

B. HYDRAULICS

1. General: Hydraulic computations are included in this section for all storm sewers, major and minor greenbelts. Lined drainage swales are shown on the enclosed drainage plan as representative only and are not designed herein.

2. Greenbelt: The following is a summary of the major greenbelt design flows.

<u>Hydrograph Point</u>	<u>Design Control Point</u>	<u>Design Runoff CFS</u>	<u>Undeveloped Runoff CFS</u>
1-----		158.4-----	212.5
	1	158.4	212.5
	2	166.2	234.5
2-----		167.4-----	256.0
	3	118.7	266.6
3-----		313.5-----	289.6
	4	315.4	343.7
	5	326.7	396.1
	6	349.8	471.1
	7	383.7	596.8
4-----		401.1-----	616.1
	8	411.6	651.5
	9	439.3	662.5
	10	471.8	677.2
	11	514.2	687.0
	12	544.3	718.6
5-----		640.4-----	735.6

The greenbelt design flows below the dam are controlled by the outlet works of the dam, since emergency releases will govern over spillway discharges.

Since the flows within the majority of this greenbelt are below those of the natural, undeveloped, state, no drainage facilities other than at road crossings are proposed. Special considerations must be given to control inlet flows to prevent bank erosion. Lined channels and gabion drop structures are specified where erosion within the primary greenbelt is considered possible.

The following are the principal minor greenbelt design flows:

<u>Area</u>	<u>Location</u>	<u>Design Flow-CFS</u>
IV	13	114.2
	14	114.2
V	pT6	128.2/105.0
	15	105.0
	16	141.1
	17	155.5
	18	170.8

<u>Area</u>	<u>Location</u>	<u>Design Flow-CFS</u>
XIII	19	178.3
	20	192.4
	C	31.2
	D	51.5
	Outfall	51.5

The following are the allowable spacings for 6-foot drop gabion units in the minor greenbelt, where erosion control is considered mandatory.

<u>Point</u>	<u>Natural Slope</u>	<u>Allowable Slope</u>	<u>Spacing</u>
From-To	%	%	Ft.
VI-15	2.81	1.00	331
15-16	2.95	1.00	308
16-17	2.79	1.00	335
17-18	2.34	1.00	448
18-19	2.22	1.00	492
19-20	1.82	1.00	732

The following are the capacities of the existing culverts near the outfall point of the primary basin. This analysis is based on detailed as-builts in previous basin studies, which conflict with information on other plans.

<u>Culvert Location</u>	<u>Type</u>	<u>Capacity-CFS</u>	<u>Required head-FT</u>
D & R.G.Railroad	10'x10' Stone Arch	900.45*	2.87
Cascade Avenue	10'x10' Conc. Arch	812.85*	3.20
I-25	10'x10' R.C.B.	2544.1*	11.00

* Because of the interrelation of these culverts, the capacity will be limited by the tailwater depths, which will limit the effective head. It may be concluded that a maximum of 1400 CFS will be contained by the three culverts without overtopping existing roadways.

The outlet works of the dam is limited in design so that emergency reservoir releases will not overtop the roadways below. Two 60-inch RCP culvert are tentatively provided with Howell-Bunger valves or other energy dissipator means. The reservoir can then be drained, under no inflow conditions, in about 21-1/2 hours.

The culvert on lower Rockrimmon Boulevard is designed for the 1400 CFS maximum release, a 10-foot by 7-foot reinforced concrete box being provided.

The above structures below the major dam are subject to redesign under detailed studies related to emergency release criteria for the dam.

3. Monument Creek: A detailed study of the Monument Creek channel has been made to determine its capability of withstanding the predicted 100 year storm of the Corps of Engineers. It has been requested that the channel be left in its existing state, and this request has been approved by the City Engineer and the City Drainage Board. This will require controlled drainage inlets to prevent bank erosion in susceptible areas, similar to that shown on the enclosed Plate C1.

A portion of the area in the Southeast part of the flood plain is applicable to the proposed City Flood Plain ordinance pertaining to Floodway Fringe Zoning. This area is so designated on Plate C1. Riprap to provide the prescribed flood protection elevation is shown and included in the cost estimate. It should be noted that the costs (\$ 34,705) attributed to reclaiming this 3.64 Acre parcel may prohibit its development.

HYDRAULIC COMPUTATIONS
BASIN AS PROPOSED
(12 SHEETS)

Street and Storm Sewer Calculations

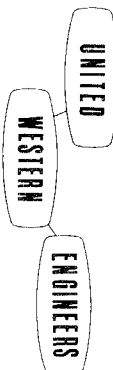
STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
Delmonico Blvd.	XII A			21.2	21.2/30.0		
	XII B-halfway	580	6324 2.41%	30.0	0/30.0	30.0 30.0	2-10' CB 27"CMP @ 1% 30"CMP @ 1.83% min.
	XII B	680	6310 5.88%	41.2	11.2/30.0	30.0	24"CMP @ 6.00% min.
	XIII F	560	6270 2.14%	58.1	28.1/30.0	58.1	2-10' CB 27"CMP @ 1% 42"CMP @ 1.14% min.
	XIII G	240	6258 15.0%	76.1	18.0/30.0	58.1	24"CMP @ 22.5% min.
	Outfall		6222		0/30.0		Dissipator



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 Calc. by O. E. Watts date
 Checked by date

Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
I	I _B in.	1460'	6727.5 0.0408	76.0	76.0/84.5		
	I _B cent.	1030'	6668 0.0485	102.0	60.0/92.4	42	2-16' CB, w/30" CMP (60%) 1030'-30" CMP-3.57% min
	I _c cent.-1	280'	6618 .0071	108.0	22.0/34.9	86	2-12' CB, w/30" CMP (100%) 280'-54" CMP-0.65% min.
	I _c cent.-2	460'	6616 .0478	132.0	46/91.4	86	460'-42" CMP-2.92% min.
	I _c final	715'	6594 0.0224	144.0	58/63.2	86	715'-48" CMP-1.22% min.
	I _D outfall	225'	6578 0.0533	144.0	0.01 -	144.0	2-16', CB w/36" CMP 225'-48" CMP-3.43% min
	I _D greenbelt		6566				



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 Calc. by N. H. Patel date 10-12-72
 Checked by O. E. Watts date 12-72

Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
II	II C	1160'	6650 .0517	90.3	90.3/95.1		
	II D	690'	6590 .0471	108.9	73.9/90.4	35	2-16' CB, w/30" CMP (50%) 690'-30" CMP-2.48% min.
	II D cent.	720'	6557.5 .0396	147	77.0/83.4	70	2-16' CB, w/30" CMP (50%) 720'-36" CMP-3.75% min.
	II E cent.	490'	6529 .0469	162.2	22.2/90.4	140	2-16' CB, w/36" CMP (100%) 490'-48" CMP-3.24% min.
	II Ef		6506			(162.2) +38.7 =200.9	2-10' CB, w/24" CMP (70%) 38.7 cfs. direct from III L
		340'	.0471 6490	200.9	0.0/-		340'-54" CMP-3.56% min.
	III G cent.		6501			38.7	2-12' CB, w/27" CMP
	III L final	380	0.0	38.7			385'-54" CMP-0.13% min.
	II E final		6506				

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 Calc. by N. H. Patel date 10-11-72
 Checked by O. E. Watts date 12-72

Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
Rockrimmon Blvd. IV	IV B in.		6501	25.1			
		585'	0.0547	45.4	23.4/30.0	22.0	2-12'CB,w/24"CMP(50%)
	IV B final		6469				585'-24"CMP-3.22% min
		395	0.0456	61.6	27.6/30.0	34.0	2-8CB/21"CMP(50%)
	IV C final		6451				395'-30"CMP-2.34% min
		205	0.0536	66.5	26.9/30.0	39.6	2-4'CB,w/18"CMP(50%)
	IV D final		6440				205'-30"CMP-3.17% min
		300	0.0267	71.5	19.9/30.0	51.6	2-8'CB,w/21"CMP(50%)
	IV E cent.		6432				300'-36"CMP-20.4% min
						118.8	67.2cfs direct from 36"CMP
		195	0.0615	143.7	24.9/30.0		195'-42"CMP-5.55% min
	IV E final		6420			124.4	2-4'CB,w/18"CMP(50%)
		280	0.0357	147.8	23.4/30.0		280'-48"CMP-2.56% min
	IV F final		6410			158.4	2-12'CB,w/30"CMP(78%)
		100	0.085	158.4	0.0/-		100'-42"CMP-8.44% min
	IV G final- ditch		6401.5				
	IV K final		6460			67.2	2-16' w/36" CMP
		615	0.0455	67.2			615'-36"CMP-3.46% min
	IV E cent		6432				

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 Checked by O. E. Watts date 12-72

Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
IV Rockrimmon Blvd	IV M initial		6455	10.0			
		215	0.0372	17.4	17.4/31.6		
	IV M cent.		6447			17.4	2-8'CB,w/24"CMP(100%)
		350	0.0400	35.4	18.0/32.8		350'-24"CMP-2.02% min
	IV o cent.		6433			35.4	2-8'CB,w/24"CMP(100%)
		700'	0.0357	65.8	30.4/79.1		700'-30"CMP-2.54% min
	V c cent.		6408			51.4	2-10'CB,w/21"CMP(50%)
		590'		79.3	27.9/30.0		590'-36"CMP-2.02% min
	V D-ditch		6370			79.3	2-10'CB,w/27"CMP(100%)

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Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW/ CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
Del monico Blvd - X	X A initial		6415	0			
	X A final	595	0.0319				
		505	6396	19.3		16.0	2-10'CB,w/21"CMP(50%)
	X B final		0.0218		28.5/30.0		505'-24"CMP-1.71% min
		390	6385	44.5		38.0	2-12'CB,w/24"CMP(50%)
	X C final		0.0205		28.8/30.0		390'-36"CMP-1.11% min
		240	6377	66.8		46.4	2-6'CB,w/18"CMP(50%)
	X D final		0.0104		28.8/30.0		240'-42"CMP-0.85% min
		670	6374.5	75.2		68.4	2-12'CB,w/24"CMP(50%)
	X F final		0.0343		26.9/30.0		670'-42"CMP-1.84% min
			6351.5	95.3		95.3	2-10'CB,w/27" CMP
	IX G-drainage ditch	345	0.0188		95.3/-		345'-48"CMP-1.50% min
			6345.0	95.3			

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Street and Storm Sewer Calculations

STREET	LOCATION	DIST	ELEVATION & SLOPE	TOTAL RUNOFF	STREET FLOW/ CAPACITY	PIPE FLOW	TYPE PIPE, CATCH BASIN & SLOPE %
Rockrimmon Blvd.	XIV A			22.0			
	XIV A final		6324				
		310	0.0565	32.3	16.3/30.0	16.0	2-10'CB,w/21"CMP(50%)
	XIV B final		6306.5				310'-21"CMP-3.48% min
		465	0.0409	41.6	25.6/30.0	16.0	465'-21"CMP-3.48% min
	XIV C final		6287.5				
		375	0.0987	41.6	0.0/-	41.6	2-10'CB,w/27"CMP(78%)
	XIII D - in ditch		6250				375'-30"CMP-3.5% min

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 Calc. by N. H. Patel date 10-16-72
 Checked by O. E. Watts date 12-72

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
IVa- final	13	6401.5								
	590	0.0466	0.21589	114.23	4.11	1.70	5.78	3' x 3'		0.008
	14	6374								
	130	0.04615	0.21483	128.25	4.64	1.78	6.337	3' x 3'		0.002
										0.010
	Pt. VI	6368								
	178	0.02809	0.16760	105.00	4.869	1.81	6.552		48"RCP A=12.566 ft ²	0.006
	15	6363								
	305	0.02951	0.17178	141.13	6.385	2.01	8.080	4' x 3'		0.005
	16	6354								
V _L	520	0.02788	0.16699	155.53	7.239	2.10	8.82	4' x 3'		0.008
	17	6339.5								
	530	0.02358	0.15357	170.75	8.641	2.25	10.125	4' x 3'		0.009
	18	6327								
	135	0.02222	0.14907	178.34	9.298	2.31	10.672	4' x 3'		0.002
	19	6324								
	220	0.01818	0.13484	192.35	11.087	2.47	12.202	4' x 3'		0.004
	20	6320								0.034 used 0.023

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 Calc. by N. H. Patel date 12-22-72
 Checked by O. E. Watts date 12-72

Culvert & Channel Calculations

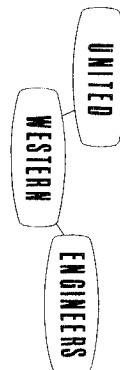
AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q 50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
XII	C-begin	6255								
	650'	0.01077	0.10378	31.2	2.337	1.38	3.809	3 x 2		
	D-end	6248								
	965'	0.01036	0.10178	51.5	3.933	1.67	5.578	3 x 2		
	RR Blvd	6238								
	200'	0.10500	0.32404	51.5	8.238	2.22			30" CMP	
	RR Blvd	6217								
	220'	0.0500	0.22361	51.5	1.790	1.25	3.125	3 x 2		
	Greenbelt	6206								

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 Calc. by O. E. Watts date 12-72
 Checked by date

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
XVI B	Hwy.R.O.W. 350'	N 4.0% use 3.5 min.	0.1871	32.5	1.35	1.12	2.51	1.5'x2.0'	127.8	12"
	Flood plain				D-8/3= 4.88	D=1.81		24"RCP	42.3	
XVI E	RR 18" pipe 320	N 3.4% use 3.0 min	0.1732	55.7	2.50	1.41	3.98	1.5'x2.5'	190.1	12"+
	Rd.culvert				D-8/3= 9.03	D=2.28		30"RCP	71.0	



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 Calc. by B.E.J. date 3-13-73
 Checked by date

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
I-D	Point I	6551								
	490	4.2857	0.2070	158.39	5.947	1.95	7.605	3'x3'*		0.007
	1	6530								
	480	2.9167	0.1708	166.21	7.563	2.14	9.159	3'x3'*		0.007
	2	6516								
	180	1.6667	0.1291	167.37	10.076	2.38	11.329	3'x3'*		0.003
										=0.017
IIIG	Point II	6513								used
	340	4.4118	0.2100	118.72	4.394	1.74	6.055	4'x2'		0.042
	3	6498								0.005
	740	3.7838	0.1945	313.49	12.527	2.58	13.313	4'x3'*		0.009
									8'x3'RCB	=0.014
IIIG	Point III	6470								used
	310	3.2258	0.1796	315.41	13.649	2.66	14.151	4'x3.5'*		0.012
	4	6460								0.004
	300	3.3333	0.1826	326.74	13.907	2.68	14.365	4'x3.5'*		0.004
	5	6450								
	430	3.0233	0.1739	349.79	15.633	2.80	15.680	4'x3.5'*		0.005
	6	6437								
	720	2.5000	0.1581	383.66	18.860	3.01	18.120	4'x4'*		0.009
	7	6419								
	110	1.8182	0.1348	401.07	23.124	3.25	21.125	4'x4'*		0.002
									7'x4'RCB	=0.024
VIIIG	Point*IV	6417								used
										0.023
*Runoff is less than natural state-leave channel in natural condition, see next page.										

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
VIII G	Point IV	6417								
	1090	3.3027	0.1817	411.63	17.607	2.93	17.170	4'x4'*		0.013
	8	6381								
	340	2.6471	0.1627	439.26	20.983	3.13	19.594	4'x4'*		0.004
	9	6372								
	450	2.0000	0.1414	471.82	25.933	3.39	22.984	4'x4'*		0.006
	10	6363								
	300	3.0000	0.1732	514.25	23.076	3.24	20.995	4'x4'*		0.003
	11	6354								
	980	1.9388	0.1392	544.34	30.392	3.60	25.920	5'x4'*		0.013
IX G	12	6335								
	520	3.2692	0.1808	640.35	27.527	3.47	24.082	5'x4'		0.005
	Point V	6318								<div> <div>=0.044</div> <div>used</div> <div>0.032</div> </div>
*Runoff is less than in natural state-leave channel in natural condition. Sizing of fully lined sections are for conservative hydrograph computations only.										

UNITED WESTERN ENGINEERS

Project Rockrimmon North
 Calc. by N. H. Patel date 11-28-72
 Checked by O. E. Watts date 11-28-72

HYDRAULIC COMPUTATIONS
BASIN WITH NO STAGING CONSIDERED
FOR COMPARITIVE PURPOSES ONLY
GREENBELTS ONLY
(3 sheets)

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q 50	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
Major Green- belt	I	6551								
	490	4.29	0.2070	225.9	8.482	2.23	9.95	3 x 3		
	1	6530								
	480	2.92	0.1708	245.2	11.157	2.47	12.20	3 x 3.5		
	2	6516								
	180	1.67	0.1291	264.1	15.90	2.82	15.90	4 x 3.5		
	II	6513		8						
	340	4.41	0.2100	346.2	12.81	2.60	13.52	3 x 3.5		
	3	6498								
	740	3.78	0.1945	524.9	20.97	3.13	19.59	4 x 4		
	III 69	6470							8x5RCB	
	310(246)	3.23	0.1796	548.5	23.74	3.28	21.52	4 x 4		
	4	6460								
	300	3.33	0.1826	571.3	24.32	3.31	21.91	4 x 4		
	5	6450								
	430	3.02	0.1739	604.0	26.99	3.44	23.67	5 x 4		
	6	6437								
	720	2.50	0.1581	658.8	32.39	3.69	27.23	5 x 4.5		
	7	6419								
	110	1.82	0.1348	667.2	38.47	3.93	30.89	5 x 5		
	IV 116	6417							8x6RCB	
	1090(974)	3.30	0.1817	686.5	29.36	3.55	25.21	5 x 4.5		
	8	6381								
	340	2.65	0.1627	692.5	33.08	3.75	28.12	5 x 4.5		
	9	6372								
	450	2.00	0.1414	700.5	38.50	3.93	30.89	5 x 5		
	10	6363								
	300	3.00	0.1732	705.8	31.67	3.65	26.64	5 x 4.5		
	11	6354								
	980	1.94	0.1392	723.1	40.37	4.00	32.00	5 x 5		
	12	6335								

Culvert & Channel Calculations

AREA	LOCATION & DISTANCE	ELEV & S %	S 1/2	Q ₅₀ 100	b 8/3	b	S F AREA	USE DITCH	CULVERT ETC.	TIME HRS
Major Green- belt	12	6335								
	520	3.27	0.1808	732.3	31.48	3.65	26.64	4 x 4.5		
	V	6318								
	1820	3.08	0.1754	899.5	39.86	3.99	31.84	5 x 5		
	Junct Pt.	6262								
	550	1.45	0.1206	1353.8	87.24	5.34	57.63	6 x 6		
	X	6254								
	2080	1.73	0.1315	1507.6	89.10	5.39	58.10	6 x 6		
	RR Blvd 146	6218							10x9RCB	
	(594)740	1.62	0.1273	1562.3	95.38	5.52	60.94	6 x 6.5	10x9RCB	x160'
	@track:XI culv.	6206								
IV H	14			Q50						
	VI	Same as previous calc's, 128.2								
	178	6368							54" CMP	
V H	16	2.81		164.3						
	520	6354								
	17	2.79	0.1670	178.7	8.32	2.21	9.77	3 x 3		
	530	6339.5								
	18	2.36	0.1536	194.0	9.82	2.36	11.14	3 x 3		
	135	6327								
	19	2.22	0.1491	201.5	10.50	2.42	11.71	3 x 3.5		
	220	6324								
	20	1.82	0.1348	215.5	12.42	2.57	13.21	4 x 3.5		
	470	6320								
	Junct.	2.55	0.1598	298.3	14.51	2.73	14.91	4 x 3.5		
		6308								
V P	V P			Q50						
	7	Same as previous calc's 27.2								
	880	6366								
	Junct	6.59	0.2567	37.7	1.14	1.05	2.21	2 x 2		
		6308								

UNITED
WESTERN
ENGINEERS

Project Rockrimmon North
Calc. by O. E. Watts
Checked by _____ date 1-11-73
Page 2 of 3

[illegible]

Project Rockrimmon North Page 3 of 3
Calc. by O. E. Watts date _____
Checked by _____ date _____

HYDROLOGIC ENGINEERING STUDY
ROCKRIMMON NORTH DRAINAGE BASIN
PART IV - COST ESTIMATE

A. UNIT PRICES AND ACREAGE

The following Unit prices are utilized for estimating the costs included in this section. Other unit prices, are as shown on the particular estimates. These costs are the current experience of various developers and contractors in the Colorado Springs region.

<u>Item</u>	<u>Unit</u>	<u>Unit Cost</u>
Excavation-Ditches	Cubic Yard	\$ 2.00
Concrete in Minor Structures	Cubic Yard	100.00
Concrete in Major Structures	Cubic Yard	60.00
Concrete in Massive Structures	Cubic Yard	40.00
Concrete Paving-Minor ditches	Square Yard	8.00
Concrete Paving-Major ditches	Square Yard	6.00
Structural Reinforcing Steel	Pound	0.20
Gabion Velocity Control Units	ea	20.00-30.00
Riprap-Minor	Cubic Yard	40.00
Riprap-Gabions	Cubic Yard	30.00
Riprap-Major	Cubic Yard	6.00

The acreage used in computed fees is the total area of the basin excluding that portion owned by the St. Francis Academy as follows:

Total area	1401.20 acres
St. Francis Academy	15.75
Net Area	1385.45 acres

All of the above net area is within the City limits.

B. COLLECTION SYSTEM

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
Lined Drainage Swales	7830 LF	\$ 2.50	\$ 19575.00
Curb Outlets	19 ea	150.00	2850.00
Curb Inlets	28 ea	150.00	4200.00
Riprap	27 CY	40.00	1080.00
Four-Foot catch basin	5 ea	700.00	3500.00
Six-Foot catch basin	6 ea	900.00	5400.00
Eight-Foot catch basin	12 ea	1000.00	12000.00
Ten-Foot catch basin	18 ea	1100.00	19800.00
Twelve-Foot catch basin	11 ea	1200.00	13200.00
Sixteen-Foot catch basin	18 ea	1400.00	25200.00
18 inch CMP culvert	874 LF	11.00	9614.00
21 inch CMP culvert	1260 LF	11.75	14805.00
24 inch CMP culvert	2941 LF	12.25	36027.25
27 inch CMP culvert	917 LF	13.00	11921.00
30 inch CMP culvert	5224 LF	13.75	71830.00
36 inch CMP culvert	3814 LF	15.00	57210.00
42 inch CMP culvert	2000 LF	17.00	34000.00
48 inch CMP culvert	2070 LF	19.00	39330.00
54 inch CMP culvert	1035 LF	21.00	21735.00

48 inch RCP culvert	178 LF	30.50	5429.00
30 inch CMP Headwalls	2 ea	300.00	600.00
Energy Dissipators	6 ea	2000.00	12000.00
2 foot x 1.5 foot lined channel	90 LF	7.75	697.50
2 foot x 2 foot lined channel	870 LF	9.18	7986.60
3 foot x 2 foot lined channel	1835 LF	10.21	18735.35
3 foot x 3 foot lined channel	720 LF	13.32	9590.40
4 foot x 2 foot lined channel	20 LF	11.25	225.00
Gabion Velocity Control Structures	5	2000.00	10000.00
4 foot x 2 foot RCB culvert	41.5 LF	26.20	1087.30
Sub total			\$468628.40
10% Engr. and Cont.			<u>46862.84</u>
TOTAL			<u>\$515491.24</u>
Per acre cost			\$ 372.07

C. PRIMARY GREENBELT

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
4 foot x 2 foot lined drainage channel	340 LF	\$ 8.22	\$ 2794.80
4 foot x 4 foot lined drainage channel	450 LF	13.91	6259.50
5 foot x 4 foot lined drainage channel	520 LF	14.88	7737.60
Gabion Velocity Control Units	3 ea	2000.00	6000.00
7 foot x 4 foot RCB culvert	116 LF	60.00	6960.00
8 foot x 3 foot RCB culvert	64 LF	60.00	3840.00
10 foot x 7 foot RCB culvert	146 LF	90.00	13140.00
Dam No. 1 modifications	LS	3500.00	3500.00
Dam No. 2 modifications	LS	3250.00	3250.00
Subtotal			\$53481.90
10% Engr. & Cont.			<u>5348.19</u>
TOTAL			<u>\$58830.09</u>
Per acre cost			\$ 42.46

D. MONUMENT CREEK AREA FACILITIES

(As shown on Plate C1)

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
Lined drainage swales	1260 LF	\$ 2.50	\$ 3150.00
Curb Outlets	5 ea	150.00	750.00
Curbe Inlets	1 ea	150.00	150.00
Riprap	601 CY	40.00	24040.00
12 foot catch basin	3 ea	1200.00	3600.00
24 inch RCP culvert	790 LF	10.50	8295.00
30 inch RCP culvert	50 LF	13.50	675.00

36 inch RCP culvert	870 LF	\$ 19.00	\$ 16530.00
48 inch RCP culvert	100 LF	30.50	3050.00
1.5'x2.0' concrete channel	350 LF	8.73	3055.50
1.5'x2.5' concrete channel	320 LF	10.18	3257.60
2.0'x2.0' concrete channel	190 LF	10.95	2080.50
Energy Dissipators	1 ea	2000.00	2000.00
12 foot x 10 foot RCB culvert	50 LF	175.00	8750.00

Sub total			\$79383.60
10% Engr. & Cont.			7938.36

TOTAL			<u>\$87321.96</u>
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Per acre cost			\$ 63.03
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E. DAM

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Price</u>	<u>Cost</u>
Foundation Stripping	22,133	CY	\$ 0.40	\$ 8853.20
Core Trench Excavation	6,356	CY	0.60	3813.60
Spillway Excavation	34,820	CY	0.20	6964.00
Dam Embankment	236,344	CY	0.45	106354.80
Spillway Concrete	1542.30	CY	40.00	61692.00
Spillway Steel	169,650	Lbs	0.20	33930.00
Seeding and Mulching	5.44	ac	850.00	4624.00
Riprap	7099	CY	6.00	42594.00
Powerline Relocation	LS		25150.00	25150.00
60" RCP class D outlet conduits	900	LF	50.00	45000.00
Valve Structure	LS		10000.00	10000.00
Energy Dissipator	LS		5000.00	5000.00

Sub total			\$353975.60
5.32% Design and 3.00% Inspection			29450.77
Geological Investigation			12000.00

TOTAL			<u>\$395426.37</u>
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Per acre cost			\$ 285.41
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F. RECOMMENDED FEES

<u>Item</u>	<u>Cost per acre</u>
Collection System	\$372.07
Greenbelt	42.46
Monument Creek Facilities	63.03
Dam	285.41
Hydrology Study	9.38

TOTAL	\$772.35
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The recommended per acre drainage fee is \$772.35.

G. UNSTAGED FACILITIES

The following is an estimate of the facilities required if no staging were performed - that is, if no flood control dams were used to limit the basin runoff.

1. Collection System:

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
Lined Drainage Swales	7830 LF	\$ 2.50	\$19575.00
Curb Outlets	19 ea	150.00	2850.00
Curb Inlets	28 ea	150.00	4200.00
Riprap	6 CY	40.00	240.00
Four foot catch basin	5 ea	700.00	3500.00
Six foot catch basin	6 ea	900.00	5400.00
Eight foot catch basin	12 ea	1000.00	12000.00
Ten foot catch basin	18 ea	1100.00	19800.00
Twelve foot catch basin	11 ea	1200.00	13200.00
Sixteen foot catch basin	18 ea	1400.00	25200.00
18 inch CMP culvert	874 LF	11.00	9614.00
21 inch CMP culvert	1260 LF	11.75	14805.00
24 inch CMP culvert	2941 LF	12.25	36027.25
27 inch CMP culvert	917 LF	13.00	11921.00
30 inch CMP culvert	5224 LF	13.75	71830.00
36 inch CMP culvert	3814 LF	15.00	57210.00
42 inch CMP culvert	2000 LF	17.00	34000.00
48 inch CMP culvert	2070 LF	19.00	39330.00
54 inch CMP culvert	1213 LF	21.00	25473.00
30 inch CMP Headwalls	2 ea	300.00	600.00
54 inch CMP Headwalls	2 ea	696.00	1392.00
Energy Dissipators	6 ea	2000.00	12000.00
2 foot by 1.5 foot lined channel	90 LF	7.75	697.50
2 foot by 2 foot lined channel	3090 LF	9.18	28366.20
3 foot by 2 foot lined channel	1835 LF	10.21	18735.35
3 foot by 3 foot lined channel	1770 LF	13.32	23576.40
3 foot by 3.5 foot lined channel	135 LF	15.00	2025.00
4 foot by 2 foot lined channel	20 LF	11.25	225.00
4 foot by 3.5 foot lined channel	690 LF	15.27	10536.30
4 foot by 4 foot lined channel	2470 LF	13.91	<u>34357.70</u>
Sub total			\$538686.70
10% Engr. & Cont.			<u>53868.67</u>
TOTAL			<u>\$592555.37</u>
PER ACRE COST			\$ 427.70

2. Primary Greenbelt System

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
3 foot x 3 foot lined channel	490 LF	\$ 13.32	\$ 6526.80
3 foot x 3.5 foot lined channel	820 LF	15.00	12300.00
4 foot x 3.5 foot lined channel	340 LF	15.27	5191.80
4 foot x 4 foot lined channel	1286 LF	13.91	17888.26
4 foot x 4.5 foot lined channel	520 LF	15.42	8018.40
5 foot x 4 foot lined channel	430 LF	14.88	6398.40
5 foot x 4.5 foot lined channel	2334 LF	16.42	38324.28
5 foot x 5 foot lined channel	3250 LF	17.80	57850.00
6 foot x 6 foot lined channel	2630 LF	21.98	57807.40
6 foot x 6.5 foot lined channel	740 LF	23.75	17575.00
8 foot x 5 foot RCB culvert	246 LF	65.00	15990.00
8 foot x 6 foot RCB culvert	116 LF	70.00	8120.00
10 foot x 9 foot RCB culvert	740 LF	100.00	74000.00
Remove Existing Culverts	Lump sum	5000.00	5000.00
Detour D & RG Railroad	Lump sum	35000.00	35000.00
Sub total			\$365990.34
10% Engr. & Cont.			36599.03
TOTAL			<u>\$402589.37</u>
Per acre cost			\$ 290.58

3. Recommended Fees:

<u>Item</u>	<u>Cost Per Acre</u>
Collection System	\$427.70
Primary Greenbelt	290.58
Monument Creek Facilities (See Para. F)	63.03
Drainage Study	<u>9.38</u>
TOTAL	\$790.69

The fees would be recommended at \$790.69 per acre.

HYDROLOGIC ENGINEERING STUDY
ROCKRIMMON NORTH DRAINAGE BASIN
SECTION V - CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This report is prepared for the Golden Cycle Land Corporation as required by the City Engineer and the City Drainage Board due to the revised Master Land Use Plan for the Rockrimmon Area and requested revisions to existing master basin studies. This study replaces that portion previously studied in March of 1967 by Karcich and Weber and a portion of the Dry Creek Drainage Basin Report prepared by R. Keith Hook and Associates in November, 1966. It also encompasses a portion of Monument Creek in accordance with the proposed flood plain ordinance.

This study is prepared in accordance with all current drainage criteria and regulations of the City. In addition, it complies with the decision of the City Attorney that the outflow under fully developed conditions remain below that of the basin in its natural state. It will comply with these requirements in Senate Bill #116 now before the State Legislature.

The basin lies West of Interstate 25, being bounded on the West by the Mount Saint Francis Academy, on the South by the Rockrimmon South Basin and on the North by Woodmen Road, encompassing all "unstudied" portions of current and future filings within Rockrimmon. The total area of the basin is 1,401.20 acres, of which 15.75 acres is within the Mount St. Francis Academy and outside the City Limits. The balance of 1,385.45 acres is used for computing proposed drainage fees.

This study incorporates all proposed developments within the basin, which comprise about 95% of the total area. Proposed facilities include all items approved on Master Development Plans by City Council and project items which have not yet been presented to Council.

Existing drainage and flood control facilities are utilized wherever possible and predicted runoff is well within their capacities. It is intended that alternatives to structures proposed herein may be approved at the time of platting of areas within the basin, however these alternatives are to be designed in accordance with criteria included in this report. The runoff upon full development from a 100 year storm under the proposed facilities would be 34.5 percent of the runoff from the natural basin.

The drainage facilities proposed within this report have an estimated current construction cost of approximately \$1,070,000 or a net cost per acre of \$772.35, all of which are considered applicable toward drainage fee assessment. The proposed fee is \$772.35 as compared with the current fee of \$774.00, which is assessed on outdated criteria. Structures required for storm drainage without the proposed reservoirs would create a fee of \$790.69 per acre, however, the runoff from the basin would be 150 percent of the natural

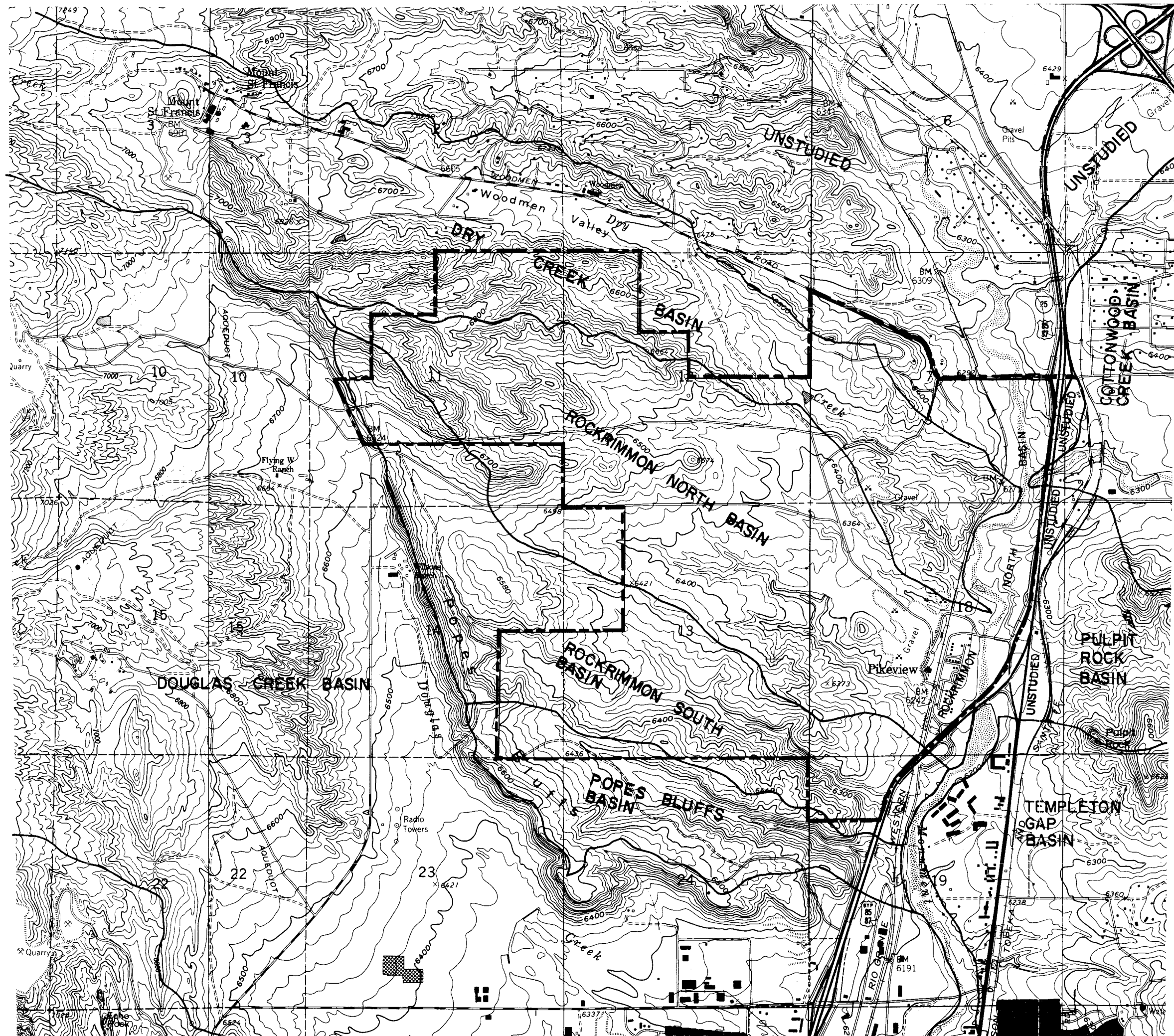
runoff and would increase the flows in Monument Creek. This would be in violation of current interpretations of Colorado Law and would be in clear violation of current proposed legislation.

B. RECOMMENDATIONS

It is recommended that this report be accepted as proposed, and that a drainage fee on the Rockrimmon North Basin, as defined herein, be set in the amount of \$ 772.35 per acre.

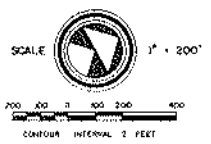
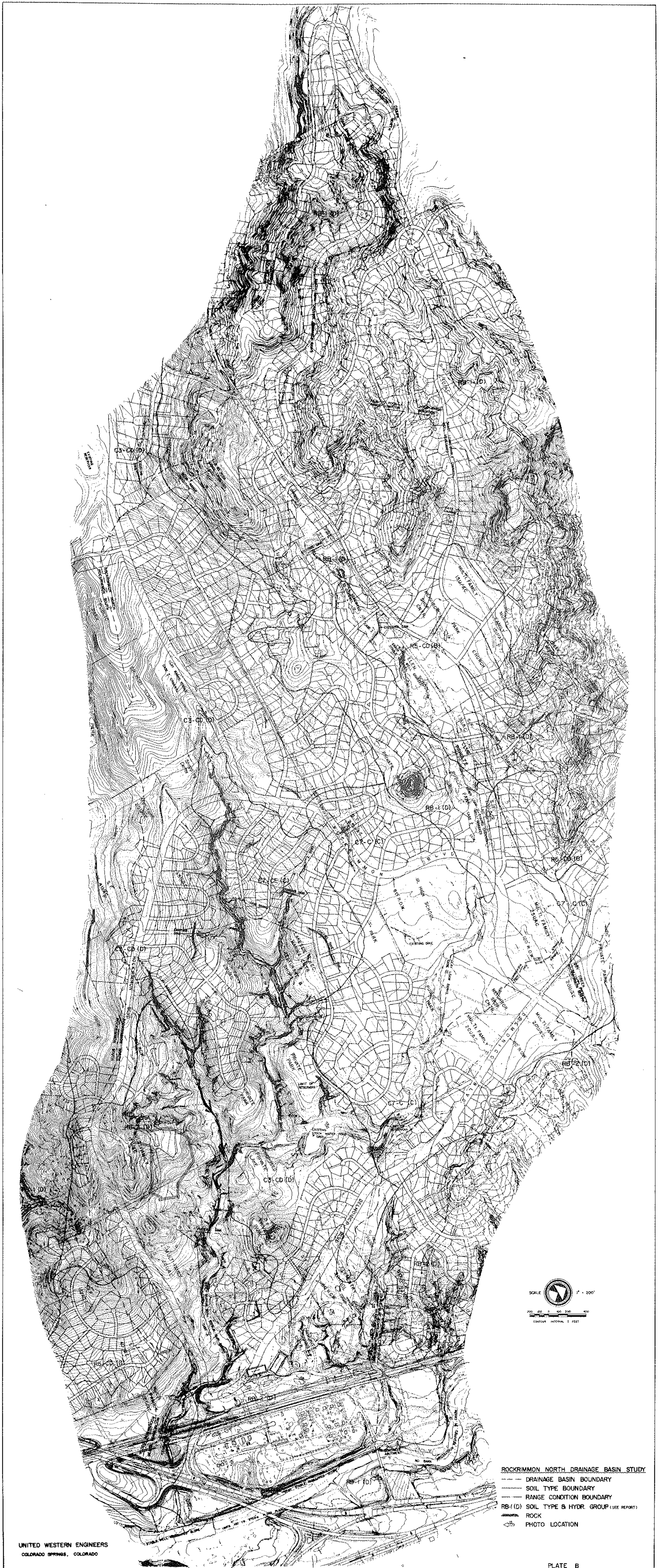
ENGINEERING HYDROLOGIC STUDY
OF THE
ROCKRIMMON NORTH DRAINAGE BASIN
SECTION VI - APPENDIX

<u>Plate</u>	<u>Description</u>
A	Location Map
B	Soils, Range and Existing Channels map.
B1	Soils, Range and Existing Channels map, Monument Creek portion.
C	Drainage Plan
C1	Drainage Plan, Monument Creek portion
E	Typical Channel Section-Type 1
F	Typical Channel Section-Type 2
G	Typical Channel Section-Type 3
H	Typical Velocity Check Dam
I	Typical Flood Control Dam Spillway
J	Standard City Catch Basin
K	Curb Inlet
L	Curb Outlet
M	Culvert Energy Dissipator
N	Photographs - Basin in Natural State, 7 sheets

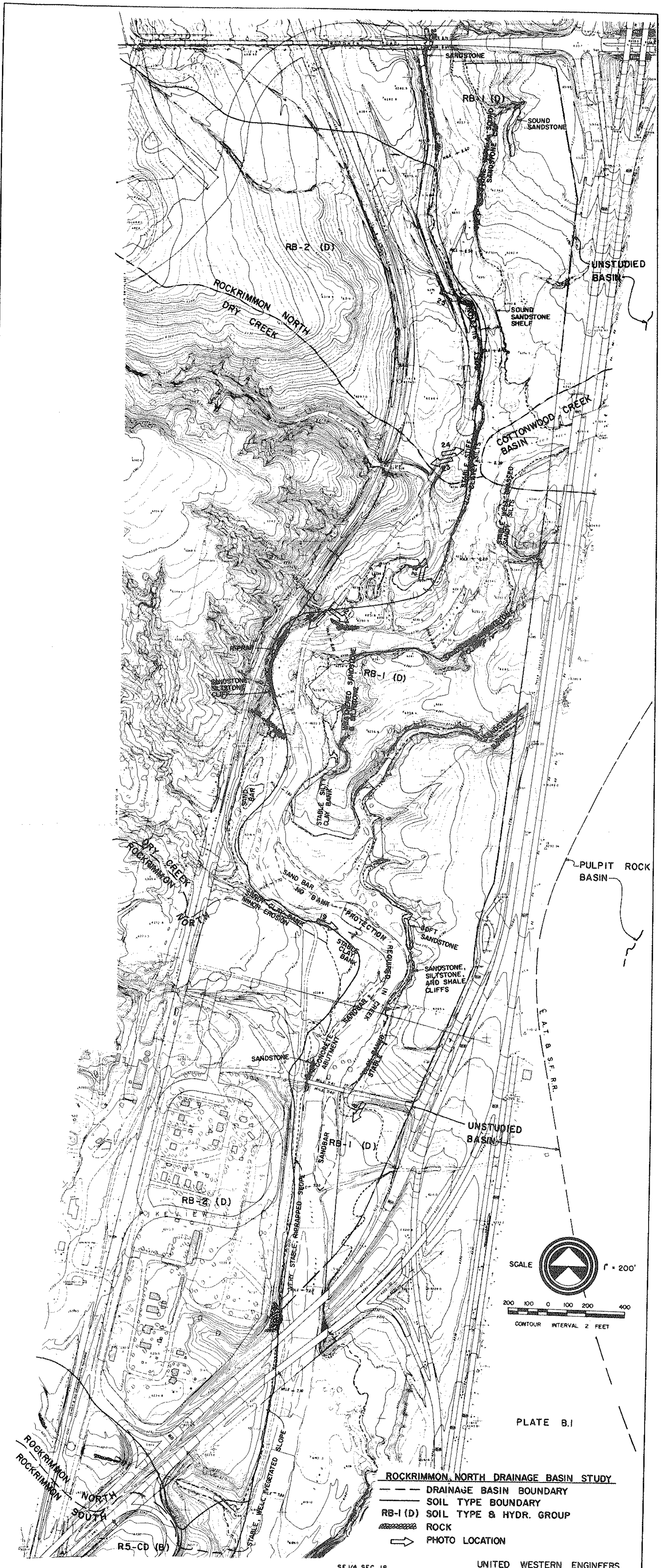


ROCKRIMMON
BOUNDARY

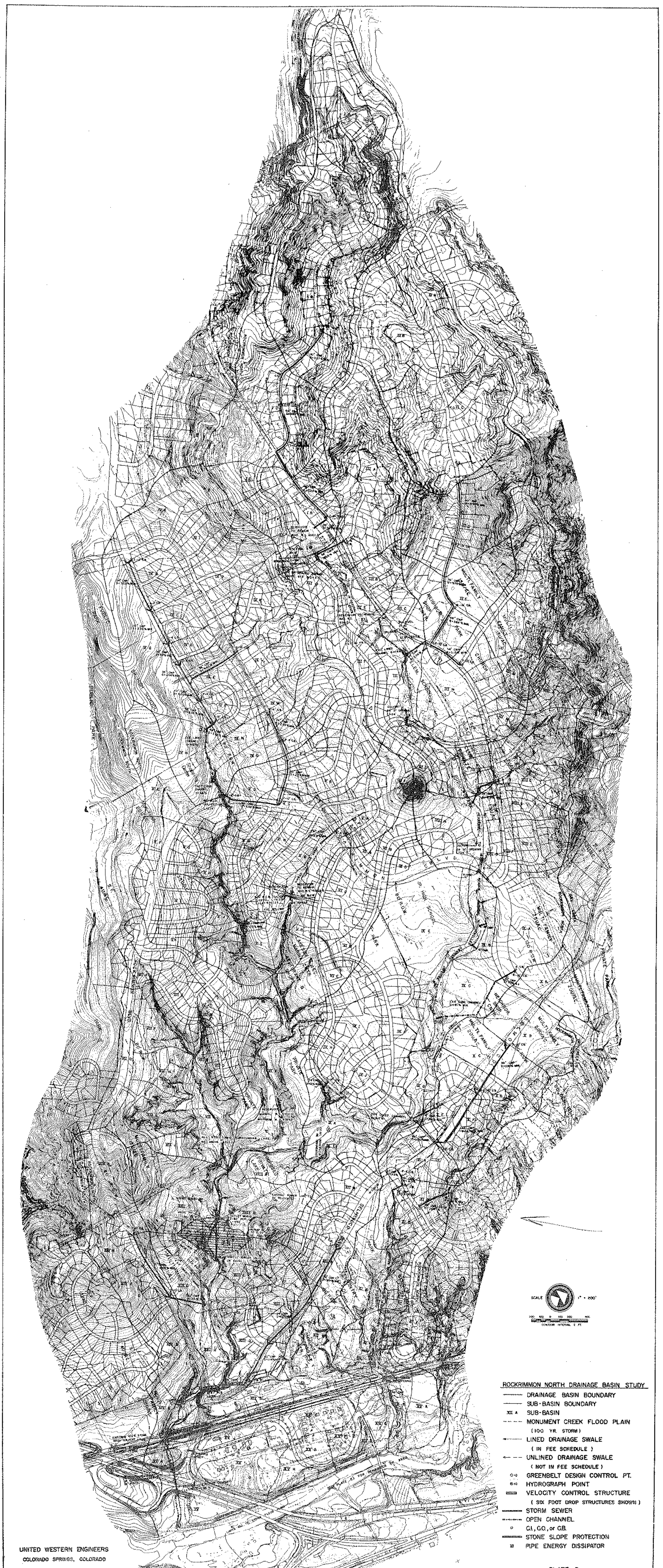
UNITED
WESTERN
ENGINEERS
LOCATION MAP
PLATE A



- ROCKRIMMON NORTH DRAINAGE BASIN STUDY
- DRAINAGE BASIN BOUNDARY
 - SOIL TYPE BOUNDARY
 - RANGE CONDITION BOUNDARY
 - RB-1 (D) SOIL TYPE & HYDR. GROUP (SEE REPORT)
 - ROCK
 - PHOTO LOCATION



ROCKRIMMON NORTH DRAINAGE BASIN STUDY
--- DRAINAGE BASIN BOUNDARY
--- SOIL TYPE BOUNDARY
RB-1 (D) SOIL TYPE & HYDR. GROUP
ROCK
➔ PHOTO LOCATION

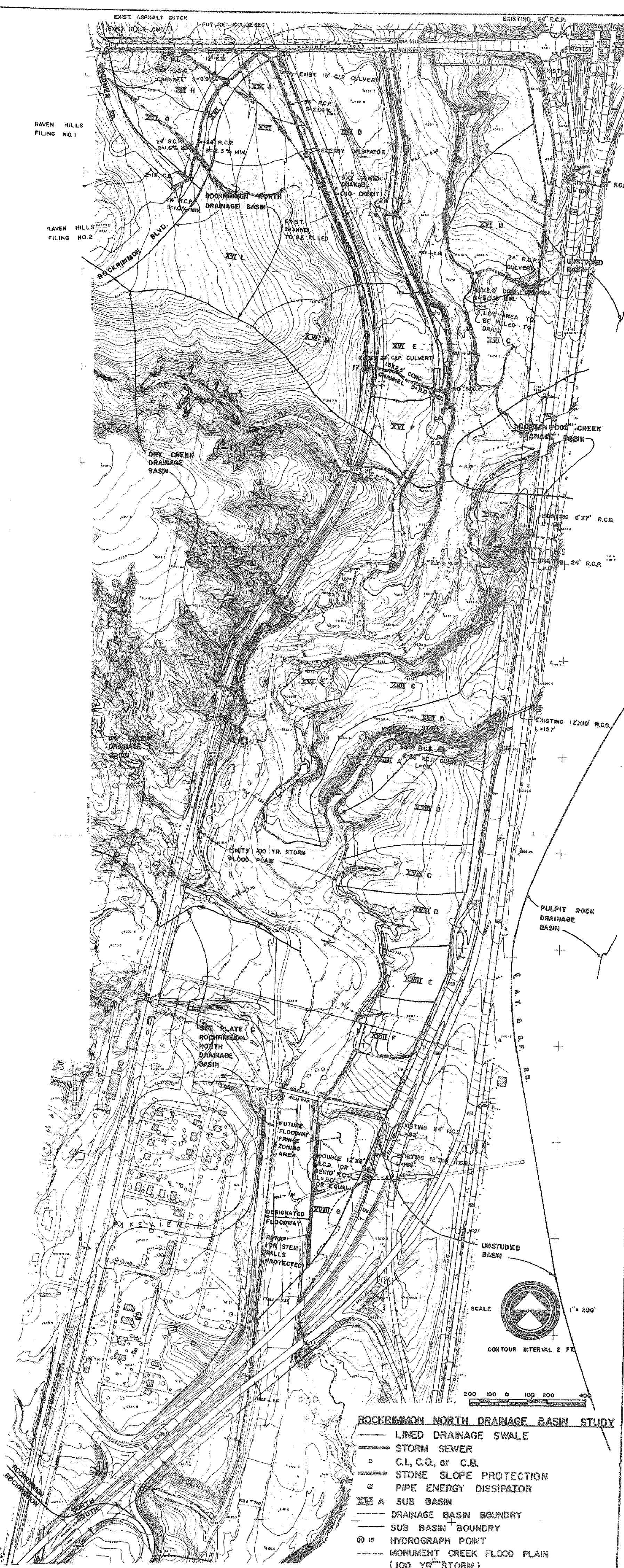


UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO

- ROCKRIMMON NORTH DRAINAGE BASIN STUDY
- DRAINAGE BASIN BOUNDARY
 - SUB-BASIN BOUNDARY
 - XII A SUB-BASIN
 - - - MONUMENT CREEK FLOOD PLAIN
(100 YR. STORM)
 - LINED DRAINAGE SWALE
(IN FEE SCHEDULE)
 - UNLINED DRAINAGE SWALE
(NOT IN FEE SCHEDULE)
 - GREENBELT DESIGN CONTROL PT.
 - HYDROGRAPH POINT
 - VELOCITY CONTROL STRUCTURE
(SIX FOOT DROP STRUCTURES SHOWN)
 - STORM SEWER
 - OPEN CHANNEL
 - CI, CO, or CB
 - STONE SLOPE PROTECTION
 - ⊗ PIPE ENERGY DISSIPATOR

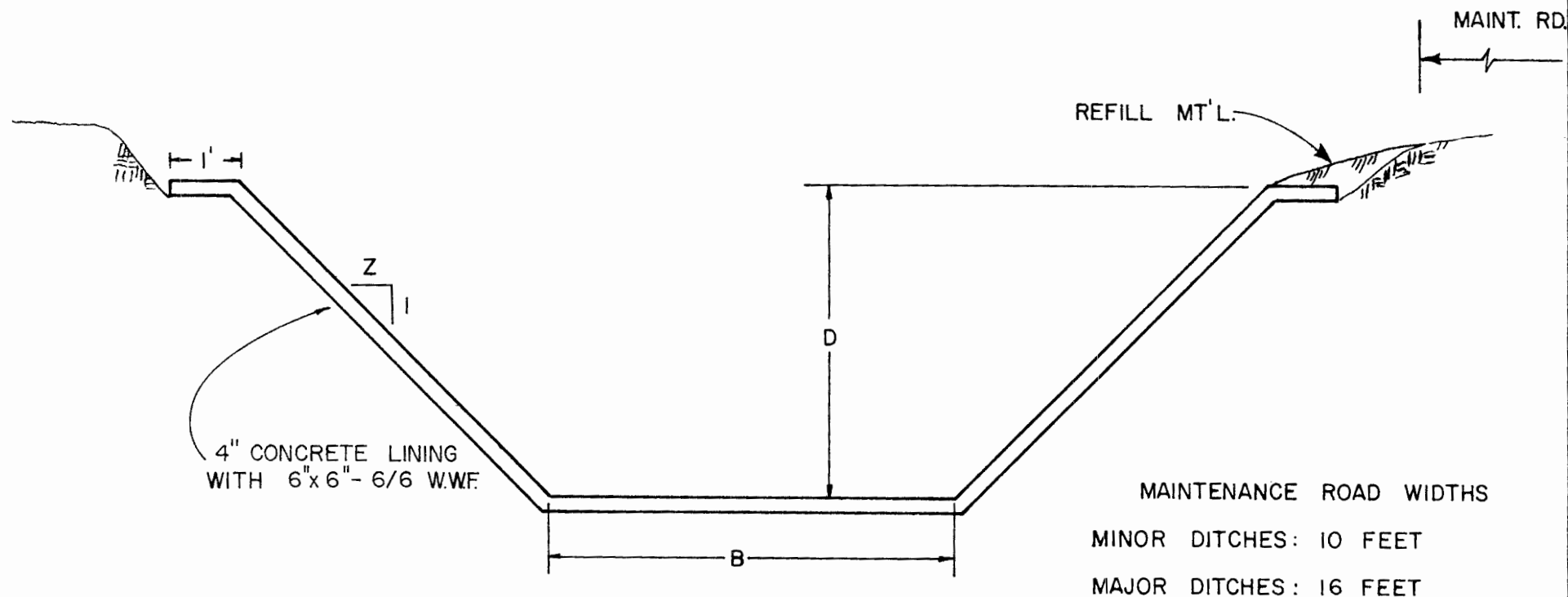
RAVEN HILLS
FILING NO. 1

RAVEN HILLS
FILING NO. 2



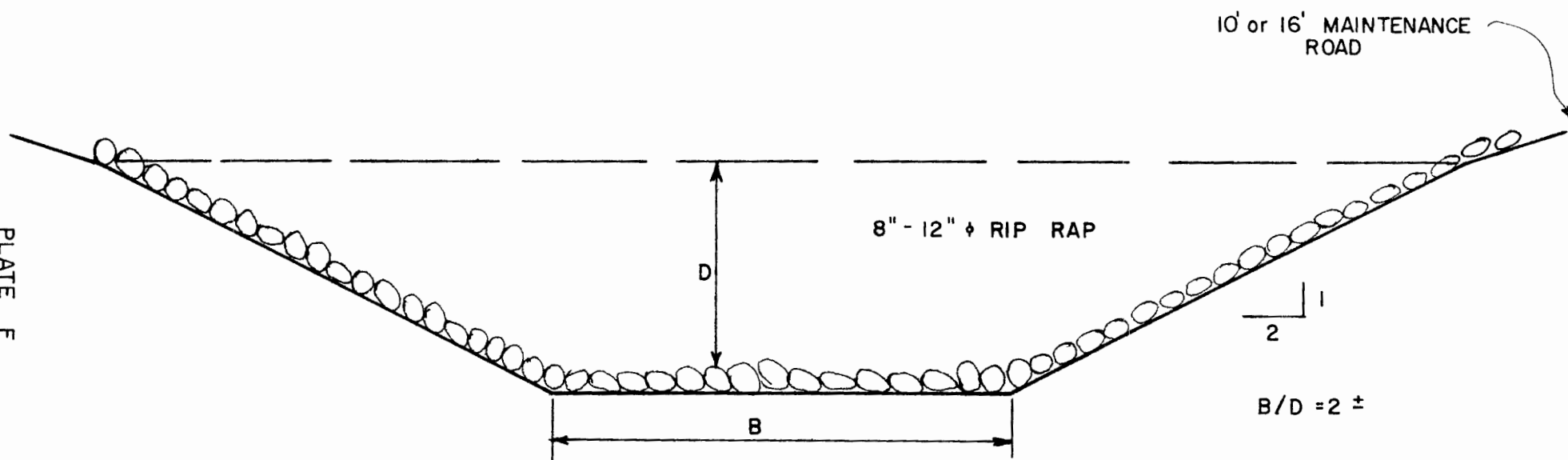
ROCKRIMMON NORTH DRAINAGE BASIN STUDY

- LINED DRAINAGE SWALE
- STORM SEWER
- C.I., C.O., or C.B.
- STONE SLOPE PROTECTION
- PIPE ENERGY DISSIPATOR
- XVI A SUB BASIN
- DRAINAGE BASIN BOUNDARY
- SUB BASIN BOUNDARY
- ⊙ IS HYDROGRAPH POINT
- MONUMENT CREEK FLOOD PLAIN (100 YR. STORM)
- OPEN CHANNEL



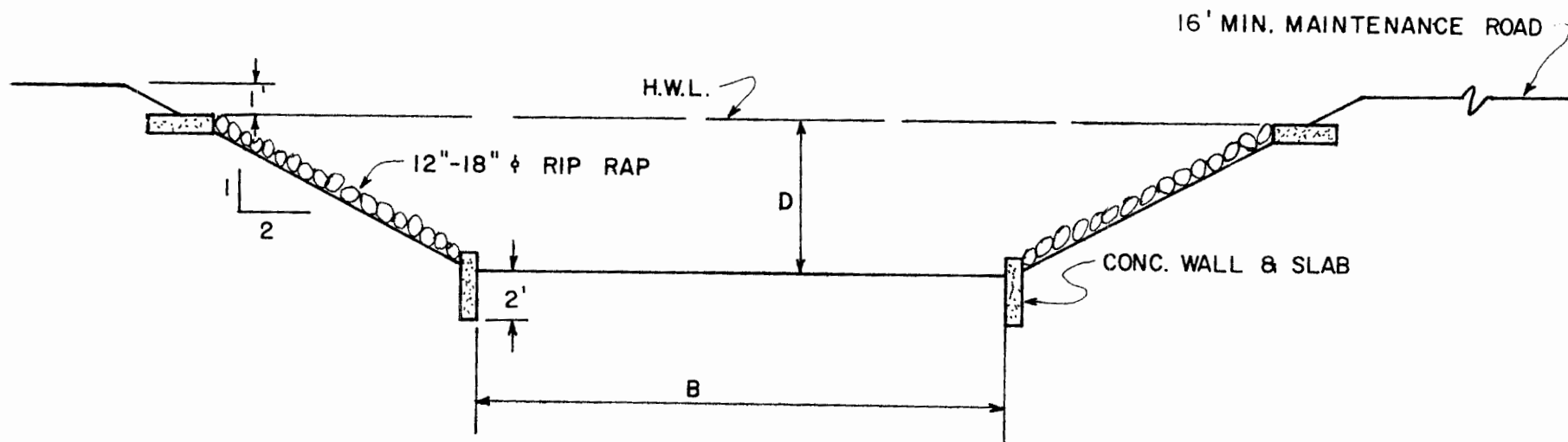
SECTION OF PROPOSED CONCRETE DITCH LINING
TYPE I DITCH

PLATE F



SECTION OF PROPOSED CONCRETE DITCH LINING

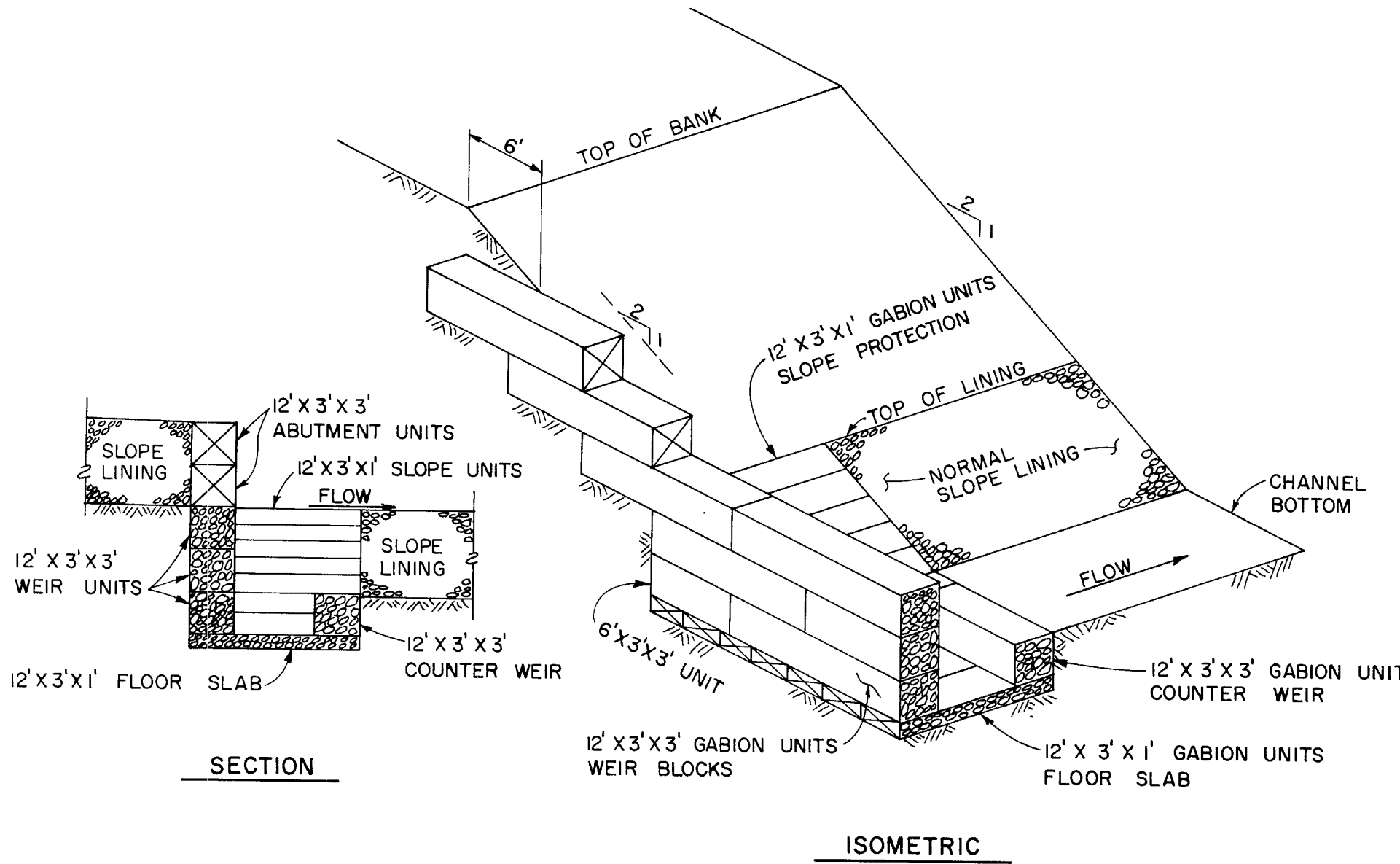
TYPE 2 DITCH
MAX. VELOCITY 10 F.P.S.



SECTION OF PROPOSED CONCRETE DITCH LINING

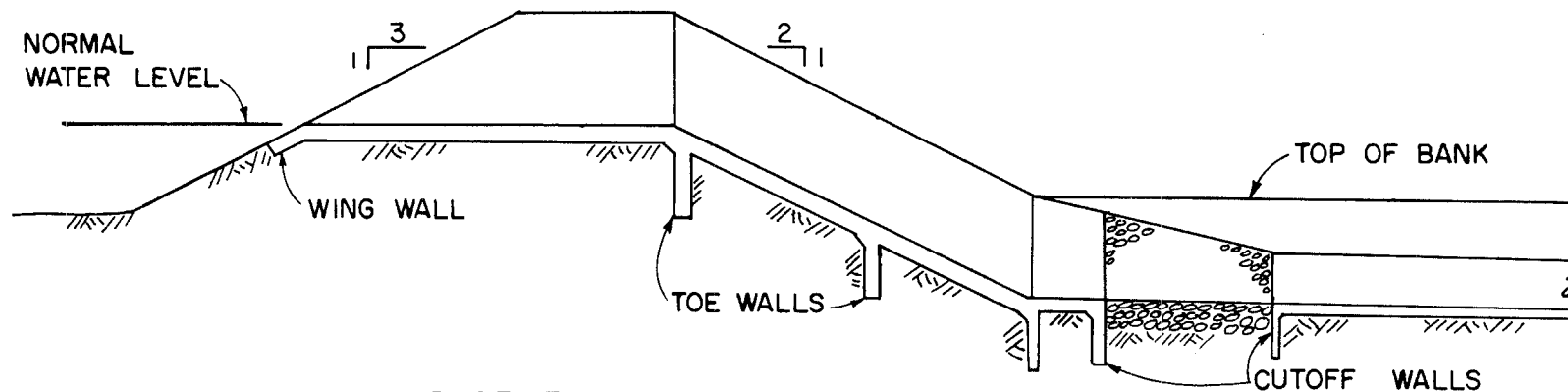
TYPE 3 DITCH

MAX. VELOCITY GOVERNED
BY BOTTOM SOILS,
NOT TO EXCEED 10 F.P.S.

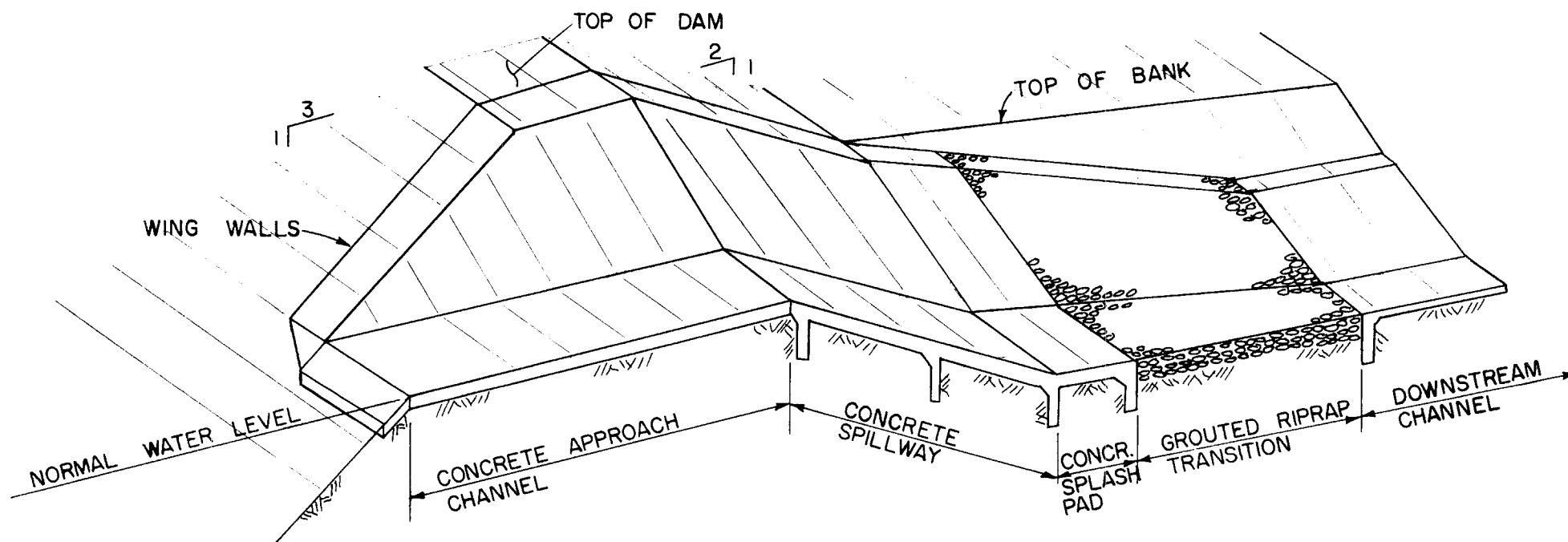


TYPICAL GABION VELOCITY CHECK DAM

6' DROP SHOWN
 (UNITS OF VARIABLE SIZE TO FIT REQUIREMENTS)

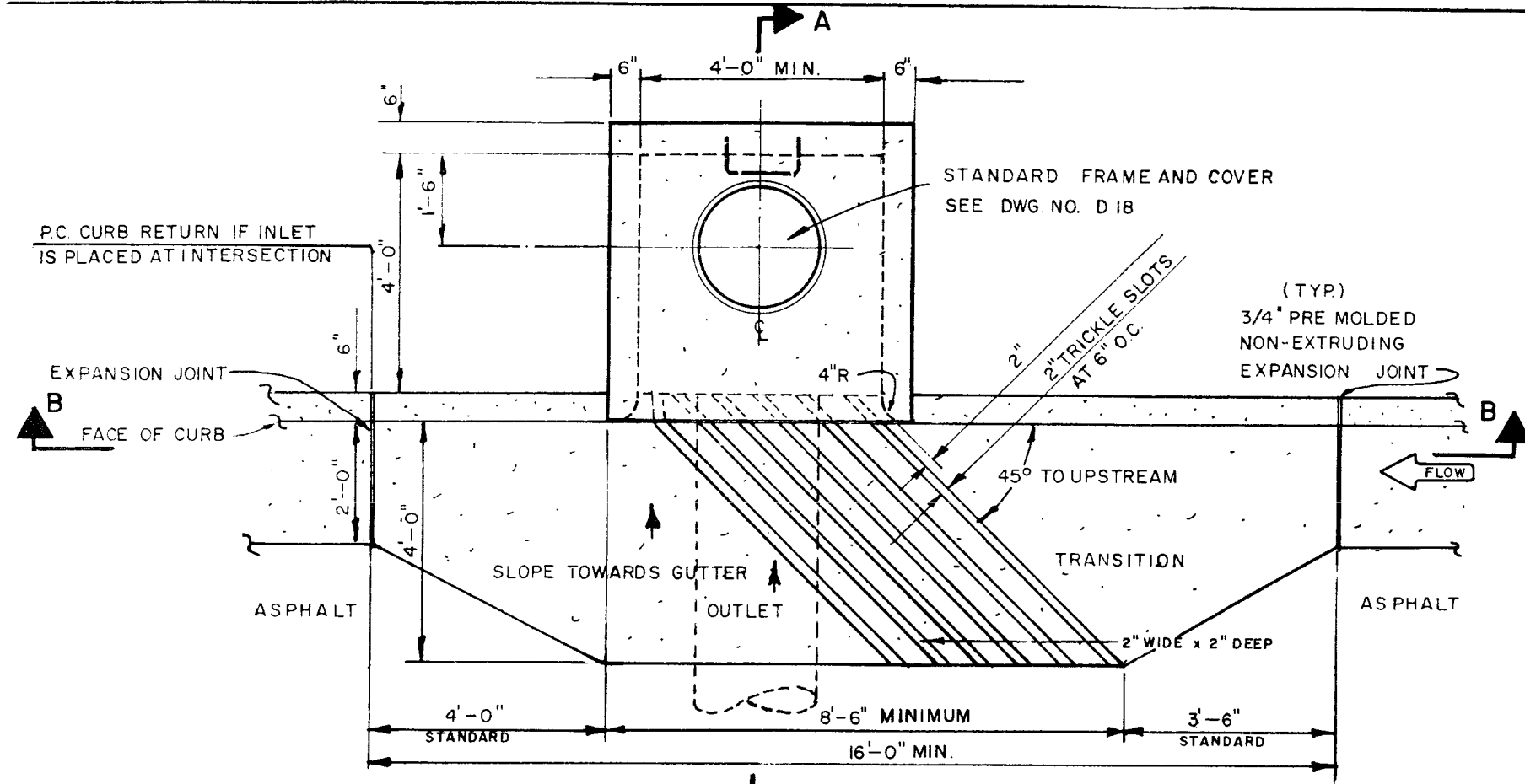


PROFILE



ISOMETRIC

TYPICAL FLOOD CONTROL DAM SPILLWAY

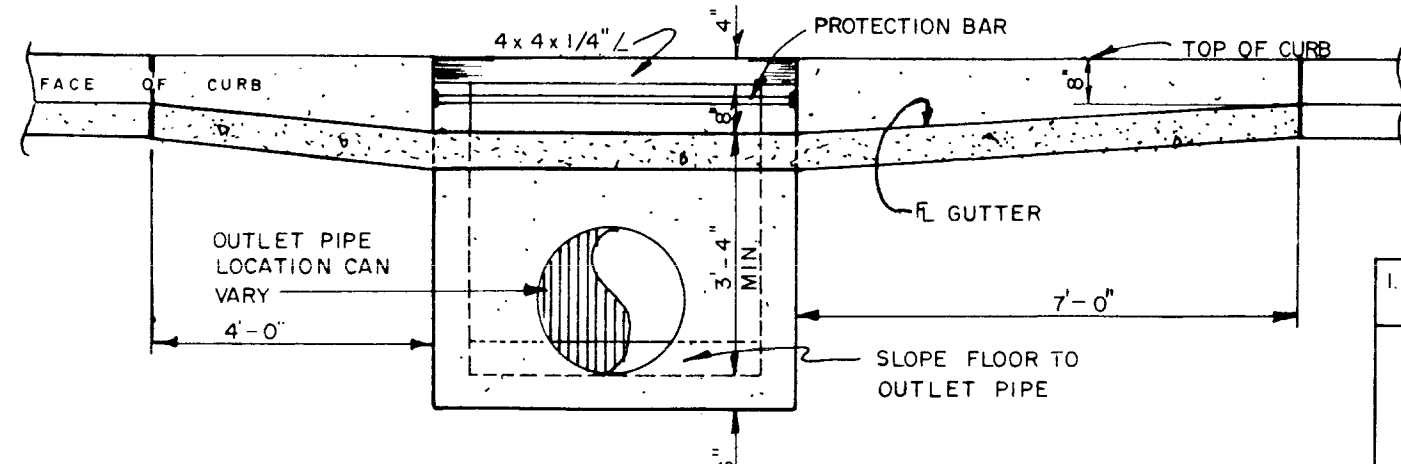


PLAN VIEW

3/8" = 1'-0"

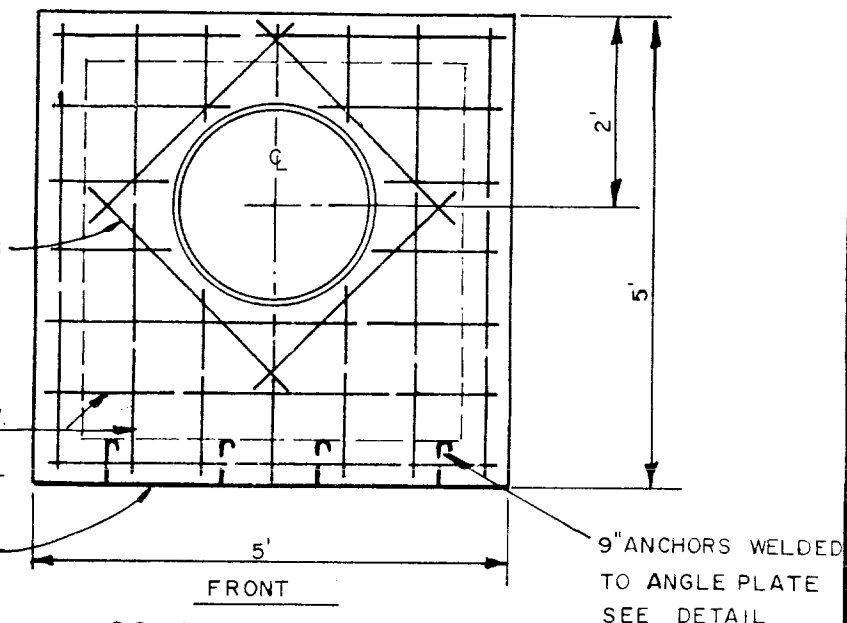
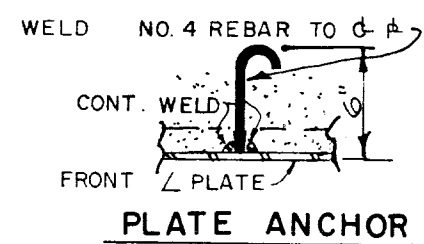
NOTES

CONNECTION PIPE OR OUTLET PIPE MAY VARY AS TO LOCATION WITHIN INLET
 CURVATURE OF LIP AT GUTTER AND SIDE OPENINGS SHALL BE MADE WITH CURVED FORMS
 DEPTH AND LENGTH OF INLET MAY VARY. LENGTH SHOULD VARY BY INCREMENTS OF 2'-0"
 WALL THICKNESS SHOULD INCREASE TO 8" IF DEPTH IS GREATER THAN 4'-0" AND TO 10" AT DEPTHS OVER 8'-0"
 FLOOR OF INLET SHALL BE TROWELLED TO A SMOOTH HARD SURFACE AND WILL SLOPE TOWARDS OUTLET
 MANHOLE SHOULD BE LOCATED AS SHOWN ALONG BACK WALL
 OUTLET PIPE TO BE TRIMMED TO FINAL SHAPE AND SET IN PLACE BEFORE INLET IS POURED
 PROTECTION BAR REQUIRED, 6" TO CL FROM FLOW LINE OF GUTTER
 WHEN DEPTH IS GREATER THAN 4'-0" STEPS WILL BE PLACED 17" APART WITH TOP STEP 6" BELOW INSIDE COVER
 STEPS WILL BE 3/4" PLAIN ROUND GALV. 2'-8" LONG BENT TO DIMENSIONS SHOWN ON PLAN
 WALL AND FLOOR REINFORCING AS PER DWG. D-26
 CONCRETE SHALL BE OF 3000 P.S.I. AT 28 DAYS (STRENGTH)
 IF OPENING IS GREATER THAN 4'-0" SUPPORT BARS WILL BE REQUIRED AT 3' INTERVALS SEE D-19
 SURFACE OF ALL EXPOSED CONCRETE SHALL CONFORM IN SLOPE, GRADE, COLOR FINISH AND SCORING TO EXIST OR PROPOSED SURFACES



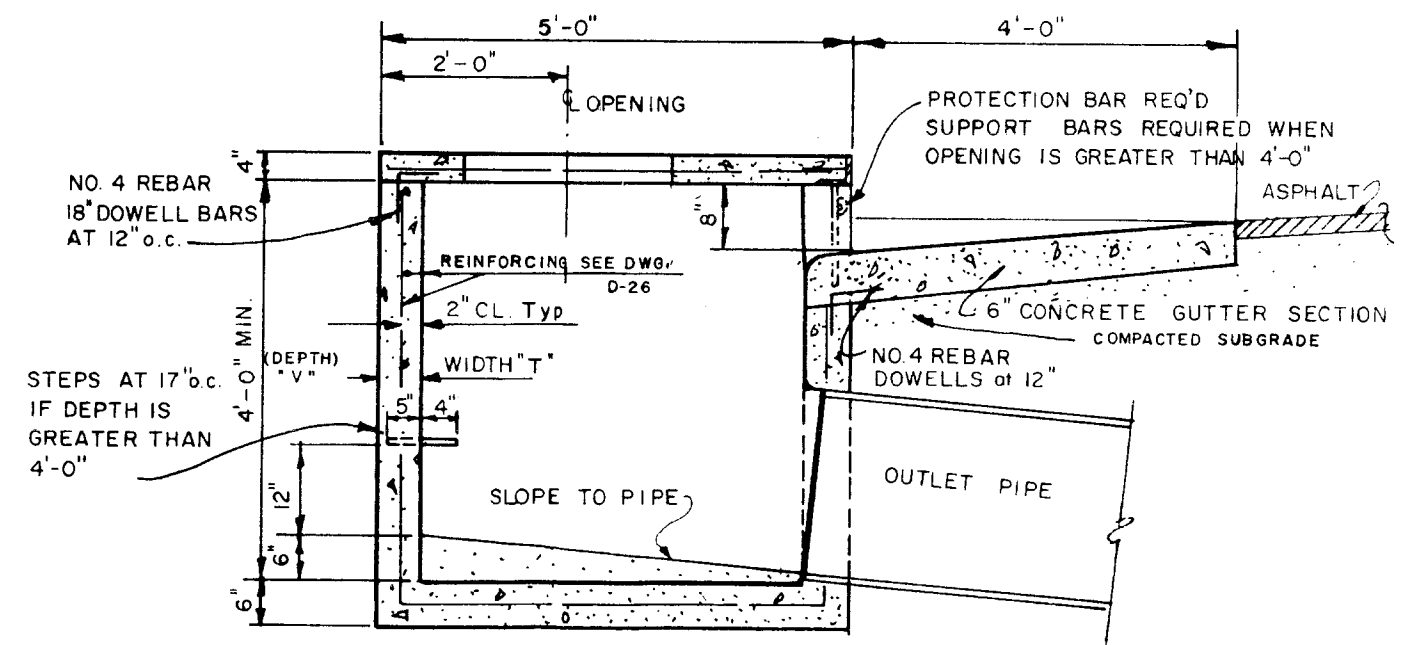
SECTIONAL ELEVATION B-B

3/8" = 1'-0"



COVER DETAIL

1/2" = 1'-0"



SECTION A - A

1/2" = 1'-0"

I.D. OUTLET IN.	CAPACITY CMP. R.C.P.	BOX REQ'D. FT.	THROAT OPENING
18	5.6cfs	10cfs	4' x 8"
21	8.4	155	6' x 8"
24	12	22	8' x 8"
27	16	30	10' x 8"
30	22	40	12' x 8"
36	35	51	16' x 8"
42	52	—	16' x 8"

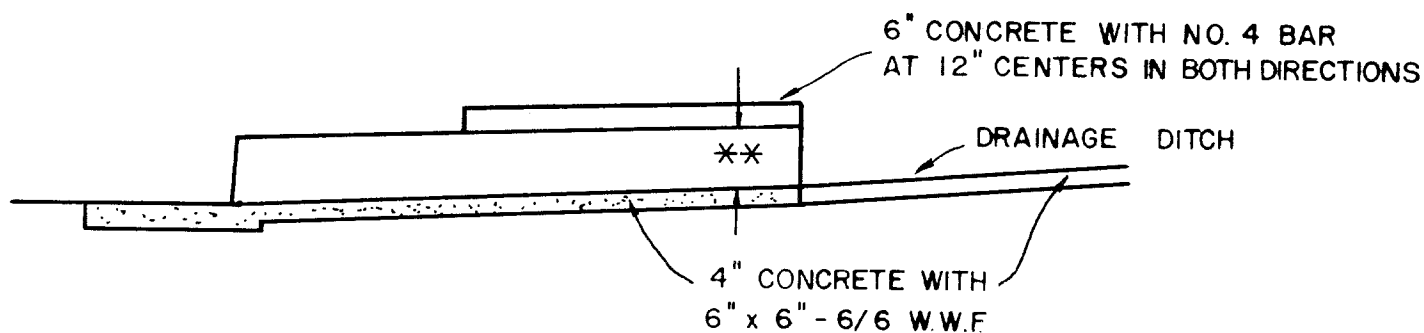
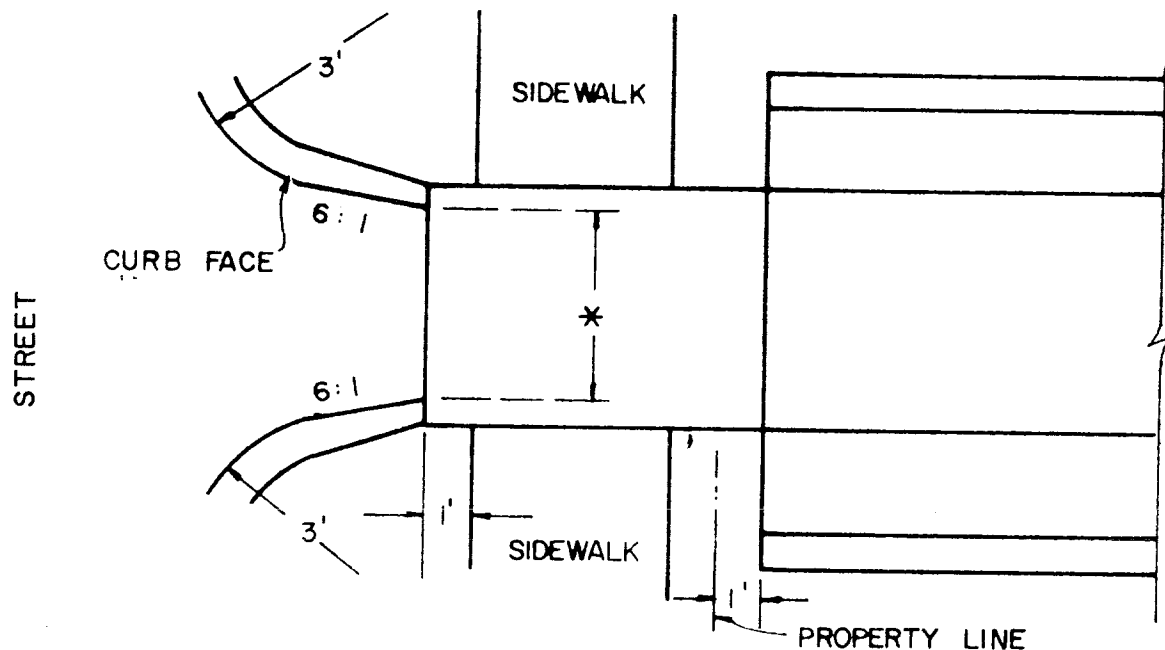
THIS DWG. REPLACES CATCH BASIN NO'S. 1, 2 & 3 AS SHOWN ON DWG'S. D-10, D-11 & D-12

CITY OF COLORADO SPRINGS, COLO.

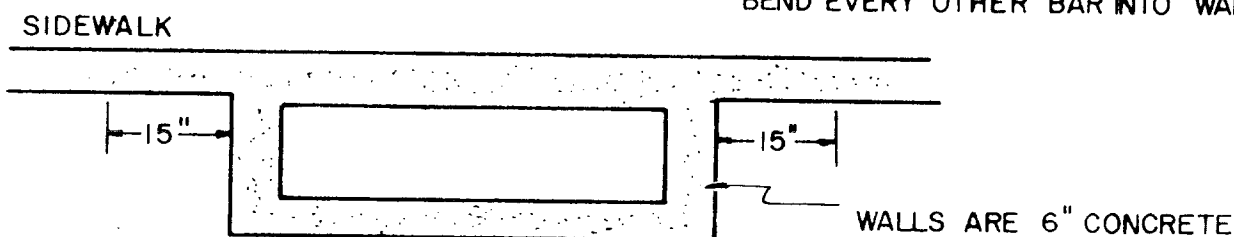
STANDARD CATCH BASIN DETAILS

APPROVED BY: *Ruth Martin*
CITY ENGINEER

SCALE: AS SHOWN DATE: JAN. 1970 DWN BY: R. A. MARTIN DWG. NO: D-10R



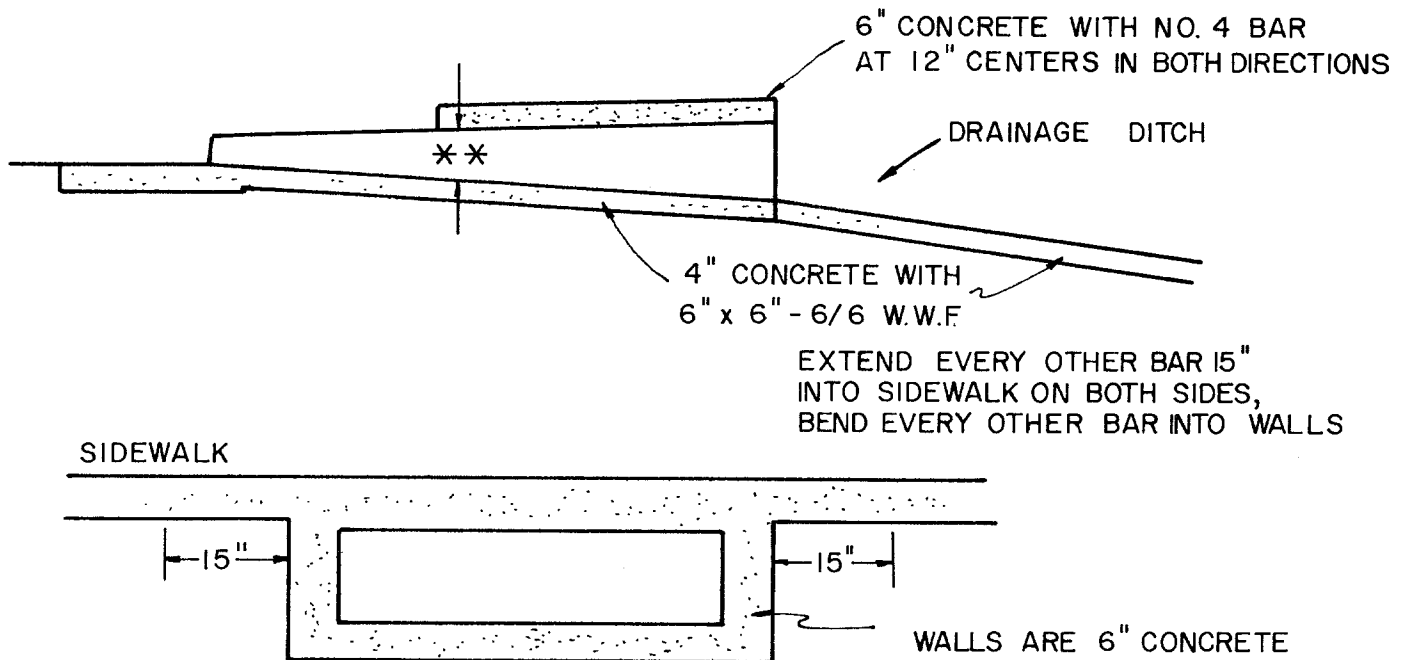
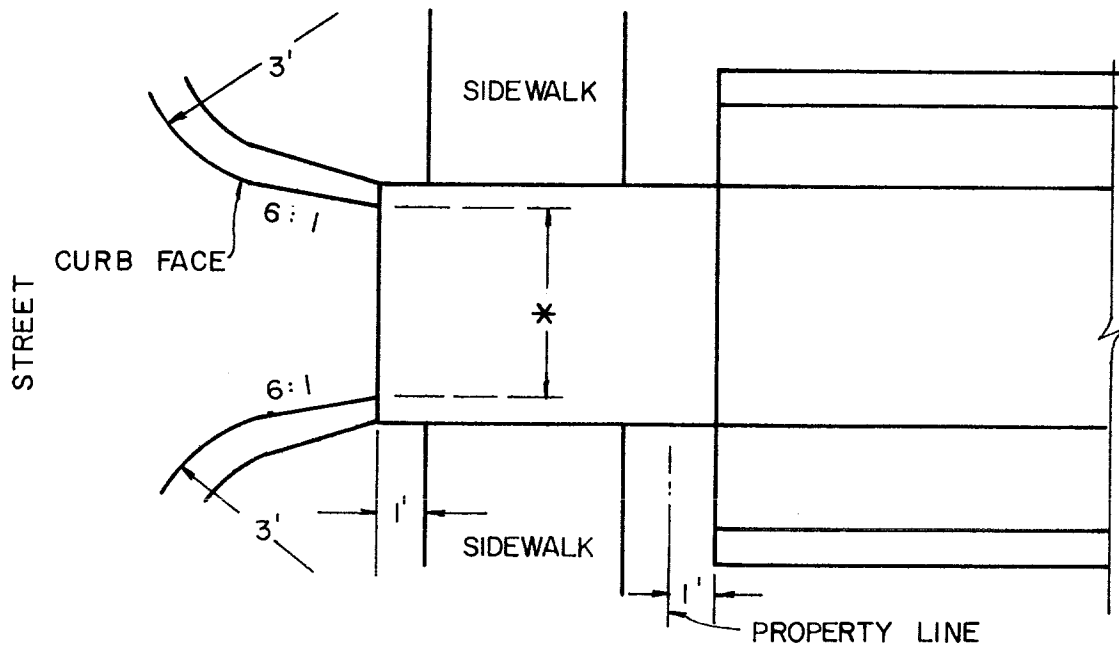
EXTEND EVERY OTHER BAR 15"
INTO SIDEWALK ON BOTH SIDES,
BEND EVERY OTHER BAR INTO WALLS



NOTES:

1. SIDEWALK MAY BE PLACED ANYWHERE FROM CURB TO PROPERTY LINE BY EXTENDING THE TOP SLAB TO MATCH THE POSITION OF THE SIDEWALK
2. * VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 4'
- ** VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

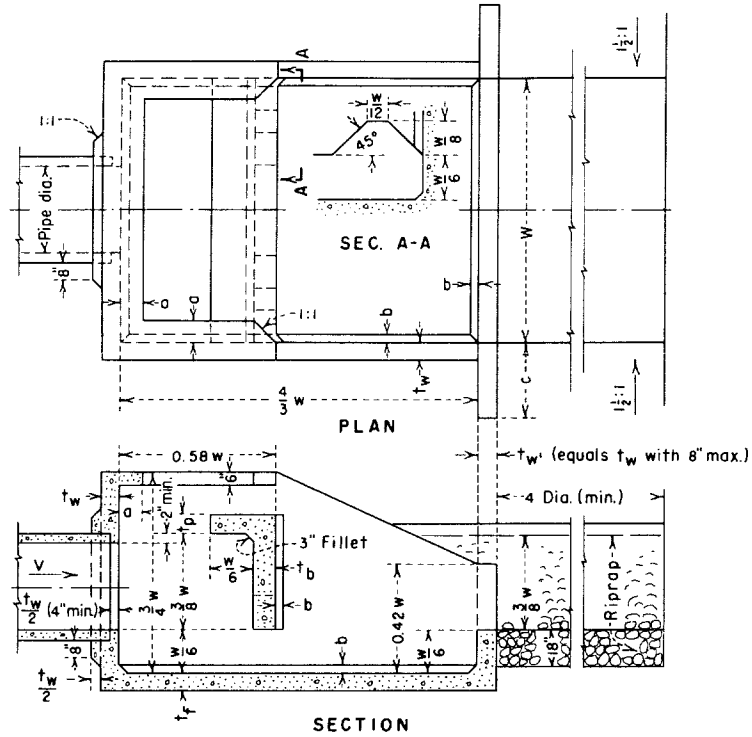
CURB INLET



NOTES:

1. SIDEWALK MAY BE PLACED ANYWHERE FROM CURB TO PROPERTY LINE BY EXTENDING THE TOP SLAB TO MATCH THE POSITION OF THE SIDEWALK
2. * VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 4'
- ** VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

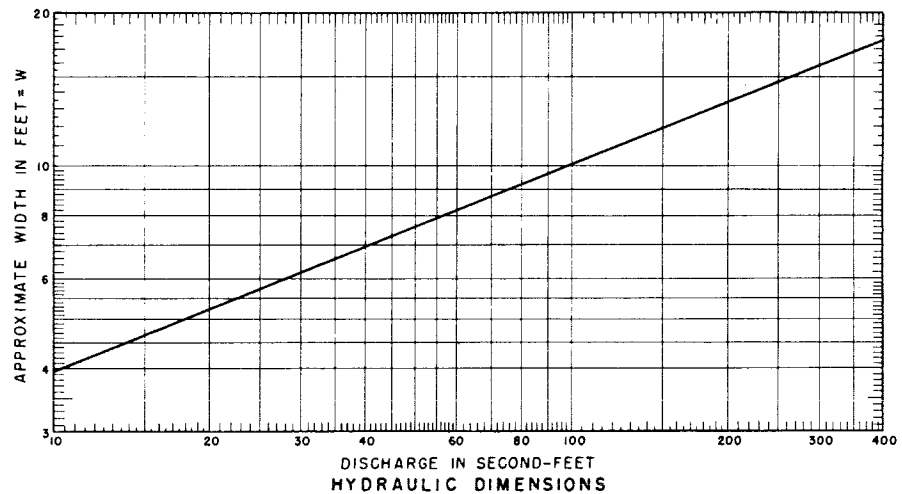
CURB OUTLET



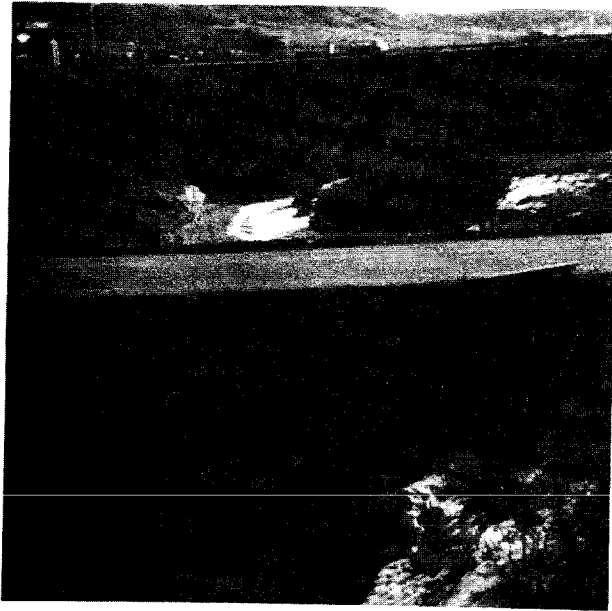
Q	a	b	c	t_w	t_b	t_p
100	9"	3"	3'-0"	8"	8"	8"
200	12"	4"	3'-0"	10"	11"	8"
300	14"	6"	3'-0"	12"	12"	8"
400	16"	6"	3'-0"	12"	13"	8"

Suggested minimum thickness of concrete is 6"

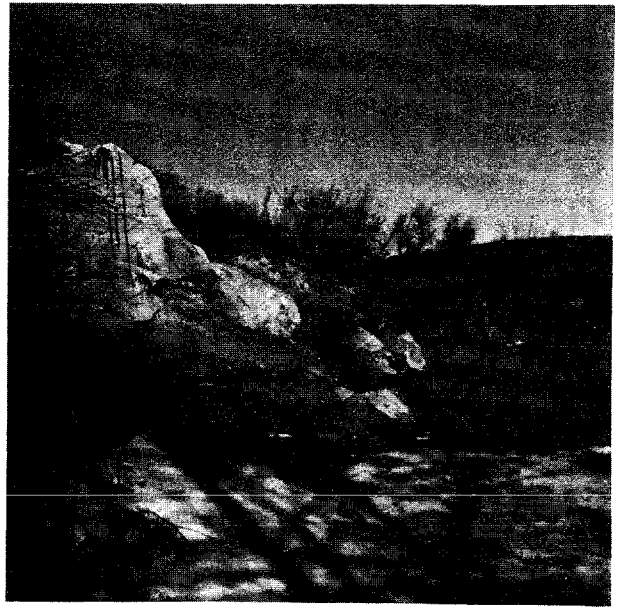
SUGGESTED CONCRETE DIMENSIONS



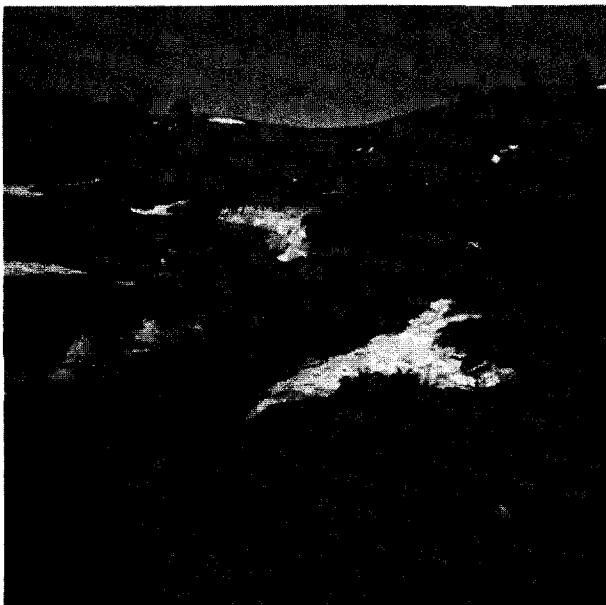
CULVERT ENERGY DISSIPATOR



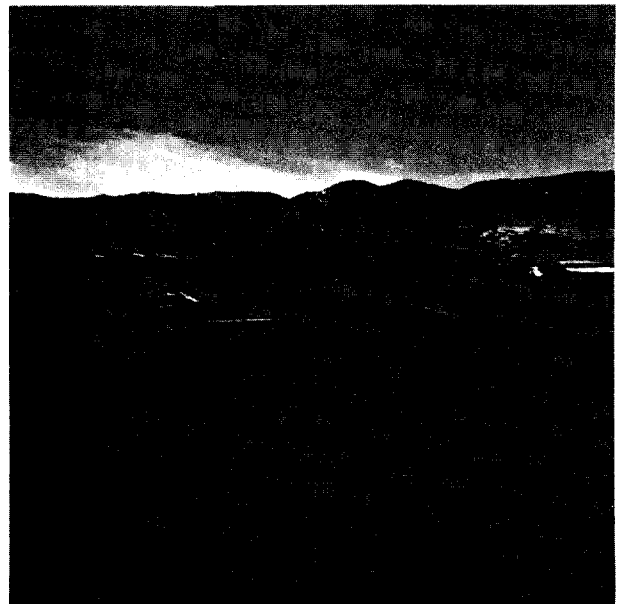
1. Existing culverts near outfall point of primary greenbelt, Cascade Avenue and I-25.



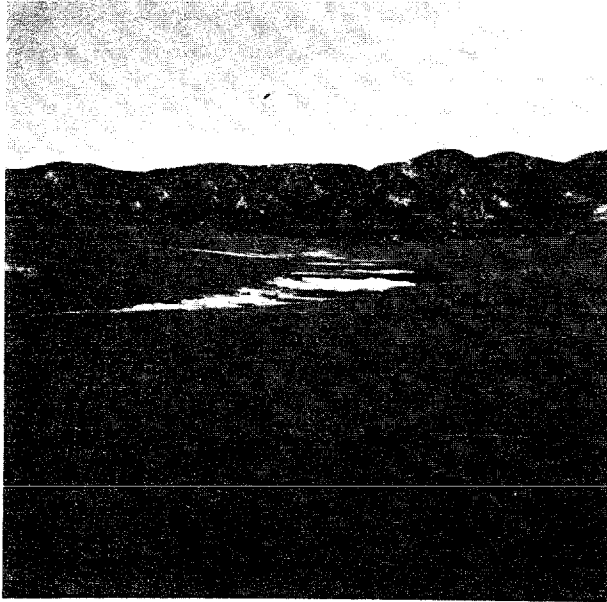
2. Future Rockrimmon Boulevard crossing of primary greenbelt.



3. Primary greenbelt near toe of proposed high dam.



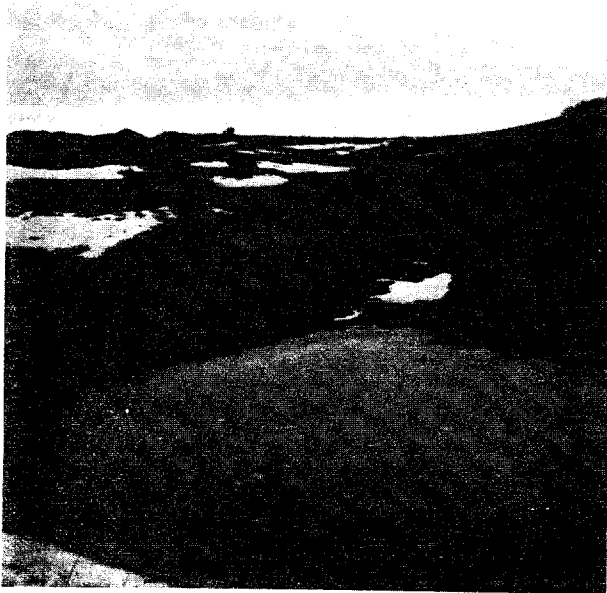
4. Minor greenbelt Shopping Center and School site - fully lined channel proposed.



5. Future alignment of Arterial connection to the West, to have storm sewer.



6. View from existing erosion control dam in minor greenbelt, (to remain).



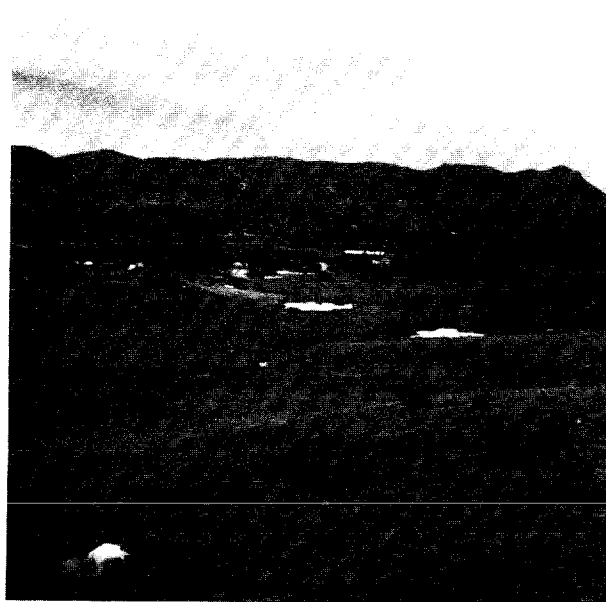
7. Single Family Residential area, existing dike to be removed.



8. Primary greenbelt-to remain in natural condition with controlled inlets; part of lineal park system.



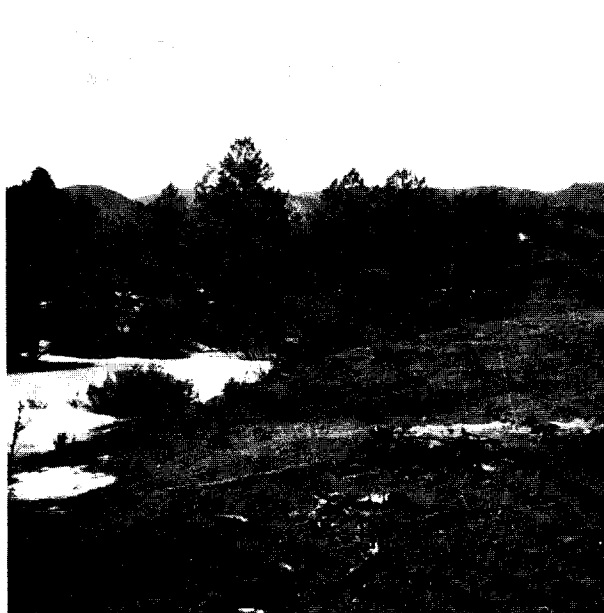
9. Primary Greenbelt below Rockrimmon Boulevard crossing - to remain in natural condition with inlet control.



10. Primary greenbelt (lineal Park) to remain in existing condition with controlled inlets.



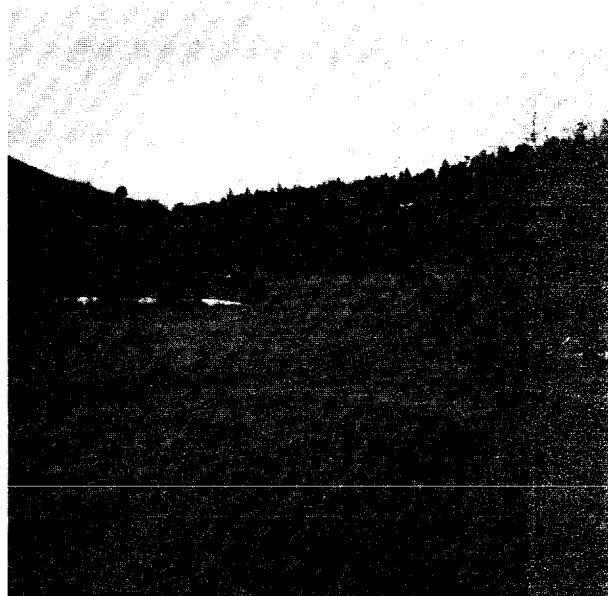
11. Primary greenbelt at minor road crossing-to remain in natural condition with inlet control.



12. Primary greenbelt between dams #1 and #2 - to remain natural.



13. Primary greenbelt above dam #1, to remain natural-controlled inlet with energy dissinator proposed.



14. Approximate location of future street with storm sewer.



15. Approximate location of future street with storm sewer, and park site.



16. Approximate location of future street near ton of proposed storm sewer.



17. Minor greenbelt to remain natural, riprapping of encroaching fills required. Pulpit Rock in background. This greenbelt formally in Dry Creek Basin.



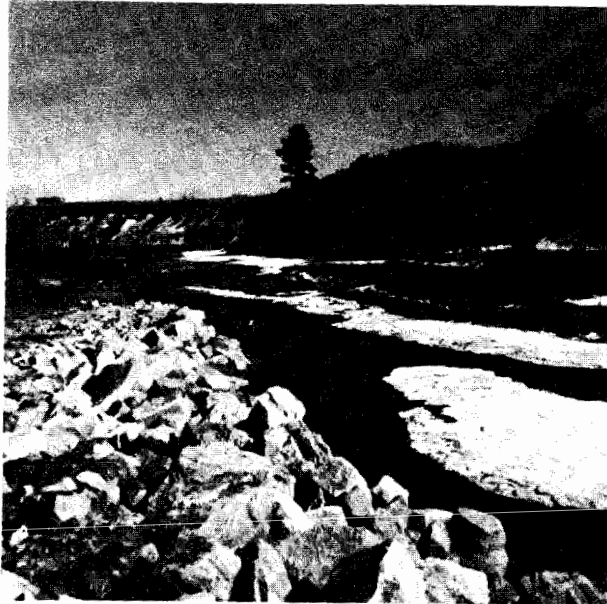
18. Monument Creek, proposed Floodway Fringe Zoning Area.



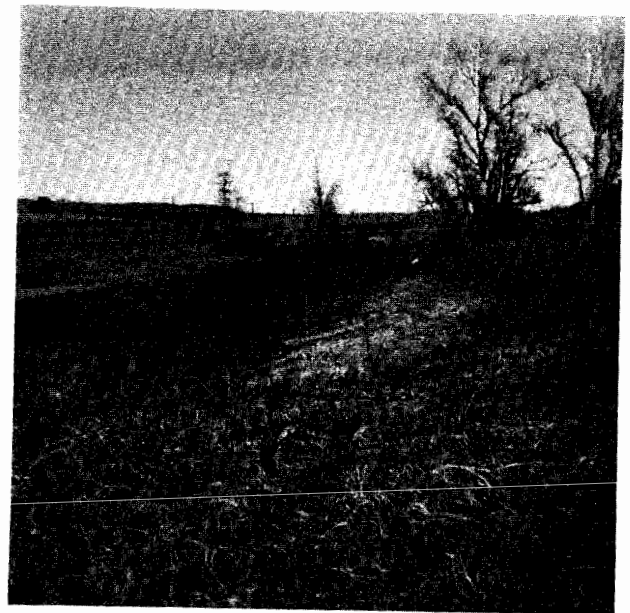
19. Monument Creek Channel to remain in natural state.



20. Monument Creek Channel to remain in existing state, City sewer main manhole in foreground.



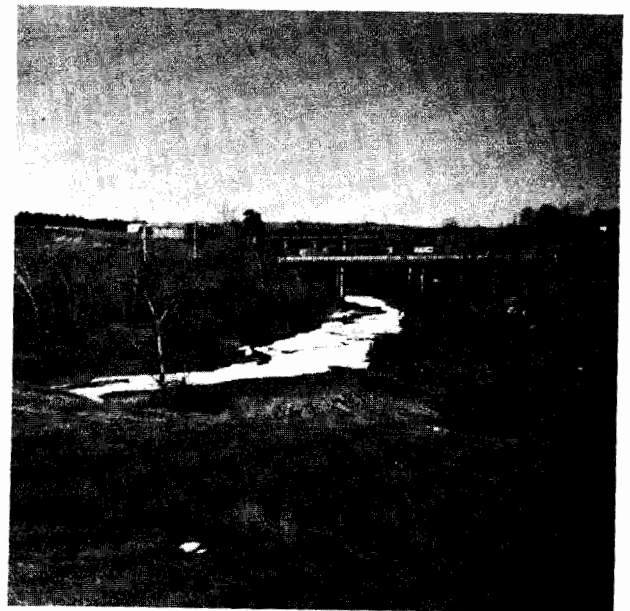
21. Monument Creek Channel to remain in existing state, riprap protects City sewer crossing.



22. Dry Creek Primary Greenbelt Outfall.



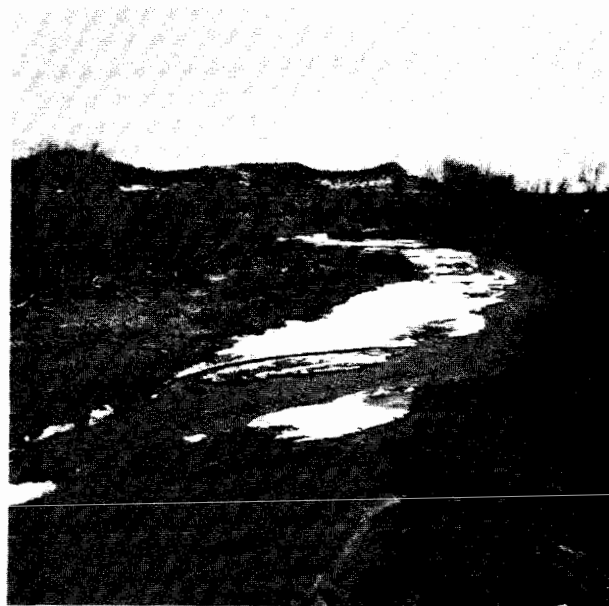
23. Existing Railroad Bridge across primary Dry Creek Greenbelt.



24. Cottonwood Creek Primary greenbelt outfall.



25. Monument Creek Channel to remain in natural state-sandstone shelf in foreground.



26. Monument Creek Channel from Woodmen Road, to remain in natural state.