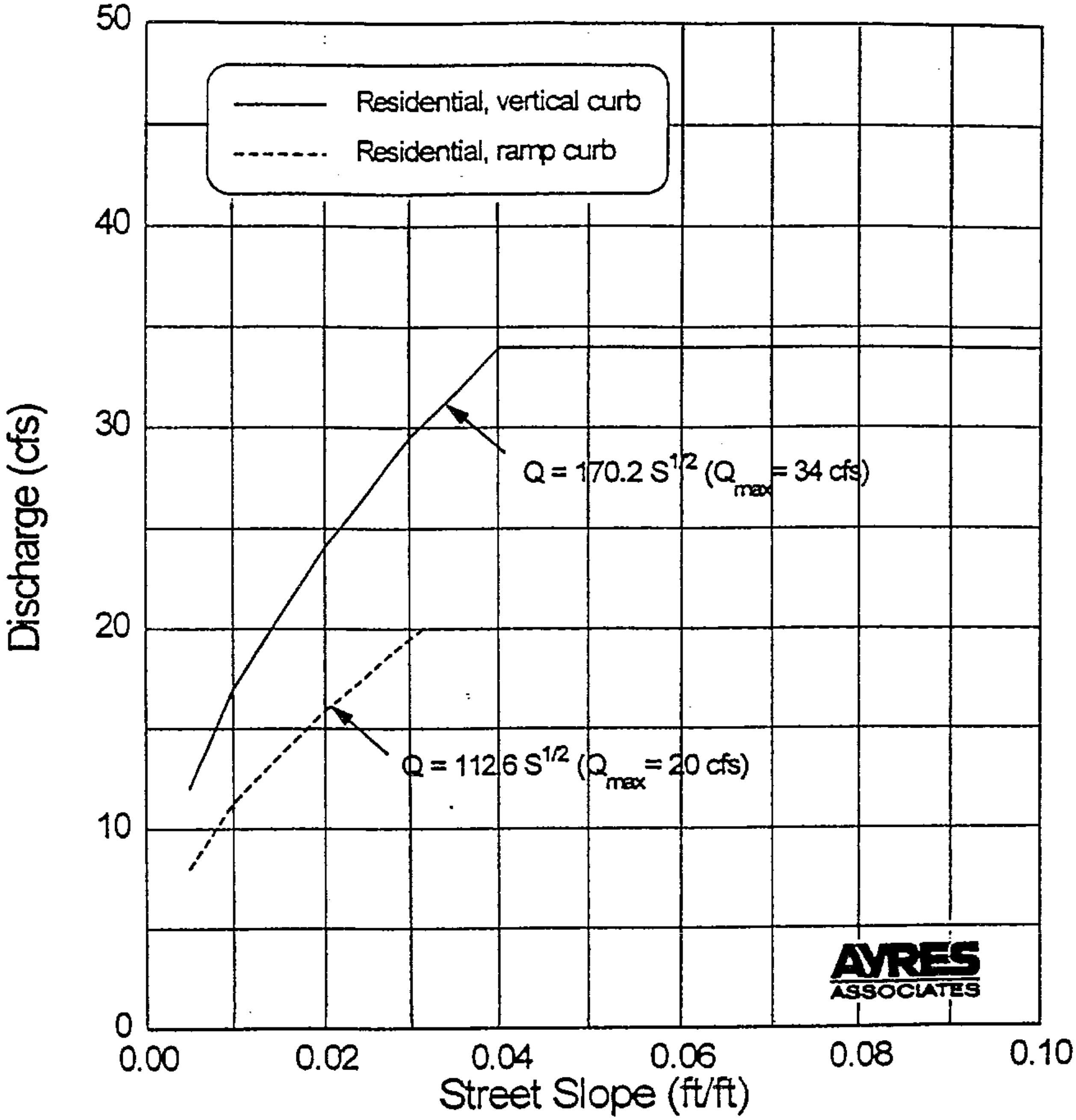
TEMPORARY HISTORIC DETENTION FACILITY

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 12.00 cfs

Hydrograph file: NONE STORED Tc = 12.90 minutes

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES Inflow (ac-ft)	Storage (ac-ft)
0.600	0.600	13	6.562	5.60	22.05	0.392	0.179
0.600	0.600	15	6.100	5.60	20.50	0.423	0.180
						Storage Maximum	
0.600	0.600	17	5.780	5.60	19.42	0.455	0.182
0.600	0.600	20	5.300	5.60	17.81	0.491	0.174
0.600	0.600	30	4.200	5.60	14.11	0.583	0.120
0.600	0.600	40	3.500	5.60	11.76	Qpeak < Qallow	

RESIDENTIAL STREET (34' Flowline to flowline)



Interim Release October 12, 1994
City of Colorado Springs

Use this graph to determine the allowable street capacity per side, initial storm, for the typical street section using a 2% crown.

JR Engineering, Ltd.

CLIENT RMC / Wiepking JOB NO. 8639.25/50

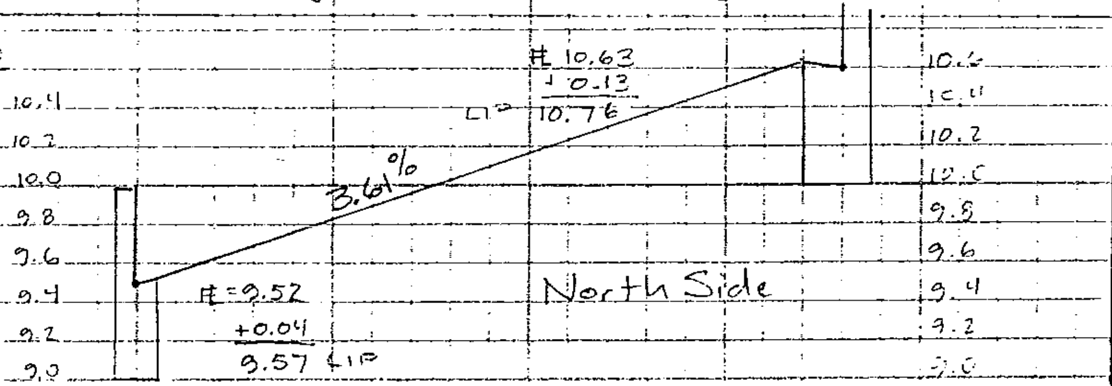
PROJECT Trail Ridge at Northgate BY BES CHK. BY DATE 5/20/97

SUBJECT Voyager Parkway – Street Capacity Calcs. SHEET NO. 1 OF 3

...rt Side Superelevated Regions	Liberty Heights Bndy Sta: 53+00 +/- to 62+18.00 → FULL SUPER (3.60%)
	S / N
	Sta. 62+18.00 to Sta. 65+18.00 → Transition to Mid Runout 2% / 0%
	Sta. 65+18.00 to Sta. 67+06.00 +/- (per scaling) → Transition to Normal Crown Section; 75+77+97 to 78+77.97 Trans. to Super; 78+77.97 → Full Super
Inlet Structure	Existing → Median At Grade Inlet (12'), 6" opening – D19 inlet @ Sta 63+57.07 per URS plans : Cross slope = ~2.15% towards median.
Ct.3 Assump.	Type 1 Ct.3 (Assumed to be "carry") / Type 3 Ct.3 (Assumed to be "carry") → Superelevated Areas (Seems to be close to x-slopes called on plans)
Lane Config.	Phase 2B (Existing) does not include Accel/Decel lanes thus 36' +/- section adjacent to RMC/Wiepking sites.

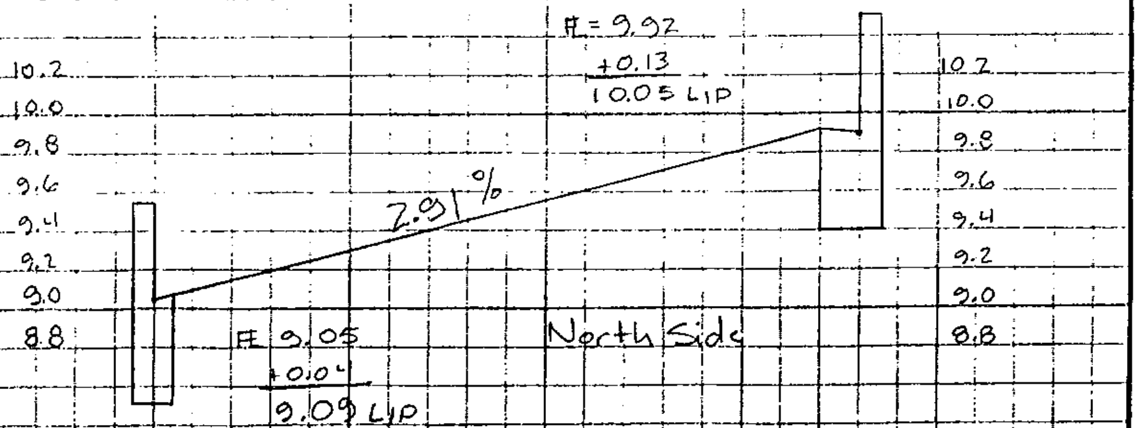
X-section West of Wiepking entrance

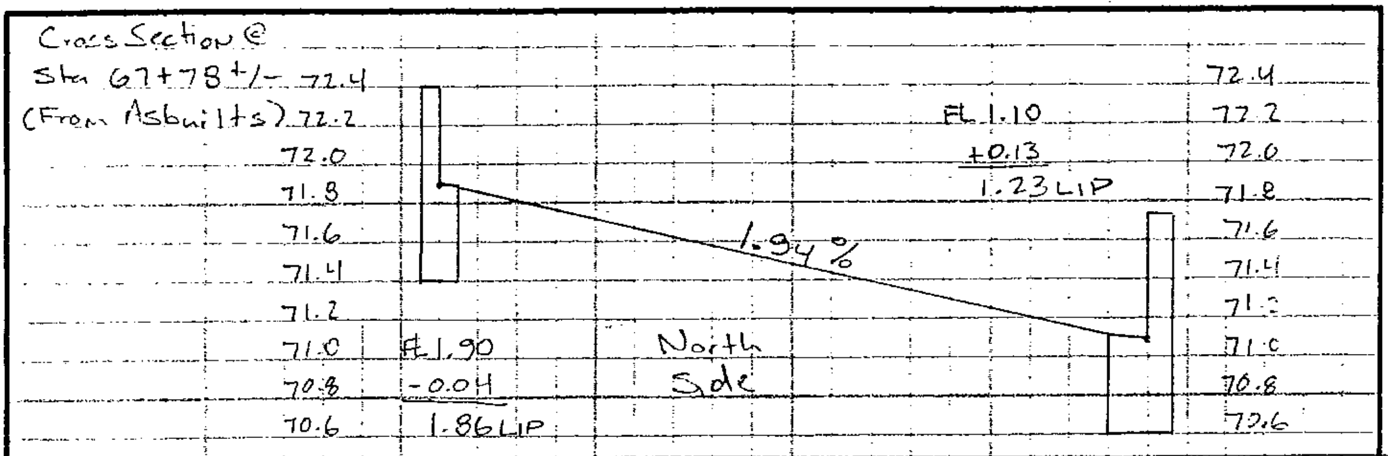
Cross Section @ 67+69 +/- (From Asbuilts)

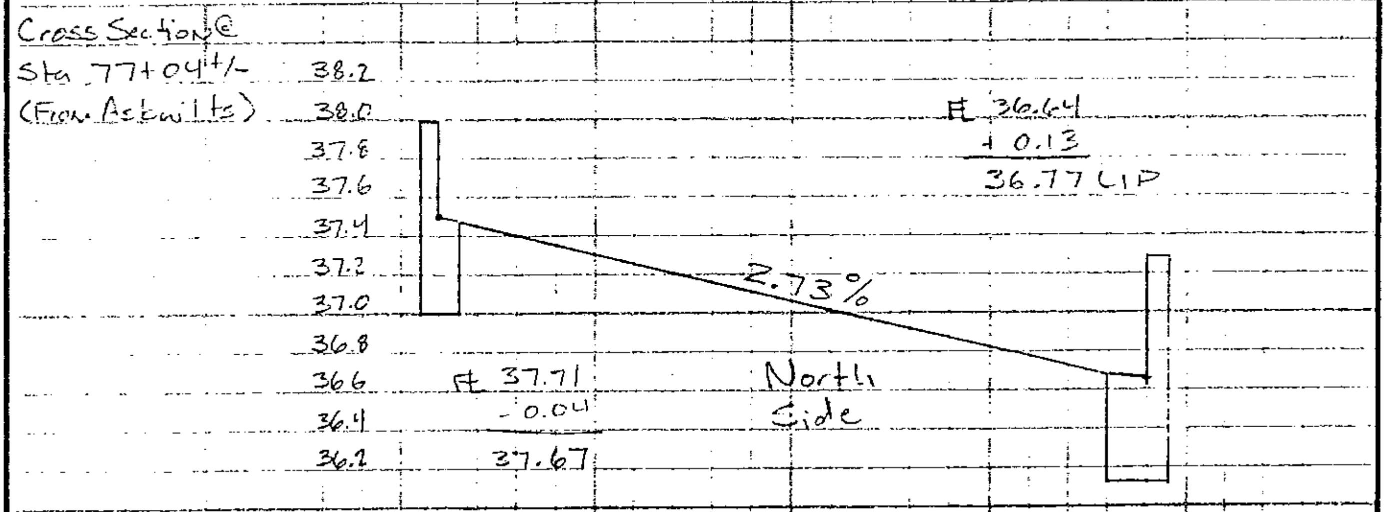


X-section ... D-19 Inlet (12')

Cross Section @ 63+57 +/- (From Asbuilts)







Criteria: Initial Storm 6" depth max, *34 cfs max, one 10 ft lane open
(Arterial)

Major Storm 8" depth max

X-SECTION	Q_5 Cap	Q_{100} Cap	Street Slope
(1) 57+69	20	44	1.65% +/-
(2) 63+57	* 34 MAX	80	4.07% +/-
(3) 67+78	* 34 MAX	89	4.18% +/-
(4) 77+04	22	53	2.54% +/-

JR Engineering, Ltd.

CLIENT RMC / Wiepking JOB NO. 863?5/30

PROJECT Trail Ridge at Northgate BY BES CHK. BY ______ DATE 5/20/97

SUBJECT Voyager Parkway - Street Capacity Calcs SHEET NO. 3 OF 3

Mod. Izzards Eq.

Voyager Parkway - Arterial Street Capacity Calculations

57+69
$Z_A = 27.70$
Z_B 25.00
5yr Storm (6" Depth)
100yr Storm (8" Depth)
Assume Median @ 8"

$Q_A = 0.56\left(\frac{27.7}{0.016}\right)(0.46)^{8/3}(s)^{1/2} = 122 s^{1/2}$

$Q_B = 0.56\left(\frac{25.0}{0.016}\right)(0.50^{8/3} - 0.46^{8/3})(s)^{1/2} = 28 s^{1/2}$

→ $150 s^{1/2}$ Initial

$Q_A = 0.56\left(\frac{27.7}{0.016}\right)(0.62^{8/3})(s)^{1/2} = 283 s^{1/2}$

$Q_B = 0.56\left(\frac{25.0}{0.016}\right)(0.67^{8/3} - 0.63^{8/3})(s)^{1/2} = 46 s^{1/2}$

→ $329 s^{1/2}$ Major

63+57
$Z_A = 34.36$
$Z_B = 25.00$
5yr Storm (6" Depth)
100yr Storm (8" Depth)
Assume Median @ 8"

$Q_A = 0.56\left(\frac{34.36}{0.016}\right)(0.46)^{8/3}(s)^{1/2} = 152 s^{1/2}$

$Q_B = 0.56\left(\frac{25.00}{0.016}\right)(0.50^{8/3} - 0.46^{8/3})(s)^{1/2} = 28 s^{1/2}$

→ $180 s^{1/2}$ Initial

$Q_A = 0.56\left(\frac{34.36}{0.016}\right)(0.63^{8/3})(s)^{1/2} = 351 s^{1/2}$

$Q_B = 0.56\left(\frac{25.0}{0.016}\right)(0.67^{8/3} - 0.63^{8/3})(s)^{1/2} = 46 s^{1/2}$

→ $397 s^{1/2}$ Major

67+78
$Z_A = 51.55$
$Z_B = 16.00$
5yr storm (6" Depth)
100yr storm (8" Depth)

$Q_A = 0.56\left(\frac{51.55}{0.016}\right)(0.37)^{8/3}(s)^{1/2} = 127 s^{1/2}$

$Q_B = 0.56\left(\frac{25.00}{0.016}\right)(0.50^{8/3} - 0.37^{8/3})(s)^{1/2} = 76 s^{1/2}$

→ $203 s^{1/2}$ Initial

$Q_A = 0.56\left(\frac{51.55}{0.016}\right)(0.54^{8/3})(s^{1/2}) = 349 s^{1/2}$

$Q_B = 0.56\left(\frac{16.00}{0.016}\right)(0.67^{8/3} - 0.54^{8/3})(s)^{1/2} = 84 s^{1/2}$

→ $433 s^{1/2}$ Major

77+04
$Z_A = 36.63$
$Z_B = 16.00$
5yr storm (6" Depth)
100yr Storm (8" Depth)

$Q_A = 0.56\left(\frac{36.63}{0.016}\right)(0.37)^{8/3}(s)^{1/2} = 91 s^{1/2}$

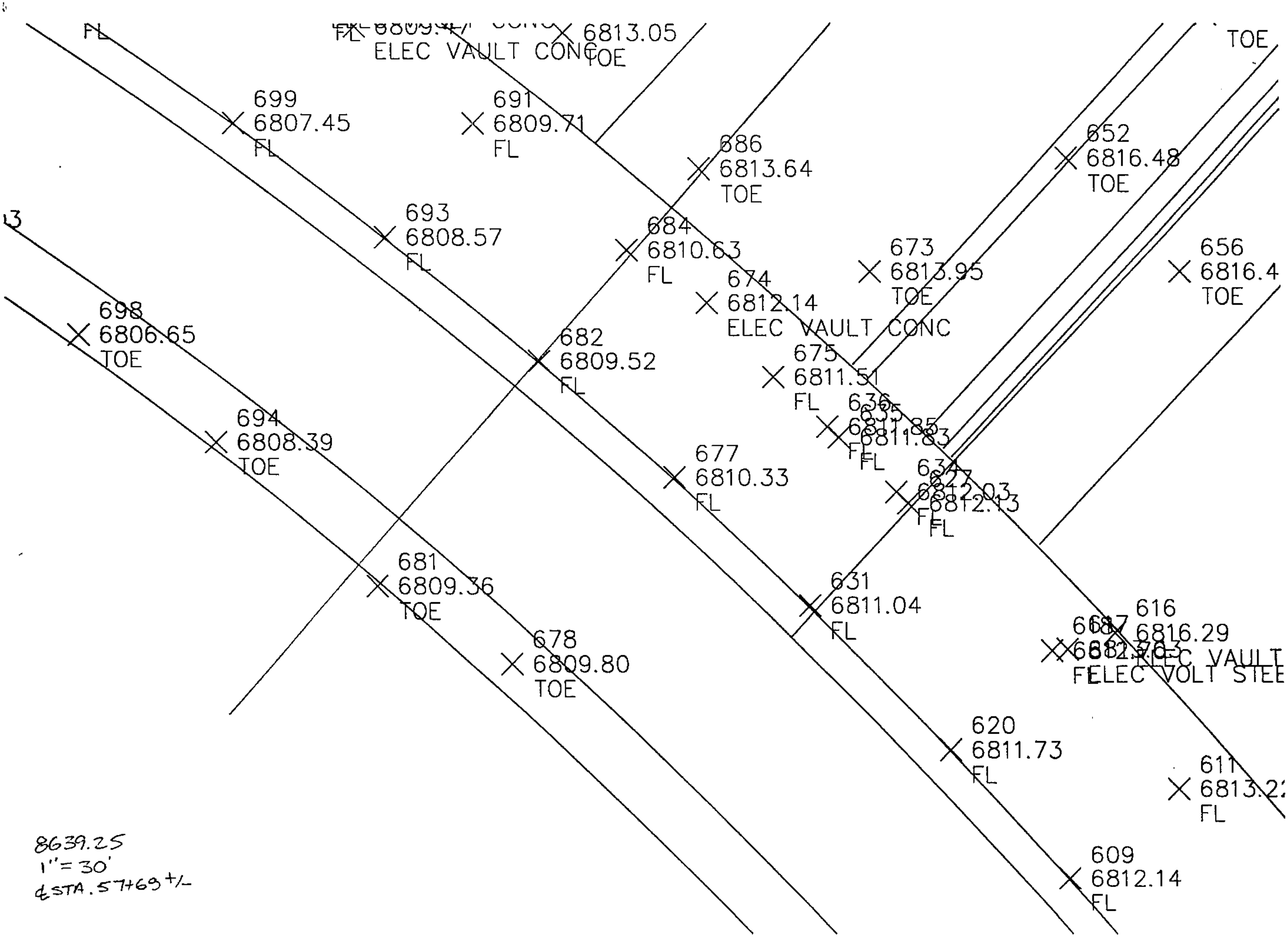
$Q_B = 0.56\left(\frac{16.0}{0.016}\right)(0.50^{8/3} - 0.37^{8/3})(s)^{1/2} = 49 s^{1/2}$

→ $140 s^{1/2}$ Initial

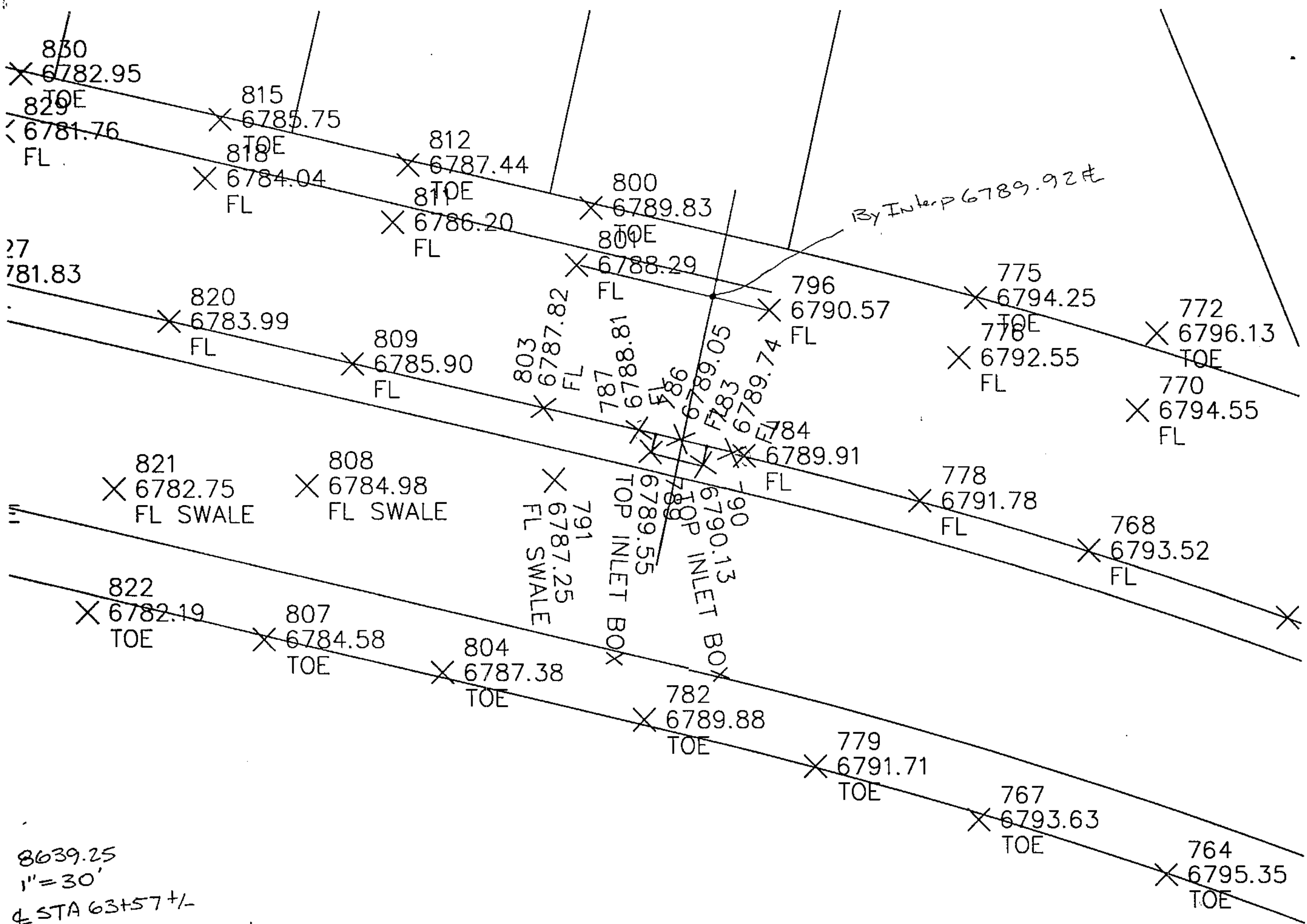
$Q_A = 0.56\left(\frac{36.63}{0.016}\right)(0.54^{8/3})(s)^{1/2} = 248 s^{1/2}$

$Q_B = 0.56\left(\frac{16.0}{0.016}\right)(0.67^{8/3} - 0.54^{8/3})(s)^{1/2} = 84 s^{1/2}$

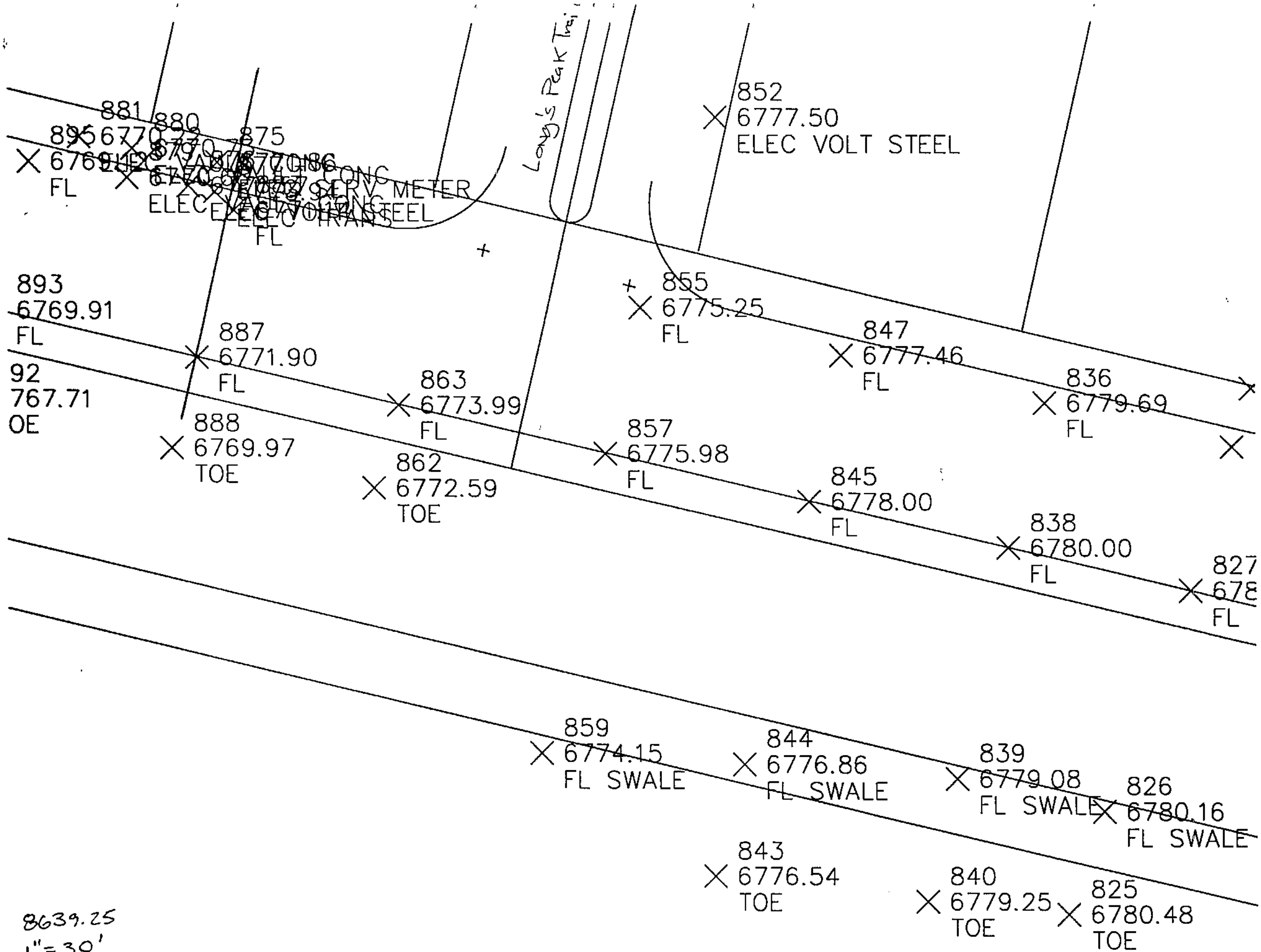
→ $332 s^{1/2}$ Major



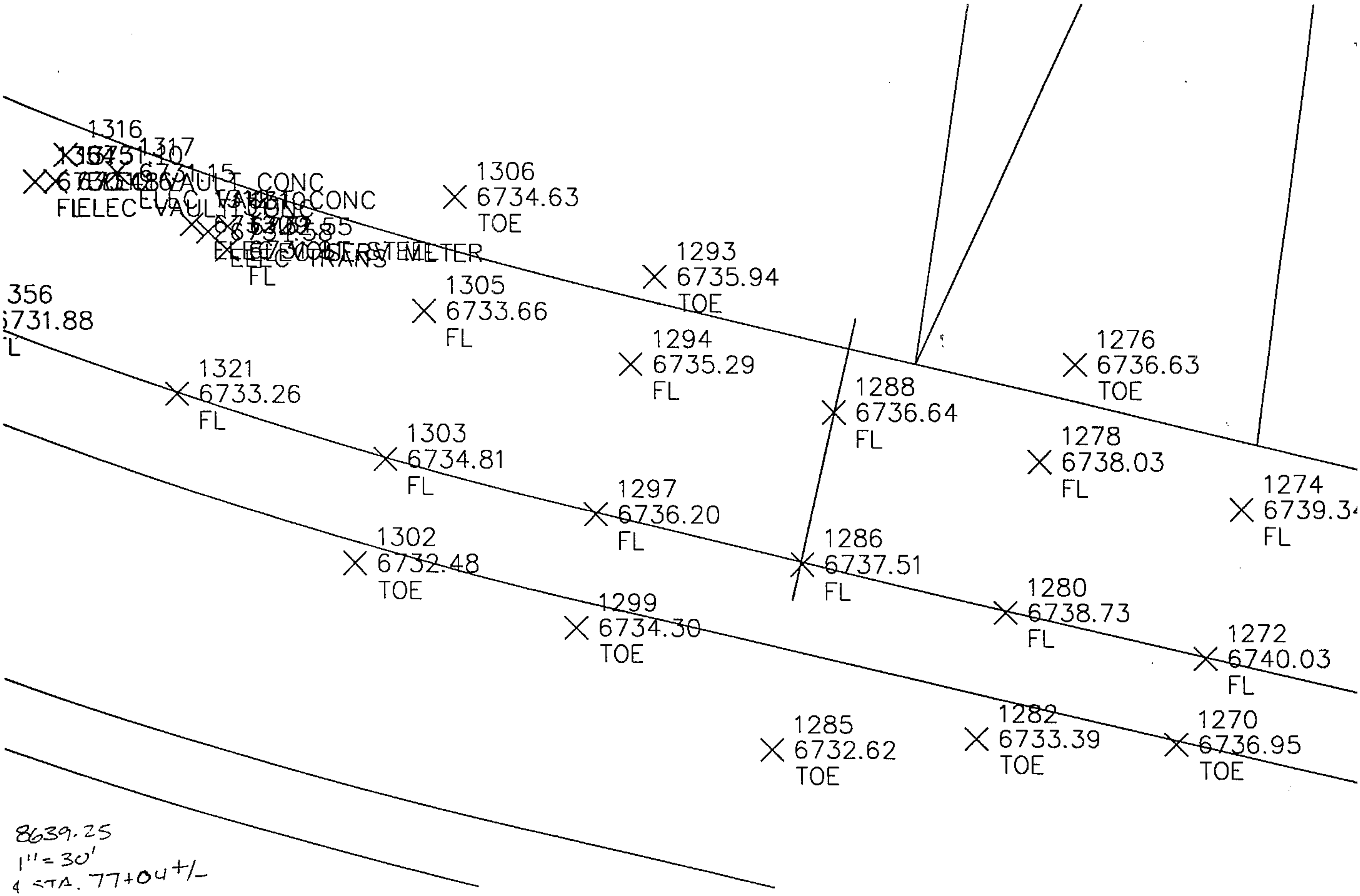
8639.25
1" = 30'
℄ STA. 57+69 +/-



8639.25
1" = 30'
℄ STA 63+57 +/-
Existing 12' D-19 Inlet



8639.25
1" = 30'
℄ STA. 67+78 +/-
(West of RMC Entrance 80')



1316
1317
1356
6731.88
1306
6734.63
TOE
1293
6735.94
TOE
1305
6733.66
FL
1294
6735.29
FL
1276
6736.63
TOE
1321
6733.26
FL
1288
6736.64
FL
1278
6738.03
FL
1303
6734.81
FL
1297
6736.20
FL
1274
FL
1302
6732.48
TOE
1286
6737.51
FL
1280
6738.73
FL
1299
6734.30
TOE
1272
6740.03
FL
1285
6732.62
TOE
1282
6733.39
TOE
1270
6736.95
TOE
8639.25
1" = 30'
℄ STA. 77+04 +/-

DRAINAGE MAPS