MASTER DEVELOPMENT DRAINAGE PLAN

FOR

MILLERS CROSSING SUBDIVISION

Prepared for:
Sandpiper, LLC
P.O. Box 1392
Colorado Springs, CO 80901-1392

Prepared by:
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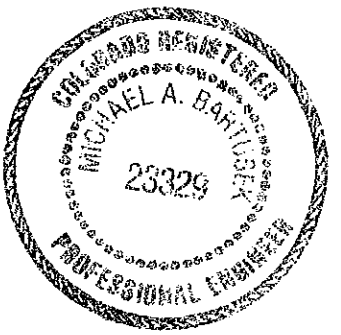
July 14, 2000
991204

ADP
Associated Design Professionals, Inc.

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/County 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.

Michael A. Bartusek, P.E. #23329



DEVELOPER'S STATEMENT

I, the Developer, have read, and will comply with, all of the requirements specified in this drainage report and plan.

SANDPIPER, LLC

By: _____

Title: General Manager

Address: P.O. Box 1392
Colorado Springs, CO 80901-1392

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

_____ 7/24/00

City Engineer Date

Conditions:

Prior to development beyond Filings No. 1 & 2, Financial Assurances must be posted for Sand Creek channel improvements as called for in the MDDP, and construction of these channel improvements must be completed with the next filing developed.

MILLERS CROSSING SUBDIVISION
MASTER DEVELOPMENT DRAINAGE PLAN

GENERAL

This drainage study is for a 37.78-acre site located in the east central portion of Colorado Springs. A 19.02-acre portion of the site was previously platted as the Meadowlark Subdivision. No fees are required on this previously platted portion of the site. The site is to be built in six (6) filings, with most of the storm sewer facilities to be built during the initial phase of work. The entire site is located within the Sand Creek Drainage Basin. The parcel is further described as being within the southeast quarter of Section 14, Township 14 S, Range 66 W, of the 6th P.M., in El Paso County, Colorado.

METHOD OF COMPUTATION

The methodology utilized for this report is in accordance with the *City/County Drainage Criteria Manual*. The Rational Method for computation of runoff was used.

$$Q = cia$$

Where Q = maximum rate of runoff in cubic feet per second
c = runoff coefficient representing drainage area characteristics
i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
a = drainage basin size in acres

EXISTING DRAINAGE CHARACTERISTICS

The existing site is directly tributary to the Sand Creek Channel. The site slopes gently to the south, with a portion sloping to the southwest. Drainage from the site sheet flows overland toward Airport Road, then makes its way along Airport Road to Sand Creek. Some minor ponding occurs in existing low areas along the existing Miller Road. Over 30 acres of off-site flows are directed toward the Millers Crossing Subdivision from developed single-family subdivisions to the north. These subdivisions include the following:

Eastborough Subdivision No. 8
Eastborough Subdivision No. 10
Eastcrest Subdivision No. 2

Most of the drainage from these subdivisions was to be transported to Airport Road by an improved Miller Road. However, the improvements never occurred, and the direct route for the storm flows was never completed.

A small portion of the Eastborough Subdivision is transported to the eastern edge of the subdivision by an existing storm sewer. These flows were to be directed to Sand Creek. However, they have been redirected into Millers Crossing Subdivision by a diversion ditch. No flows from the subdivisions west of the site enter the proposed subdivision.

The existing unimproved Sand Creek channel passes through the site. Areas of ongoing bank erosion are occurring along its reach.

The existing FEMA 100-year floodplain was erroneously shown encroaching on a portion of the property. This was caused by an error in the channel bottom elevation at the bridge crossing at Airport Road of 6.7 feet. A FEMA LOMR has been received, which revises the floodplain on Map No. 08041C0753-F, dated March 17, 1997. A revised floodplain map is on file with the Regional Floodplain Administrator.

DEVELOPED DRAINAGE CHARACTERISTICS

The site will be regraded with streets constructed to safely transport flows to proposed inlets where they can be intercepted by a proposed storm system. The proposed storm system will directly outfall into the improved Sand Creek channel near the Airport Road bridge. Since the existing 100-year channel flows are only five to six feet deep, no backflow into the subdivision should occur. All on-site flows will be passed along the public roadways in accordance with current drainage criteria.

The existing flows from the Eastborough Subdivision (Basins OS2, OS3, and OS4) and Basins A1 and A2 flow to a low point in Miller Road. The flows will be collected by two 20-

foot D10-R inlets in a sump and will be transported to a 48-inch RCP to the south side of Canon Wren Lane. A four-foot D10R inlet will be placed at the low point on the south side of Canon Wren Lane to intercept flows from Basins A3 and A4. This inlet will be directly connected into the 48-inch RCP storm system. Prefabricated bends and manholes will be used throughout the system to reduce energy loss within the storm system.

The 48-inch RCP storm sewer will be placed within the proposed street section (see Typical Street Section). The storm sewer will use joint deflections and prefabricated bends to follow the street curve south along Canyon Wren Lane. It will continue south to the intersection with Tetman Lane, where a 24-inch storm sewer lateral will be constructed to the sump in Tetman Lane. An eight-foot D10R sump inlet will intercept flows from Basins B1 and B2 on the north side of the street, and a four-foot D10R sump inlet will intercept flows from Basin B3 on the south side of the street.

Because of existing site grades, the trunk storm sewer will need to be increased in size to a 54-inch. From Tetman Lane, the 54-inch storm sewer will continue south to Clinebell Lane. A 24-inch RCP storm lateral will be built to a sump in Clinebell Lane. A six-foot D10R sump inlet will intercept flows from Basins C1 and C2, and a six-foot D10R sump inlet will pick up flows from Basin C3.

The storm sewer will be increased to 60 inches and will continue south to Skylark Road. A 24-inch RCP storm lateral will be built to a sump in Skylark Road. A six-foot D10R sump inlet will intercept flows from the north side of Skylark Road, which includes Basins D1 and D2. A four-foot D10R sump inlet will be built on the south side of Skylark Road to intercept flows from Basins D3 and D4. In addition, a low point will be created along Canyon Wren Lane at the Skylark Road intersection. This will require the construction of a six-foot D10R inlet on the west side of Canyon Wren Lane to pick up flows from Basins E1 and E2.

From Skylark Road, the 60-inch trunk sewer will continue south along Canyon Wren Lane turning easterly toward the Miller Road intersection. A 24-inch RCP lateral will be built

to a sump in Miller Road located north of the intersection. A four-foot D10R sump inlet will intercept flows from Basin F1 on the east side of Miller Road. Flows from Basins F2, F3 and F4 on the west side of Miller Road will also be intercepted by a four-foot D10R inlet.

At the intersection of Canyon Wren Drive and Miller Road the 60-inch RCP storm sewer will turn south by utilizing two 45-degree bends. It will continue south until it intercepts a 20-foot drainage easement adjacent to Airport Road. At this point, 45-degree bends will turn the storm sewer east toward Sand Creek. A 24-inch RCP lateral will extend south from the 60-inch storm sewer to a low point in Miller Road. A six-foot D10R sump inlet will intercept flows from Miller Road, including Basins G1 and flows tributary to Airport Road, including Basins OS5 and OS6.

From this low point in Airport Road, the 60-inch RCP storm sewer will continue east within the Airport Road right-of-way to Sand Creek, just upstream of the Airport Road bridge. A Type C grate inlet will also be built on the south side of the Walton Acres Subdivision to intercept flows from Basins H1 and OS7.

The area identified as Basin I1 in the northwest corner of the site will flow along the existing portion of Whippoorwill Lane and into the Eastborough Subdivision No. 9.

A proposed swale will be constructed along the eastern edge of the subdivision to prevent the existing ditch flows from the 24-inch storm sewer (OS1) from entering the site and to direct them toward Sand Creek, as was delineated in the original drainage report for the existing subdivision.

The developed flows from this site are included in *Appendix A* of this report. Sand Creek channel improvements will be constructed in accordance with the *Sand Creek Drainage Basin Study*, completed by Kiowa Engineering, dated October 1995, which delineates improvements in this reach of Sand Creek. The proposed improvements include placing rock riprap along the channel banks for the entire reach of the channel and a 12-foot maintenance road on the east side of the channel. In addition, two grade control structures

are proposed within the project limits. A drainage tract will be dedicated to include the improved channel and maintenance road. Specific report improvements have been included in *Appendix B* of this report. Based on the recommendations included in the DBPS, the estimated reimbursable costs for the channel improvements within the Millers Crossing boundaries are as follows:

Item Description	Quantity	Cost	Amount
Riprap channel improvements	840 LF	$331.00*	$278,040.00
Grade Control Structure	220 LF	$350.00	77,000.00
		Engineering 10%	35,504.00
		Contingencies 5%	17,752.00
		TOTAL	**$408,296.00**

*Unit cost for both sides of the channel

In addition, 323 linear feet of the unimproved Sand Creek channel are adjacent to the Walton Acres subdivision. In accordance with the approved drainage report, funds have been set aside to construct the Sand Creek improvements along this subdivision boundary. As part of the development of the Millers Crossing subdivision, the existing Letter of Credit will be cashed, as agreed to by Walton Acres' owner; and the improvements will be constructed as part of the overall improvements. The proposed improvement costs are estimated as follows:

Item Description	Quantity	Cost	Amount
Riprap channel banks	323 LF	$165.50	$53,456.50
		Engineering 10%	5,345.65
		Contingencies 5%	2,672.83
		TOTAL	**$61,474.98**

As discussed above, a large drainage system is required to accommodate the flows from the adjacent subdivisions, even though no provisions have been made in the Sand Creek DBPS to reimburse this drainage system. On June 25, 1998, the Drainage Board ruled that the proposed trunk sewer should be considered as a public, reimbursable system. The estimated cost for this system is as follows:

Item Description	Quantity	Cost	Amount
Headwall	1 EA	$1,000	$1,000.00
24" CMP	40 LF	25	1,000.00
36" RCP	41 LF	70	2,870.00
48" RCP	333 LF	110	36,630.00
54" RCP	435 LF	120	52,080.00
60" RCP	1043 LF	130	135,590.00
24" FES	1 EA	250	250.00
20' D10R	2 EA	3,000	6,000.00
Prefabricated MH	4 EA	1,000	4,000.00
Bend	13 EA	750	9,750.00
Pipe Transition	2 EA	750	1,500.00
Riprap	45 CY	35	1,575.00
		Subtotal	$252,245.00
		5% Contingencies	12,612.25
		10% Engineering	25,224.50
		TOTAL	**$290,081.75**

The proposed public non-reimbursable storm sewer system costs are as follows:

Item Description	Quantity	Cost	Amount
18" RCP	187 LF	$30	$5,610.00
24" RCP	290 LF	35	10,150.00
30" RCP	145 LF	45	6,525.00
4' D10R	5 EA	2,250	11,250.00
6' D10R	5 EA	2,750	13,750.00
8' D10R	2 EA	2,500	5,000.00
Type C Inlet	1 EA	1,000	1,000.00
		Subtotal	53,285.00
		5% Contingencies	2,664.25
		10% Engineering	5,328.50
		TOTAL	**$61,277.75**

BASIN FEE DETERMINATION

Since a portion of the 37.78-acre site parcel was previously platted, only 18.76 acres of the site are subject to the Sand Creek Basin drainage fees. The 2000 fees are calculated as follows:

Sand Creek Basin Fees: 18.76 Acres x $6,394 = $119,951

Sand Creek Bridge Fees: 18.76 Acres x $381 = $7,148

Sand Creek Pond Fees: 18.76 Acres x ($414 + $1,426) = $34,518

SUMMARY

Since the cost of Sand Creek channel improvements are greater than the drainage basin fees, a drainage credit will be due to the subdivision. Bridge and pond fees will still need to be paid. Since the Millers Crossing site was erroneously included within the FEMA 100-year floodplain, a revision to the floodplain limits has been received. Financial assurances for all public improvements will be posted at the time of the first Building Permit.

APPENDIX A

DRAINAGE CALCULATIONS

C FACTOR CALCULATION								
	TOTAL	ROOF	DRIVEWAY	SIDEWALK	PAVEMENT	LAWN	5 YR	100 YR
	LOT AREA	AREA	AREA	AREA	AREA	AREA	C	C
OS1	C FACTOR PER EASTBOROUGH SUB. #10						0.60	0.70
OS2	C FACTOR PER EASTBOROUGH SUB. #10						0.60	0.70
OS3	5200	1250				3950	0.41	0.49
OS4	5200	1250				3950	0.41	0.49
OS5	40510	3925	2640		22000	11945	0.71	0.77
OS6	19165	0			19165	0	0.90	0.95
OS7	155510	630				154880	0.25	0.35
A1	7372	1450	288	271.2	1322.1	4040.7	0.54	0.62
A2	16550	2900	288	520	2535	10307	0.50	0.58
A3	3632.2	725	288	223.2	1088.1	1307.9	0.67	0.73
B1	8311.2	2175	288	223.52	1089.66	4535	0.55	0.62
B2	20040	2900	576	920	4485	11159	0.54	0.62
B3	3632.2	725	288	223.2	1088.1	1307.9	0.67	0.73
C1	8434.05	2175	288	231.08	1126.515	4613.5	0.54	0.62
C2	10890	1450	288	970	4728.75	3453.3	0.69	0.76
C3	6028	1450	288	288	1404	2598	0.62	0.69
D1	6028	1450	288	288	1404	2598	0.62	0.69
D2	14375	1450	288	830	4046.25	7760.8	0.55	0.63
D3	14375	1450	288	680	3315	8642	0.51	0.59
D4	10890	1450	288	600	2925	5627	0.56	0.64
E1	6200	1450	288	248	1209	3005	0.58	0.66
E2	6200	1450	288	248	1209	3005	0.58	0.66
F1	79715	4350	864	3200	15600	55701	0.45	0.53
F2	84070	10150	2016	2000	9750	60154	0.43	0.52
F3	17425	2900	576	1400	6825	5724	0.69	0.75
F4	37460	5800	1152	1120	5460	23928	0.48	0.57
G1	11760	0	0	440	1072.5	10248	0.33	0.43
H1	44430	0	0	0	0	44430	0.25	0.35
I1	36590	4350	1152	1200	5850	24038	0.47	0.56
J1	34410	6525	864	1480	7215	18326	0.55	0.63
J2	86685	14500	2448	3200	15600	50937	0.52	0.60
J3	30060	5075	1008	1600	7800	14577	0.58	0.66
J4	31800	5800	1152	1200	5850	17798	0.54	0.61
J5	125000	21750	4320	3920	19110	75900	0.51	0.59
J6	16990	0	0	1240	6045	9705	0.53	0.61

MILLERS CROSSING SUBDIVISION
MASTER DEVELOPMENT DRAINAGE PLAN (MDDP)
PROJ. #991204
DRAINAGE CALCULATION SHEET

file: milx-nwr
04/04/00

							Initial Tci			Travel Time								length	vel.		
AREA	AREA	C5	C100	C5 X A	C100 X A		Slope	ti		Slope	V	Tt	TC	I5	I100	Q5	Q100	L	V	^t	
DESIG.	(acre)	(5 yr)	(100 yr)			L (ft)	(%)	(min)	L (ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)	(feet)	(fps)	(min)	
DEVELOPED CONDITIONS																					
OS1	4.90	0.60	0.70	2.94	3.43	100	2.00	7.44	1000	6.00	5.00	3.33	10.77	3.92	6.86	11.54	23.51				OS1
OS2	29.90	0.60	0.70	17.94	20.93	250	4.00	9.36	1850	2.50	3.10	9.95	19.30	2.97	5.19	53.26	108.54	300	3.0	1.67	OS2
OS3	3.32	0.41	0.49	1.36	1.63	175	4.00	10.80	1300	0.75	1.75	12.38	23.18	2.69	4.70	3.66	7.64	100	1.0	1.67	OS3
A1	3.52	0.54	0.62	1.90	2.18	100	2.00	8.33	1300	0.75	1.75	12.38	20.71	2.86	5.00	5.44	10.90				A1
OS3+A1				3.26	3.81								24.85	2.59	4.52	8.44	17.21				OS3+A1
OS4	0.58	0.41	0.49	0.24	0.28	100	4.00	8.17	250	0.75	1.75	2.38	10.55	3.96	6.92	0.94	1.97	100	1.0	1.67	OS4
A2	0.38	0.50	0.58	0.19	0.22	150	2.00	10.93	150	0.75	1.75	1.43	12.36	3.69	6.45	0.70	1.42				A2
OS4+A2				0.43	0.50								12.21	3.71	6.49	1.59	3.27				OS4+A2
OS3-A2				3.69	4.31								24.85	2.59	4.52	9.54	19.49				OS3-A2
OS2-A2				21.63	25.24								24.85	2.59	4.52	55.94	114.03	66	11.6	0.09	OS2-A2
A3	1.60	0.67	0.73	1.07	1.17	50	2.00	4.52	1050	0.75	1.75	10.00	14.52	3.43	5.98	3.67	6.99				A3
DP1				22.70	26.41								24.95	2.58	4.51	58.58	119.05	275	11.6	0.40	DP1
B1	3.20	0.55	0.62	1.76	1.98	140	2.00	9.68	900	0.75	1.75	8.57	18.25	3.06	5.34	5.38	10.59				B1
B2	0.46	0.54	0.62	0.25	0.29	75	2.00	7.21	250	1.20	2.10	1.98	9.20	4.19	7.32	1.04	2.09				B2
B1+B2				2.01	2.27								18.25	3.06	5.34	6.14	12.12				B1+B2
B3	1.52	0.67	0.73	1.02	1.11	50	2.00	4.52	900	0.75	1.75	8.57	13.09	3.60	6.28	3.66	6.97				B3
B1-B3				3.03	3.38								18.25	3.06	5.34	9.25	18.04	100	10.0	0.17	B1-B3
DP2				25.73	29.79								25.34	2.56	4.47	65.81	133.09	217	10.8	0.33	DP2
C1	2.63	0.54	0.62	1.42	1.63	140	2.00	9.86	725	0.75	1.75	6.90	16.76	3.19	5.58	4.53	9.09				C1
C2	0.25	0.69	0.76	0.17	0.19	40	2.00	3.86	0	0.75	1.75	0.00	5.00	5.19	9.06	0.90	1.72				C2
C1+C2				1.59	1.82								16.76	3.19	5.58	5.09	10.15				C1+C2
C3	1.93	0.62	0.69	1.20	1.33	100	2.00	7.14	725	0.75	1.75	6.90	14.05	3.48	6.08	4.17	8.10				C3
C1+C2+C3				2.79	3.15								14.05	3.48	6.08	9.71	19.17				C1+C2+C3
DP3				28.52	32.94								25.68	2.54	4.43	72.40	146.07	210	11.7	0.30	DP3
D1	1.34	0.62	0.69	0.83	0.92	100	2.00	7.14	550	0.75	1.75	5.24	12.38	3.69	6.45	3.07	5.96				D1
D2	0.33	0.55	0.63	0.18	0.21	90	2.00	7.76	100	0.75	1.75	0.95	8.71	4.28	7.48	0.78	1.55				D2
D1+D2				1.01	1.13								12.38	3.69	6.45	3.74	7.30				D1+D2
D3	0.33	0.51	0.59	0.17	0.19	100	2.00	8.78	100	0.75	1.75	0.95	9.73	4.10	7.16	0.69	1.39				D3
D4	0.25	0.56	0.64	0.14	0.16	100	2.00	8.03	150	0.75	1.75	1.43	9.46	4.14	7.24	0.58	1.16				D4
D3+D4				0.31	0.35								9.73	4.10	7.16	1.26	2.54				D3+D4
D1-D4				1.32	1.49								12.38	3.69	6.45	4.87	9.59				D1-D4
OS2-D4				29.84	34.43								25.97	2.52	4.40	75.25	151.66				OS2-D4
E1	1.48	0.58	0.66	0.86	0.98	110	2.00	8.11	500	0.75	1.75	4.76	12.88	3.63	6.33	3.11	6.19				E1

E2	0.36	0.58	0.66	0.21	0.24	110	2.00	8.11	100	0.75	1.75	0.95	9.07	4.22	7.36	0.88	1.75				E2
E1+E2				1.07	1.21								12.88	3.63	6.33	3.87	7.69				E1+E2
DP4				30.91	35.64								25.97	2.52	4.40	77.94	157.01	550	9.6	0.95	DP4
F1	1.83	0.45	0.53	0.82	0.97	40	2.00	6.12	600	0.75	1.75	5.71	11.83	3.77	6.58	3.10	6.38				F1
F2	1.93	0.43	0.52	0.83	1.00	110	2.00	10.45	370	0.88	1.90	3.25	13.70	3.52	6.15	2.92	6.18	50	1.8	0.48	F2
F3	0.40	0.69	0.75	0.28	0.30	60	2.00	4.72	320	0.88	1.90	2.81	7.53	4.53	7.91	1.25	2.37				F3
F2+F3				1.11	1.30								14.18	3.47	6.05	3.83	7.89				F2+F3
F4	0.86	0.48	0.57	0.41	0.49	120	2.00	10.10	200	0.75	1.75	1.90	12.01	3.74	6.54	1.54	3.20				F4
F2-F4				1.52	1.79								14.18	3.47	6.05	5.26	10.86				F2-F4
F1-F4				2.34	2.76								14.18	3.47	6.05	8.12	16.73				F1-F4
DP5				33.25	38.41								26.93	2.47	4.31	82.13	165.71	158	10.6	0.25	DP5
G1	0.27	0.33	0.43	0.09	0.12	150	5.00	10.37	50	0.75	1.75	0.48	10.84	3.91	6.84	0.35	0.79				G1
OS5	0.93	0.71	0.77	0.66	0.72	150	5.00	5.25	450	1.80	2.70	2.78	8.03	4.42	7.72	2.92	5.53				OS5
G1+OS5				0.75	0.83								8.03	4.42	7.72	3.31	6.42				G1+OS5
OS6	0.34	0.90	0.95	0.31	0.32	30	2.00	1.63	275	0.86	1.90	2.41	5.00	5.19	9.06	1.59	2.93				OS6
G1-OS6				0.97	1.04								8.03	4.42	7.72	4.27	8.02				G1-OS6
DP6				34.21	39.45								27.18	2.46	4.29	84.06	169.29	391	10.6	0.61	DP6
H1	1.02	0.25	0.35	0.26	0.36	230	2.00	19.18	0	1.00	2.00	0.00	19.18	2.98	5.20	0.76	1.86				H1
OS7	3.57	0.25	0.35	0.89	1.25	500	1.00	35.54	300	0.50	1.40	3.57	39.11	1.97	3.44	1.76	4.30				OS7
H1+OS7				1.15	1.61								39.11	1.97	3.44	2.26	5.53				H1+OS7
DP7				35.36	41.05								27.79	2.43	4.24	85.76	173.91				DP7
I1	0.84	0.47	0.56	0.39	0.47	175	1.00	15.58	200	1.00	2.00	1.67	17.25	3.15	5.50	1.24	2.59				I1
EAST TRIBUTARY																					EAST TRIB
J1	0.79	0.55	0.63	0.43	0.50	140	2.00	9.68	175	0.75	1.75	1.67	11.35	3.84	6.70	1.67	3.34	350	1.8	3.33	J1
J2	1.99	0.52	0.60	1.03	1.19	200	2.00	12.20	350	0.75	1.75	3.33	15.54	3.32	5.79	3.43	6.92				J2
J1+J2				1.47	1.69								15.54	3.32	5.79	4.87	9.80	200	1.8	1.90	J1+J2
J3	0.69	0.58	0.66	0.40	0.46	100	2.00	7.74	400	0.75	1.75	3.81	11.55	3.81	6.65	1.52	3.03				J3
J1-J3				1.87	2.15								17.44	3.13	5.47	5.85	11.74				J1-J3
J4	0.73	0.54	0.61	0.39	0.45	100	2.00	8.33	300	0.75	1.75	2.86	11.19	3.86	6.74	1.52	3.00				J4
J1-J4				2.26	2.59								17.44	3.13	5.47	7.08	14.17	34	10.0	0.06	J1-J4
J5	2.87	0.51	0.59	1.46	1.69	120	2.00	9.61	900	1.50	2.30	6.52	16.14	3.25	5.68	4.76	9.63				J5
J6	0.39	0.53	0.61	0.21	0.24	40	2.00	5.36	300	0.75	1.75	2.86	8.22	4.38	7.65	0.91	1.82				J6
J5+J6				1.67	1.93								16.14	3.25	5.68	5.44	10.98				J5+J6
DP8				3.93	4.52								17.50	3.12	5.46	12.29	24.69				DP8

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 1+36.65 TO 1+00.00

Solve For Actual Depth

Given Input Data:

Diameter.....	5.00 ft
Slope.....	0.0050 ft/ft
Manning's n.....	0.013
Discharge.....	173.90 cfs

Computed Results:

Depth.....	3.87 ft
Velocity.....	10.67 fps
Flow Area.....	16.30 sf
Critical Depth....	3.78 ft
Critical Slope....	0.0053 ft/ft
Percent Full.....	77.37 %
Full Capacity.....	184.16 cfs
QMAX @.94D.....	198.10 cfs
Froude Number.....	0.95 (flow is Subcritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 1+36.65 TO 4+24.16

Solve For Actual Depth

Given Input Data:

Diameter.....	5.00 ft
Slope.....	0.0050 ft/ft
Manning's n.....	0.013
Discharge.....	169.30 cfs

Computed Results:

Depth.....	3.78 ft
Velocity.....	10.64 fps
Flow Area.....	15.91 sf
Critical Depth....	3.73 ft
Critical Slope....	0.0051 ft/ft
Percent Full.....	75.53 %
Full Capacity.....	184.16 cfs
QMAX @.94D.....	198.10 cfs
Froude Number.....	0.97 (flow is Subcritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 4+24.16 TO 6+85.54

Solve For Actual Depth

Given Input Data:

Diameter.....	5.00 ft
Slope.....	0.0040 ft/ft
Manning's n.....	0.013
Discharge.....	165.70 cfs

Computed Results:

Depth.....	4.13 ft
Velocity.....	9.56 fps
Flow Area.....	17.33 sf
Critical Depth....	3.69 ft
Critical Slope....	0.0051 ft/ft
Percent Full.....	82.52 %
Full Capacity.....	164.72 cfs
QMAX @.94D.....	177.19 cfs
Froude Number.....	0.79 (flow is Subcritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 6+85.54 TO 11+35.12

Solve For Actual Depth

Given Input Data:

Diameter.....	4.50 ft
Slope.....	0.0070 ft/ft
Manning's n.....	0.013
Discharge.....	157.00 cfs

Computed Results:

Depth.....	3.52 ft
Velocity.....	11.78 fps
Flow Area.....	13.33 sf
Critical Depth....	3.67 ft
Critical Slope....	0.0064 ft/ft
Percent Full.....	78.13 %
Full Capacity.....	164.53 cfs
QMAX @.94D.....	176.98 cfs
Froude Number.....	1.10 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 11+35.12 TO 13+52.61

Solve For Actual Depth

Given Input Data:

Diameter.....	4.50 ft
Slope.....	0.0060 ft/ft
Manning's n.....	0.013
Discharge.....	146.10 cfs

Computed Results:

Depth.....	3.53 ft
Velocity.....	10.91 fps
Flow Area.....	13.40 sf
Critical Depth....	3.55 ft
Critical Slope....	0.0059 ft/ft
Percent Full.....	78.52 %
Full Capacity.....	152.32 cfs
QMAX @.94D.....	163.86 cfs
Froude Number.....	1.01 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 13+52.61 TO 15+69.86

Solve For Actual Depth

Given Input Data:

Diameter.....	4.00 ft
Slope.....	0.0080 ft/ft
Manning's n.....	0.013
Discharge.....	133.10 cfs

Computed Results:

Depth.....	3.43 ft
Velocity.....	11.62 fps
Flow Area.....	11.46 sf
Critical Depth....	3.44 ft
Critical Slope....	0.0079 ft/ft
Percent Full.....	85.63 %
Full Capacity.....	128.48 cfs
QMAX @.94D.....	138.21 cfs
Froude Number.....	1.01 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 15+69.86 TO 18+44.36

Solve For Actual Depth

Given Input Data:

Diameter.....	4.00 ft
Slope.....	0.0080 ft/ft
Manning's n.....	0.013
Discharge.....	119.10 cfs

Computed Results:

Depth.....	3.04 ft
Velocity.....	11.61 fps
Flow Area.....	10.26 sf
Critical Depth....	3.29 ft
Critical Slope....	0.0068 ft/ft
Percent Full.....	76.09 %
Full Capacity.....	128.48 cfs
QMAX @.94D.....	138.21 cfs
Froude Number.....	1.18 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 18+44.36 TO 19+10.19

Solve For Actual Depth

Given Input Data:

Diameter.....	4.00 ft
Slope.....	0.0080 ft/ft
Manning's n.....	0.013
Discharge.....	114.00 cfs

Computed Results:

Depth.....	2.93 ft
Velocity.....	11.55 fps
Flow Area.....	9.87 sf
Critical Depth....	3.22 ft
Critical Slope....	0.0065 ft/ft
Percent Full.....	73.30 %
Full Capacity.....	128.48 cfs
QMAX @.94D.....	138.21 cfs
Froude Number.....	1.22 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 19+10.19LT TO 19+10.19RT

Solve For Actual Depth

Given Input Data:

Diameter.....	3.00 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.013
Discharge.....	57.00 cfs

Computed Results:

Depth.....	2.13 ft
Velocity.....	10.60 fps
Flow Area.....	5.38 sf
Critical Depth....	2.45 ft
Critical Slope....	0.0074 ft/ft
Percent Full.....	71.12 %
Full Capacity.....	66.70 cfs
QMAX @.94D.....	71.75 cfs
Froude Number.....	1.33 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 1+00 TO 1+40.66 EAST TRIB

Solve For Actual Depth

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.013
Discharge.....	14.20 cfs

Computed Results:

Depth.....	1.15 ft
Velocity.....	7.61 fps
Flow Area.....	1.87 sf
Critical Depth....	1.36 ft
Critical Slope....	0.0061 ft/ft
Percent Full.....	57.43 %
Full Capacity.....	22.62 cfs
QMAX @.94D.....	24.34 cfs
Froude Number.....	1.38 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: MILLER'S CROSSING

Comment: PROP STM SEW - STA 1+40.66 TO 3+05.88 EAST TRIB

Solve For Actual Depth

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.013
Discharge.....	24.30 cfs

Computed Results:

Depth.....	1.85 ft
Velocity.....	8.01 fps
Flow Area.....	3.03 sf
Critical Depth....	1.74 ft
Critical Slope....	0.0105 ft/ft
Percent Full.....	92.38 %
Full Capacity.....	22.62 cfs
QMAX @.94D.....	24.34 cfs
Froude Number.....	0.84 (flow is Subcritical)

MILLERS CROSSING SUBDIVISION
STREET & INLET CAPACITY
ULTIMATE CONDITIONS

04/25/00			DESIGN	STREET					Q +					
DESIGN PT	SIDE	DESCRIPTION	YEAR	WIDTH	ST CAP	S	Sx	Q(area)	BYPASS	T	Qi/Q	Li	Qi	Qby
A1	LT	STREET	5	17.00	8.50	0.0075	0.02	8.44	8.44	16.93				
		STREET	100	17.00	8.50	0.0075	0.02	17.21	17.21	22.11				
A2	LT	STREET	5	17.00	8.50	0.0075	0.02	1.59	1.59	9.05				
		STREET	100	17.00	8.50	0.0075	0.02	3.27	3.27	11.86				
MILLERS RD	RT	WINDOW SUMP	5	17.00	17.84	0.0330	0.02	27.47	27.47	19.96	1.48	20	40.68	-13.21
		WINDOW SUMP	100	17.00	17.84	0.0330	0.02	57.02	57.02	26.25	1.21	20	69.06	-12.04
MILLERS RD	LT	WINDOW SUMP	5	17.00	17.84	0.0330	0.02	27.47	27.47	19.96	1.48	20	40.68	-13.21
		WINDOW SUMP	100	17.00	17.84	0.0330	0.02	57.02	57.02	26.25	1.21	20	69.06	-12.04
A3	RT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	3.67	3.67	12.39	1.61	4	5.90	-2.23
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	6.99	6.99	15.77	1.00	4	6.99	0.00
B1	LT	STREET	5	17.00	8.50	0.0075	0.02	5.38	5.38	14.30				
		STREET	100	17.00	8.50	0.0075	0.02	10.59	10.59	18.43				
B2	LT	WINDOW SUMP	5	17.00	13.96	0.0202	0.02	1.04	6.14	12.48	1.93	8	11.86	-5.72
		WINDOW SUMP	100	17.00	13.96	0.0202	0.02	2.09	12.12	16.10	1.17	8	14.17	-2.05
B3	RT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	3.66	3.66	12.38	1.61	4	5.89	-2.23
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	6.97	6.97	15.76	1.00	4	6.98	-0.01
C1	LT	STREET	5	17.00	8.50	0.0075	0.02	4.53	4.53	13.41				
		STREET	100	17.00	8.50	0.0075	0.02	9.09	9.09	17.41				
C2	LT	WINDOW SUMP	5	17.00	13.89	0.0200	0.02	0.90	5.09	11.65	1.66	6	8.45	-3.36
		WINDOW SUMP	100	17.00	13.89	0.0200	0.02	1.72	10.15	15.09	1.00	6	10.17	-0.02
C3	RT	WINDOW SUMP	5	17.00	13.89	0.0200	0.02	4.17	4.17	10.81	1.91	6	7.97	-3.80
		WINDOW SUMP	100	17.00	13.89	0.0200	0.02	8.10	8.10	13.87	1.18	6	9.60	-1.50
D1	LT	STREET	5	17.00	8.50	0.0075	0.02	3.07	3.07	11.59				
		STREET	100	17.00	8.50	0.0075	0.02	5.96	5.96	14.86				
D2	LT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	0.78	3.74	12.48	1.00	6	6.83	-3.09
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	1.55	7.30	16.03	1.00	6	10.60	-3.30
D3	LT	STREET	5	17.00	8.50	0.0075	0.02	0.69	0.69	6.62				
		STREET	100	17.00	8.50	0.0075	0.02	1.39	1.39	8.61				
D4	LT	WINDOW SUMP	5	17.00	13.89	0.0200	0.02	0.58	1.26	6.90	1.00	4	3.76	-2.50

		WINDOW SUMP	100	17.00	13.89	0.0200	0.02	1.16	2.54	8.98	1.00	4	4.54	-2.00
E1	LT	STREET	5	17.00	8.50	0.0075	0.02	3.11	3.11	11.64				
		STREET	100	17.00	8.50	0.0075	0.02	6.19	6.19	15.07				
E2	LT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	0.88	3.87	12.64	1.00	6	6.90	-3.03
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	1.75	7.69	16.35	1.00	6	10.73	-3.04
F1	RT	WINDOW SUMP	5	17.00	10.76	0.0120	0.02	3.10	3.10	10.65	1.00	4	4.84	-1.74
		WINDOW SUMP	100	17.00	10.76	0.0120	0.02	6.38	6.38	13.96	1.00	4	6.43	-0.05
F2	RT	STREET	5	17.00	8.78	0.0080	0.02	2.92	2.92	11.23				
		STREET	100	17.00	8.78	0.0080	0.02	6.18	6.18	14.88				
F3	RT	STREET	5	17.00	8.78	0.0080	0.02	1.25	3.83	12.44				
		STREET	100	17.00	8.78	0.0080	0.02	2.37	7.89	16.31				
F4	RT	WINDOW SUMP	5	17.00	10.76	0.0120	0.02	1.54	1.54	8.19	1.00	4	4.12	-2.58
		WINDOW SUMP	100	17.00	10.76	0.0120	0.02	3.20	3.20	10.77	1.00	4	5.30	-2.10
G1	LT	STREET	5	17.00	12.03	0.0150	0.02	0.35	0.35	4.51				
		STREET	100	17.00	12.03	0.0150	0.02	0.79	0.79	6.12				
OS5	LT	STREET	5	29.50	67.91	0.0252	0.02	2.92	3.31	9.50				
		STREET	100	29.50	67.91	0.0252	0.02	5.53	6.42	12.17				
OS6	LT	WINDOW SUMP	5	29.50	39.67	0.0086	0.02	1.59	4.27	12.78	1.00	6	6.95	-2.68
		WINDOW SUMP	100	29.50	39.67	0.0086	0.02	2.93	8.02	16.19	1.00	6	10.66	-2.64
OS7	LT	GRATE SUMP	5	12.00	3.87	0.0100	0.02	2.26	2.26	9.79	4.96	2.83	11.20	-8.94
		GRATE SUMP	100	12.00	3.87	0.0100	0.02	5.53	5.53	13.69	2.03	2.83	11.21	-5.68
I1	LT	STREET	5	17.00	13.89	0.0200	0.02	1.24	1.24	6.86				
		STREET	100	17.00	13.89	0.0200	0.02	2.59	2.59	9.04				
J1	LT	STREET	5	17.00	17.40	0.0314	0.02	1.67	1.67	7.05				
		STREET	100	17.00	17.40	0.0314	0.02	3.34	3.34	9.14				
J2	LT	STREET	5	17.00	8.50	0.0075	0.02	3.43	4.87	13.77				
		STREET	100	17.00	8.50	0.0075	0.02	6.92	9.80	17.90				
J3	LT	STREET	5	17.00	8.50	0.0075	0.02	1.52	5.85	14.76				
		STREET	100	17.00	8.50	0.0075	0.02	3.03	11.74	19.16				
J4	LT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	1.52	7.08	15.85	1.00	8	9.98	-2.90
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	3.00	14.17	20.56	1.00	8	16.57	-2.40
J5	RT	STREET	5	17.00	17.40	0.0314	0.02	4.76	4.76	10.44				
		STREET	100	17.00	17.40	0.0314	0.02	9.63	9.63	13.60				
J6	RT	WINDOW SUMP	5	17.00	8.50	0.0075	0.02	0.91	5.44	14.36	1.00	6	7.61	-2.17
		WINDOW SUMP	100	17.00	8.50	0.0075	0.02	1.82	10.98	18.68	1.00	6	11.71	-0.73

APPENDIX B

SAND CREEK RECOMMENDATION

TABLE VIII-2: SAND CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGEWAY CONVEYANCE COST ESTIMATE
WITH SELECTED DETENTION ALTERNATIVES

SEGMENT NUMBER	REACH NUMBER	SEGMENT LENGTH (FT)	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	GRADE CONTROL LENGTH (FT)	TOTAL REIMBURSABL COSTS	TOTAL COST
LOWER SAND CREEK									
101	SC-1	1400	10-YR RIPRAP	1400	268	4	250	$413,950	$413,950
102	"	1970	"	1470	268	4	500	$471,460	$471,460
103	"	1030	"	1030	268	1	230	$0	$311,690
104	"	1800	10-YR RIPRAP	420	268	2	260	$0	$152,860
			TOE PROTECTION	1750	130	0	0	$0	$227,500
112	"	3530	10-YR RIPRAP	1300	268	9	1580	$0	$593,300
			10-YR RIPRAP (1 SIDE)	2130	130			$0	$276,900
115	"	3680	10-YEAR RIPRAP	2950	268	9	800	$0	$914,600
			100-YEAR RIPRAP	600	360	0	0	$0	$216,000
136	"	1440	"	0	0	1	170	$0	$26,350
119	SC-2	2150	100-YEAR RIPRAP	480	331	6	1020	$316,980	$316,980
121	"	2250	"	2250	331	9	1350	$1,217,250	$1,217,250
125-1	"	2900	"	2780	331	7	1110	$1,308,680	$1,308,680
125-2	"	1950	10-YEAR RIPRAP	1950	238	4	620	$681,100	$681,100

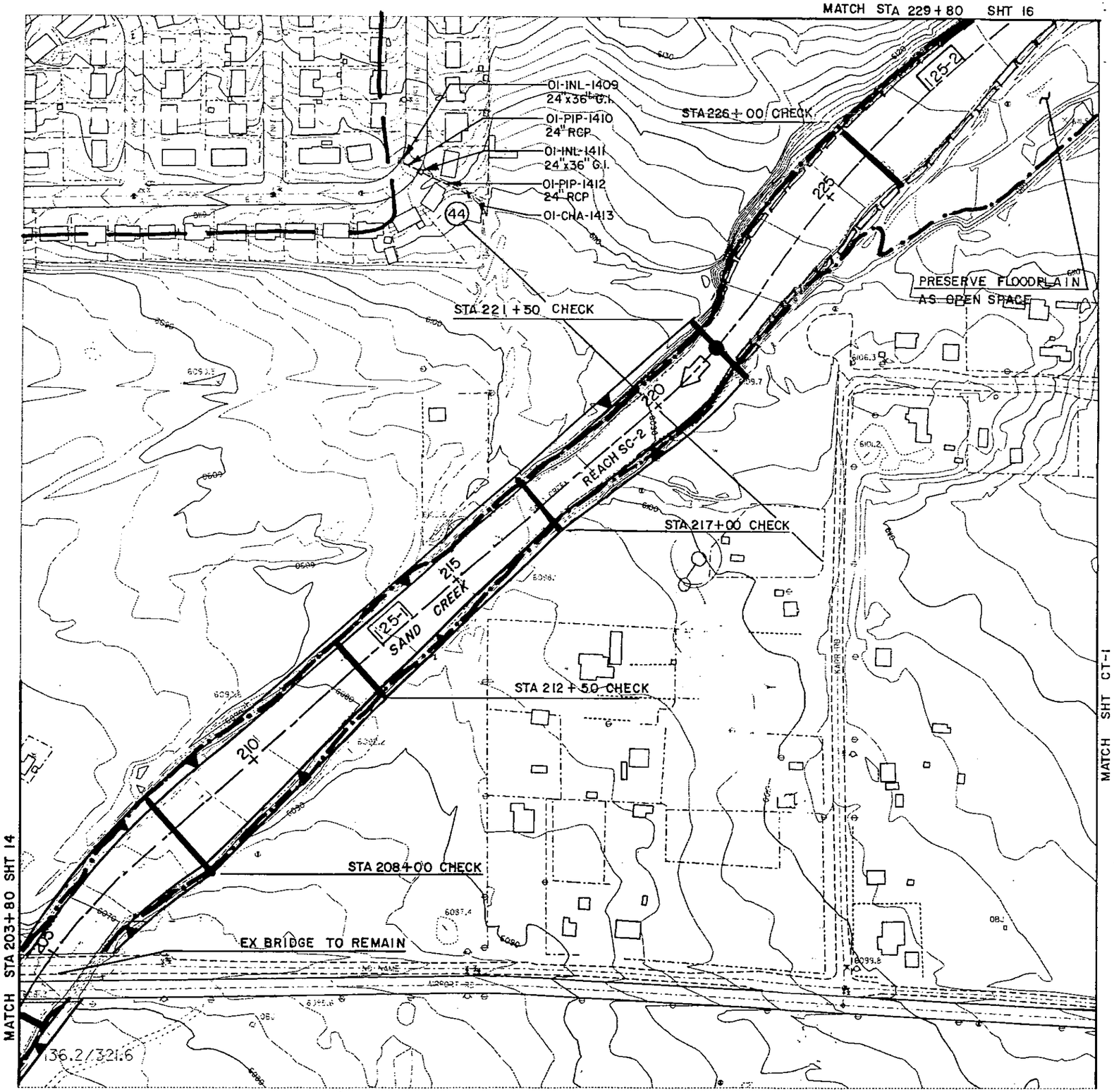
THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS		
SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
125-1	100	100-YEAR RIPRAP LININGS 7' DEPTH
FOR PROFILE SEE SHEET P-4		

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
--PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS

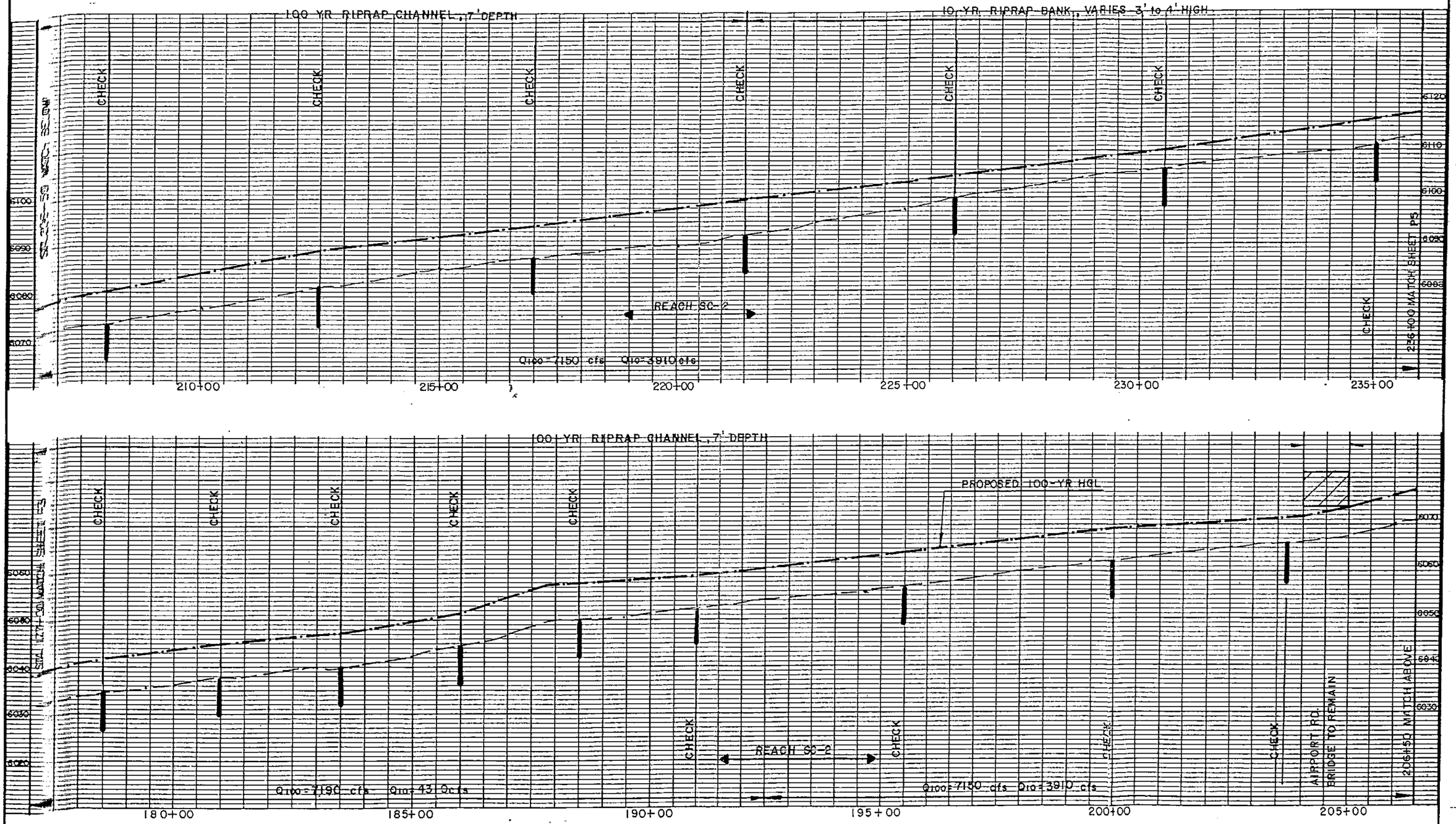
SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
125-1	100	100-YEAR RIPRAP LININGS 7' DEPTH
125-2	100	10-YEAR RIPRAP LININGS 4' HIGH

FOR PROFILE SEE SHEET P-4

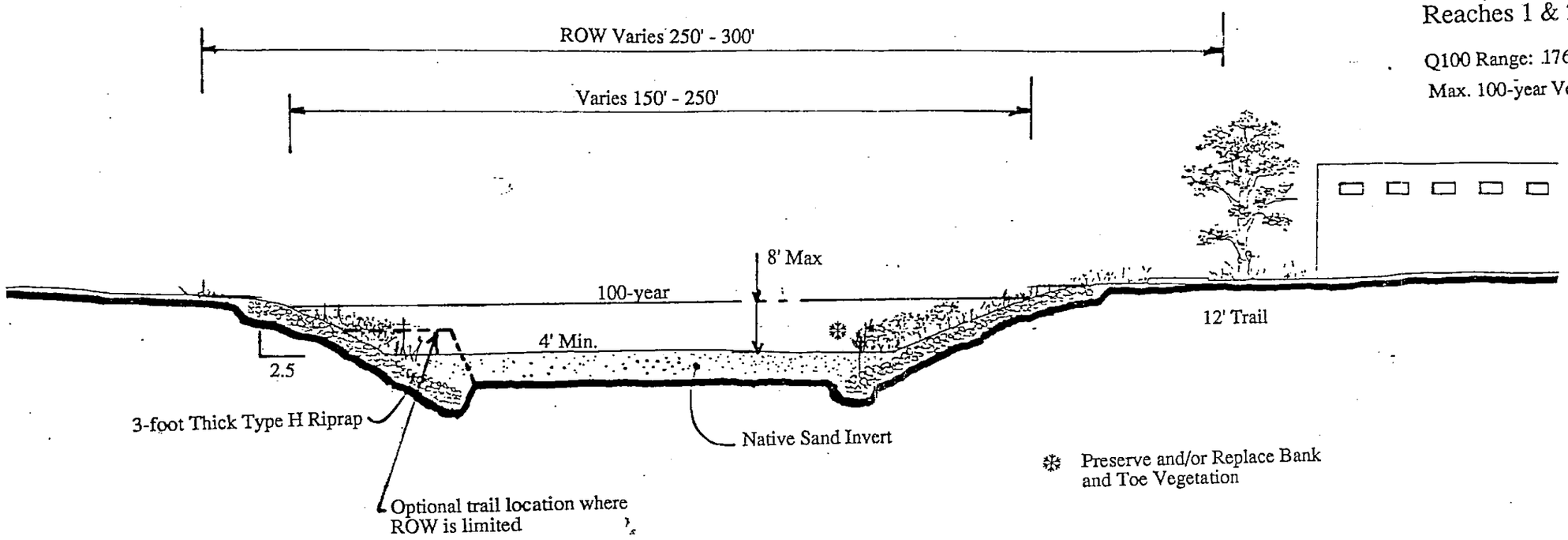
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-09
Date:	9-92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	



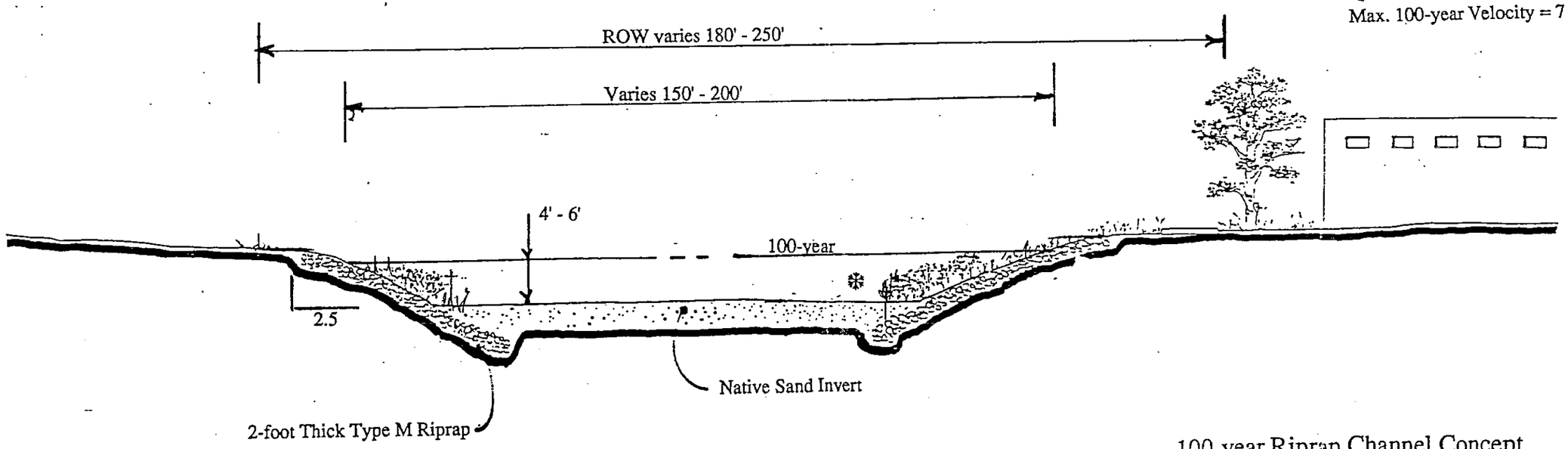
Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	SAND CREEK Station 177+00 to 236+00	P-4



Reaches 1 & 2

Q100 Range: 17670 to 8500 cfs

Max. 100-year Velocity = 10 fps



Reaches 3 - 6

Q100 Range: 8500 to 2400 cfs

Max. 100-year Velocity = 7 fps

100-year Riprap Channel Concept

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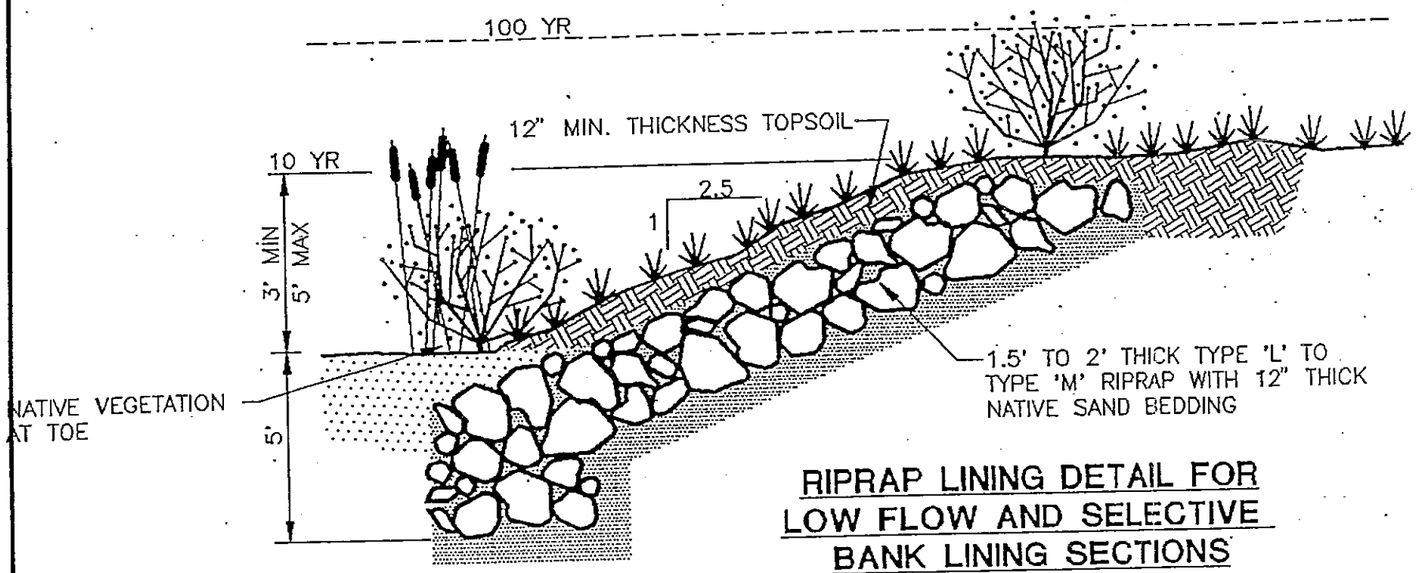
SAND CREEK DRAINAGE BASIN PLANNING STUDY

Typical Channel Sections

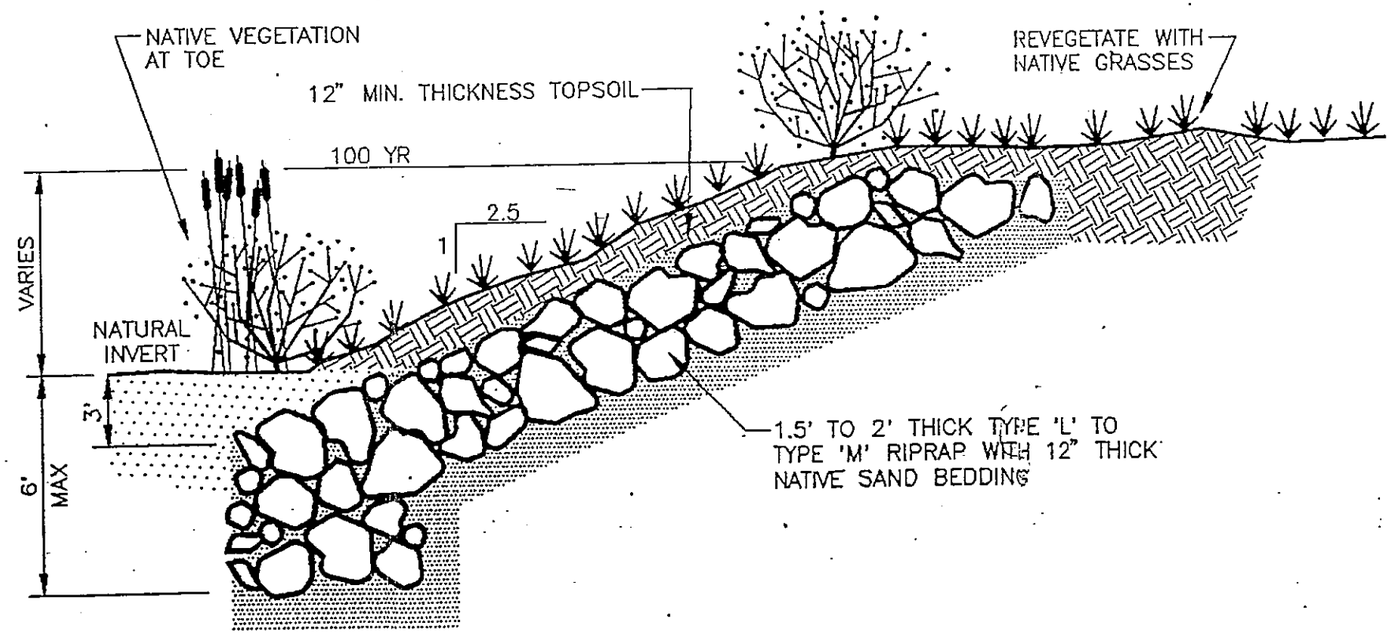
Project No.	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

CS-1



RIPRAP LINING DETAIL FOR LOW FLOW AND SELECTIVE BANK LINING SECTIONS

NTS



RIPRAP LINING DETAIL FOR 100 YR CHANNEL SECTIONS

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SAND CREEK DRAINAGE BASIN PLANNING STUDY

Project No.
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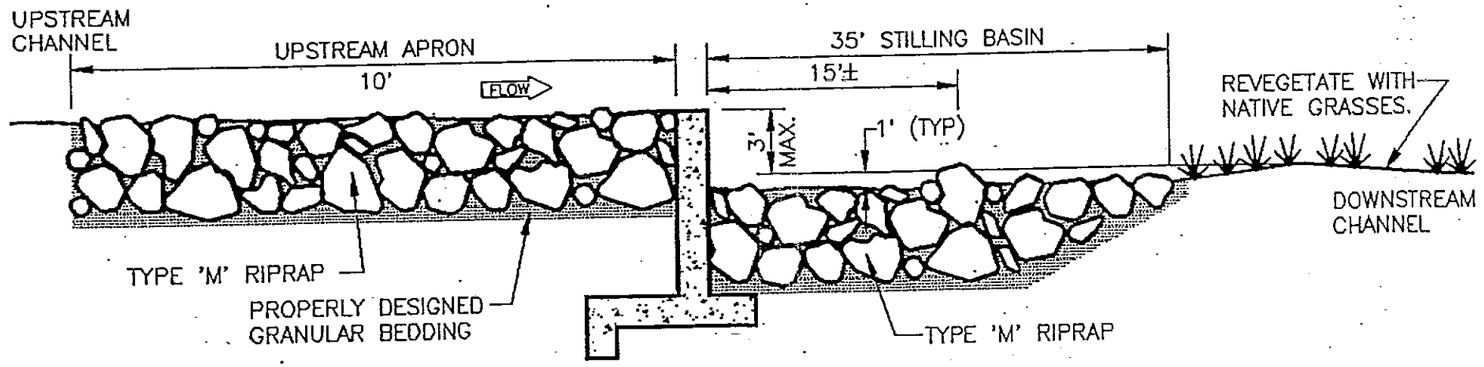
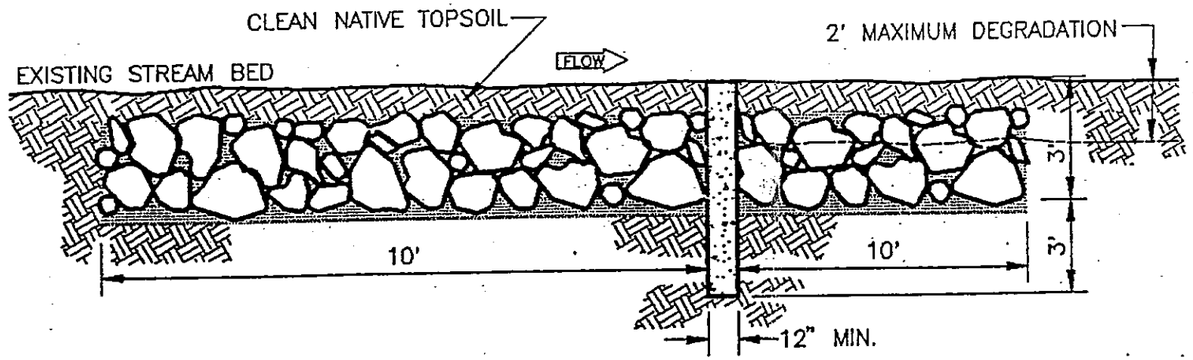
CS-6



NOTE: DIMENSIONS OF APRON, STILLING BASIN, RIPRAP, AND CHECK STRUCTURE IS TO BE DETERMINED DURING FINAL DESIGN.

TYPICAL DROP STRUCTURE GENERALIZED PROFILE

NTS



TYPICAL EROSION CONTROL CHECK PROFILE

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CS-7

APPENDIX C

DESIGN CHARTS

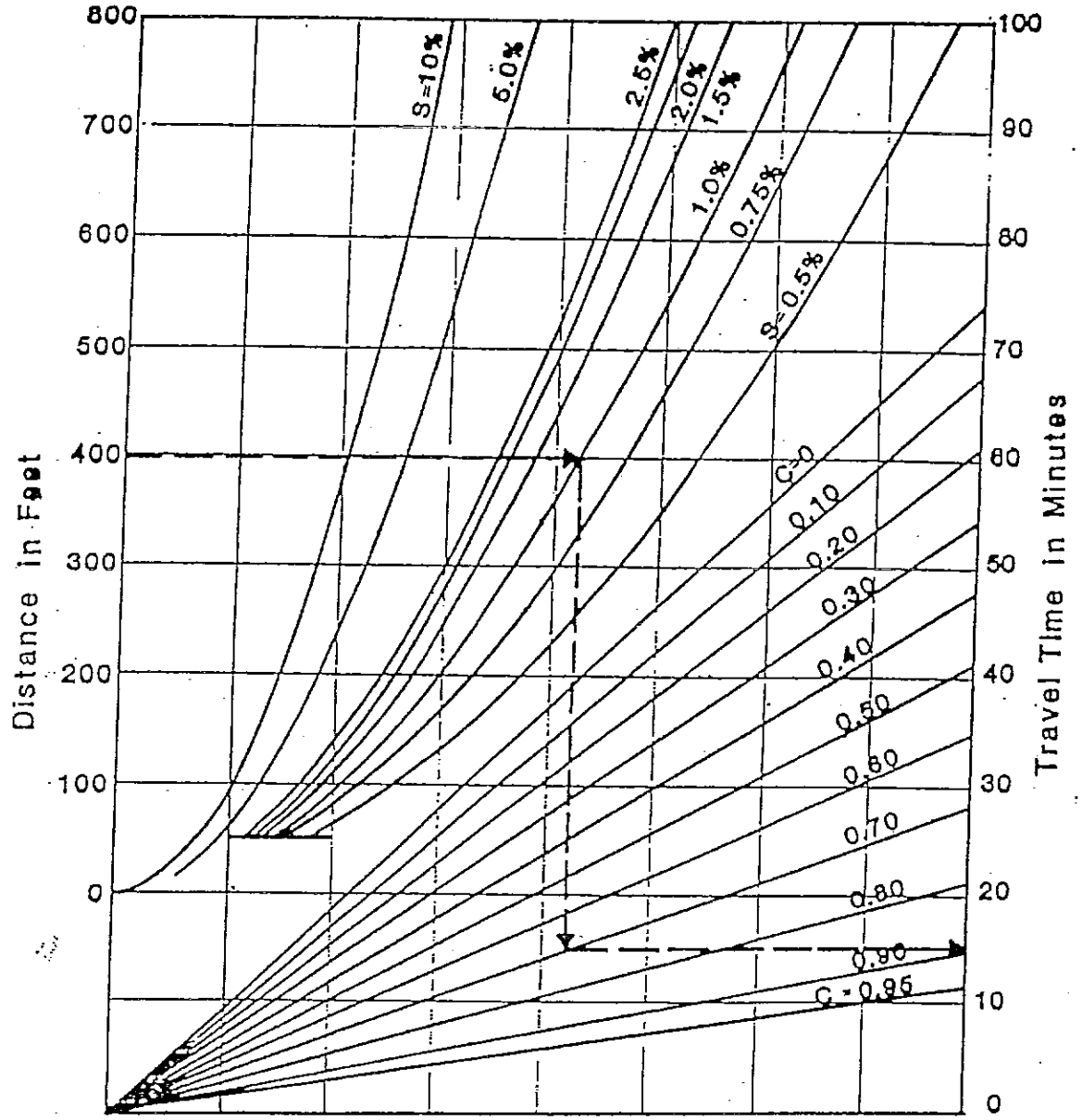
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90



REFERENCE : Wright – McLaughlin Engineers, Urban Storm Drainage Criteria Manual, Vol. 1, Denver Regional Council of Governments, Denver, Co. 1977

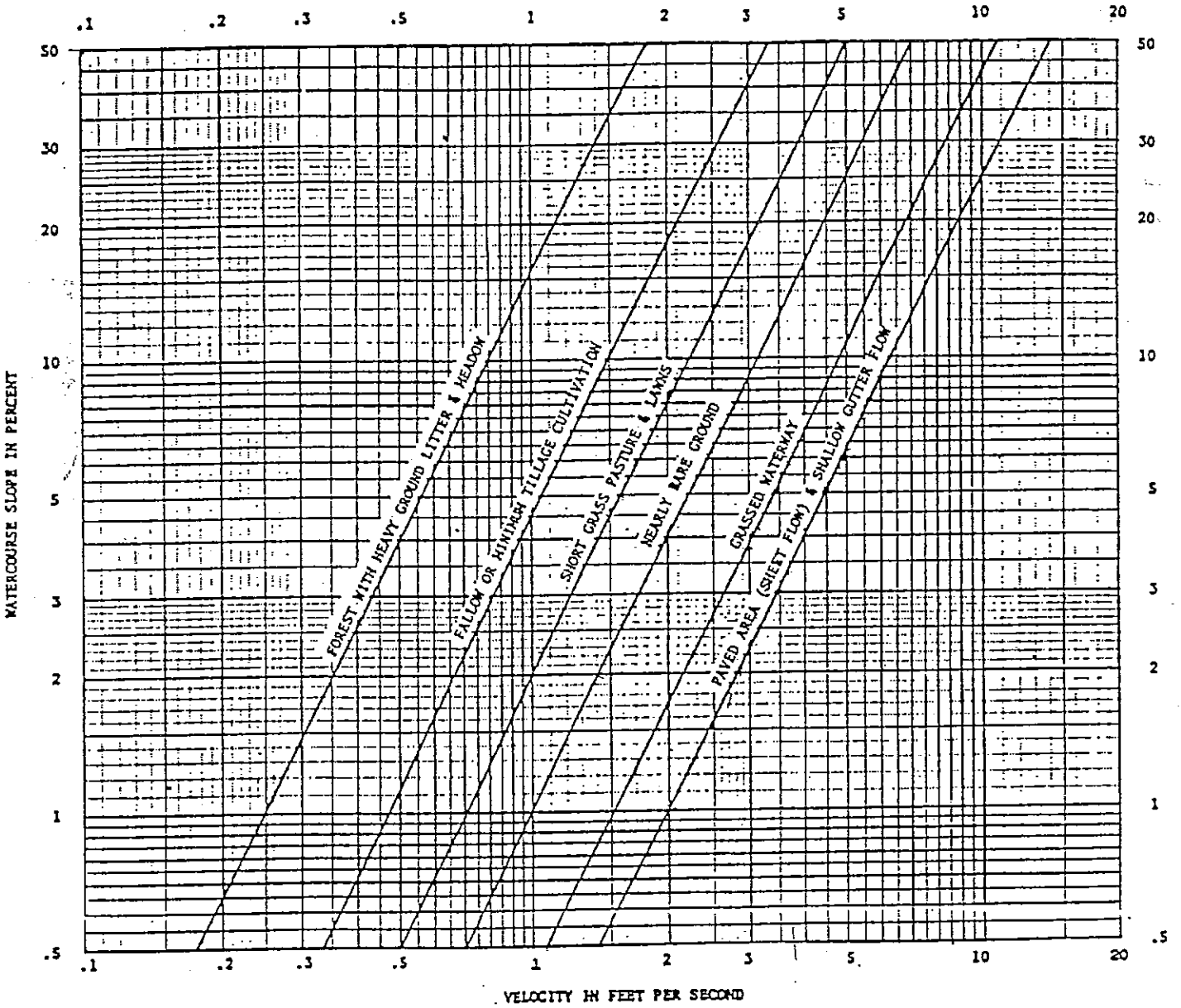
HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Overland Flow Curves

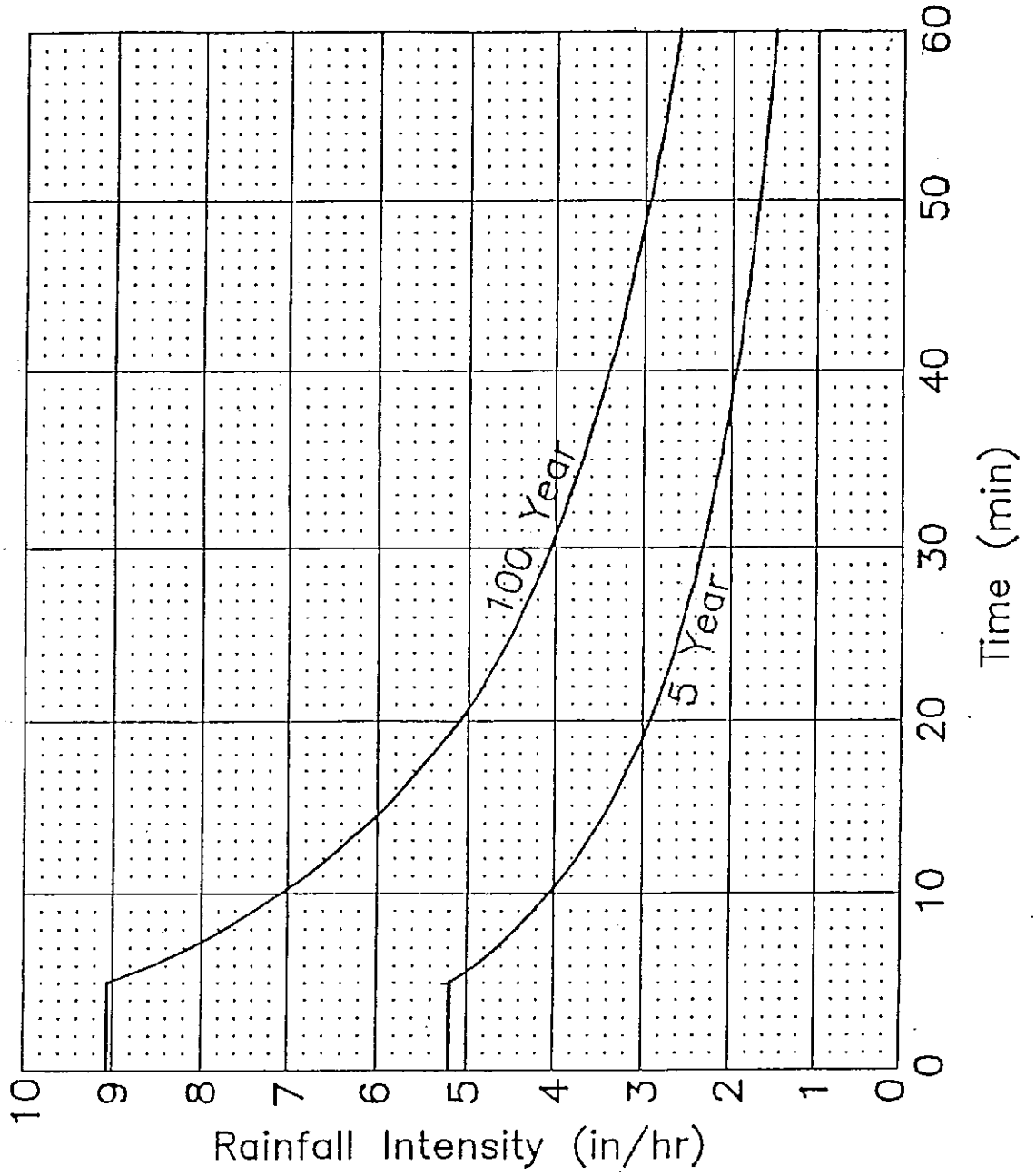
Date: OCT. 1987

Figure: 5-2



--Average velocities for estimating travel time for overland flow.

FIGURE 4



$$I_t = \frac{36.4 * I_{60}}{t_c^{0.83} + 6.72}$$

5 Year: I_{60}= 1.50
100 Year: I_{60}= 2.62

RE: Based upon Pikes Peak Area Council of Governments Areawide Urban Runoff Control Manual.

The City of Colorado Springs / El Paso County Drainage Criteria Manual Storm Rainfall Time Intensity – Frequency Curves	Date: MAR. 1995 Figure: 5 – 1