MASTER DRAINAGE STUDY

FOR

SPRING CREEK SHOPPING CENTER

AND

PRELIMINARY & FINAL DRAINAGE REPORT

FOR

SPRING CREEK FILING NO. 5

PREPARED BY:

K L H Engineering Consultants, Inc.

206-208 Sutton Lane

Colorado Springs, CO 80907

KLH J.N. 85 585 16

August 1988

GENERAL LOCATION AND DESCRIPTION:

Spring Creek Shopping Center is a proposed 16.99 acre General Retail Center (including 0.93 acres public street), located in the Spring Creek Development in the City of Colorado Springs, El Paso County, Colorado. This site lies adjacent to the following streets: Monterey Road to the South, South Circle Drive (State Highway 29) to the East, the proposed extension of Server Drive to the North, and a proposed Interior Road to the West. The site is presently surrounded to the North and West by unplatted lands (See Drainage Plan in the Appendix section of this report). Spring Creek Shopping Center is located entirely within the Spring Creek Master Drainage Basin.

Spring Creek Filing No. 5 is a 12.01 acre subdivision of the Southerly portion of Spring Creek Shopping Center, located at the Northwest corner of the intersection of South Circle Drive and Monterey Road. This subdivision contains one 11.08 acre lot and 0.93 acres public street (Monterey Road). Spring Creek Filing No. 5 is to be built as Phase I of the Spring Creek Shopping Center. Phase II will be the remainder of the Spring Creek Shopping Center, as shown on the Drainage Plan.

The existing slopes on this site range from approximately 3% to 6%, with fall in a general Northerly direction. According to the SCS Soil Survey of El Paso County Area, Colorado, the soils within this site consist of the following:

1) Nelson-Tassel fine sandy loams, SCS Soils Number 56, Hydrologic Soils Group B;
2) Truckton loamy sand, SCS Soils Number 95, Hydrologic Soils Group B;

3) Truckton sandy loam, SCS Soils Number 97, Hydrologic Soils Group B.

The SCS Soils Numbers are shown on the Drainage Plan.

DRAINAGE BASINS AND SUB-BASINS:

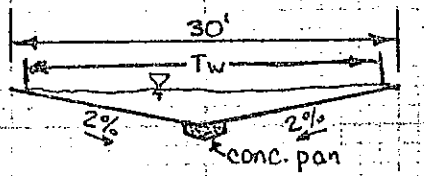
Spring Creek Shopping Center is located in the Spring Creek Master Drainage Basin. This site was originally included in the study area of the "Master Drainage Study for Spring Creek Development Phase II and Final Drainage Report for Spring Creek Filing No. 4", prepared by KLH Engineering Consultants, Inc., dated February, 1986, and amended by letter dated August 8, 1988. No part of Spring Creek Shopping Center lies within a defined 100-year floodplain, according to the FEMA maps (Panel 279).

This drainage study is generally in agreement with the "Master Drainage Study for Spring Creek Development Phase II and Final Drainage Report for Spring Creek Filing No. 4" (hereinafter referred to as Phase II "Master Drainage Study"). The reader is referred to this Phase II "Master Drainage Study" for a complete discussion of basin characteristics and downstream facilities.

As shown on the Drainage Plan, exterior runoff presently enters this site from the roadside ditch along the West side of Circle Drive. This runoff flows overland across the Spring Creek Shopping Center. This roadside ditch will be regraded as necessary in order to contain this runoff within the Right-of-Way. No other exterior runoff enters this site. Historically, runoff generated onsite flows overland in a general Northerly direction. Runoff from the South is intercepted by Monterey Road and the South Circle Drive roadside ditch.

Check capacity of asphalt swale (Westerly access drive) - Spring Creek Filing No. 5

Check for following section:



Sub-basin R-2 ("Master Drainage Study for Spring Creek Shopping Center and Preliminary & Final Drainage Report for Spring Creek Filing No. 5")

- $Q_{10} = 16.7$ cfs

However, portion of sub-basin lies North of Spring Creek Fil. No. 5, and portion of Q_{10} is intercepted by private storm sewer (building roof drain which ties in to storm sewer).

10cfs

∴ For swale @ 0.50% (see grading plan, sheet 7 of 15)
$Q = 6$ cfs

```
TRAPIZOIDAL CHANNEL
SOLUTION FOR NORMAL DEPTH USING
MANNINGS EQUATION
SECTION  1
-----------------------------------
Q=     6.0000 cfs
S=      .0050 ft/ft
B=     0.0000 ft
Z=    50.0000
N=      .0190
V=     1.4984 fps
Tw=   28.1250 ft   Tt= 128.1250 ft
Y=      .2813 ft   D =   1.2813 ft
```

Tw<30' OK

For swale @ 2.77% (see grading plan, sheet 7 of 9)
$Q = 10$ cfs

```
SECTION  2
-----------------------------------
Q=    10.0000 cfs
S=      .0277 ft/ft
B=     0.0000 ft
Z=    50.0000
N=      .0190
V=     3.2433 fps
Tw=   24.8047 ft   Tt= 124.8047 ft
Y=      .2480 ft   D =   1.2480 ft
```

Tw<30' OK

DRAINAGE DESIGN CRITERIA:

The Phase II "Master Drainage Study", in which the drainage for this site was previously studied, was prepared under the previous City Criteria, using the procedures outlined in the "City of Colorado Springs Determination of Storm Runoff Criteria, March 1977." As a result, flow shown in the Phase II "Master Drainage Study" are 5-year and 100-year flows, calculated using the Modified SCS Methodology.

As required by the new City Criteria (City of Colorado Springs & El Paso County Drainage Criteria Manual), runoff quantities from both the 10-year and 100-year storms were calaulated for the sub-basins. The Rational Method was used to calculate flows since the drainage area is less than 100 acres. Runoff calculations are included in the Appendix section of this report. Where necessary, runoff quantities from the Phase II "Master Drainage Study" were recalculated to reflect the new criteria.

Drainage facilities were designed using the methods outlined in the City/County Drainage Criteria Manual. Facilities were sized for either the 10-year or 100-year flows, depending on location and flow quantities. Drainage facility design calculations are included in the Appendix.

DRAINAGE FACILITY DESIGN:

The existing storm sewer facilities in Monterey Road are in agreement with the storm sewer shown in the Phase II "Master Drainage Study". This existing system consists of a 6' curb inlet on grade and

a sumped 8' curb inlet, connected by 18" RCP, with approximately 70 LF of 24" RCP from the 8' inlet to the temporary outlet at the North side of Monterey Road. As shown in the Phase II "Master Drainage Study", this storm sewer was to be continued Northerly in a street proposed at the low point in Monterey. However, a street is no longer proposed at this location, so a sumped inlet will be required at the low point in Monterey to pick up the 100-year flow which does not enter the inlets on the South side of Monterey. The public storm sewer will be extended Northerly in a drainage easement, and will eventually connect to the proposed Interior Road storm sewer system (see Drainage Plan). As a part of Phase I construction, this pipe will be installed to approximately 50' beyond the limits of Phase I, where it will outlet into a into a temporary ditch, as shown on the Drainage Plan. This pipe will be extended Northerly to the Interior Road as a part of Phase II construction.

An existing roadside ditch is located along the West side of South Circle Drive to drain the West half of the Right-of-Way. An existing 18" CMP culvert across Monterey Road carries the drainage Northerly from the high point located South of Monterey (see Phase II "Master Drainage Study"). The roadside ditch adjacent to the Spring Creek Shopping Center will be regraded where necessary to carry the Right-of-Way runoff in a Northerly direction past the proposed Server Drive extension (as shown in the Phase II "Master Drainage Study"). A 24" CMP culvert will be provided at the Circle Drive access point in Spring Creek Filing No. 5. An 18" CMP culvert presently exists across the proposed Server Drive, however this culvert will need to be upsized to 24", and the existing flowline will be lowered somewhat due to the regrading of the roadside ditch. This construction will

take place with the development of Phase I. All work performed along South Circle Drive will be subject to Colorado Department of Highways requirements.

To reduce the sheetflow in the parking area, a private 12' sumped curb inlet will be provided at the Northerly end of sub-basin 1. A 24" RCP (private) will carry this runoff onto the Phase II area. This pipe will temporarily outlet into a ditch which will carry the runoff offsite, as shown on the Drainage Plan. A CMP culvert will be installed under the temporary access easement to drain the Phase II area lying Easterly of this easement. Upon development of the Phase II area, the 24" RCP will be extended Northerly, and the CMP will be abandoned.

Sub-basins 1, 2, and 3 will all drain in a Northerly direction to the proposed Interior Road, as shown on the Drainage Plan. Runoff from sub-basin 1 will enter sub-basin 3 as both sheetflow and pipeflow (from the private inlet/pipe system). As previously mentioned, the private 24" RCP will be extended Northerly with Phase II construction to tie into the proposed Interior Road storm sewer system. The sheetflow from sub-basin 1 will combine with runoff from sub-basin 3 to flow overland and in the street to the Interior Road low point. The majority of runoff from sub-basin 2 will sheetflow to the access easement located adjacent to the Westerly boundary. This runoff will flow down the access driveway to the Interior Road, where it will turn and run Easterly to the low point in the Interior Road. Two sumped 18' curb inlets will be required at this low point to pick up the combined 100-year flow from these three sub-basins, minus the flow intercepted by the private 12' inlet in sub-basin 1 (approximately 24 cfs). The 100-year runoff will be carried Westerly in a storm sewer pipe to be

located in the Interior Road. This pipe and the 18' inlets will be built with the development of Phase II. The private storm sewer from Spring Creek Shopping Center and the public storm sewer from Monterey Road will connect to the Interior Road storm sewer.

The Interior Road storm sewer system will be continued with future development to the North. Downstream of the junction of the Interior Road and Monterey Road storm sewers, the storm sewer will be sized to carry the combined 100-year flow from these two systems plus the 10-year flow from the downstream sub-basins. The 10-year storm will be used as the design storm, where possible, with the 100-year runoff being carried in the streets.

The developed runoff from Spring Creek Shopping Center and from the Monterey Road storm sewer flows onto lands presently owned by Webb-Hancock Associates.

Webb-Hancock Associates agrees to accept these developed flows.

EROSION CONTROL:

The developed flows from Spring Creek Shopping Center will flow overland to an existing stockpond located Northwest of this site (see Phase II "Master Drainage Study"). This stockpond will be used as a sediment control device, with straw bales placed in the overflow area of this pond. Strawbales will also be placed at areas of flow concentration in the Spring Creek Shopping Center Phase II area (as shown on Drainage Plan) to provide construction period erosion control for Phase I construction. The portion of South Circle Drive Right-of-Way adjacent to Spring Creek Filing No. 5 will be permanently landscaped with the Phase I construction. The estimated cost for the Spring Creek Filing No. 5 temporary erosion control is $1,000.00.

DRAINAGE FACILITY COST ESTIMATE
Spring Creek Filing No. 5 (Phase I)
(Public, reimburseable)

16' Type R Inlet	1 Ea @ $3000/Ea	=	$	3,000.00
36" RCP	510 LF @ $ 55/LF	=		28,050.00
Manhole	2 Ea @ $2000/Ea	=		4,000.00
24" CMP	180 LF @ $ 37/LF	=		6,660.00
			$	41,710.00
+15% Engineering & Contingency				6,256.50
TOTAL (Public, reimiburseable)			$	47,966.50

(Private, nonreimburseable)

12' Type R Inlet	1 Ea @ $2500/Ea	=	$	2,500.00
24" RCP	165 LF @ $ 40/LF	=		6,600.00
24" CMP(temporary)	40 LF @ $ 37/LF	=		1,480.00
Riprap	20 CY @ $ 40/CY	=		800.00
			$	11,380.00
+15% Engineering & Contingency				1,707.00
TOTAL (Private, nonreimburseable)			$	13,087.00

Phase II - Spring Creek Shopping Center
(Public, reimburseable)

18' Type R Inlet	2 Ea @ $3200/Ea	=	$	6,400.00
36" RCP	260 LF @ $ 55/LF	=		14,300.00
48" RCP	500 LF @ $ 75/LF	=		37,500.00
Manhole	1 Ea @ $2000/Ea	=		2,000.00
			$	60,200.00
+15% Engineering & Contingency				9,030.00
TOTAL (Public, reimburseable)			$	69,230.00

(Private, nonreimburseable)

24" RCP	300 LF @ $ 40/LF	=	$	12,000.00
			$	12,000.00
+15% Engineering & Contingency				1,800.00
TOTAL (Private, nonreimburseable)			$	13,800.00

DRAINAGE & BRIDGE FEES

Spring Creek Drainage Basin:

Spring Creek Filing No. 5

1988 Drainage Fee:	12.01 Ac @ $4196.00/Ac =	$ 50,393.96
1988 Bridge Fee:		-0-

Phase II - Spring Creek Shopping Center

1988 Drainage Fee:	4.98 Ac @ $4196.00/Ac =	$ 20,896.08
1988 Bridge Fee:		-0-

DRAINAGE REPORT STATEMENTS

Spring Creek Shopping Center
Spring Creek Filing No. 5

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.

Name

Developer's Statement:

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

WEBB-HANCOCK ASSOCIATES JOINT VENTURE
THE SCHUCK CORPORATION, GENERAL PARTNER

By: _____

Title: V.P. Schuck Corp.

Address: 25 N. Cascade
Colorado Springs, CO 80903

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

8/2/88
Date

Conditions:

* SUBJECT TO THE REQUIREMENTS OF AN AMENDMENT TO THE SPRING CREEK FILING NO. 4 DRAINAGE REPORT FOR OUTFALL FACILITIES

AN EROSION CONTROL LETTER OF CREDIT ($1000) REQUIRED PRIOR TO PLATTING

THE DRAINAGE EASEMENT WEST OF SUBBASIN NO. 2 IS TO BE PAVED TO CONTAIN RUNOFF AND PREVENT EROSION

SUBJECT TO ANY ADDITIONAL REQUIREMENTS OF THE COLORADO DEPARTMENT OF HIGHWAYS

APPENDIX

JOB # 85-585-16

DATE 7/11/88

PAGE 1 OF 2

RUNOFF CALCULATIONS USING RATIONAL METHOD

Q = CIA

SUB-BASIN	LAND USE	Soil Group	AREA	$C_{(10\ YEAR)}$	$C_{(100\ YEAR)}$	TIME OF CONCENTRATION	$I_{(10\ YEAR)}$	$I_{(100\ YEAR)}$	$Q_{(10\ YEAR)}$	$Q_{(100\ YEAR)}$
S-26* & S-27* Design pt.= Monterey Rd. sump	P.U.D. P.U.D. Streets	B C&D	3.4 Ac 4.2 Ac 2.2 Ac 9.8 Ac	0.55 0.65 0.90 C_{10w}= 0.67	0.65 0.75 0.95 C_{100w}= 0.76	t_c = 0.133 hr* = 8.0 min.	5.0 in/hr	7.5 in/hr	32.8 cfs	55.9 cfs
Circle Drive R.O.W. to Spring Creek Filing No. 5 entrance Design pt.= culvert entrance	Pvmt. & walk Grass	B B	1.35 Ac 1.35 Ac 2.7 Ac	0.90 0.25 C_{10w}= 0.58	0.95 0.35 C_{100w}= 0.65	Grass-lined ditch @ 2.3 fps average 950 LF @ 2.3 fps = 6.9 min. t_c = 6.9 min.	5.3 in/hr	8.0 in/hr	8.3 cfs	14.0 cfs
Circle Drive R.O.W. to Server Des. pt.= culvert entrance @ Server Dr.	Pvmt. & sidewalk Grass	B B	2.45 Ac 2.45 Ac 4.9 Ac	0.90 0.25 C_{10w}= 0.58	0.95 0.35 C_{100w}= 0.65	Grass-lined ditch @ 2.3 fps average 1700 LF @ 2.3 fps = 12.3 min. t_c = 12.3 min.	4.3 in/hr	6.4 in/hr	12.2 cfs	20.4 cfs
(1) Design pt.= private inlet	Retail (82.5% imp.)	B	6.3 Ac 6.3 Ac	0.83 C_{10w}= 0.83	0.85 C_{100w}= 0.85	Sheet flow across parking, 750' @ ~1% avg. From Fig. 5-2 (DCM) t_c = 11 min. t_c = 11.0 min.	4.4 in/hr	6.8 in/hr	23.0 cfs	36.4 cfs
(2) Design pt.= W. access drive @ Interior Rd.	Retail (90% imp.)	B	4.8 Ac 4.8 Ac	0.85 C_{10w}= 0.85	0.88 C_{100w}= 0.88	Sheet flow across roofs, 220' @ 0.5% t_c = 6 min. Sheet flow across parking, 550' @ 1.5% t_c = 7 min. t_c = 13.0 min.	4.1 in/hr	6.2 in/hr	16.7 cfs	26.2 cfs
(3) Design pt.= Interior Rd. sumped inlets	Retail (82.5% imp.) Streets	B B	5.8 Ac 1.8 Ac 7.6 Ac	0.83 0.90 C_{10w}= 0.85	0.85 0.95 C_{100w}= 0.87	Sheet flow across parking, 500' @ 2%, t_c = 7 min. Street flow, 150' @ 1% avg, v_{avg} = 4fps, t_c = 0.6 min. t_c = 7.6 min.	5.1 in/hr	7.7 in/hr	32.9 cfs	50.9 cfs
(1), (2), (3) Design pt.= Interior Road sumped inlets	Retail (82.5% imp.) Retail (90% imp.) Streets	B B B	12.1 Ac 4.8 Ac 1.8 Ac 18.7 Ac	0.83 0.85 0.90 C_{10w}= 0.84	0.85 0.88 0.95 C_{100w}= 0.87	Sheet flow across parking 750' @ 1% avg., t_c = 11 min. 550' @ 2% avg., t_c = 7 min. t_c = 18 min.	3.6 in/hr	5.4 in/hr	56.5 cfs	87.9 cfs

* From "Master Drainage Study for Spring Creek Development Phase II"

JOB # 85-585-16

DATE July, 1988

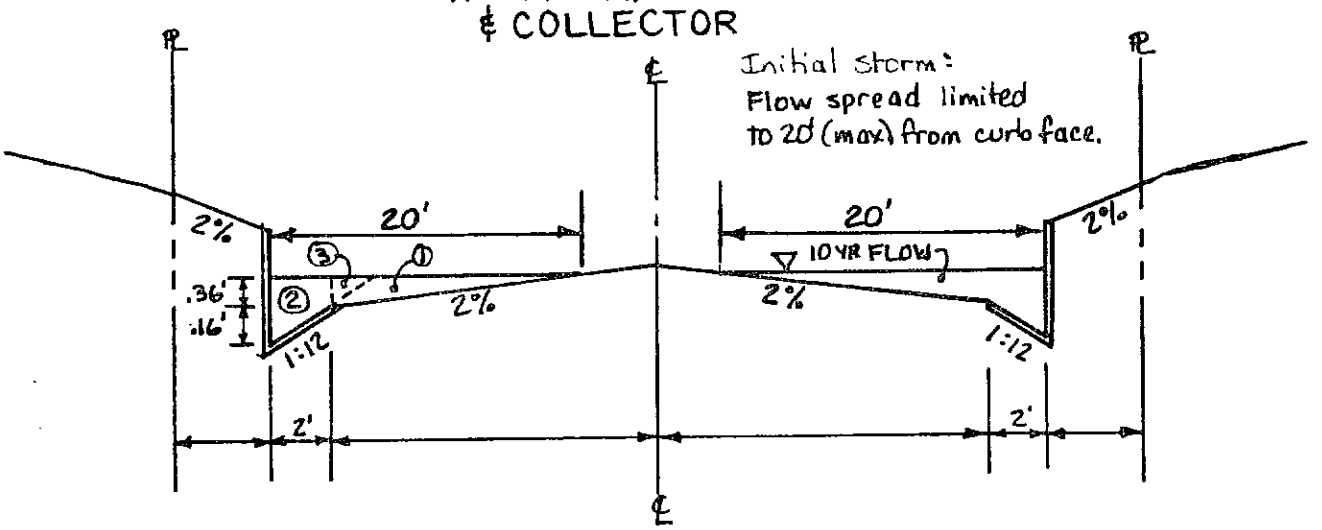
RUNOFF CALCULATIONS USING RATIONAL METHOD

Q = CIA

SUB—BASIN	LAND USE	Soil Group	AREA	$C_{(10\ YEAR)}$	$C_{(100\ YEAR)}$	TIME OF CONCENTRATION	$I_{(10\ YEAR)}$	$I_{(100\ YEAR)}$	$Q_{(10\ YEAR)}$	$Q_{(100\ YEAR)}$
S-26*, S-27*, & ①, ②, ③	P.U.D.	B	3.4 Ac	0.55	0.65					
	P.U.D.	C&D	4.2 Ac	0.65	0.75					
	Retail (82.5% imp.)	B	12.1 Ac	0.83	0.85	Sheet flow across parking				
	Retail (90% imp.)	B	4.8 Ac	0.85	0.88	750' @ 1% avg., t_c = 11 min.				
	Streets		4.0 Ac	0.90	0.95	550' @ 2% avg., t_c = 7 min.				
			28.5 Ac	C_{10_W} = 0.78	C_{100_W} = 0.83	t_c = 18 min.				
Design pt. = junction of Interior Rd. 48" RCP & Monterey 36" RCP							3.6 in/hr	5.4 in/hr	80.0 cfs	128 cfs

* From "Master Drainage Study for Spring Creek Development Phase II"

MINOR ARTERIAL & COLLECTOR



INITIAL STORM:

$$Q = 0.56\left(\frac{z}{n}\right)(Y)^{8/3}(s)^{1/2}$$

$$Q_1 = 0.56\left(\frac{50}{.016}\right)(0.36)^{8/3}\,s^{1/2} = 114.77\,s^{1/2}$$

$$Q_2 = 0.56\left(\frac{12}{.016}\right)(0.52)^{8/3}\,s^{1/2} = 73.44\,s^{1/2}$$

$$Q_3 = 0.56\left(\frac{12}{.016}\right)(0.36)^{8/3}\,s^{1/2} = 27.55\,s^{1/2}$$

$$\tfrac{1}{2}\text{ STREET } Q = Q_1 + Q_2 - Q_3 = 160.66\,s^{1/2}$$

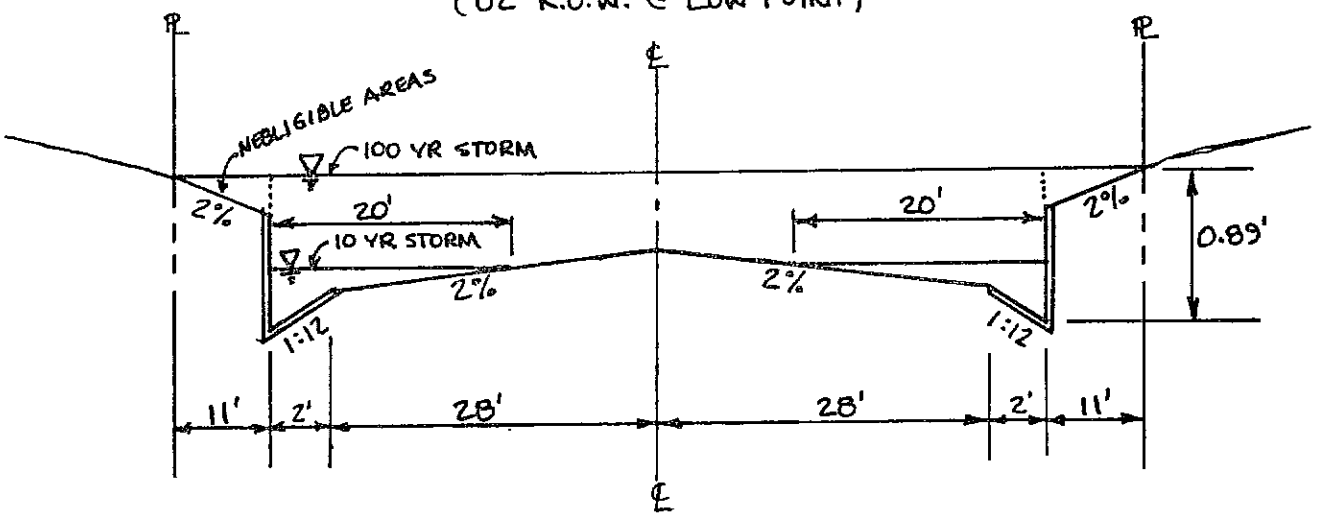
MAJOR STORM

Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of water at the gutter flow line shall not exceed 12 inches.

$$Q = \frac{1.49}{n} R^{2/3} A s^{1/2}$$

Note: area behind curb face is neglected due to obstructions in area.

MONTEREY ROAD (MINOR ARTERIAL)
(82' R.O.W. @ LOW POINT)



INITIAL STORM

½ street capacity = $160.66\ s^{1/2}$

STREET SLOPE	Q ½ STREET (cfs)
3.0%	27.8 cfs
2.0%	22.7 cfs
1.0 %	16.1 cfs
0.96%	15.7 cfs

MAJOR STORM

Entire Street

Flow Area = $2[(0.16)(2)(1/2) + (0.56)(28)(1/2) + (0.56)(2) + (0.17)(30)] = 28.44$ SF

WP = 60'

$$Q = \frac{1.49}{n} R^{2/3} A\, s^{1/2}$$

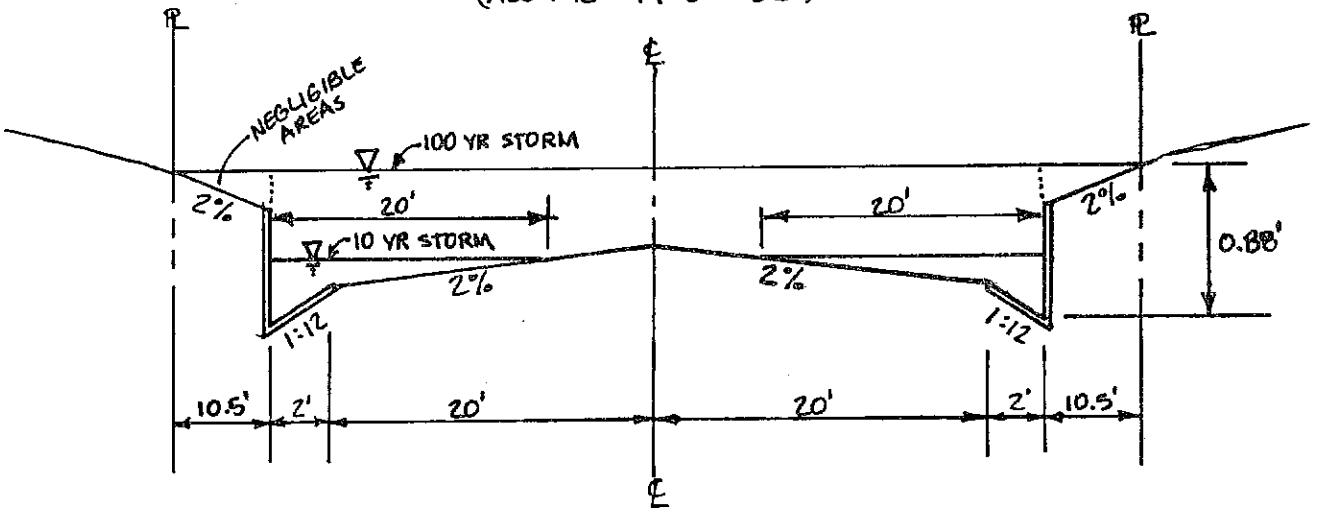
$$Q = \frac{1.49}{.016} \left(\frac{28.44}{60}\right)^{2/3} (28.44)\, s^{1/2}$$

$$Q = 1610\, s^{1/2}$$

STREET SLOPE	Q WHOLE STREET (cfs)
1.0%	161 cfs
0.96%	158 cfs
0.2 %	72 cfs
0.1 %	51 cfs

INTERIOR ROAD (FUTURE)

(ASSUME 44' ON 65')



Assume Type B street (Collector or Minor Arterial)

INITIAL STORM

½ street capacity = $160.66\ s^{1/2}$

STREET SLOPE	$Q_{½\ STREET}$ (cfs)
2.0%	22.7 cfs
1.5%	19.7 cfs
1.0%	16.1 cfs
0.50%	11.4 cfs

MAJOR STORM

Entire Street

Flow Area = $2[(0.16)(2)(½) + (0.40)(20)(½) + (0.40)(2) + (0.32)(22)] = 24.00$ SF

WP = 44'

$$Q = \frac{1.49}{n} R^{2/3} A\, s^{1/2}$$

$$Q = \frac{1.49}{.016}\left(\frac{24.00}{44}\right)^{2/3}(24.00)\, s^{1/2}$$

$$Q = 1492\, s^{1/2}$$

STREET SLOPE	$Q_{WHOLE\ STREET}$ (cfs)
2.0%	211 cfs
1.0%	149 cfs
0.5%	106 cfs
0.2%	66.7 cfs

MONTEREY ROAD- INLET SIZING

Existing 6' D-10R on grade ($s \approx 1.0\%$) and sumped 8' D-10R

Per hydrology calculations for sub-basins S-26 and S-27 (see "Master Drainage Study for Spring Creek Development Phase II") - from page 1 of calculations, this report

$Q_{10} = 32.8$ cfs
$Q_{100} = 55.9$ cfs

During major storm, 80% of $Q_{100} = 55.9$ cfs will flow in street past 6' D-10R.
$\therefore Q_{100} \approx 45$ cfs
Flow spread $\approx 30'$
From DCM Fig. 7-9, $Q_i/Q = 0.18$
$\therefore Q_i = 0.18(45) = 8.1$ cfs

$\therefore$ 6' D-10R inlet pickup = 8.1 cfs

Capacity of sumped 8' D-10R:

Height of opening = 8" = 0.67'
Depth of water in gutter = 8" + (2% × 11') = 0.89'
From Denver's Urban Storm Drainage Criteria Manual, Figure 3-1: $Q/L = 2.3$ cfs/ft
$\therefore$ 8' D-10R capacity = (2.3 cfs/ft)(8 ft) = 18.4 cfs

Remaining flow to be picked up

56 cfs (Q_{100}) − 8.1 cfs (6' D-10R pickup) − 18.4 cfs (8' D-10R pickup) = 29.5 cfs

$$\frac{29.5 \text{ cfs}}{2.3 \text{ cfs/ft opening}} = \frac{12.8'}{80\%} = 16.0' \text{ opening length required}$$

80% ← 20% clogging

$\therefore$ 16' Type R inlet (sumped) required on North side Monterey Road @ low pt.

PIPE SIZING - MONTEREY ROAD TO FUTURE INTERIOR ROAD STORM SEWER

$Q_{100} = 56$ cfs

Check HW/D for:	30" RCP	HW/D = 2.7	HW = 6.8'
	36" RCP	HW/D = 1.5	HW = 4.5'
	42" RCP	HW/D = 1.1	HW = 3.8'
Check s_f for:	30" RCP	$s_f = 1.87\%$	
	36" RCP	$s_f = 0.71\%$	
	42" RCP	$s_f = 0.31\%$	

Average slope for storm sewer between Monterey Road & Interior Road is approximately 1.8% ±.

$\therefore$ Choose 36" RCP due to both headwater & friction slope considerations.

INTERIOR ROAD - INLET SIZING

Flow in street = flow from sub-basins 1, 2, & 3 minus runoff intercepted by 12' private inlet in sub-basin 1 (approx. 24 cfs pickup in 100-yr storm).
∴ Flow = 88 - 24 = 64 cfs to be picked up @ sumped inlets.

Assume equal flow intercepted each side of street

∴ Each inlet to pick up 32 cfs

From Denver's Urban Storm Drainage Criteria Manual, Fig. 3-1:
for height of opening = 8" = 0.67'
depth of water in gutter = 8" + (2% * 10') = 0.87'
y_o/h = 0.87/0.67 = 1.30 ⇒ Q/L = 2.3 cfs/ft

$$32 \text{ cfs} / 2.3 \text{ cfs/ft} = 13.9' / 80\% = 17.4 \Rightarrow \text{SAY } 18' \text{ opening length required}$$

∴ 2 ~ 18' sumped inlets required @ low point (1 each side of street)

PIPE SIZING - SUMPED INLETS TO JUNCTION w/ MONTEREY ROAD STORM SEWER SYSTEM

Q_{100} = 88 cfs

Check S_f for:		
	36" RCP	S_f = 1.75%
	42" RCP	S_f = 0.77%
	48" RCP	S_f = 0.38%
	54" RCP	S_f = 0.20%

Since street slope and pipe slope are in opposite directions, select pipe size with $S_f \leq 0.5\%$ to allow for losses @ junctions, bends, etc.

∴ Choose 48" RCP.

PIPE SIZING - DOWNSTREAM OF MONTEREY 36" & INTERIOR ROAD 48" JUNCTION

Q_{100} = 128 cfs

Check S_f for:		
	42" RCP	S_f = 1.62%
	48" RCP	S_f = 0.79%
	54" RCP	S_f = 0.42%

Choose 48" RCP since street slope will likely exceed 0.79%.