MASTER DEVELOPMENT DRAINAGE PLAN
FOR
OLYMPIC VILLAGE SUBDIVISION
AND
FINAL DRAINAGE STUDY
OLYMPIC VILLAGE FILING NO. 1

COLORADO SPRINGS, COLORADO

DREXEL BARRELL JOB NO. CE-7164

Drexel Barrell

Engineers/Surveyors
Incorporated

Boulder,
Colorado Springs

740 Wooten Road
Suite 108
Colorado Springs,
Colorado 80915

719 591 5151

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DREXEL BARRELL JOB NO. CE-7164

Prepared For

Mr. Anton Nelson
28 Polo Drive
Colorado Springs, Colorado 80906

Prepared By

Drexel Barrell
740 Wooten Road, Suite 108
Colorado Springs, Colorado 80915

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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.

Bryan T. Law, P.E. #25043

DEVELOPER'S STATEMENT:

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

Anton Nelson Living Trust
Business Name

By: Anton Nelson

Title: _____

Address: 738 Polo Drive

Colorado Springs
80906

CITY OF COLORADO SPRINGS ONLY:

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

City Engineer

4/30/96
Date

Conditions: Prior to issuance of building permits on this site, an acceptance letter by CDOT approving the proposed drainage plan must be received and filed with the City.
Private on-site detention may be required.
DRL

MASTER DEVELOPMENT DRAINAGE PLAN FOR OLYMPIC VILLAGE SUBDIVISION AND FINAL DRAINAGE STUDY OLYMPIC VILLAGE FILING NO. 1

COLORADO SPRINGS, COLORADO

INTENT OF THIS STUDY

Olympic Village Filing No. 1 is currently undergoing platting for use as a service station site. This study is intended to fulfill city requirements for the first phase of this subdivision. During the plat review process, the City of Colorado Springs requested that the entire 22 acre site be reviewed for drainage issues as part of a master planning effort. For Filing No.1, this study is intended to suffice as a Final Drainage Report. The remaining 19 acres are hereby being master planned under a Master Development Drainage Plan. The enclosed plat depicts the Filing No.1 area while the drainage plan reflects the entire site. At such time as engineering design for preliminary site layout is prepared for the remaining 19 acre tract, a final drainage study will be submitted for city review. We are trying to show the big picture with the final outcome at this time being the approval for Filing No.1 only. It is understood that permits will need to be acquired from CDOT during the construction phase of this project after review of the construction documents by the city and CDOT.

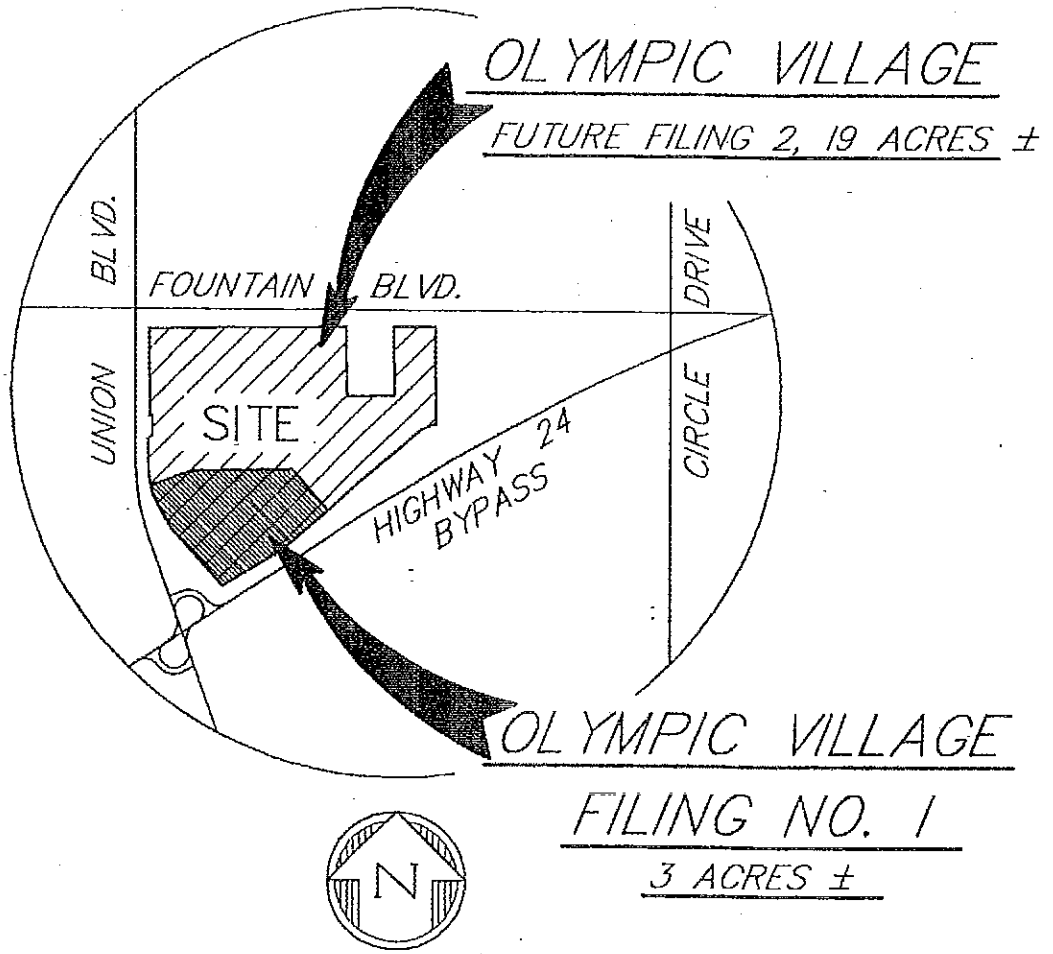
GENERAL LOCATION AND DESCRIPTION

The proposed OLYMPIC VILLAGE FILING No.1 is located in the SW1/4 of section 21, T14S, R66W of the 6th P.M., within the City of Colorado Springs, Colorado. The site is bordered by Fountain Boulevard on the north, Union Boulevard on the west and the newly constructed US 24 bypass on the southeast.

The total 22.04 acre development is zoned PIP. Filing No.1 consists of 1 lot and access road. The additional land north and east of the proposed service station site, Filing No. 2, is under design but is not complete at this time. The additional 19 acres will be Filing No.2 and will be revisited in a subsequent final drainage study when platted. The conceptual layout and storm drainage patterns for the entire 22 acres has been studied for site master planning purposes, as requested by the city, and to enable a cost estimate for the site to be generated. Only facilities for Filing No.1 will be constructed at this time.

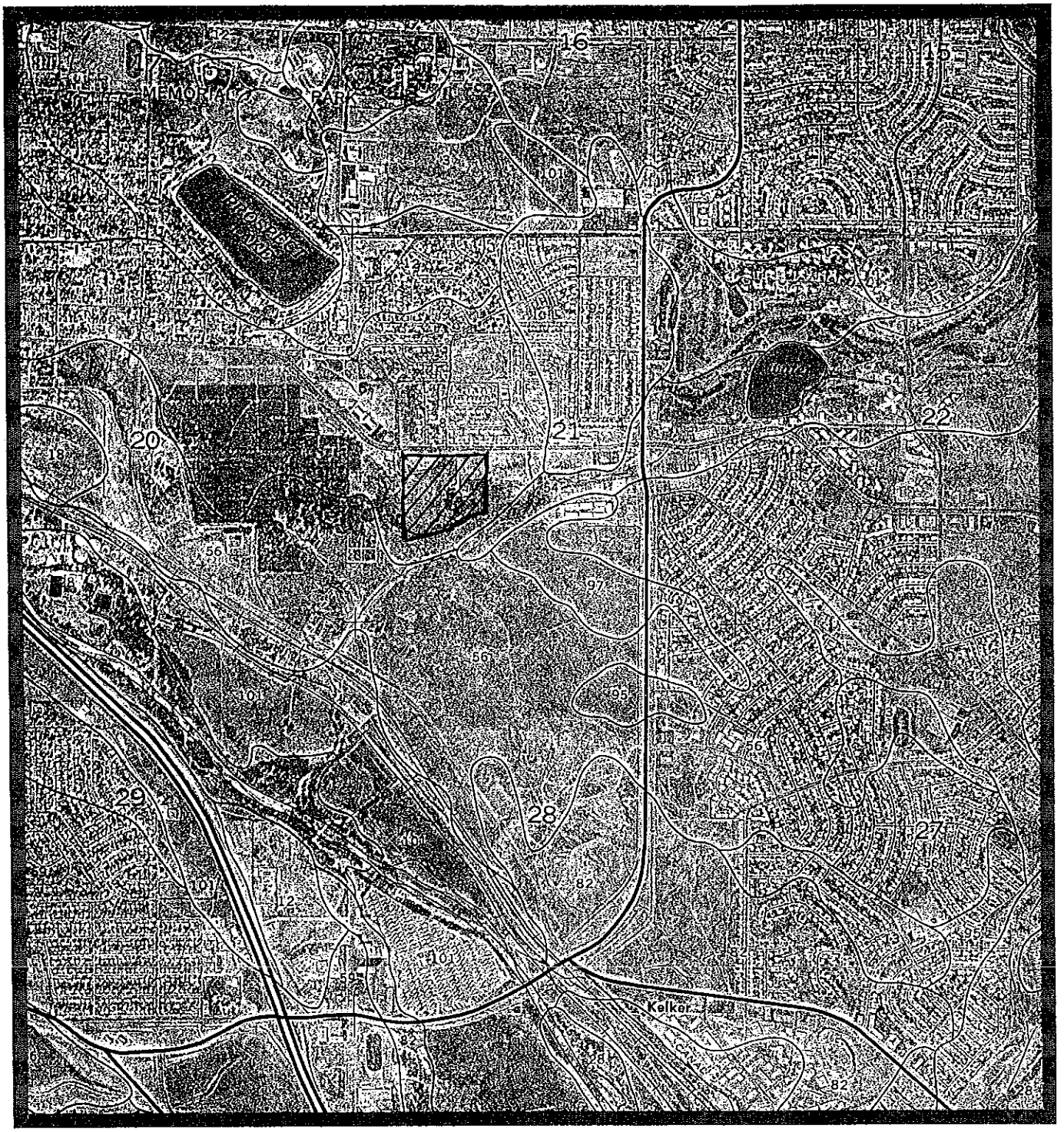
Existing topography inclines to the northwest from 1 to 9 percent. Soils fall within the Blakeland Loamy Sand derived by Archeozoic sedimentary rock. Permeability is rapid with a moderate to slight hazard of erosion. This sand is in hydrologic soils group A, in accordance to USDA SCS soil survey. The site was utilized as a borrow area for Union Boulevard and US 24 construction. Existing cover is largely described as weeds and native grasses with no apparent rock outcrops or live streams.

This site is not with the FEMA 100-year flood plan. All flows proceed to Spring Creek. The entire project lies in the Spring Creek Drainage Basin.



VICINITY MAP

NO SCALE



NOT TO SCALE

USDA-SCS SOIL SURVEY MAP
DEPICTING
OLYMPIC VILLAGE SUBDIVISION
WITHIN THE
BLAKELAND LOAMY SAND COMPLEX (8)

DRAINAGE BASINS AND SUB-BASINS

OLYMPIC VILLAGE SUBDIVISION is divided into 6 Sub-Basins which form the basis for the analysis of developed rainfall runoff. Sub-Basins 1 through 5 are within the 19 acre master planned area for future platting. Sub-Basin 6 is OLYMPIC VILLAGE FILING NO. 1, which is currently under review for platting. Offsite flows from the subdivision north of Fountain Boulevard were reviewed from past drainage plans and construction documents (See Bibliography). Historic onsite drainage flows and proposed flows follow in generally the same patterns. The Highway 24 bypass report, prepared for CDOT and the city by DMJM, indicates that flows from this site are to be accommodated by the detention pond and drainage system constructed with the bypass. Excerpts from this report are enclosed in Appendix 2.

DRAINAGE DESIGN CRITERIA

The Sub-Basins were analyzed as outlined in the City of Colorado Springs Drainage Criteria Manual utilizing the rational method. Runoff calculations are based on the empirical equation, Q=CIA. The runoff coefficient, C, was determined from Table 5-1 for each Basin for the proposed land use and hydrologic soil group. Rainfall intensity (I) for the 5 and 100-year storms were extrapolated from the City of Colorado Springs Rainfall Intensity Curves for a storm duration equal to the calculated time of concentration to each design point.

DRAINAGE FACILITY DESIGN

The following discussion is divided into seven sections; six drainage Sub-Basins and proposed offsite improvements by others. Enclosed is the drainage plan which depicts the entire property's anticipated drainage patterns and proposed drainage facilities. Sub-Basins 1 through 5 are for master planning purposes as requested by the city. At this time only conceptual layouts are available for use. The intent of drainage layout and computations for these areas follows that of the Highway 24 Bypass report, by DMJM for CDOT and the city. Only Basin 6 which is Filing No. 1 is being platted and planned for constructed at this time.

SUB-BASIN 1 contains 3.1 acres and is primarily composed of the purposed cut slope in the northwest corner of the property and parking areas west and south of the conceptual 4-story hotel. Flow in the Sub-Basin is proposed to travel south along the curbed parking areas to a 16' long sump inlet in the southwest corner of the Sub-Basin. The 5 and 100-year estimated values are 10.9 and 19.9 cfs respectively. A 16' long sump inlet at design point 1 will flow to a manhole in the proposed access road and continue to the southwest corner of Basin 6 to a sump inlet structure at design point 6A. The proposed 18" R.C.P. will have a capacity of 26.3 cfs at 6.25% slope to the manhole and then continue across Basin 6 via a 24" at 1.50% slope with a capacity of 27.8 cfs.

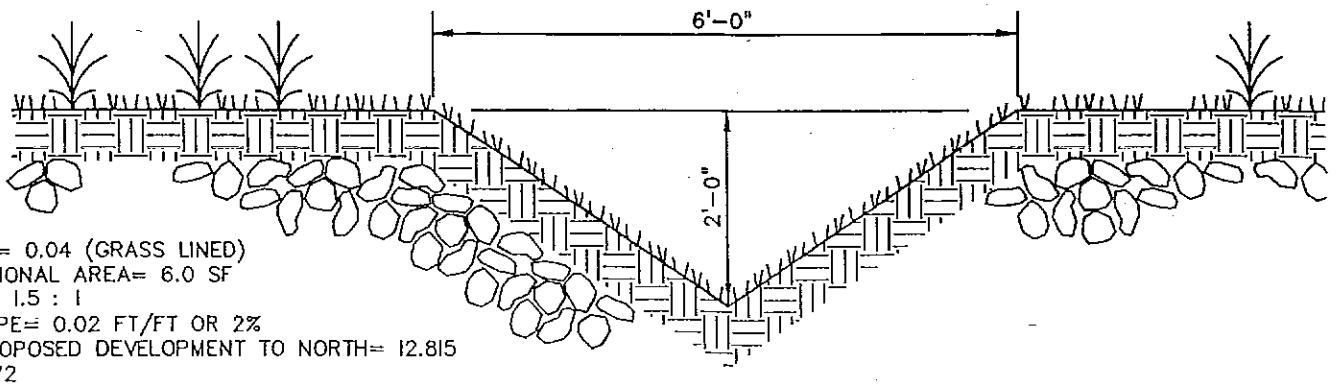
SUB-BASIN 2 contains 7.9 acres and is comprised of the northern and ½ of the southern parking areas as well as the two 4-story hotel buildings, tennis courts, pools and a portion of the access road. Flows in this Sub-Basin originate on the cut bank on the northwest corner of the Basin and proceed to drain easterly to the access road. All

drainage in this Sub-Basin generally moves easterly and flows in the gutter pan to a sump area where the access road turns west along the northern border of Sub-Basin 6. 5 and 100-year quantities of 23.1 and 45.1 cfs were estimated for this Basin at design point 2A. Two tandem 18' long sump inlets were sized for this flow with capacities of 23.7 cfs each totaling 47.4 cfs. An 18" R.C.P. outlet pipe running along the plat boundary to a manhole and then proceeding to the existing CDOT mitigation/detention pond. Capacity of the outlet pipe at design point 2B is computed to be 46.2 cfs at 13.67%. The 18" R.C.P. between the tandem boxes will be 16' long at a 5.00% slope with a capacity of 23.5 cfs. This outlet flow was previously planned by DMJM as part of the CDOT/City of Colorado Springs Highway 24 Bypass Drainage Study. Approval and easements will be acquired from CDOT in the construction phase of Filing No. 2.

SUB-BASIN 3 contains 5.3 acres and is comprised of the parking and access for the proposed 4-story hotel/meeting room site. Beginning at the north along Fountain Boulevard and proceeding overland to the parking area, then running along the curbing to a sump area in the southeast corner of the Sub-Basins to Design Point 3A. Flows to this point were computed to be 12.4 and 23.7 cfs for the 5 and 100-year storm events respectively. An 18' long sump inlet with a capacity of 23.7 cfs is the proposed outlet structure. A 15" R.C.P. outlet pipe at Design Point 3B has a capacity of 26.4 cfs at a slope of 16.67%. Flow from this outlet will be directly discharged into the mitigation/detention pond, as was the intent in the DMJM report. In addition to this storm discharge an anticipated 1.2 cfs for the 5-year and 2.9 cfs for the 100-year storm will be generated from the vegetated slope on the southern boundary of this Sub-Basin. This flow will run overland, as it did historically, to the pond.

SUB-BASIN 4 contains 3.8 acres and is comprised of an existing restaurant lot in the northwest, a proposed parking/commercial area to the east and grass open space to the south. The proposed and existing commercial areas to the north are separated from the open space to the south by an existing low velocity V ditch. Along the entire east side of the Basin is an existing larger V ditch which has been modified to a high velocity trapezoidal lined ditch at the southeast corner of the Basin. Overland flow from the proposed commercial site on the north will flow south to Design Point 4A which is the existing low velocity V ditch. Inflows are estimated to be 12.8 and 23.9 cfs for the 5 and 100-year storms with a depth of 1.9' for the 100-year event and a capacity of 27.9 cfs. This ditch may be removed after more intense design layout is completed and a pipe and drain system installed which would deposit the flow in the north-south V ditch on the eastern property line. As of this time no conceptual layout was available for this area. Inflow from the subdivisions on the north side of Fountain Boulevard for Boggs Place are collected into a 42" R.C.P. and carried east along the southern line of Fountain Boulevard to the V ditch which runs north/south in Basin 4. The inflow for Q_{100} is 67 cfs and was taken from construction drawings by William P. Weber and Associates (Drawing No 82-810, July 16, 1982) titled Prospect Park Storm Sewer. This offsite flow creates a depth of 2.22' in the ditch at Design Point 4B where

Sewer. This offsite flow creates a depth of 2.22' in the ditch at Design Point 4B where the east-west ditch intersects the larger north-south ditch . The Q_{100} estimated flow is 90.0 cfs with a depth in the ditch of 2.49' at the confluence. Capacity of the V ditch immediately downstream of the confluence is 320.4 cfs at a depth of 4'. At Design Point 4D in the southeast corner of the Basin very near the property boundary, the ditch changes to a concrete block-rip rapped-grass lined trapezoidal high velocity ditch which empties into the head water of the mitigation/detention pond to the south. The trapezoidal ditch receives little to no side slope flows and is carrying 90.0 cfs in the 100-year event at a depth of 1.24 feet. Capacity of the ditch is 1054.5 cfs at a depth of 4'. This improved ditch was constructed by CDOT in response to erosion of the slope and coordinated with construction activities of the US 24 bypass. The remaining area is to be grass covered, with landscaping, and is estimated to generate 1.1 and 2.7 cfs for the 5 and 100-year events respectively. Total estimated 5 and 100-year storm flows are estimated to be 13.9 and 26.6 cfs for this Sub-Basin. At the time of platting for this property; easements will be completed and put to record for the ditches and or storm sewer system in relation to an engineering design for this portion of the site.

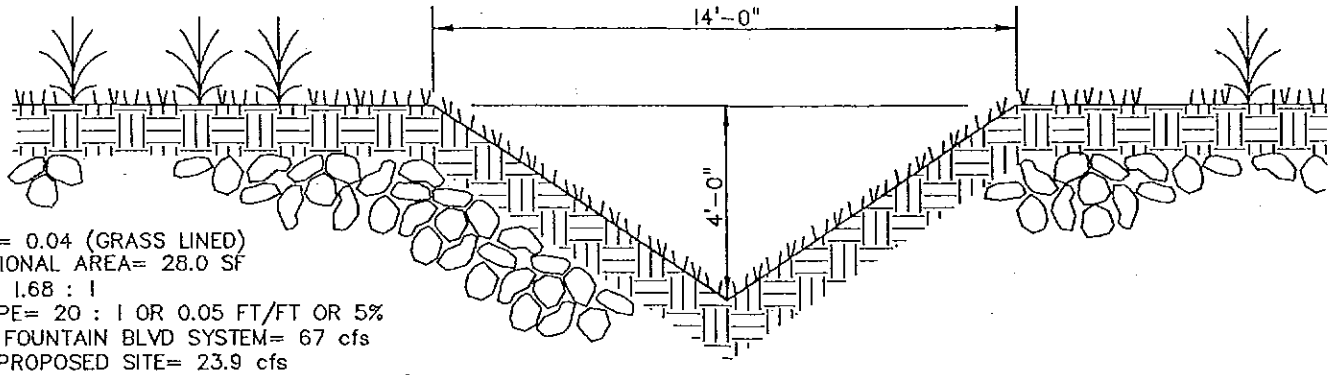


MANNINGS N= 0.04 (GRASS LINED)
CROSS-SECTIONAL AREA= 6.0 SF
SIDE SLOPE= 1.5 : 1
BOTTOM SLOPE= 0.02 FT/FT OR 2%
Q_5 FROM PROPOSED DEVELOPMENT TO NORTH= 12.815
Q_{100} = 23.872
Q CAPACITY= 27.89
V MAX= 4.65 fps

EXISTING LOW VELOCITY GRASS LINED "V" DITCH

SECTION A
NO SCALE

4A

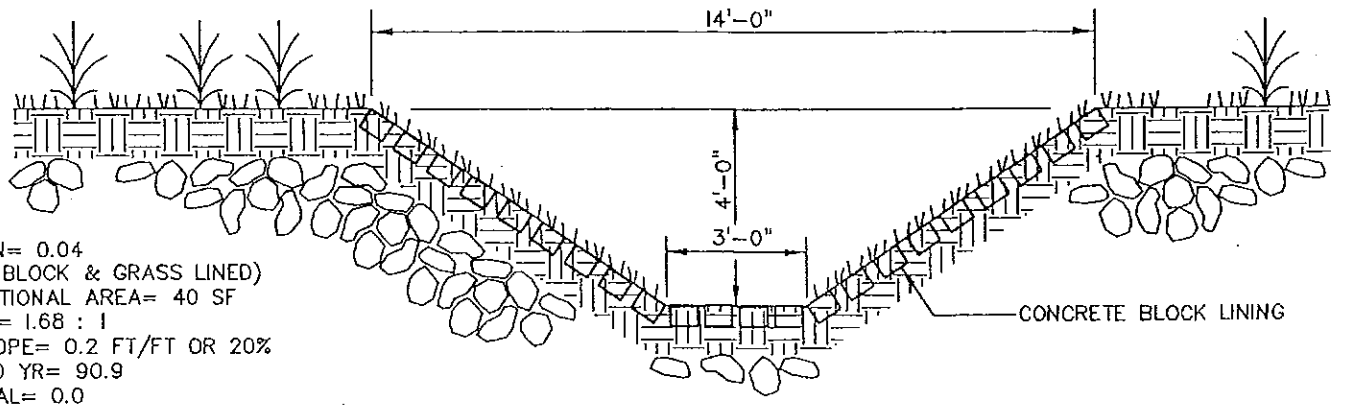


MANNINGS N= 0.04 (GRASS LINED)
CROSS-SECTIONAL AREA= 28.0 SF
SIDE SLOPE= 1.68 : 1
BOTTOM SLOPE= 20 : 1 OR 0.05 FT/FT OR 5%
INPUT FROM FOUNTAIN BLVD SYSTEM= 67 cfs
Q_{100} FROM PROPOSED SITE= 23.9 cfs
Q_{100} IMMEDIATELY BELOW INTERSECTION= 90.9 cfs
Q CAPACITY= 320.4 cfs
V MAX= 11.9 fps

EXISTING LOW VELOCITY GRASS LINED "V" DITCH

SECTION B
NO SCALE

4B 4C



MANNINGS N= 0.04
(CONCRETE BLOCK & GRASS LINED)
CROSS-SECTIONAL AREA= 40 SF
SIDE SLOPE= 1.68 : 1
BOTTOM SLOPE= 0.2 FT/FT OR 20%
Q INPUT 100 YR= 90.9
Q ADDITIONAL= 0.0
Q CAPACITY= 1054.5 cfs
V MAX= 27.1 fps

EXISTING HIGH VELOCITY, CONCRETE BLOCK LINED, GRASS LINED, TRAPEZOIDAL DITCH

SECTION C
NO SCALE

4D

SUB-BASIN 5 contains 1.5 acres and resides along the eastern edge of Union Boulevard. This area slopes from the proposed site to the back of curb and includes a small portion of the access road at the southern access point. Composite flows from the Sub-Basin are 2.3 and 5.6 cfs for the 5 and 100-year runoff events. This offsite flow to Union Boulevard was planned to be handled by the existing drop inlets along the eastern curb. There is no anticipated problem as the Basin is long and narrow and the flow will be captured over 4 inlets. This was the intent for drainage of the site in the Union Boulevard drainage/construction drawings.

SUB-BASIN 6 is OLYMPIC VILLAGE FILING NO. 1 containing 3.0 acres more or less. This is the proposed service station site. The parking and refueling area is bounded by 8" barrier curbing and funnels the runoff from the approximately 1.7 acres of paved area into a 12' long sump inlet at Design Point 6A. Storm runoff is estimated to be 7.6 and 14.2 cfs for the 5 and 100-year events to this inlet. Capacity of the inlet is 15.8 cfs. This sump inlet is to be utilized as a junction structure for the 24" R.C.P. running from Design Point 1 in Sub-Basin 1. Inflows to the junction box from Sub-Basin 1 are estimated to be 10.9 and 19.9 cfs for the 5 and 100-year runoff events. Utilizing the 100-year event flow and adding the runoff from the service station paved area, a total of 34.1 cfs are anticipated. The outfall pipe is planned to be a 24" R.C.P. at 8.59% slope with a capacity of 66.4 cfs at Design Point 6B. This flow is accompanied by overland flow from the grassed side slope with estimated runoff volumes of 1.7 and 2.4 cfs for the 5 and 100-year events. Overland flow will become shallow concentrated flow near the existing 36" cmp which now runs under the US 24 bypass ramp. Combined flow from Sub-Basin 6 is estimated to be 9.3 and 16.6 cfs for the 5 and 100-year runoff events. This is in conformance with the design intent, historical patterns for this site and the bypass interchange drainage system as described in the DMJM report and approved by CDOT. At Design Point 7 the capacity of the existing 36" cmp at 4.09% is 73.1 cfs which after running through a small unlined ditch moves to Design Point 8 which is also a 36" cmp at 6.61% with a capacity of 92.0 cfs. Flows from Design Point 8 then enter into the Spring Creek System.

Proposed Offsite Improvements and Potential Changes are anticipated for this site. As per review of plans by Wilson and Company (Drawing No. 84-840, dated June 1985) titled Drainage Improvements In Prospect Park Subdivision 1, 2 and 5", there will no longer be a need for the northern half of the existing V ditch on Sub-Basin 4. These plans show an extension of the existing 42" R.C.P. to an improved ditch further to the east crossing, Prospect Park Subdivision No. 5. In conversation with city officials, the proposed plan will be implemented at such time that Prospect Park Subdivision No. 5 is developed. Once construction is completed there will no longer be reason to maintain the existing northern half of the existing ditch on Sub-Basin 4. This V ditch will however need to remain in place until such time as the 42" R.C.P. extension along Fountain Boulevard is constructed.

The general development plan for this site includes a raised median to be constructed on Union Boulevard. The drainage plan enclosed shows the position of D 10 R inlet

which is 6 feet in length and on grade. Capacity of this inlet is 3.15 cfs in the 100-year event and should be adequate to handle flows from the paved roadway. This inlet will need to be constructed and tied into the existing 15" R.C.P. at the time of median construction.

As there are only conceptual layouts available at this time, changes in the location of inlets and pipes may occur. Revisions to grading plans and configuration may occur with processing of engineering drawings with the city. The general drainage patterns of this proposed plan should be adhered to and runoff estimates are anticipated to be accurate since the highest and most developed land use was chosen for this study.

CONCLUSION AND RECOMMENDATION

In keeping with the basic historical drainage patterns with this proposed plan, the existing offsite improvements will be able to handle the 5 and 100-year runoff events. It is recommended at this time to construct the improvements on the service station site for Filing No.1 and stubb out to the manhole in the access road near the southern access point. The two tandem 18' sump inlets and inlet pipe of Basin 2 should be constructed with the access road. A sincere attempt will need to be made to control fugitive sediment from deteriorating the existing inlets, pipes and pond with proper erosion control measures.

COST ESTIMATE OF DRAINAGE FACILITIES FOR OLYMPIC VILLAGE FILING NO. 1

APRIL 1996

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
24" R.C.P.	LF	330	$30.00	$9,900.00
Flared End Section	Ea	1	$250.00	$250.00
12' D 10 R Inlet	EA	1	$3,000.00	$3,000.00
6' D 10 R Inlet (Union Blvd.)	EA	1	$1,000.00	$1,000.00
Standard Manhole	EA	1	$1,700.00	$1,700.00
Grouted Rip Rap Outfall Protection	SF	100	$2.00	$200.00
			SUBTOTAL	$16,050.00
			Engineering & Contingencies (25%)	$4,012.50
			TOTAL	$20,062.50 Private

Drainage Fee:
3.0 acres at $4,863.00 per acre $14,589.00

Bridge Fee:
3.0 acres at $0 per acre $ 0.00

~~TOTAL $34,651.50~~

NOTE:
Drexel Barrell cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgement as a design professional familiar with the construction industry and this development.

CONCEPTUAL LAYOUT COST ESTIMATE
FOR FUTURE FILING NO. 2
ADDITIONAL MASTER PLANNED FACILITIES

APRIL 1996

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
15" R.C.P.	LF	152	$20.00	$3,040.00
18" R.C.P.	LF	376	$25.00	$9,400.00
24" R.C.P.	LF	80	$30.00	$2,400.00
Flared End Section	EA	2	$250.00	$500.00
16' D-10-R	EA	1	$7,500.00	$7,500.00
18' D-10-R	EA	3	$8,500.00	$25,500.00
Standard Manhole	EA	1	$1,700.00	$1,700.00
Grouted Rip Rap	SF	256	$2.00	$512.00
			SUBTOTAL	$50,552.00
			Engineering and Contingencies (25%)	$12,638.00
			TOTAL	$63,190.00

Drainage Fees
19.04 acres at $4,863.00 per acre $92,591.52

Bridge Fees
19.04 acres at $ 0 per acre $ 0.00

TOTAL $155,781.52

NOTE:
Drexel Barrell cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgement as a design professional familiar with the construction industry and this development

REFERENCES

1. Drainage Criteria Manual, City of Colorado Springs and El Paso County, November 1991.

2. Prospect Park Master Drainage Plan, Wilson and Company, April 1982.

3. Spring Creek Drainage Study, Lincoln Devore Testing Laboratory, March 1968.

4. Preliminary Drainage Report For Lot 1, Block 2, Prospect park Subdivision No. 5, Drexel Barrell and Company, November 1991.

5. Hydrologic Engineering Study Of The Spring Creek Drainage Basin, United Western Engineers, August 1961.

6. State Highway 24 Bypass Drainage Study, Phase I, Part II, Colorado Department of Highways and DMJM, September 1990.

7. Spring Creek Drainage Basin Planning Study, VRS Consultants, June 1992.

8. Plan - Prospect Park Storm Sewer, sheet 1 of 1, Drawing No. 82-810, William P. Weber and Associates, July 1982.

9. Plan - Drainage Improvements in Prospect Park Subdivisions No. 1, 2 and 5, sheets 1-5, Drawing No. 84-840, Wilson and Company, June 1985.

10. Plan - 54" R.C.P. Storm Sewer Trunkline - Union Boulevard, City of Colorado Springs and Colorado Department of Transportation, Project STU M240-015, August 1989.

APPENDIX 1
DB&CO COMPUTATIONS BY SUB-BASIN AND DESIGN POINT

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164
Client	**By / Date**
ANTON NELSON	CMC 3-25-96

BASIN 1 AREA = 3.1 ACRES.

OVERLAND PORTION. 0.96 ACRES.

L = 150

S = 25% (ASSUMES NO MORE THAN 4:1 SLOPE FOR CUT IN NW CORNER)

V = 7.1 ft/sec FROM CHART 3.1

C = 0.25 5yr FLOW
= 0.35 100yr FLOW

i = 4.6 5yr
4.75 100yr

$TC = TC_5 = 1.87 (1.1 - 0.25) 150^{0.5} \times 25^{-0.33}$
$= 1.87 (0.85) \ 12.25 \times 0.346$
= 6.73 MINUTES OR 404 SECONDS.

$TC_{100} = 1.87 (1.1 - 0.35) 150^{0.5} \times 25^{-0.33}$
$= 1.87 (0.75) \ 12.25 \times 0.346$
= 5.94 minutes or 357 seconds.

$Q_5 = CiA = 0.25 (4.6) 0.96 = 1.10$ cfs.

$Q_{100} = CiA = 0.35 (4.75) 0.96 = 1.59$ cfs.

PARKING LOT AREA 2.14 ACRES.

L = 530'
S = 5% (ASSUMES NO MORE THAN 5%
V = 4.6 ft/sec.
C = 0.90 5yr FLOW
0.95 100yr FLOW.

$TC = \frac{530'}{4.6 \text{ ft/sec}} \div 60 = 1.92$ MINUTES.

i = 5.1 5yr
9.0 100yr.

$Q_5 = CiA = 0.90 (5.1) 2.14 = 9.82$ CFS
$Q_{100} = CiA = 0.95 (9.0) 2.14 = 18.29$ CFS.

4840 PEARL EAST CIRCLE, SUITE 114 (303) 442-4338
BOULDER, COLORADO 80301

740 WOOTEN RD. #108 (719) 591-5151
COLORADO SPRINGS, COLORADO 80915

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164
Client	**By / Date**
ANTON NELSON	CMC 3-26-96

BASIN 1 CONTINED

SUMP INLET COMPS. (SAG LOCATION)

Q_5 = OVERLAND + PARKING = 1.10 + 9.82 = 10.92

Q_{100} = OVERLAND + PARKING = 15.9 + 18.29 = 19.88

INLET LENGTH (WEIR FORMULA)

$$19.88_{Q100} = \frac{3 \times L \times 0.67^{3/2}}{1.25}$$

$$19.88 = \frac{3 \times L \times 0.548}{1.25} = 1.315(L)$$

$$L = \frac{19.88}{1.315} = 15.118$$

USING STANDARD OPENING OF 16' NOMINAL, CAPASITY IS:

$$Q_{100} = \frac{3.0 \times 16 \times 0.548}{1.25} = \frac{26.304}{1.25} = 21.04 \text{ cfs.}$$

GRATE INLET IN SAG LOCATION

FOR Q_{100} OF 19.88

$$Q_{100} = \frac{3 \times P \times d^{1.5}}{F} \times 2$$

WHERE: P = PERIMETER OF GRATE
d = Depth of water to 0.4'
F = CLOGGING FACTOR 2

$$19.88_{Q100} = \frac{3 \times P \times 0.4^{1.5}}{2} \times 2$$

$$19.88_{Q100} = (3)(0.25)\,P = 0.75P$$

$$P = \frac{19.88}{0.75} = 26.51 \text{ ft.}$$

GRATE 4' x 9'

* USE SUMP INLET FOR COST EFFECTIVENESS.

USE 18" RCP TO HANDLE Q100 OF 19.88

USINGS MANNINGS PIPE CALCULATOR IN SOFT DESK CIVIL DESIGN VER 11.0

18" 80 LF TO MH

PIPE FULL CAPASITY	26.26
SLOPE	6.25%
n	0.013
WS DEPTH	18" (PIPE FULL)
ORFICE DIA	18"
fps	14.86 fps.

24" 330 LF TO 1A

	27.79
	1.5
	0.013
	24"
	24"
	8.82

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164
Client	**By** / **Date**
ANTON NELSON	CMC / 3-26-96

BASIN 2 AREA 7.9 ACRES

OVERLAND FLOW AREA = 1.46 ACRES.

$L = 220'$

$S = 25\%$ (ASSUMES 4:1 SLOPE FOR CUT IN NW CORNER

$V = 7.1$ ft/sec FROM CHART 3.1

$C = 0.25$ 5yr FLOW

0.35 100yr FLOW

$t = 4.4$ 5yr FLOW

8.2 100yr FLOW

$TC = TC_5 = 1.87\,(1.1 - 0.25)\,220^{0.5} \times 25^{-0.33}$

$= 1.87\,(0.85)\,14.83 \times 0.346$

$= 8.16$ MINUTES $\approx$ 489 SEC

$TC_{100} = 1.87\,(1.1 - 0.35)\,220^{0.5} \times 25^{-0.33}$

$= 1.87\,(0.75)\,14.83 \times 0.346$

$= 7.19$ MINUTES $\approx$ 432 SEC

$Q_5 = CiA = 0.25(4.4)\,1.46 = 1.61$ cfs

$Q_{100} = CiA = 0.35\,(8.2)\,1.46 = 4.19$ cfs.

PARKING LOT AREA = 0.559 ACRES

$L = 400'$

$S = 2\%$ (ASSUMED CROSSLOPE PARKING LOT SLOPE)

$V = 2.9$ ft/sec FROM CHART 3.1

$C = 0.90$ 5yr FLOW

0.95 100yr FLOW

$t = 5.1$ 5yr FLOW

9.0 100yr FLOW

$TC = \frac{400}{2.9} \div 60 = 2.29$ MINUTES.

$Q_5 = CiA = 0.90\,(5.1)\,0.559 = 2.566$ cfs.

$Q_{100} = CiA = 0.95\,(9.0)\,0.559 = 4.779$ cfs.

STREET FLOW. AREA = 5.881 ACRES

WIDTH STREET C/G TO C/G = 36'

C/G = 0.5 VERTICAL

CROWN OFFSET = $\emptyset$

STREET GRADE = 5% (ASSUMED MAXIMUM)

$L = 600'$

$n = 0.16$

Project	Job Nº
OLYMPIC VILLAGE SUBDIVISION	CE-7113

Client	By	Date
ANTON NELSON	CMC	3-26-96

BASIN 2 CONTINUED

STREET FLOW CONTINUED

$R = 0.5$

$V = 4.6$ FROM CHART 3.1

$i = 5.1$ 5yr FLOW

9.0 100yr FLOW

$V = \frac{1.49}{0.016} \times 0.5^{0.66} \times 0.05^{0.5}$

$13.12 = 93.125 \times 0.63 \times 0.22$

$TC = \frac{600}{4.6} = 2.22$ MINUTES

$Q_5 = CiA = 0.90\ (5.1)\ 5.881 = 26.99$ CFS.

$Q_{100} = CiA = 0.95\ (9.0)\ 5.881 = 50.28$ CFS.

} AERIAL SAMPLE SIZE

COMPOSITE RUNOFF COEFF. FACTOR FOR SUMP INLET CALCULATION

$$C_{n_5} = [0.25(1.46) + 0.90(0.559) + 0.90\ (5.881)] \div 7.9$$

$$= \frac{0.365 + 0.503 + 5.229}{7.9 \text{ ACRES}}$$

$$= \frac{6.097}{7.9} = 0.772$$

$$C_{N,100} = [0.35(1.46) + 0.95(0.559) + 0.95\ (5.881)] \div 7.9$$

$$= (0.511 + 0.531 + 5.587) \div 7.9$$

$$= 6.629 \div 7.9 = 0.8391$$

COMPOSITE T_C FOR SUMP INLET CALCULATION

T_{C5} OVERLAND + PARKING + ROAD = $8.16 + 2.29 + 2.22 = 12.67$

TC_{100} OVERLAND + PARKING + ROAD = $7.19 + 2.29 + 2.22 = 11.70$

COMPOSITE $i_5 = 3.8$

$i_{100} = 6.8$

COMPOSITE Q FOR SUMP INLET CALCULATION

$Q_5 = 0.772(3.8)\ 7.9 = 23.175$ cfs.

$Q_{100} = 0.839(6.8)\ 7.9 = 45.071$ cfs.

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CWL	3-26-96

BASIN 2 CONTINUED

SUMP INLET CALCULATION (WEIR FORMULA) FOR LENGTH

$Q_{100} = 45.071$ CFS

$$45.071 = \frac{3 \times L \times 0.67^{3/2}}{1.25}$$

$$45.071 = L\left(\frac{1.645}{1.25}\right) = 1.316L$$

$$L = \frac{45.071}{1.316} = 34.25$$

USING TWO TANDEM 18' INLET THROATS CAPASITY IS

$$Q_{100} = \frac{3 \times 18 \times 0.67^{3/2}}{1.25} = \frac{29.615}{1.25} = 23.69 \text{ cfs}.$$

USE THIS → $23.69 \text{ CFS} \times 2 \text{ INLETS} = 47.38 \text{ CFS}$.

GRATE INLET CALCULATION (WEIR FORMULA FOR PERIMETER

$Q_{100} = 45.071$

$$45.071 = \frac{3 \times P \times 0.67^{1.5}}{2} = \frac{1.645}{2} P = 0.823P$$

$$P = \frac{45.071}{0.823} = 54.76' \text{ or } 55'$$

$6' \times 43'$ GRATE

SUMP INLET CALCULATION

$Q_5 = 23.175$ cfs.

$$23.175 = \frac{3 \times L \times 0.67^{1.5}}{1.25}$$

$$23.175 = \left(\frac{1.645}{1.25}\right) L = 1.316L$$

$$L = \frac{23.175}{1.316}$$

$$L = 17.61$$

USING NOMINAL SIZE OF 18' CAPASITY IS 23.69 cfs.

WITH THIS SENARIO BLOW BY IN $Q_5 = 0.00$

$Q_{100} = 21.38$ CFS.

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CML	3-27-96

BASIN 2 CONTINUED

USING MANNINGS PIPE CALCULATOR IN SOFTDES CIVILDESIGN VER 11.0

18"RCP OUTLET PIPE

PIPEFUL CAPACITY = 46.175
SLOPE = 16.667 %
n = 0.013
WS DEPTH = 16.92 IN (97.55% FULL)
ORIFICE DIA = 18 IN
VELOCITY = 26.79 fps

2B

AREA 7.9 AC
Q5 23.175 cfs
Q100 45.071 cfs

2A

18" RCP BETWEEN TANDEM BOXES

FLOWRATE = 23.5 cfs
SLOPE = 5.00 %
MANN N = 0.013
Depth = 18"
diameter = 18"
V = 13.3 fps

Project	Job No
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CML	3-27-96

BASIN 3 AREA = 5.3 ACRES

(A) OVERLAND FLOW. AREA = 0.882 ACRES.

L = 110'

S = 5%

V = 3.6 fps.

C = 0.25 5yr FLOW

0.35 100yr FLOW

i = 4.1 5yr

7.5 100yr

$T_C = T_{C_5} = 1.87\ (1.1 - 0.25)\ 110^{0.5} \times 5^{-0.33}$

$= 1.87\ (0.85)\ 10.488 \times 0.587$

= 9.79 minutes or 587 seconds.

$T_{C100} = 1.87\ (1.1 - 0.35)\ 110^{0.5} \times 5^{-0.33}$

$= 1.87\ (0.75)\ 10.488 \times 0.587$

= 8.634 minutes or 518

$Q_5 = CiA = 0.25\ (4.1)\ 0.882 = 0.904$ cfs.

$Q_{100} = CiA = 0.35\ (7.5)\ 0.882 = 2.315$ cfs.

PARKING LOT AREA (COMMERCIAL AREA) 3.365 ACRES.

L = 800

S = 5% (ASSUMES NO GREATER THAN 5% SLOPE)

V = 4.6 fps

C = 0.90 5yr FLOW

0.95 100yr FLOW

$T_C = \frac{800}{4.6} \div 60 = 2.899$ MINUTES

i = 5.1 5yr FLOW

9.0 100yr FLOW

$Q_5 = CiA = 0.90\ (5.1)\ 3.365 = 15.445$ cfs

$Q_{100} = CiA = 0.95\ (9.0)\ 3.365 = 28.771$ cfs

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CMC	3-27-96

BASIN 3 CONTINUED

SUMP INLET CALCULATIONS

COMPOSITE RUNOFF COEFF FACTOR FOR SUMP INLET

$$C_{n5} = \left[0.25(0.882) + 0.90(3.365)\right] \div 4.247 = \frac{0.220 + 3.028}{4.247}$$

$$= 0.765$$

$$C_{n100} = \left[0.35(0.882) + 0.95(3.365)\right] \div 4.247 = \frac{0.309 + 3.197}{4.247}$$

$$= 0.826$$

COMPOSITE T_C FOR INLET CALCULATION

TC_5 OVERLAND (A) + PARKING = 9.79 + 2.899 = 12.689 MINUTES

TC_{100} OVERLAND (A) + PARKING = 8.634 + 2.899 = 11.533 MINUTES

COMPOSITE C_5 = 3.8

C_{100} = 6.75

COMPOSITE Q FOR SUMP INLET CALCULATION

3A

$$Q_{5_c} = 0.765(3.8)4.247 = 12.346 \text{ cfs.}$$

$$Q_{100_c} = 0.826(6.75)4.247 = 23.679 \text{ cfs.}$$

SUMP INLET CALCULATION (WEIR FORMULA) FOR LENGTH

$$Q_{100_c} = 23.679 \text{ cfs}$$

$$23.679 = \frac{3 \times L \times 0.67^{3/2}}{1.25}$$

$$23.679 = L\left(\frac{1.645}{1.25}\right) = 1.316L$$

$$L = \frac{23.679}{1.316} = 17.99$$

USE 18' BOX FOR NOMINAL STANDARD where CAPACITY = 23.69 cfs.

OUTLET PIPE USING SOFFDESK CIVIL DESIGN VER 11.0 MANNINGS PIPE CALCULATION

PIPEFULL / PIPE CAPACITY = 26.398 cfs
SLOPE = 16.67 % (ASSUMES 6:1 slope)
n = 0.013
WS DEPTH = 18 IN
ORIFICE DIA = 18 IN
VELOCITY = 21.51 fps

3B

USE 15" RCP OUTLET PIPE

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CMC	3-27-96

BASIN 3 CONTINUED

⑮ OVERLAND FLOW AREA = 1.053 AC.

L = 170

S = 16.67 % (ASSUMED 6:1 SLOPE)

V 6.2 FPS. FROM CHART 3.1

C 0.25 5yr FLOW

0.35 100yr FLOW

i 4.4 5yr FLOW

7.8 100yr FLOW

$Tc_5 = 1.87(1.1 - 0.25)\,170^{0.5}\,16.67^{-0.33}$

$= 1.87(0.85)\,13.038 \times 0.395$

$= 8.185$ MINUTES $\approx$ 491 SEC.

$Tc_{100} = 1.87(1.1 - 0.35)\,170^{0.5}\,16.67^{-0.33}$

$= 1.87(0.75)\,13.038 \times 0.395$

$= 7.223$ MINUTES $\approx$ 433 SEC.

$Q_5 = CiA = 0.25(4.4)\,1.053 = 1.158$ cfs.

$Q_{100} = CiA = 0.35(7.8)\,1.053 = 2.875$ cfs

BASIN 3 TOTAL ACRES = 5.3 AC.

$Q_5 = 13.504$ cfs

$Q_{100} = 26.554$

Project	Job No
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CML	3-27-96

BASIN 4 3.8 ACRE AREA.

COMMERICIAL LOTS FLOW INTO DITCH; 2.792 ACRES.

L = 320
S = 5% (ASSUMES NO GREATER SLOPE)
C = 0.90 5yr
0.95 100yr
i = 5.1 in/hr
9.0 in/hr

V = 4.6 ft/sec

$T_c = \frac{320}{4.6} = 1.159$ MINUTES.

$Q_5 = CiA = 0.90(5.1)\ 2.792 = 12.815$

$Q_{100} = CiA = 0.95(9.0)\ 2.792 = 23.872$

OVERLAND AREA TO THE SOUTH DRAINS AWAY FROM DITCH; AREA = 1.008 ACRES.

L = 200
S = 16.67 (ASSUMES NO STEEPER THAN 6:1 SLOPE AVERAGE)

V = 6.75 fps

C = 0.25 5yr FLOW
0.35 100yr FLOW
i = 4.3 5yr
7.75 100yr

$Tc_5 = 1.87(1.1 - 0.25)\ 200^{0.5} \times 16.67^{-0.33}$
$= 1.87(0.85)\ 14.14 \times 0.40$
$= 8.99$ MINUTES OR 540 SECONDS

$T_{c100} = 1.87(1.1 - 0.35)\ 200^{0.5} \times 16.67^{-0.33}$
$= 1.87(0.75)\ 14.14 \times 0.40$
$= 7.93$ MINUTES OR 476 SEC.

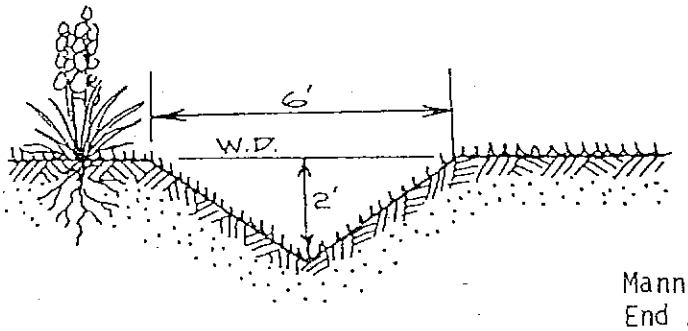
$Q_5 = CiA = 0.25(4.3)\ 1.008 = 1.08$ cfs

$Q_{100} = CiA = 0.35(7.75)\ 1.008 = 2.73$ cfs

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CMC	4-2-96

BASIN 4 CONTINUED



Mannings N = 0.04
End Area = 6.0 S.F.

BOTTOM SLOPE : 0.02 ft/ft or 2%

Q_5 from proposed development to NORTH = 12.815

Q_{100} = 23.872

Q CAPACITY = 27.89

SIDE SLOPE = 1.5 : 1

DIMENSION = TOP : 6'. DEPTH AT APEX 2'

4A

BASIN 4 CONTINUED

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON PROSPECT PARK

Comment: EXISTING DITCH

Solve For Depth

Given Input Data:

Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0200 ft/ft
Discharge.....	23.90 cfs

Computed Results:

Depth.....	1.99 ft
Velocity.....	4.47 fps
Flow Area.....	5.34 sf
Flow Top Width...	5.66 ft
Wetted Perimeter.	6.81 ft
Critical Depth...	1.74 ft
Critical Slope...	0.0313 ft/ft
Froude Number....	0.81 (flow is Subcritical)

BASIN 4 CONTINUED

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON PROSPECT PARK

Comment: DITCH CAPASITY

Solve For Discharge

Given Input Data:

Left Side Slope	1.50:1 (H:V)
Right Side Slope	1.50:1 (H:V)
Manning's n	0.040
Channel Slope	0.0200 ft/ft
Depth	2.00 ft

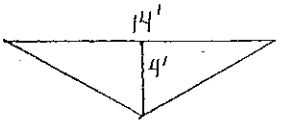
Computed Results:

Discharge	27.89 cfs
Velocity	4.65 fps
Flow Area	6.00 sf
Flow Top Width	6.00 ft
Wetted Perimeter	7.21 ft
Critical Depth	1.85 ft
Critical Slope	0.0306 ft/ft
Froude Number	0.82 (flow is Subcritical)

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CMC	4-2-96

DITCH SECTION AT INTERSECTION OF EAST/WEST DITCH - ("V" DITCH).



GRASS LINED

N = 0.04 GRASSLINED

BOTTOM SLOPE = 20:1 @ 0.05 ft/ft @ 5%

CROSSECTIONAL AREA = 28 SF

SIDESLOPE = 1.68 : 1

DIMENSION = TOP: 14' DEPTH: 4' SIDE: 8.06'

Q INPUT FROM FOUNTAIN BLVD SYSTEM = 67 cfs. △4B

Q_{100} FROM PROPOSED SITE = 23.9 cfs

Q_{100} IMMEDIATELY BELOW INTX = 90.9 cfs. △4C

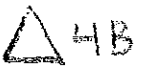
4840 PEARL EAST CIRCLE, SUITE 114 (303)442-4338
BOULDER, COLORADO 80301

740 WOOTEN RD. #108 (719) 591-5151
COLORADO SPRINGS, COLORADO 80915

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: UPSTREAM DEPTH OF FLOW Q100



Solve For Depth

Given Input Data:

Left Side Slope..	1.68:1 (H:V)
Right Side Slope.	1.68:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0500 ft/ft
Discharge.....	67.00 cfs

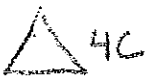
Computed Results:

Depth.....	2.22 ft
Velocity.....	8.06 fps
Flow Area.....	8.31 sf
Flow Top Width...	7.47 ft
Wetted Perimeter.	8.70 ft
Critical Depth...	2.51 ft
Critical Slope...	0.0265 ft/ft
Froude Number....	1.35 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: DOWNSTREAM DEPTH OF FLOW Q100 BELOW INTX



Solve For Depth

Given Input Data:

Left Side Slope..	1.68:1 (H:V)
Right Side Slope.	1.68:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0500 ft/ft
Discharge.....	90.90 cfs

Computed Results:

Depth.....	2.49 ft
Velocity.....	8.70 fps
Flow Area.....	10.45 sf
Flow Top Width...	8.38 ft
Wetted Perimeter.	9.75 ft
Critical Depth...	2.83 ft
Critical Slope...	0.0254 ft/ft
Froude Number....	1.37 (flow is Supercritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: DITCH CAPASITY

Solve For Discharge

Given Input Data:

Left Side Slope..	1.68:1 (H:V)
Right Side Slope.	1.68:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0500 ft/ft
Depth.....	4.00 ft

Computed Results:

Discharge.....	320.37 cfs
Velocity.....	11.92 fps
Flow Area.....	26.88 sf
Flow Top Width...	13.44 ft
Wetted Perimeter.	15.64 ft
Critical Depth...	4.69 ft
Critical Slope...	0.0215 ft/ft
Froude Number....	1.49 (flow is Supercritical)

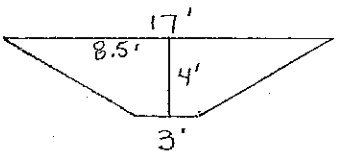
Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Project	Job No
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON	CMC	4-2-96

BASIN 4 CONTINUED

CROSSECTION AT PROPERTY LINE (TRAPAZOIDAL) 4D



N = 0.04 (CONCRETE COBBLE AND GRASS LINED)

BOTTOM SLOPE = 0.2 ft/ft or 20%

CROSSECTIONAL AREA = 40 sf

SIDE SLOPE : 1.68 : 1

DIMENSIONS : TOP: 17' BOTTOM: 3' SIDESLOPE LENGTH: 8.06'

Q INPUT 100_{YR} = 90.9

Q ADDITIONAL = 0.0

TOTAL Q_{100} OUTPUT = 90.9

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: DEPTH OF FLOW AT OUTFALL FOR Q100

Solve For Depth

Given Input Data:

Bottom Width.....	3.00 ft
Left Side Slope..	1.68:1 (H:V)
Right Side Slope.	1.68:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.2000 ft/ft
Discharge.....	90.90 cfs

Computed Results:

Depth.....	1.24 ft
Velocity.....	14.37 fps
Flow Area.....	6.32 sf
Flow Top Width...	7.18 ft
Wetted Perimeter.	7.86 ft
Critical Depth...	2.10 ft
Critical Slope...	0.0243 ft/ft
Froude Number....	2.70 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: DITCH CAPASITY AT OUTFALL

Solve For Discharge

Given Input Data:

Bottom Width.....	3.00 ft
Left Side Slope..	1.68:1 (H:V)
Right Side Slope.	1.68:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.2000 ft/ft
Depth.....	4.00 ft

Computed Results:

Discharge.....	1054.49 cfs
Velocity.....	27.12 fps
Flow Area.....	38.88 sf
Flow Top Width...	16.44 ft
Wetted Perimeter.	18.64 ft
Critical Depth...	6.72 ft
Critical Slope...	0.0180 ft/ft
Froude Number....	3.11 (flow is Supercritical)

Project	Job No
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON - FLOWS TO UNION SYSTEM	CMC	3.25.96

BASIN 5 AREA = 1.5 AC

OVERLAND PORTION

AREA (A) NORTH OF DRIVEWAY (0.4 ACRES)

V = 5.1 ft/sec FROM CHART 3.1

L = 50' (NARROWEST POINT)

C = 0.25 5yr FLOW
0.35 100yr FLOW

i = 4.7 5yr
9.0 100yr

S = 10% (10:1)

$T_C = T_{C5} = 1.87(1.1 - 0.25)50^{0.5} \times 10^{-0.33}$

$= 1.87(0.85)\ 7.07 \times 0.468$

= 5.26 MINUTES or 315 SECONDS

$T_{C100} = 1.87(1.1 - 0.35)50^{0.5} \times 10^{-0.33}$

$= 1.87(0.75)\ 7.07 \times 0.468$

= 4.64 MINUTES ~ 278 SECONDS

$Q_5 = CiA = 0.25(4.7)\ 0.4 = 0.47$

$Q_{100} = CiA = 0.35(9.0)\ 0.4 = 1.26$

AREA (B) SOUTH OF DRIVEWAY (0.93 ACRES)

V = 7.1 ft/sec FROM CHART 3.1

L = 90' (NARROWEST POINT)

C = 0.25 5yr FLOW
0.35 100yr FLOW

i = 4.6 5yr
8.9 100yr

S = 16.7% (6:1)

$TC = T_{C5} = 1.87(1.1 - 0.25)90^{0.5} \times 16.7^{-0.33}$

$= 1.87(0.85)\ 9.49 \times 0.39$

= 5.88 MINUTES ~ 353 SECONDS

$T_{C100} = 1.87(1.1 - 0.35)90^{0.5} \times 16.7^{-0.33}$

$= 1.87(0.75)\ 9.49 \times 0.39$

= 5.19 MINUTES ~ 311 SECONDS.

$Q_5 = CiA = 0.25(4.6)\ 0.93 = 1.07$ CFS

$Q_{100} = CiA = 0.35(8.9)\ 0.93 = 2.89$ CFS.

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164
Client	**By** / **Date**
ANTON NELSON	CMC / 3-25-96

BASIN 5 CONTINUED

DRIVEWAY PORTION AREA = 0.17 ACRES

V = 12.5 ft/sec FROM CHART 3.1

L = 270 FROM BASIN BOUNDARY TO UNION BLVD

C = 0.90 5yr FLOW
0.95 100yr FLOW

L = 5.1 5yr
9.0 100yr

S = 4.00%

$TC = \frac{270'}{12.5\ ft/sec} \div 60 = 0.36$ MINUTES

$Q_5 = CiA = 0.9\ (5.1)\ 0.17 = 0.78$ CFS

$Q_{100} = CiA = 0.95\ (9.0)\ 0.17 = 1.45$ CFS.

ADDITIONAL INPUTS TO STORM DRAIN SYSTEM ON UNION BLVD FROM BASIN 5

5

$Q_5 = (A)_5 + (B)_5 + DRIVEWAY_5 = Q_5 = 0.47 + 1.07 + 0.78 = 2.32$ CFS

$Q_{100} = (A)_{100} + (B)_{100} + DRIVEWAY_{100} = Q_{100} = 1.26 + 2.89 + 1.45 = 5.60$ CFS

* NO PROBLEMS BEING HANDLED BY SYSTEM IN PLACE ALONG UNION BLVD

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON - TEXACO SITE	CML	3-25-96

BASIN 6 AREA 3.0 +/- ACRES.

SUMP INLET COMPS.

$V = 4.5$ ft/s FROM FIGURE 3.1 FOR 5% SLOPE

$L = 260'$ FROM TOP OF PARKING LOT TO INLET

$T_c = \frac{260'}{4.5'/\text{sec}} \div 60 \text{ sec/min} = 0.963$ MINUTES

$C = 0.90$ FIVE YEAR
0.95 100 YEAR

$A = 1.665$ PAVED AREA

$i = 5.1$ IN/hr FROM CHART 5 yr
9.0 IN/hr FROM CHART 100 yr

6A

$Q_5 = CiA = 0.9(5.1)1.665 = \underline{7.64 \text{ CFS}}$

$Q_{100} = CiA = 0.95(9.0)1.665 = \underline{14.23 \text{ CFS}}$

INLET LENGTH (WEIR FORMULA)

$$14.23^{Q_{100}} = \frac{3.0 \times L \times 0.67^{3/2}}{1.25}$$

$$14.23 = \frac{3 \times L \times 0.548}{1.25} = L\left(\frac{1.645}{1.25}\right) = 1.316\,L$$

$$L = \frac{14.23}{1.316} = 10.81'$$

USING STANDARD OPENING OF 12' NOMINAL, CAPASITY IS:

$$Q = \frac{3.0 \times 12 \times 0.548}{1.25} = 15.78 \text{ cfs.}$$

OUTLET PIPE COMPUTATION WITH 19.88 CFS Q100 FROM BASIN 1 TOTAL INPUT 34.11 CFS
USING MANNINGS PIPE CALCULATOR IN SOFTDESK CIVIL VER 11.0

6B

PIPEFULL / CAPASITY = 166.383 cfs
SLOPE = 8.59 %
$n = 0.013$
WS DEPTH. = 24 IN. (PIPE FULL)
ORFICE DIA = 24 IN.
V fps = 21.11 fps

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164
Client	**By** / **Date**
ANTON NELSON – TEXACO SITE	CMC / 3-25-96

BASIN 6 CONTINUED.

OVERLAND FLOW BELOW PARKING LOT TO SOUTH AND WEST

S = 25% (4:1)

A = 1.335 ACRES.

L = 50' (SHORTEST LENGTH)

C = 0.25 5 YEAR

0.35 100 YEAR

i = 5.1 5 YEAR

9.0 100 YEAR

V = 7.1 ft/sec FROM 3.1 for 25% slope

TC: $TC_5 = 1.87\,(1.1 - 0.25)\,50^{0.5} \times 25^{-0.33}$

$= 1.87\,(0.85)\,7.07 \times 0.346$

= 3.89 MINUTES. OR 233.4 SEC

$TC_{100} = 1.87\,(1.1 - 0.35)\,50^{0.5} \times 25^{-0.33}$

$= 1.87\,(0.75)\,7.07 \times 0.346$

= 3.43 MINUTES. OR 205.8 SEC

$Q_5 = CiA = 0.25\,(5.1)\,1.335 = 1.70$ CFS

$Q_{100} = CiA = 0.35\,(5.1)\,1.335 = 2.38$ CFS.

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: CDOT 36" CMP UNDER RAMP D (NUMBER 5/6)

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	3.00 ft
Slope.....	0.0409 ft/ft
Manning's n.....	0.024
Discharge.....	73.06 cfs

Computed Results:

Full Flow Capacity.....	73.06 cfs
Full Flow Depth.....	3.00 ft
Velocity.....	10.34 fps
Flow Area.....	7.07 sf
Critical Depth.....	2.70 ft
Critical Slope.....	0.0360 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	73.06 cfs
QMAX @.94D.....	78.60 cfs
Froude Number.....	FULL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: NELSON OLYMPIC

Comment: CDOT 36" CMP UNDER RAMP D (NUMBER 6/7)

Solve For Full Flow Capacity

Given Input Data:

Diameter.....	3.00 ft
Slope.....	0.0661 ft/ft
Manning's n.....	0.024
Discharge.....	92.89 cfs

Computed Results:

Full Flow Capacity.....	92.89 cfs
Full Flow Depth.....	3.00 ft
Velocity.....	13.14 fps
Flow Area.....	7.07 sf
Critical Depth....	2.86 ft
Critical Slope....	0.0574 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	92.89 cfs
QMAX @.94D.....	99.92 cfs
Froude Number.....	FULL

Project	Job N°
OLYMPIC VILLAGE SUBDIVISION	CE-7164

Client	By	Date
ANTON NELSON – UNION BLVD MEDIAN INLET	CMC	4-24-96

OFFSITE ON WEST SIDE OF proposed MEDIAN SOUTH OF EXISTING

10' DIOR INLET AREA = 0.404 ACRES.

V = 4 ft/sec

L = 410 ft

C = 0.90 5yr FLOW
0.95 100yr FLOW

i = 5.1 5yr
9.0 100yr

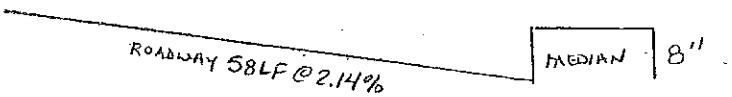
S = 4.00%

$T_C = \frac{410}{4} = 102.5$ sec or 1.708 minutes

$Q_5 = 0.90\,(5.1)\,0.404 = 1.85$ cfs

$Q_{100} = 0.95\,(9.0)\,0.404 = 3.5$ cfs.

— ON GRADE INLET COMPUTATIONS



LOGITUDINAL SLOPE 4.00%

LENGTH 410
AREA 0.404

ITERATION TO FIND 3.5 cfs DEPTH AND SPREAD

DEPTH	AREA Sf	WETTED PERIMETER	cfs	SPREAD
1.6"	0.39	6.21'	1.13	
1.75"	0.50	6.96'	1.59	
3.0"	1.46	11.93'	6.64	
2¼"	0.82	8.95'	3.07	
2½"	1.01	9.95'	4.05	
2.375"	0.92	9.45'	3.59	9.25

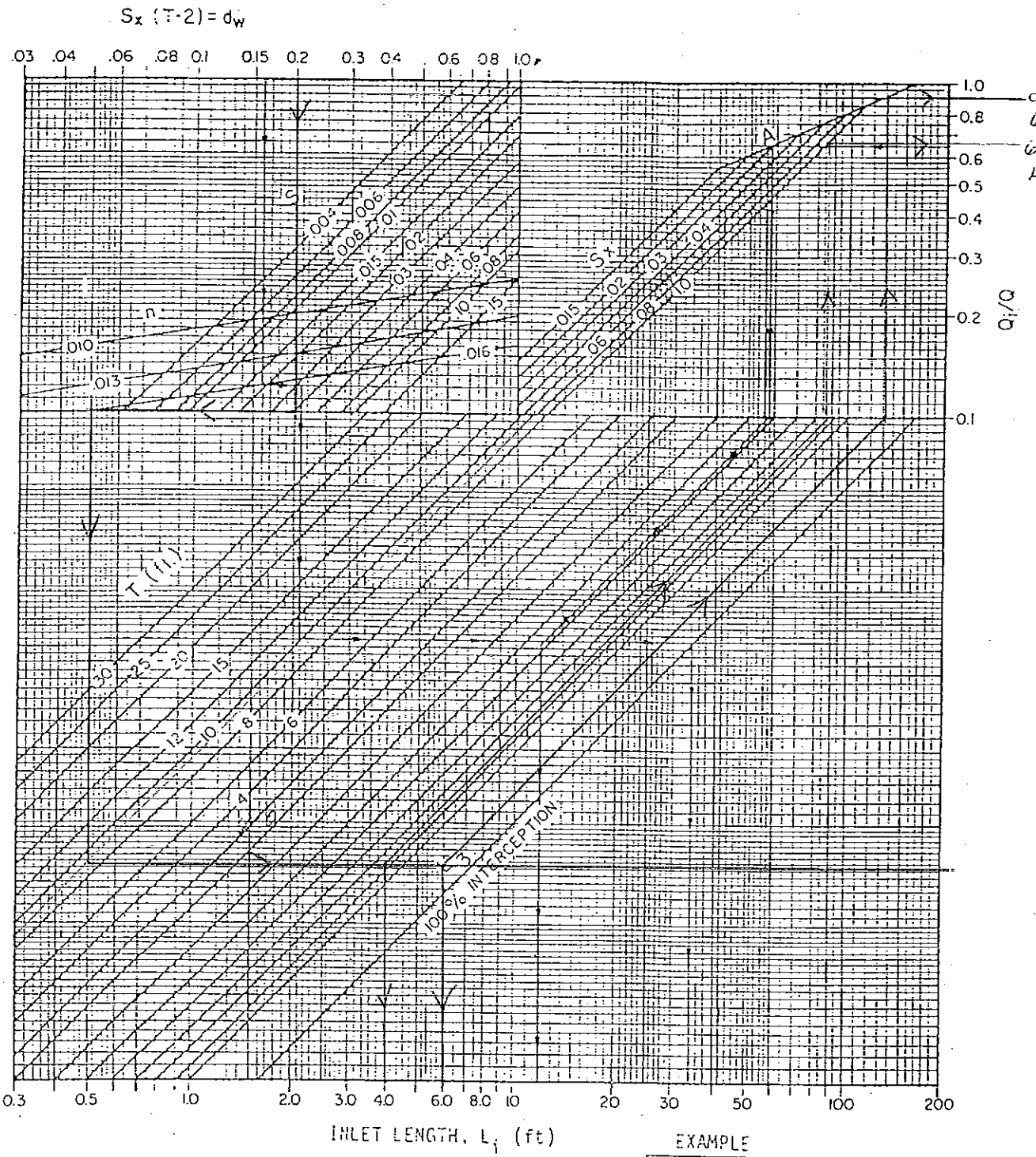
$Q = \frac{1.486}{0.016} \times (0.04)^{1/2} \times \left(\frac{A}{WP}\right)^{2/3} \times 0.404$

6' DIOR
1.85 / 3.15 / 3.5

SEE CHART ATTACHED FOR SIZING

4 LF BOX = 65% CATCH 6 LF BOX = 90% CATCH USE 6 LF BOX

01



This chart assumes, w=2 ft., a = 2" and h=6in.

REFERENCE :

Izzard, Carl. f., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

EXAMPLE

Given — S_x = 0.02 ft/ft
T = 10 ft.
S = 0.03 ft/ft

Find — L_i = 11.8 ft L_i = 34 ft.
Q_i/Q= 0.55 Q_i/Q=1.0

HDR Infrastructure, Inc
A Centerra Company

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

CONTINUOUS GRADE
Standard Curb-Opening Inlet Chart

Date
OCT. 1987

Figure
7-9

APPENDIX 2
DMJM EXCERPTS FROM HIGHWAY 24 BYPASS DRAINAGE STUDY

Project FCU 024-3 (9)

Colorado Springs, Colorado

State Highway 24 Bypass

Drainage Study

Phase I, Part II

Prepared For

Colorado

Department of Highways

DMJM

the basin has a quick reaction to storms. This is reflected in the time of concentration calculation for the SCS method and the weighted slope for the CUHP method.

E. PEAK FLOW DISCHARGES

Several methods were used to determine peak flows for the sub-basins surrounding Spring Creek. For sub-basin A, which lies north of the pond, the Soil Conservation Service (SCS) TR-20 method and the Colorado Urban Hydrograph Procedure (CUHP) method were used. For sub-basin F and I the CUHP method was used. For the other remaining sub-basins the both the Rational Method and the CUHP method were used. Peak flow calculations are based on a 100-year storm frequency. Computations and basin parameters for the different methods are shown in Appendices A through C of draft report. Map 1 shows the boundary lines for the sub-basins. For the area west of Circle Dr. and south of Spring Creek, design discharges have been previously determined by KLH Engineering. These discharges have been accepted by the City of Colorado Springs and approved for use in this study by CDOH.

1. Soil Conservation Service (SCS) TR-20

The TR-20 method utilizes a unit hydrograph which is produced from SCS index ratios and the unit peak parameters for each basin. These index ratios are averages obtained from storms in various geographic regions throughout the United States. With this method surface runoff is influenced by the determination of the appropriate curve number (CN). The curve number is dependent upon antecedent conditions, soil type and the types of ground cover. A summary of the curve number determination for Basin A for the 2-hour and 24-hour storms is in Appendix A of the draft report. Only Basin A was analyzed using the SCS Hydrograph procedure.

Five minute incremental hydrographs were calculated using the unit hydrograph and the incremental runoff. For basin A, both the 2-hour and the 24-hour flood hydrographs were generated. Both storms yielded similar peak flow results as shown in the hydrograph worksheets in Appendices A and B of the draft report.

The time of concentration calculations were computed using the formulas outlined in the Urban Drainage Criteria Manual, and compared very closely to the criteria found in the City of Colorado Springs\El Paso County Drainage Criteria Manual.

2. Colorado Urban Hydrograph Procedure (CUHP)

The CUHP is a unit hydrograph method developed by the Colorado

DMJM

JOB No. 4263.01 | SHEET No. 3/5

BY- HRK | DATE 11/30/89

SUBJECT: ~~UNION~~ ~~CIS 24~~ BYPASS INTERCHANGE - CROSS CULVERTS

CULVERT NO. 5 —

t_c = 10 MIN
I_{100} = 7 IN/HR
DA = 8.7 AC
C = 0.6

$Q_{100} = CIA = (.6)(7)(8.7) = 36.5$ CFS

H/D = 1.05 FOR 36" PIPE

DHW = INVERT + 3.15
AHW = INVERT + 3.90

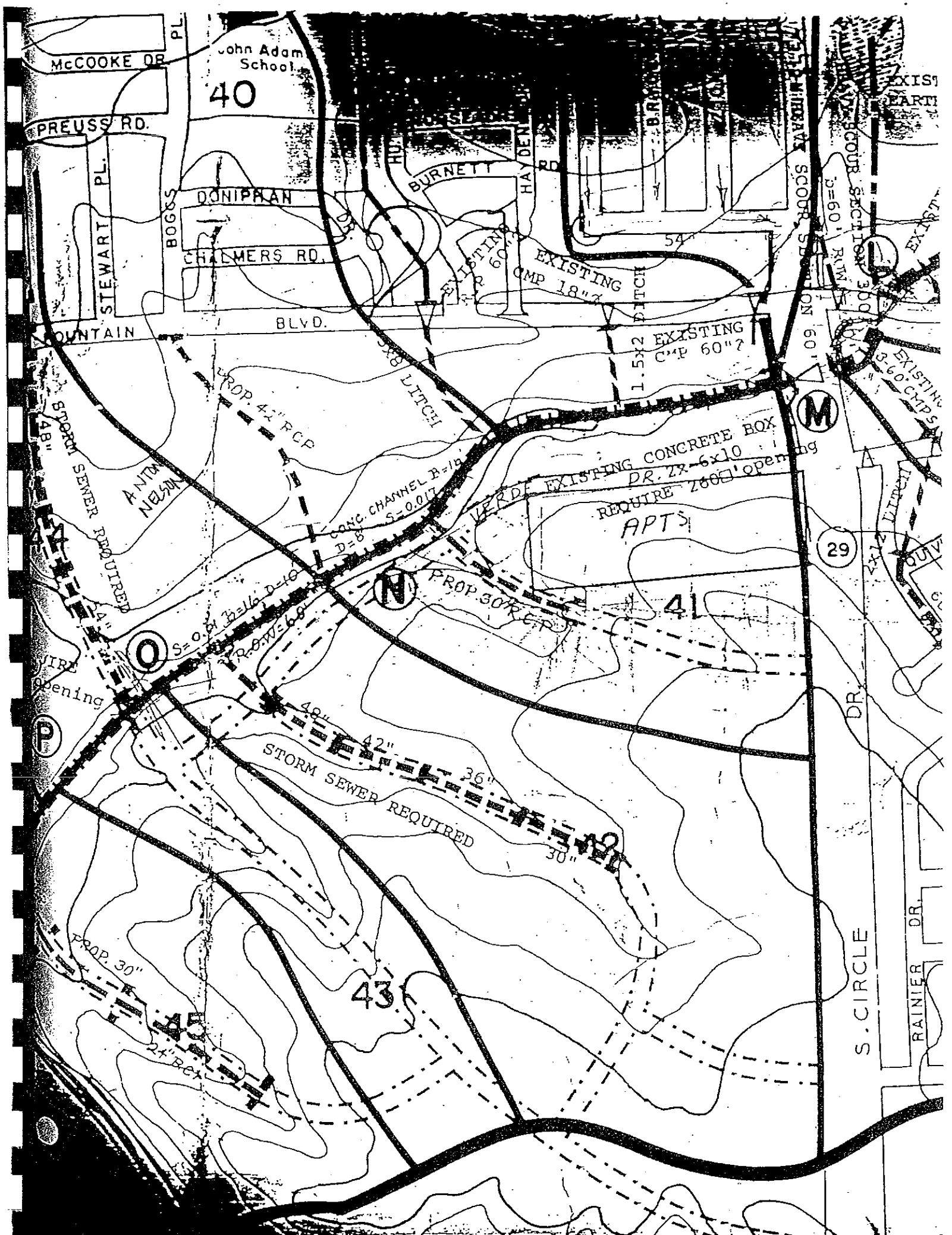
CULVERT NO. 6 —

t_c = 10 MIN
I_{100} = 7 IN/HR
DA = 10.3 AC
C = 0.6

$Q_{100} = CIA = (.6)(7)(10.3) = 43.3$

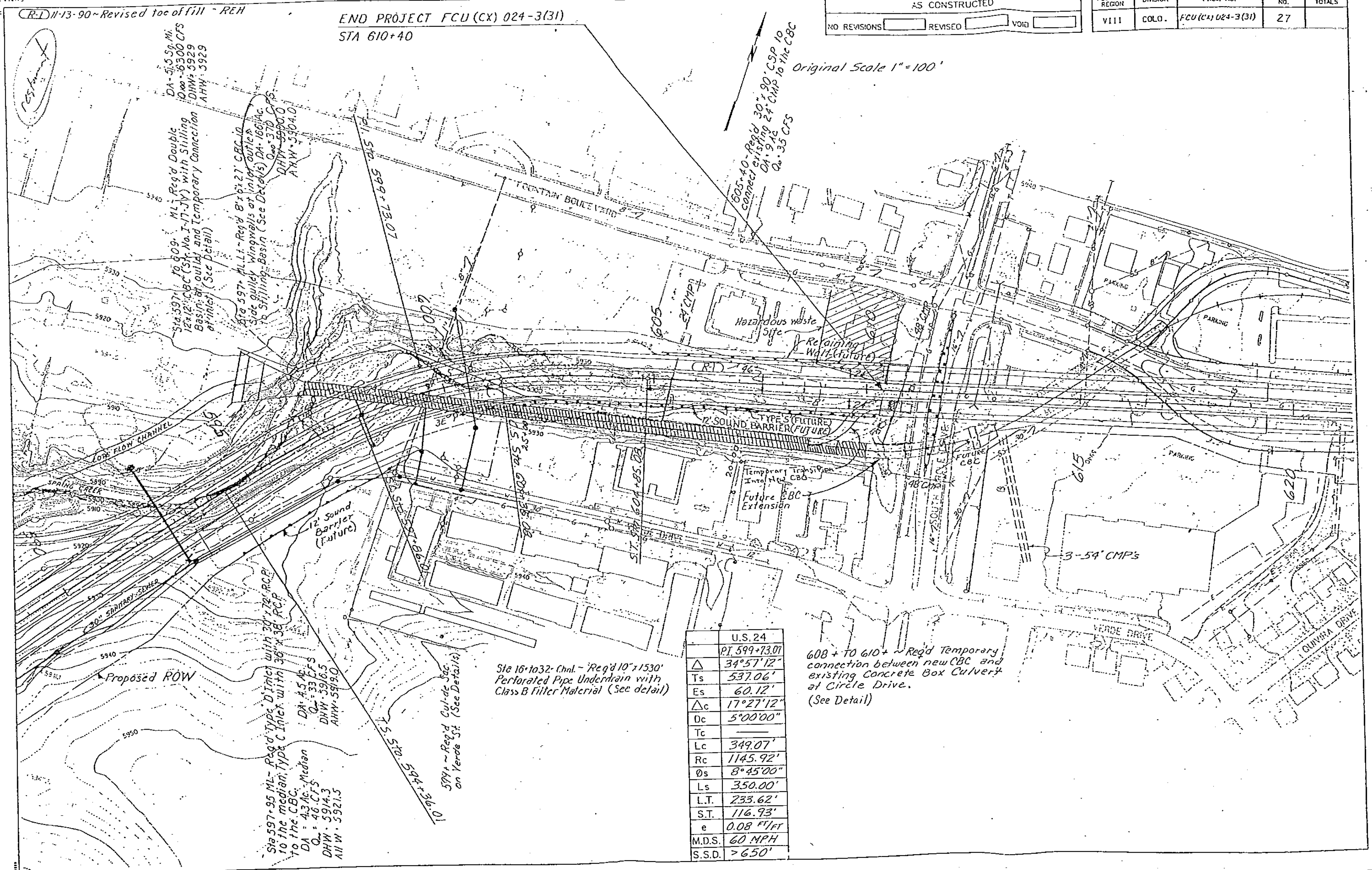
H/D = 1.2 FOR 36" PIPE

DHW = INVERT + 3.6'
AHW = INVERT + 3.9'


McCOOKE DR.
PL.
John Adam School
40
PREUSS RD.
STEWART PL.
BOGGS
DONIPHAN
CHALMERS RD.
BURNETT
HAYDEN RD.
BLVD.
EXISTING 60" CMP 18"?
EXISTING 1.5x2 ARCH PIPE
EXISTING 1.5x2 ARCH PIPE CMP 60"?
54"
SCOUR SECTION 60'
SCOUR SECTION 30'
EXISTING 3-60" CMPS
PROP. 42" RCP
5x8 LITCH
STORM SEWER REQUIRED
48"
ANTI NOISE
CONC. CHANNEL B=18' D=8' S=0.017
VERIFY EXISTING CONCRETE BOX DR. 2x6x10 REQUIRE 2x6 Opening
APTS
29
41
PROP. 30" RCP
S=0.04 B=16 D=10 R.O.W.=60'
Opening
48"
42"
36"
30"
STORM SEWER REQUIRED
PROP. 30"
43
24" RCP
S. CIRCLE
DR.
RAINIER
DR.

AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

FED. ROAD REGION	DIVISION	PROJ. NO.	SHEET NO.	SHEET TOTALS
VIII	COLO.	FCU (CX) 024-3(31)	27	



	U.S. 24
	P.I. 599+73.07
△	34°57'12"
Ts	537.06'
Es	60.12'
△c	17°27'12"
Dc	5°00'00"
Tc	———
Lc	349.07'
Rc	1145.92'
Øs	8°45'00"
Ls	350.00'
L.T.	233.62'
S.T.	116.93'
e	0.08 FT/FT
M.D.S.	60 MPH
S.S.D.	>650'

AS CONSTRUCTED					
NO REVISIONS		REVISED		VOID	

FED. ROAD REGION	DIVISION	PROJ. NO	SHEET NO.
VIII	COLO.	FCU(CX) 024-3(31)	26

R-1 11-13-90 - Revised structure note - REH

ANTON NELSON

Utilities
City of Colorado Springs: Wastewater
Water
Electric
Gas

Sta 563+74.00 Begin Proj FCU(CX) 024-3(31) =
Sta 563+74.0 on FCU 024-3(25)

SPRING CREEK

Sta 562+00 MI - Reqd Riprap existing side ditch (See Detail)

Sta 87+ Union Blvd - Remove existing concrete structure

Sta 87+08 Union Blvd - Req'd Double 13'x10'x320' CBC, Wingwalls Lt. and Rt. and Concrete Apron at outlet (See Details)

Sta 977+67 Ramp F - Req'd 36"x108' Culvert Pipe with End Sections and 40' of d50 12" Riprap channel at outlet
DA = 9 Ac.
Q100 = 39 CFS
DHW = 5893.3
AHW = 5893.5

Sta 568+33 HL - Reqd 42"x29' RCP Cross Culvert with Type 'S' Headwall and d50 9" Riprap Lt. and Type 'D' Inlet Rt.
DA = 25 Ac.
Q100 = 81 CFS
DHW = 5883.5
AHW = 5892.0

Sta 566+17 HL - Reqd Type 'S' Culvert Pipe Inlet with 24'x171' Culvert Pipe and End Section Lt.

Sta 470+70 Ramp A - Reqd 24"x105' Culvert Pipe with End Sections Lt. and Rt.

Sta 780+00
DA = 2 Ac.
Q100 = 37 CFS
DHW = 5901.2
AHW = 5905

Sta 760+59 Ramp D - Reqd 36"x141' Culvert Pipe with End Sections Lt. and Rt. and d50 9" Riprap at outlet

Sta 892+83 Ramp E - Reqd 36"x134' Culvert Pipe with End Sections Lt. and Rt. and d50 12" Riprap at outlet
DA = 40 Ac.
Q100 = 143 CFS
DHW = 5896.8
AHW = 5903.0

Sta 367+13 Ramp B - Reqd 24"x71' Culvert Pipe with End Sections Lt. and Rt.

Sta 895+00

Sta 85+59 Union Blvd Rt - Req'd Ditch from Union side ditch Rt. 40' to match existing ground
W=2' Z=6 d=Varies

Existing Stm

Sta 583+60 MI - Reqd Inlet Special with wing walls, apron 78'x80' RCP 72"x310' RCP to an Outlet Structure with Riprap (See Details)
DA = 136 Ac.
Q100 = 551 CFS
DHW = 5922.2
AHW = 5924.0
m = 9.83'
K = 4.0'
L = 14.0'
θ = 60°

Sta 584+00 HI - Reqd 6'x10' Perforated Pipe Underdrain and 6"x344' of Non-Perforated Pipe Underdrain

Sta 592+80 - Reqd 42"x237' RCP Cross culvert with 54"x45' RCP Energy Dissipator, Type 'D' Inlet, Type 'S' Headwall at outlet with d50 = 9" Riprap
D.A. 31 Ac.
Q100 = 71 CFS
DHW = 5916.6
AHW = 5921

Ramp A
Ramp B
Ramp C
Ramp D
Ramp E
Ramp F

Sewer Access road

Limits of Grading

R-1

12/20/89 19:35:46 LINCOLN:::(USER/BB101/DRAW) PLAN_SH1 BB101 H107

APPENDIX 3
VELOCITY CHART

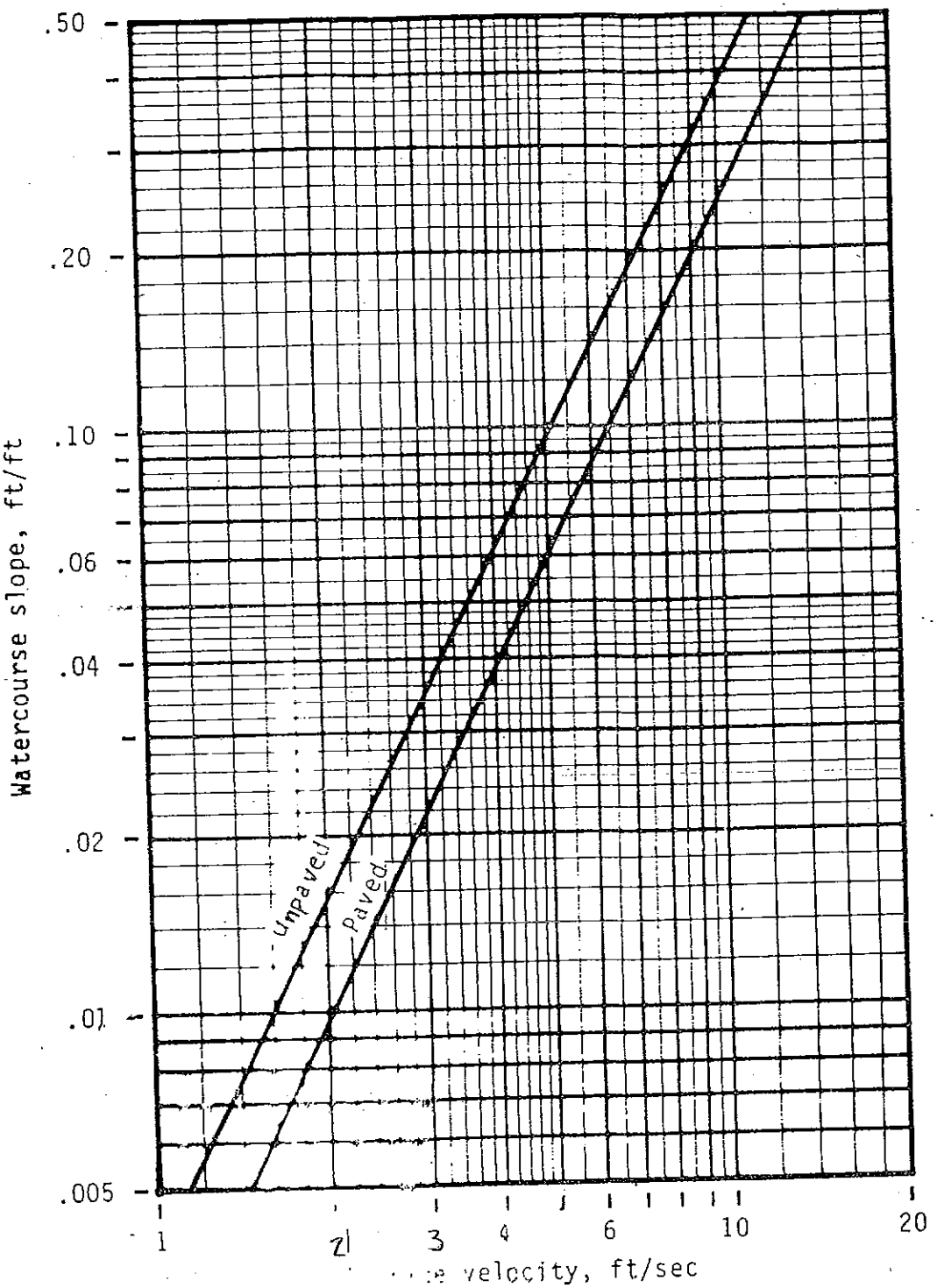
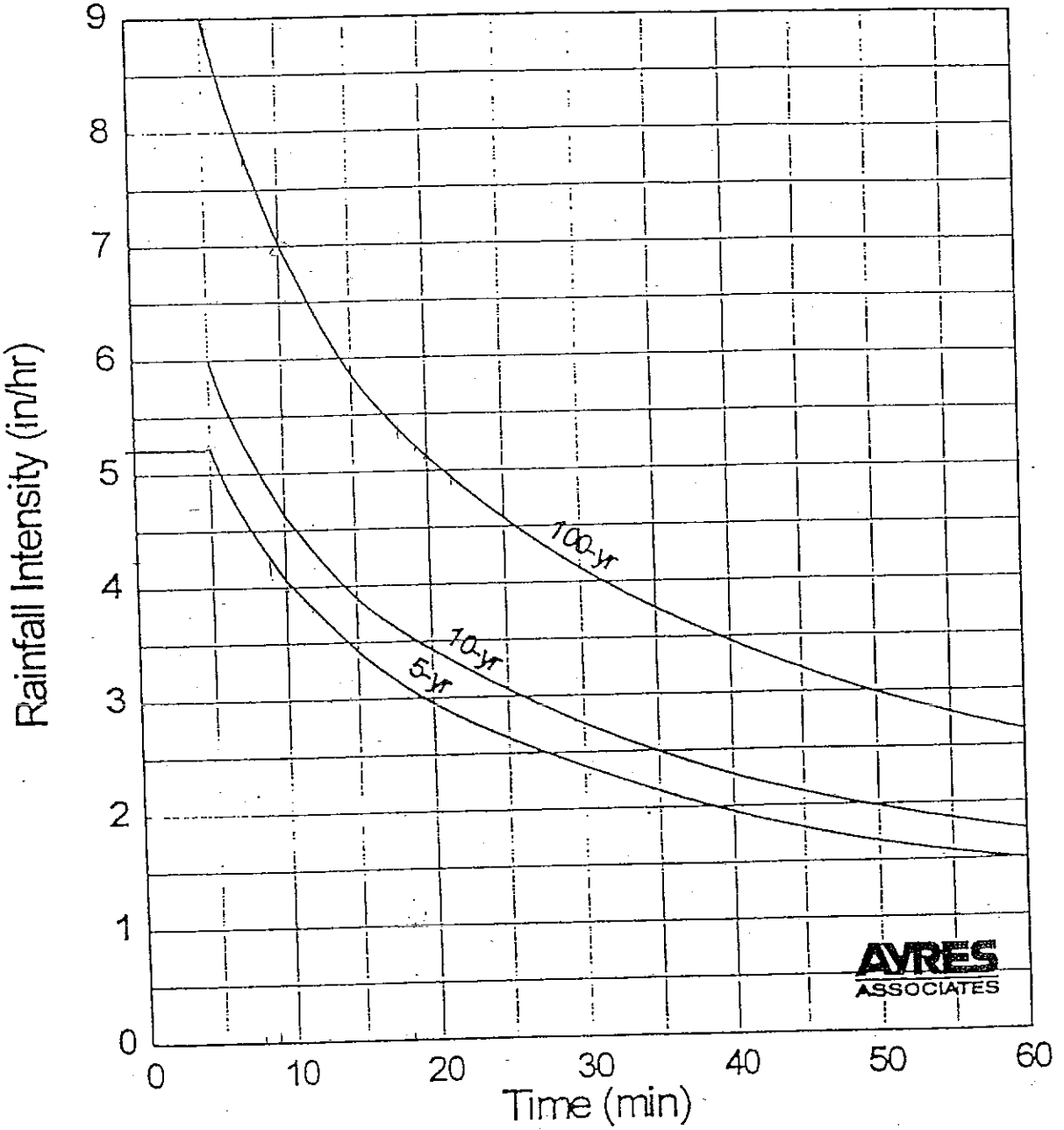


Figure 3-1.—Average ... mating travel time for shallow concentrated flow.

APPENDIX 4
RAINFALL INTENSITY CURVE

New



Interim Release October 12, 1994 , Rainfall Intensity Curves
City Of Colorado Springs Drainage Criteria Manual