COTTONWOOD COMMONS MASTER DEVELOPMENT DRAINAGE REPORT
and
FINAL DRAINAGE REPORT FOR COTTONWOOD COMMONS FILING NO. 1

October, 1998

Prepared for:

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Prepared by:

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Project# 97-090

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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 of Colorado Springs for drainage reports, and said drainage 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.

Kent D. Rockwell, P.E.

Kent D. Rockwell, P.E.

COLORADO REGISTERED KENT D. ROCKWELL 25086 10/16/95 PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT

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

Development Management, Inc.

BY: James Kuhlman DATE 10/15/95

TITLE: Agent For DMI Proj. Mngr.

ADDRESS: 4065 Sinton Road, Suite 200
Colorado Springs, CO 80907

CITY OF COLORADO SPRINGS

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

Tim Mahoney
CITY ENGINEER

11/7/95
DATE

COTTONWOOD COMMONS MASTER DEVELOPMENT DRAINAGE REPORT
and
FINAL DRAINAGE REPORT FOR COTTONWOOD COMMONS FILING NO. 1

PURPOSE

The purpose of this Drainage Report is to identify the proposed runoff patterns, quantities and drainage facilities required to facilitate the development of Cottonwood Commons. This report will specifically identify the drainage requirements for Cottonwood Commons Filing No. 1 and identify general requirements for the remainder of the proposed development.

This report also provides information on the adequacy of the existing culverts under Dublin Boulevard to convey flows across Dublin Boulevard from south to north.

SUMMARY OF DATA

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs and El Paso County "Drainage Criteria Manual", October 1987, revised November 1991.

2. Soil Survey for El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.

3. "Flood Insurance Studies for Colorado Springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1997.

4. "Cottonwood Creek Drainage Basin Planning Study" by URS Consultants, Inc., August, 1995.

5. "Cottonwood Creek Drainage Basin Planning Study" by Ayres Associates, October, 1996.

GENERAL LOCATION AND DESCRIPTION

The Cottonwood Commons development is located within the City of Colorado Springs, El Paso County, Colorado, within Section 11, Township 13 South, Range 66 West of the 6th P.M. (see Vicinity Map -Figure 1). The site is bound on the north and east by Tributary 1 of Cottonwood Creek, on the west by Rangewood Drive and on the south by Dublin Boulevard.

The site generally slopes from south to north. Tributary 1 of Cottonwood Creek runs along the northeasterly property line. A smaller tributary bisects the site into an eastern and western portion. An existing 126" corrugated metal pipe (CMP) discharges into the smaller tributary conveying flows from the south side of Dublin Boulevard to the north side of Dublin Boulevard. Likewise, two-132" CMP's carry flows under Dublin Boulevard and into Tributary 1 of Cottonwood Creek.

The entire development lies within the Cottonwood Creek Drainage Basin.

SOILS

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the soils underlying the Cottonwood Commons development consists of Tassel soil (soil type 89) as shown on Figure 2. The Tassel series is a hydrological group D soil; therefore, runoff coefficients were selected based on the D type soils.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panels #08041CO517F and #08041CO536F, portions of the site are within a 100 year floodplain. The limits of the 100 year floodplain are shown on the Developed Drainage Plan.

DRAINAGE CRITERIA

The current City of Colorado Springs/El Paso County Drainage Criteria was utilized in this report. Peak runoff quantities were determined using the Rational Method for both the 5 year and 100 year storms.

HISTORIC DRAINAGE BASIN DESCRIPTIONS

A brief description of each historic drainage basin including historic runoff rates, drainage patterns and existing drainage facilities for each basin is provided in this section of the report. A summary of peak historic runoff rates for the basins and designated design points are depicted on the Historic Drainage Plan provided in the back of the report.

The Prudent Line for Tributary 1 of Cottonwood Creek is depicted on the Historic Drainage Plan. The Prudent Line concept will be utilized for Tributary 1 of Cottonwood Creek. The secondary tributary bisecting the site from south to north will not utilize the Prudent Line concept and will have rip-rap lined side slopes.

Basin H-1 consist of 1.97 acres at the eastern side of the site. Runoff rates of 1.6 cubic feet per second (cfs) during the 5 year storm and 4.2 cfs during the 100 year storm are generated from this basin. These flows discharge to Tributary 1 of Cottonwood Creek, located to the north of this basin, as sheet flow.

Historic Basin H-2 consists of the smaller tributary traversing the site from Dublin Boulevard to Tributary 1 of Cottonwood Creek, plus the surrounding area on either side of the channel. This basin generates historic flow rates of Q_5 = 6.0 cfs and Q_{100} = 15.3 cfs. Approximately 850 cfs will enter the site through the existing 126" CMP from the south once full development occurs upstream.

The east half of Rangewood Drive and a small area just east of Rangewood comprises Basin H-3. This 1.77 acre historic basin generates runoff rates of 3.4 cfs during the 5 year storm and 6.9 cfs during the 100 year storm. These flows continue northerly within Rangewood Drive to the low point at Cottonwood Creek.

Runoff rates of Q_5 = 3.1 cfs and Q_{100} = 8.0 cfs are generated from the northwest portion of the site (Basin H-4). These flows discharge directly to Tributary 1 as sheet flow.

Basin H-5 consists of the north half of Dublin Boulevard from Rangewood Drive to the east property line of the subject parcel which is also the low point of Dublin Boulevard. Runoff rates of 3.9 cfs during the 5 year storm and 7.7 cfs during the 100 year storm reach this low point as street flow.

DEVELOPED DRAINAGE BASIN DESCRIPTIONS

Cottonwood Commons will consist of 8 office/commercial sites with a separate lot to be developed as a parking lot. The existing tributary traversing the site from south to north will remain basically in its current condition but the side slopes will be lined. Two private 84" diameter corrugated metal pipes will be installed approximately 170 feet north of Dublin Boulevard to accomodate a proposed private roadway and the 850 cfs developed flows which will be discharged through the existing 126" CMP.

A brief description of each developed drainage basin including developed runoff rates, drainage patterns and proposed drainage facilities for each basin is provided in this section of the report. A summary of peak developed runoff for the basins and designated design points are depicted on the Developed Drainage Plan provided in the back of the report. All proposed drainage facilities are approximate in size and may vary with actual layout and design.

The Prudent line concept has been adopted for development along the major drainageways in the Nor'Wood development, this includes Cottonwood Creek and Antelope Creek (Tributary No. 1) which bound a portion of this site. A grade control structure is proposed to be constructed in Antelope Creek just downstream of Dublin Boulevard. The Prudent Line concept will not be utilized on the secondary tributary bisecting the site. Instead, the side slopes of this tributary will be lined with rip-rap.

Basin I consists of 1.1 acres at the extreme northwest corner of the development and consist mainly of landscape and native areas. Runoff rates of 1.7 cfs during the 5 year storm and 4.0 cfs during the 100 year storm discharge directly to Tributary 1 of Cottonwood Creek as sheet flow.

The proposed parking lots and proposed buildings along the west side of the site comprise Basin II. This basin slopes from south to north to a proposed 8' inlet at the north end of the basin. This inlet will collect developed flow rates of Q_5 = 13.0 cfs and Q_{100} = 25.0 cfs. A 24" reinforced concrete pipe (RCP) will convey these flows to Tributary 1 of Cottonwood Creek.

Basin III consists of the east half of Rangewood Drive and the landscaping area adjacent to Rangewood Drive. This basin generates flows of 4.1 cfs during the 5 year storm and 6.8_cfs during the 100 year storm. These flow continue northerly within Rangewood Drive as street flows to the low point of Rangewood Drive. Rangewood Drive, a major arterial, with a slope of 4.0% has a 5 year street capacity of 34 cfs\side which is adequate to convey the storm flows generated from Basin III.

Basin IV consists of an additional 0.85 acres of buildings, landscaping and parking lots. This basin generates flows of Q_5 = 3.7 cfs and Q_{100} = 6.6 cfs. A proposed 4' inlet will collect these flows and an 18" RCP will convey them to the adjacent channel.

Likewise, a 4' inlet will collect the flows of Q_5 = 1.5 cfs and Q_{100} = 2.7 cfs generated from Basin V which is located just north of Basin IV. These flows will also be conveyed to the existing channel via an 18" RCP.

Basins VI and VII consists of parking and landscape areas toward the southwest corner of the site. Runoff rates generated from these basins will be collected and conveyed to the channel via 4' inlets and 18" RCP's.

The area within the proposed channel and adjacent banks comprise Basin VIII. Locally, this basin generates flows of 4.1 cfs during the 5 year storm and 9.5 cfs during the 100 year storm. The 100 year fully developed flows which will eventually be conveyed through this basin from the existing 126" CMP is 850 cfs. The sides of the channel will be improved with rip-rap lining as shown on the enclosed plans prepared by Ayres & Associates. Two 84" CMP's will be constructed approximately 200 feet north of Dublin Boulevard to convey these flows under a proposed roadway to be built across the existing channel. These pipes will be consider private and will be privately maintained. The preliminary design plans for the culverts and channel lining are enclosed in the Appendix of this report.

The entrance road from Dublin Boulevard and the parking lot just south of the entrance road comprise Basin IX. Runoff from this basin reach the low point to be constructed over the existing channel. Two private 4' inlets will be constructed on either side of the road to collect the 3.4 cfs and 5.9 cfs generated from this basin during the 5 year and 100 year storms, respectively.

Basin X is located toward the east side of the development and generates flows of 4.4 cfs and 7.7 cfs during the 5 year and 100 year storms, respectively. Runoff from this basin flows northeasterly within the proposed parking lots to a 4' inlet and 18" RCP. These flows will discharge to Tributary 1 of Cottonwood Creek as pipe flow.

The 0.38 acres located just east of Basin X is Basin XI. The runoff rates of 1.6 cfs and 2.8 cfs generated from this basin will flow easterly toward a proposed 4' inlet. These flows will also be discharged to Tributary 1 of Cottonwood Creek via an 18" RCP.

Basin XII consists of mainly landscape areas with a portion of one of the proposed buildings. Runoff rates of Q_5 = 1.2 cfs and Q_{100} = 3.0 cfs sheet flow into Tributary 1 of Cottonwood Creek.

Basin XIII consists of the north half of Dublin Boulevard from Rangewood Drive to the east property line of the project. This basin generates runoff rates of 6.9 cfs during the 5 year storm and 12.7 cfs during the 100 year storm. These flows will be collected within two existing inlets along the north side of Dublin Boulevard.

A single grade control structure is required along Tributary 1 of Cottonwood Creek between Dublin Boulevard and Rangewood Drive as specified in Ayres Prudent Line Study. This structure will be constructed as part of the Cottonwood Commons development.

The 100 year peak runoff rate in the reach of Tributary 1 of Cottonwood Creek adjacent to the site is 4177 cfs per the Ayres report. Runoff in the smaller channel is 850 cfs.

DUBLIN BOULEVARD CULVERT CROSSINGS

Ayres & Associates has also analyzed the existing culverts under Dublin Boulevard to determine their ability to convey the ultimate developed flows. Ayres results are presented in the Appendix of this report.

The H_w/D ratio for the twin 132" CMP's is 1.68 for a flow of 3,239 cfs (100 year ultimate developed flows.). This flow rate is based on revised land use assumptions previously approved by City Engineering and City Planning for the area east of Powers Boulevard. A water depth of 18.5 feet will occur at the entrance of the pipe during the 100 year storm. There is 19.5 feet of available head at this location. A grade control structure will be constructed just downstream of the twin 132" CMP's which will minimize scour potential at the outlet of these pipes.

The 126" CMP will have an H_w/D ratio of 1.02 based on an ultimate developed flow of 850 cfs.

EROSION CONTROL

Erosion control measures will be installed per approved grading/erosion control plans.

PROPOSED FACILITIES (CONSTRUCTION COST ESTIMATE):

All proposed inlets and pipes, including the proposed twin 84" CMP's will be private and non-reimbursable. The channel lining on the secondary tributary and the grade control structure on Tributary 1 are public reimbursable drainage facilities. The channel lining on the secondary channel will be publically maintained by the City of Colorado Springs. An easement will be provided to the City to maintain this channel. The proposed 84" twin CMP's will be privately maintained. Following is a cost estimate of the proposed facilities required for this development.

Cottonwood Commons Filing No. 1

(Private Non-reimbursable):

Item	Quantity	Unit Cost	Extended Cost
8' D-10-R Inlet	2 Ea.	$ 3,000.00 Ea.	$ 6,000.00
24" RCP	130 L.F.	$ 32.00/L.F.	$ 4,160.00
84" CMP	240 L.F.	$ 128.00/L.F.	$ 30,720.00
Headwall	2 Ea.	$20,000.00/Ea.	$ 40,000.00
Rip Rap Pad	1 Ea.	$ 1,500.00/Ea.	$ 1,500.00
		Sub-Total	$ 82,380.00
		15% Engineering & Contingency	$ 12,357.00
		Total	$ 94,737.00

Cottonwood Commons Future Filings

(Private Non-reimbursable):

Item	Quantity	Unit Cost	Extended Cost
4' D-10-R Inlet	8 Ea.	$2,200.00 Ea.	$ 17,600.00
18" RCP	380 L.F.	$ 25.00/L.F.	$ 9,500.00
Rip-Rap Pad	7 Ea.	$1,500.00/Ea.	$ 10,500.00
		Sub-Total	$ 37,600.00
		15% Engineering & Contingency	$ 5,640.00
		Total	$ 43,240.00

Cottonwood Commons Future Filings

Public Reimbursable Facilities (These facilities will be constructed with Cottonwood Commons Filing No. 2)

Item	**Quantity**	**Unit Cost**	**Extended Cost**
1. Channel Grade Control Structures	1 Ea.	$ 75,400.00/Ea.	$ 75,400.00
2. Rip-Rap Channel Lining	2,000 C.Y.	$ 35.00/C.Y.	$ 70,000.00
	Sub-Total		$145,400.00
	15% Engineering and Contingency		$ 21,810.00
	Total		$167,210.00

DRAINAGE, BRIDGE AND POND FEES

The Cottonwood Commons Development lies within the Cottonwood Creek Drainage Basin. Fees will be paid at the time of platting. The 1998 Drainage, Bridge and Pond Fees for the basin are listed below:

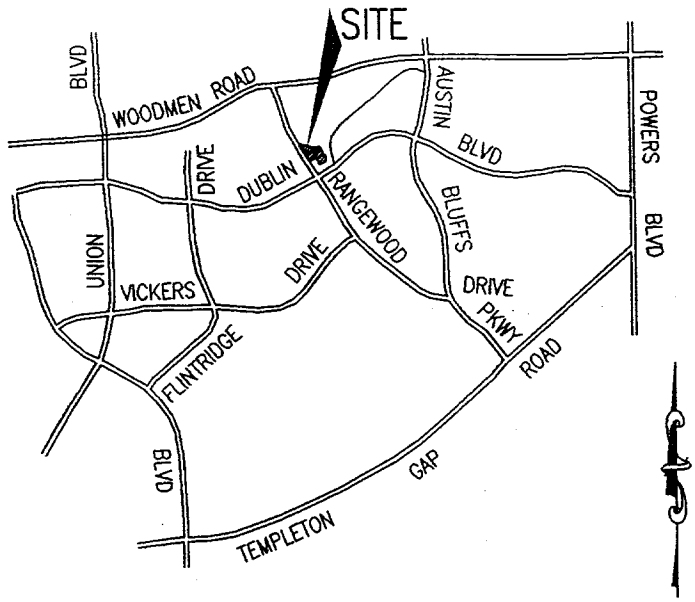
Cottonwood Commons Filing No. 1

Cottonwood Commons Filing No. 1 contains a total of 4.491 acres, of which 0.691 acres will be platted as open space with no fees due. Fees will be paid on the net 8.445 acres

Drainage Fees	4.491 Acres x $5,455/ac.	=	$24,498.41
Bridge Fees	4.491 Acres x $ 274/ac.	=	$ 1,230.53
Additional Drainage Fees (pending Cottonwood Creek Study)	4.491 Acres x $ 682/ac.	=	$ 3,062.86
Additional Bridge Fees (pending Cottonwood Creek Study)	4.491 Acres x $ 269/ac.	=	$ 1,208.08
Pond Fees (land)	4.491 Acres x $ 105/ac.	=	$ 471.56
Pond Fees (facilities)	4.491 Acres x $ 331/ac.	=	$ 1,486.52

Total 1998 Fees Cottonwood Commons Filing No. 1 $31,957.96

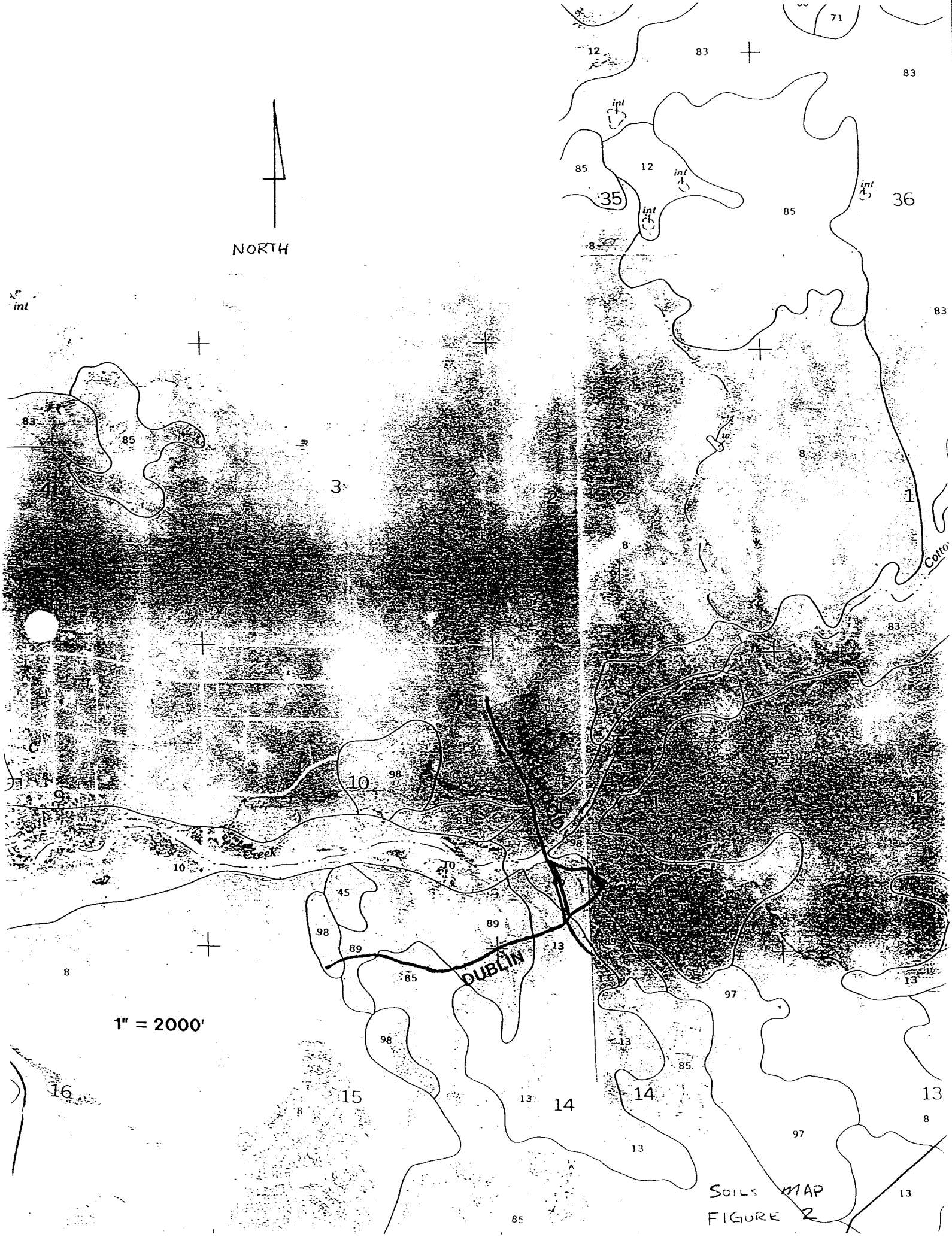
APPENDIX



Vicinity Map

NOT TO SCALE

FIGURE 1



SOILS MAP
FIGURE 2

Hydrology

Location: H-1
Area: 1.77 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	CS	C100	%Area
	.3	.45	

Composite: CS 0.30 C100 0.45 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	450	3%		22.1

T_c Total: 22.1

Intensity, I (inches/hr) from Fig 5-1

I5: 2.7 in/hr I100 4.7 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.6 cfs Q100: 4.2 cfs

Hydrology

Location: H-2
Area: 5.39 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	CS	C100	%Area
	.3	.45	

Composite: CS C100 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	300	9.0%		12.5

T_c Total: 12.5

Intensity, I (inches/hr) from Fig 5-1

I5: 3.7 in/hr I100 6.3 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.0 cfs Q100: 15.3 cfs

Hydrology

Location: H-3
Area: 1.98 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Acres	C5	C100	%Area
Landscaping Native	1.31	.3	.45	
Streets	0.67	0.9	0.9	

Composite: C5 0.50 C100 0.60 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	V(fps)	T_c
Overland	120	2%		13.0
Streets	730	4%	5	2.3

T, Total: 15.3

Intensity, I (inches/hr) from Fig 5-1

I5: 3.4 in/hr I100 5.8 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.4 cfs Q100: 6.9 cfs

Hydrology

Location: H-4
Area: 3.71 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Acres	C5	C100	%Area
	3.71	.3	.45	

Composite: C5 C100 100%

Time of Concentration: T_c in minutes: 23.4

Travel Type	L(ft)	s%	V(fps)	T_c

T, Total:

Intensity, I (inches/hr) from Fig 5-1

I5: 2.75 in/hr I100 4.75 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.1 cfs Q100: 8.0 cfs

Hydrology

Location: H-5
Area: 1.90 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	AREA
STREET	.9	.95	65%	1.23
NATURAL	.3	.45	35%	0.67

Composite: C5 .69 C100 .78 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
STREET	680	.88	1.11	10.17
OVERLAND	150	8%		9.2

T_c Total: 19.4

Intensity, I (inches/hr) from Fig 5-1

I5: 3.0 in/hr I100 5.2 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.9 cfs Q100: 7.7 cfs

Hydrology

Location:
Area: Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area

Composite: C5 C100 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c

T_c Total:

Intensity, I (inches/hr) from Fig 5-1

I5: in/hr I100 in/hr

Peak Flow: Q = CIA in cfs

Q5 cfs Q100: cfs

Hydrology

Location: I
Area: 1.1 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Acres	CS	C100	%Area
LANDSCAPE	.93	.3	.45	85%
BLDGS.	.17	.9	.9	15%

Composite: CS .39 C100 .52 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	V(fps)	T_c
OVERLAND	200	9	.33	10.25

T_c Total: 10.25

Intensity, I (inches/hr) from Fig 5-1

I5: 4 in/hr I100 6.9 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.7 cfs Q100: 4.0 cfs

Hydrology

Location: II
Area: 3.03 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	.3	.3	.45	10
BLDGS.	2.73	.9	.9	90

Composite: CS .84 C100 .86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	V(fps)	T_c
STREET	920	1.96	2.8	5.48

T_c Total: 5.48

Intensity, I (inches/hr) from Fig 5-1

I5: 5.1 in/hr I100 9.6 in/hr

Peak Flow: Q = CIA in cfs

Q5 13.0 cfs Q100: 25.0 cfs

Hydrology

Location: III
Area: 1.78 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone		C5	C100	%Area
LANDSCAPE	1.41	.3	.45	79%
BLDGS.	0.37	.9	.9	21%

Composite: C5 .42 C100 .54 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
[illegible]	[illegible]	[illegible]	[illegible]	6.4
SHEET	75	4		2.5

T_c Total: 9.0

Intensity, I (inches/hr) from Fig 5-1

I5: 4.1 in/hr I100: 7.1 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.1 cfs Q100: 6.8 cfs

Hydrology

Location: IV
Area: 0.85 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Ac.	C5	C100	%Area
LANDSCAPE	.085	.3	.45	10
BUILDINGS	.765	.9	.9	90

Composite: C5 .84 C100 .86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
STREET	215	5.6	4.75	.75

T_c Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.71 cfs Q100: 6.58 cfs

Hydrology

Location: V
Area: .35 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	.035	.3	.45	10
BLDGS.	.315	.9	.9	90

Composite: CS .84 C100 .86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_t
STREET	140	4.3	4.3	.5

T_c Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.53 cfs Q100: 2.71 cfs

Hydrology

Location: VI
Area: .25 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	.03	.3	.45	12%
BLDGS.	.215	.9	.9	88

Composite: CS .83 C100 .84 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_t
STREET	130	7.7	5.8	.37

T_c Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.06 cfs Q100: 1.85 cfs

Hydrology

Location: VII
Area: .25 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
[illegible]	.07	.3	.45	28
[illegible]	.17	.9	.9	72

Composite: CS .70 C100 .74 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
[illegible]	80	6.3	5	.27

T_c Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

IS: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

QS .91 cfs Q100: 1.67 cfs

Hydrology

Location: VIII
Area: 2.61 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	2.35	.3	.45	90
BLDGS.	.26	.9	.9	10

Composite: CS .36 C100 .49 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	135	5.9	.25	8.95

T_c Total: 8.95

Intensity, I (inches/hr) from Fig 5-1

IS: 4.4 in/hr I100 7.4 in/hr

Peak Flow: Q = CIA in cfs

QS 4.13 cfs Q100: 9.46 cfs

Hydrology

Location: IX
Area: .77 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
		.45		11
		.9	.9	89

Composite: CS .84 C100 .85 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
	20	4	.24	1.38
	70	2.4	3	.94
				2.32

T, Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 3.36 cfs Q100: 5.89 cfs

Hydrology

Location: X
Area: 1.00 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC	CS	C100	%Area
LANDSCAPE	.1	.3	.45	10
BLDG.	.9	.9	.9	90

Composite: CS .84 C100 .86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	25	8	.34	1.22
STREET	340	1.8	2.75	2.06
				3.28

T, Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 4.37 cfs Q100: 7.74 cfs

Hydrology

Location: XI
Area: .38 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	.1	.3	.45	18
PAVE.	.31	.9	.9	82

Composite: CS .79 C100 .82 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
	100	6	.52	3.2
	65	3	3.5	.3
				3.5

T_c Total: USE 5

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.56 cfs Q100: 2.8 cfs

Hydrology

Location: XII
Area: .93 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AC.	CS	C100	%Area
LANDSCAPE	.85	.3	.45	91%
BLDG.	.08	.9	.9	9%

Composite: CS .35 C100 .49 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	145	2.8	.2	12

T_c Total: 12

Intensity, I (inches/hr) from Fig 5-1

I5: 3.75 in/hr I100 6.6 in/hr

Peak Flow: Q = CIA in cfs

Q5 1.22 cfs Q100: 3 cfs

Hydrology

Location: XIII
Area: 1.91 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	C5	C100	%Area
STREET - PAV	.9	.95	

Composite: C5 .9 C100 .95 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
STREET	60	.5	1.11	10.17

T_c Total: 10.17

Intensity, I (inches/hr) from Fig 5-1

I5: 4 in/hr I100 7 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.55 cfs Q100: 12.7 cfs

Hydrology

Location: _____
Area: _____ Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	C5	C100	%Area

Composite: C5 C100 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c

T_c Total: _____

Intensity, I (inches/hr) from Fig 5-1

I5: _____ in/hr I100 _____ in/hr

Peak Flow: Q = CIA in cfs

Q5 _____ cfs Q100: _____ cfs

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DATE PAGE of

8' SUMP INLET

WORSE CASE (BASIN II)

$Q_5 = 13.0$ $Q_{100} = 25.0$

ASSUME FLOW IS SPLIT ON EITHER SIDE OF INLET

APPROACH FLOW

$$Q = 0.56\left(\frac{1}{(n)(S_x)}\right)(0.002)^{1/2} d^{8/3}$$

5 YR $$6.5 = 0.56\left(\frac{1}{(0.016)(0.02)}\right)(0.002)^{1/2} d^{8/3}$$

$0.393 = d$ $\therefore$ OK

100 YR $$12.5 = 0.56\left(\frac{1}{(0.016)(0.02)}\right)(0.002)^{1/2} d^{8/3}$$

$0.50 = d$ $\therefore$ OK

TOTAL FLOWS

5 YR $$Q = 1.7\left(\frac{1}{L} + 1.8w\right)\left(d_{max} + \frac{w}{12}\right)^{1.5}$$

$$13.0 = 1.7\left(\frac{1}{8} + 1.8(3)\right)\left(d_{max} + \frac{3}{12}\right)^{1.5}$$

$$0.571 = \left(d_{max} + \frac{3}{12}\right)^{1.5}$$

$0.499 = d_{max}$

100 YR $$25.0 = 1.7\left(\frac{1}{8} + 1.8(3)\right)\left(d_{max} + \frac{3}{12}\right)^{1.5}$$

$1.10 = d_{max} + \frac{3}{12}$

$0.60 = d_{max}$

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DATE PAGE of

BASINS IV, V, VI, VII, IX, X & XI

WORSE CASE (BASIN X)

$Q_5 = 4.4$ $Q_{100} = 7.7$

ASSUME ALL FLOWS REACH INLET FROM ONE SIDE

$Q_5 = 4.4$

$4.4 = 0.56\left(\frac{1}{0.016(0.02)}\right)(0.002)^{1/2} d^{8/3}$

$0.340 = d$

$Q_{100} = 7.7$

$7.7 = 0.56\left(\frac{1}{0.016(0.02)}\right)(0.002)^{1/2} d^{8/3}$

$0.419 = d$

TOTAL FLOWS

$4.4 = 1.7\left(4 + 1.8(3)\right)\left(d_{max} + 3/12\right)^{1.85}$

$0.25 = d$

$7.7 = 1.7\left(4 + 1.8(3)\right)\left(d_{max} + 3/12\right)^{1.95}$

$0.42 = d_{max}$

AYRES ASSOCIATES

FAX TRANSMITTAL

To: Kent Rockwell	From: Scott Queen
Company: Rockwell Minchow Consultants, Inc.	Date: July 23, 1998
Department:	Project No.: 34-0466.00
Fax Number: (719) 475-9223	Re: Dublin Boulevard culvert analyses
Number of Pages (Including this Transmittal): 4	

Remarks:

Kent,
Here is a copy of the memo I prepared for you regarding the hydraulic analyses we performed for the various culverts along Trib 1. Is this enough information for you or do you need more? Let me know.

AYRES ASSOCIATES

MEMORANDUM

To: Kent Rockwell, Rockwell-Minchow Consultants, Inc.

From: Scott Queen, P.E.

Date: September 18, 1997

Re: Hydrology and Hydraulics for Dublin, Austin Bluffs, and Oakwood Boulevards

Kent:
Following is a summary of the analyses I have completed for the Dublin, Austin Bluffs and Oakwood and Oakwood Boulevards.

We examined two different land uses in our hydrologic analyses:
1. A high-intensity (HI) land use east of Powers (as modeled in the Cottonwood Creek prudent line analysis), and
2. A lower-intensity (LI) land use east of Oakwood Boulevard, as demarcated in the information you faxed to me on September 15, 1997 (attached).

Note that the quantity of flow crossing Powers is limited in both of the above-listed cases by the existing culverts crossing Powers (twin 42" and triple 60") - no overtopping of Powers was allowed in the analysis.

Oakwood Boulevard

- 100-year discharge, HI land use = 1,047 cfs
- 50-year discharge, HI land use = 939 cfs
- 100-year discharge, LI land use = 584 cfs

- Culvert based on 584 cfs: twin-cell (7'x4') box culvert
- 100-year water surface elevation at u/s end: 6752.63; corresponding HW/D = 1.43
- Top back of east curb at low point: 6752.70

Austin Bluffs Parkway

- 100-year discharge, HI land use = 2,712 cfs
- 50-year discharge, HI land use = 2,339 cfs
- 100-year discharge, LI land use = 2,290 cfs

- Headwater elevation required to pass discharge through existing culverts:
    1. HI land use 100-yr Q: 6663.34 (D = 16.14', HW/D = 1.81)
    2. HI land use 50-yr Q: 6660.45 (D = 15.25', HW/D = 1.53)
    3. LI land use 100-yr Q: 6660.22 (D = 15.02', HW/D = 1.50)

- Headwater elevation required to pass discharge through existing culverts *and* two 6-feet tall pipe arch culverts situated on top of existing culverts (with 1' separation):
    1. HI land use 100-yr Q: 6660.40 (D = 15.2', HW/D = 1.52)
    2. HI land use 50-yr Q: 6659.38 (D = 14.18', HW/D = 1.42)
    3. LI land use 100-yr Q: 6659.25 (D = 14.05', HW/D = 1.41)

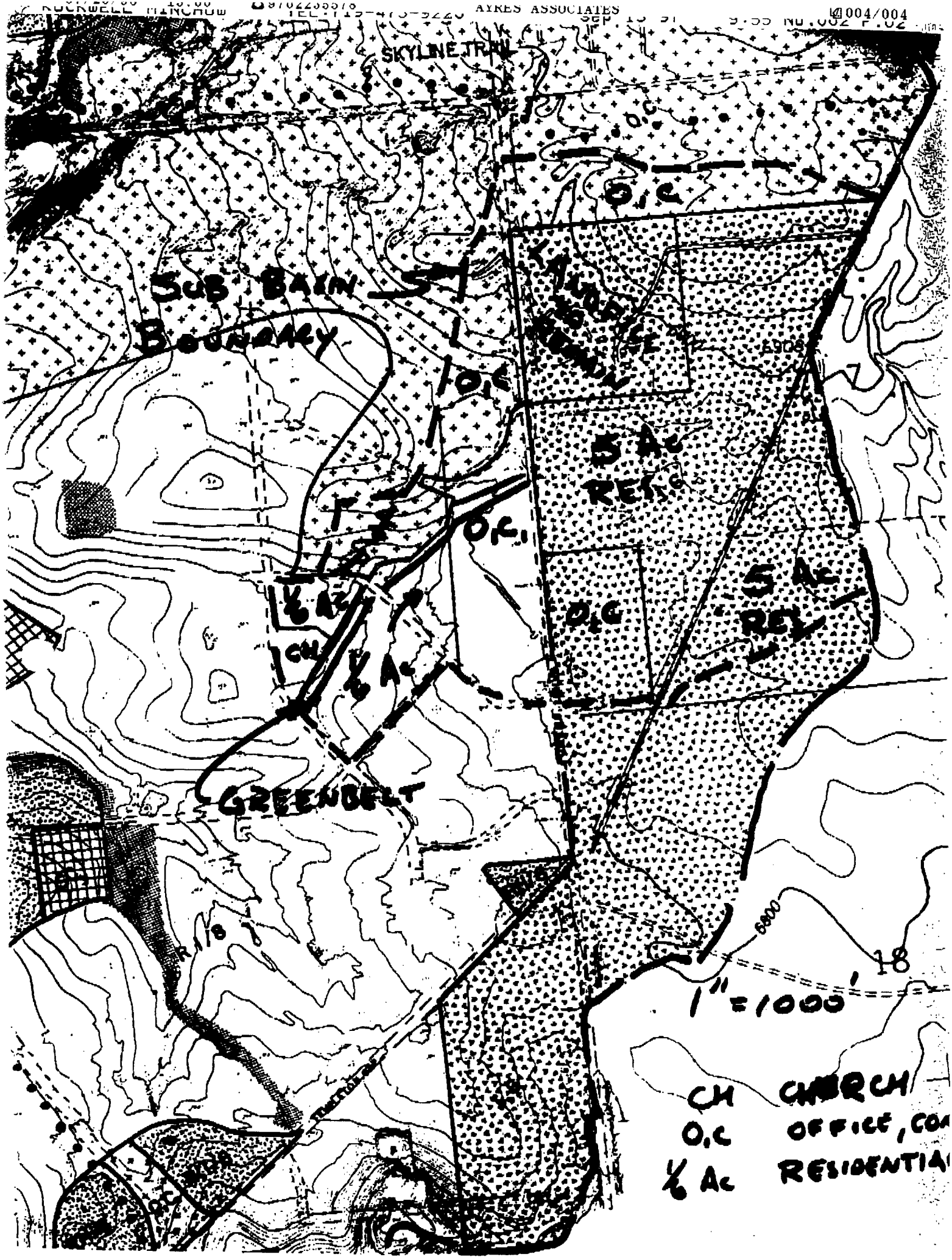
Dublin Boulevard

- 100-year discharge, HI land use = 3,643 cfs
- 50-year discharge, HI land use = 3,164 cfs
- 100-year discharge, LI land use = 3,239 cfs

- Headwater elevation required to pass discharge through existing culverts:
    1. HI land use 100-yr Q: 6630.05 (D = 20.85', HW/D = 1.90) [70 cfs overtopping]
    2. HI land use 50-yr Q: 6627.17 (D = 17.97', HW/D = 1.63)
    3. LI land use 100-yr Q: 6627.62 (D = 18.42', HW/D = 1.68)

- Headwater elevation required to pass discharge through existing culverts *and* two 5.58-feet tall pipe arch culverts situated on top of existing culverts (with 1' separation above and below existing 24" sanitary sewer):
    1. HI land use 100-yr Q: 6628.17 (D = 18.97', HW/D = 1.73)
    2. HI land use 50-yr Q: 6626.35 (D = 17.15', HW/D = 1.56)
    3. LI land use 100-yr Q: 6626.63 (D = 17.43', HW/D = 1.59)

- Headwater elevation required to pass discharge through existing culverts *and* two 5.58-feet tall pipe arch culverts situated adjacent to existing culverts under the existing 24" sanitary sewer (match crown elevation of pipe sets):
    1. HI land use 100-yr Q: 6624.61 (D = 15.41', HW/D = 1.40)
    2. HI land use 50-yr Q: 6622.77 (D = 13.57', HW/D = 1.23)
    3. LI land use 100-yr Q: 6623.06 (D = 13.86', HW/D = 1.26)


SKYLINE TRAIL
SUB BASIN BOUNDARY
O,C
5 Ac RES
½ Ac
GREENBELT
6900
1" = 1000'
CH CHURCH
O,C OFFICE, CO
½ Ac RESIDENTIA

AYRES ASSOCIATES

MEMORANDUM

To: Kent Rockwell, Rockwell Minchow Consultants, Inc.

From: Scott Queen, Ayres Associates SQ

Date: August 13, 1998

Re: Culvert hydraulics for culvert under Dublin Blvd. approx. 350' east of Rangewood Blvd.

Kent,

This memo summarizes the results of our hydraulic analysis for the above-referenced culvert. We used HY-8 (Federal Highways Administration) to perform the analysis. Tailwater conditions were provided from HEC-2 analyses of the channel downstream of the culvert. The 100-yr discharge was obtained from our Cottonwood Creek Drainage Basin Planning Study (Ayres, 1996).

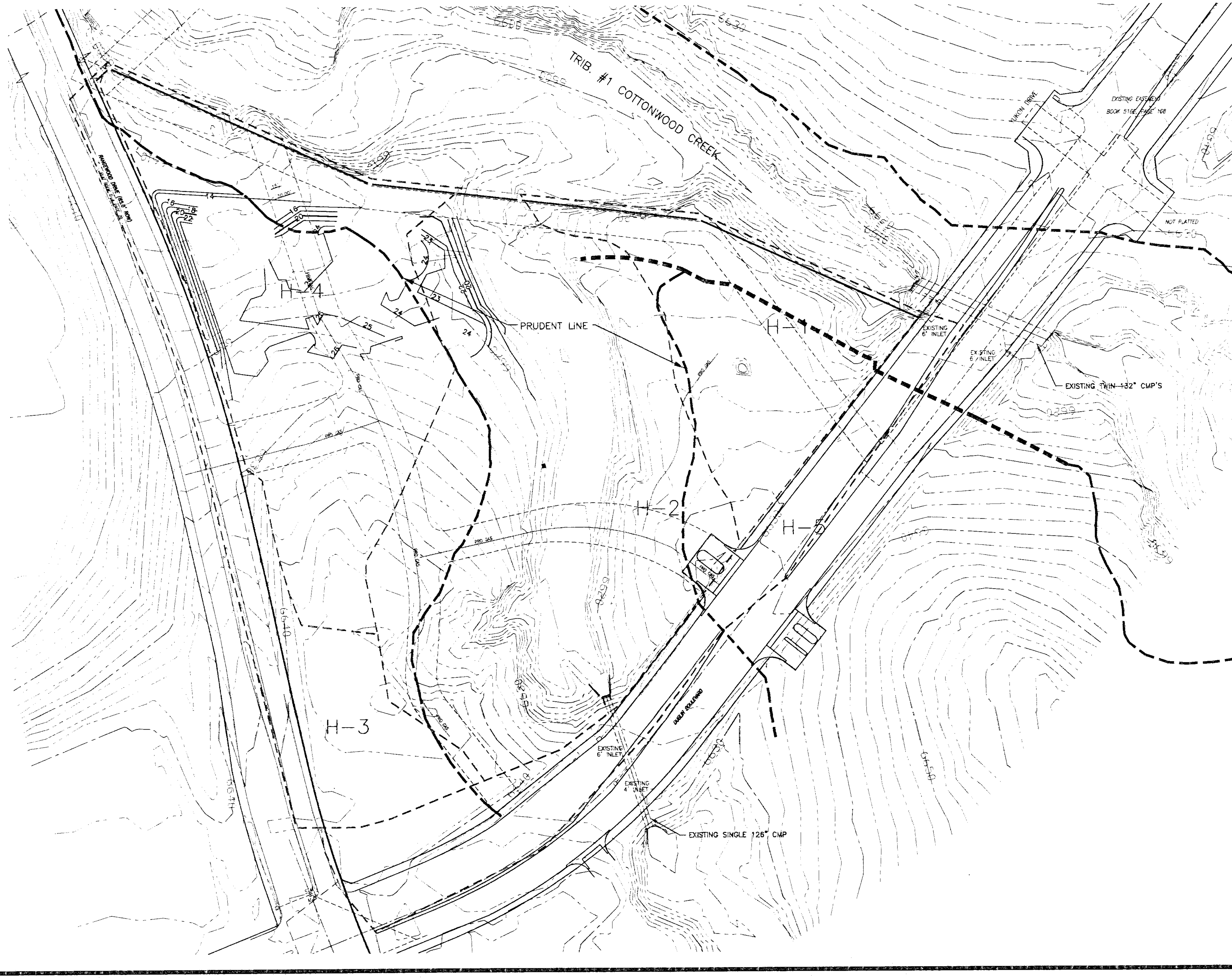
Following is a summary of the pertinent information:

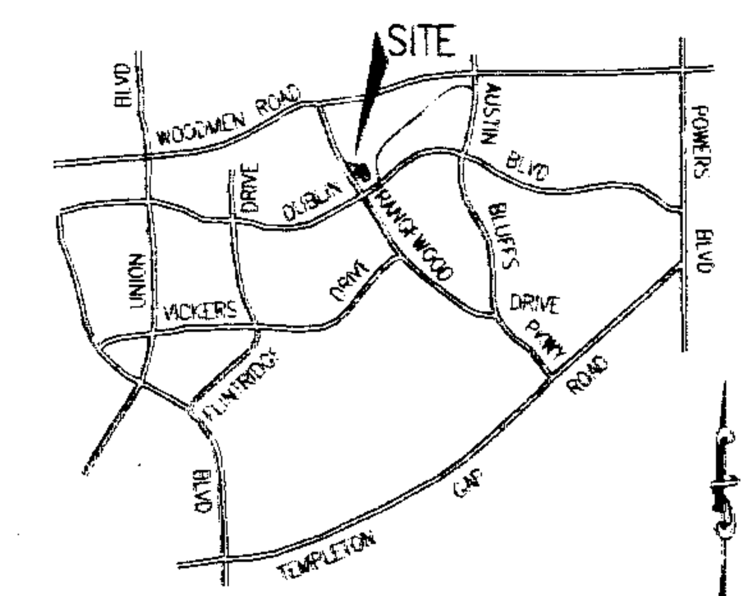
- Culvert diameter: 10.5' CMP
- Q_{100} = 849 cfs
- Culvert invert elevation: 6618.90
- 100-yr water surface elevation at culvert entrance: 6629.61
- Back of Curb elevation: ~6636.70
- Headwater Depth: 10.71'
- HW/D ratio: 1.02

I hope this is all of the information you needed. If not, please contact me at your earliest convenience.

COTTONWOOD COMMONS

HISTORIC DRAINAGE PLAN





Vicinity Map

NOT TO SCALE

LEGEND

6100	EXISTING CONTOURS
	BASIN BOUNDARIES
H-1	BASIN DESIGNATOR, BASIN AREA (ACRES), Q_5 / Q_{100} (CFS)
DP #1	DESIGN POINT
	DIRECTION OF FLOW

SUMMARY TABLE

BASIN	AREA (Ac)	Q5 (cfs)	Q100 (cfs)
H-1	1.97	1.6	4.2
H-2	5.39	6.0	15.3
H-3	1.98	3.4	6.9
H-4	3.71	3.1	8.0
H-5	1.90	3.9	7.7

1" = 60'

0 15 30 60 120

Scale in Feet

FILE: 97090DEV.DWG 10/14/98

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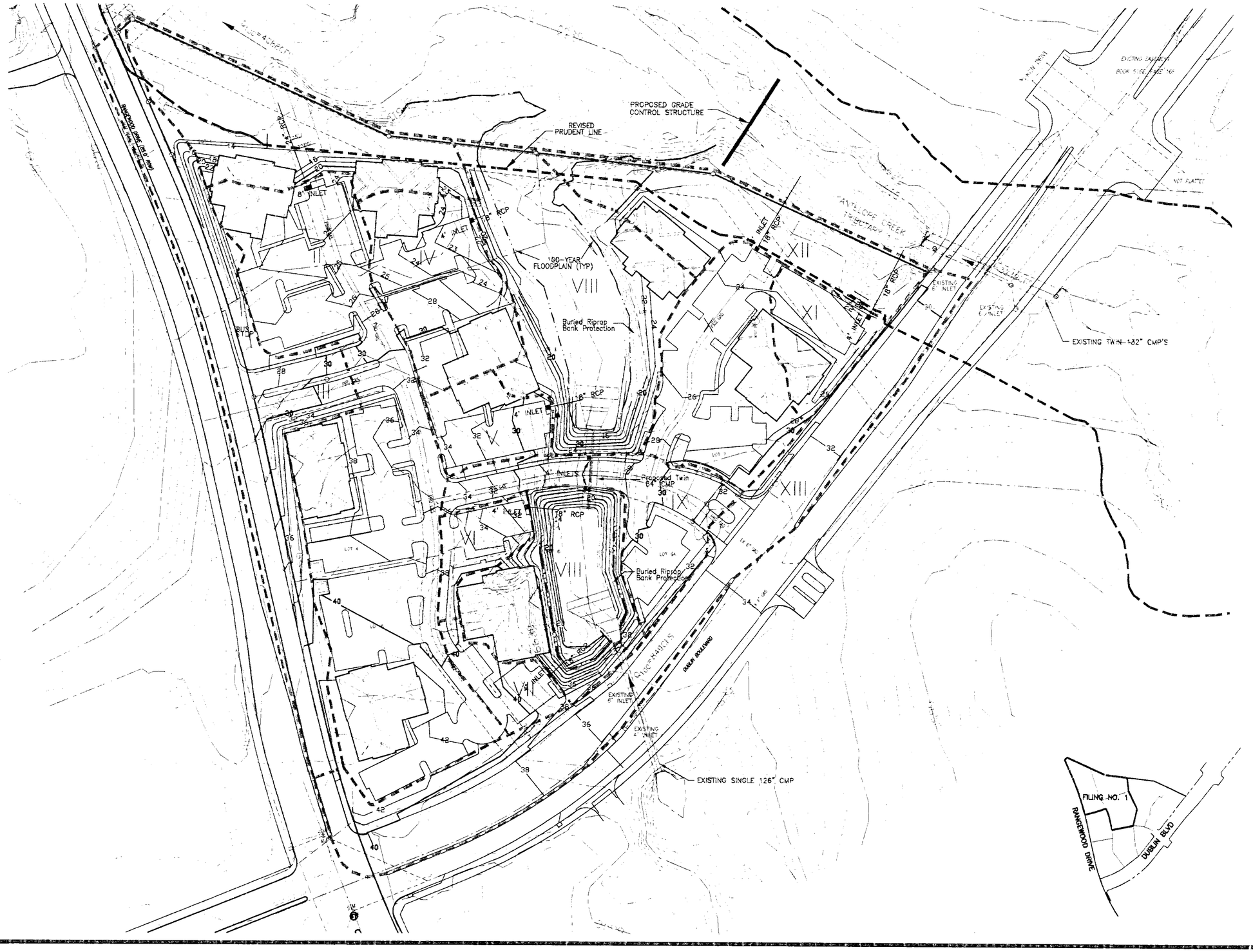
COLORADO SPRINGS, CO 80907
(719) 475-2575 • FAX (719) 475-9223

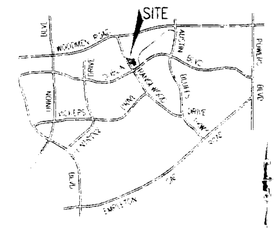
TITLE: COTTONWOOD COMMONS HISTORIC DRAINAGE PLAN

SCALE: 1"=60'	DRAWN BY: FC	97-090
DATE: 10/14/98	CHECKED BY: KDR	JOB NO.

COTTONWOOD COMMONS

DEVELOPED DRAINAGE PLAN





Vicinity Map

NOT TO SCALE

LEGEND

- EXISTING CONTOURS
- BASIN BOUNDARIES
- D-1 — BASIN DESIGNATION, BASIN AREA (ACRES), Q100 (CFS), Tc (MIN.)
- DP #1 — DESIGN POINT
- PROPOSED CONTOURS
- DIRECTION OF FLOW
- PROPOSED INLET

SUMMARY TABLE

BASIN	AREA (AC)	Q100 (CFS)	Tc (MIN.)
I			
II			
III			
IV			
V			
VI			
VII			
VIII			
IX			
XI			
XII			
XIII			

1" = 60'

0 15 30 60 120

Scale in Feet

NOT TO BE USED FOR CONSTRUCTION PURPOSES.

FILE: 97090dm DWG: 10/15/98

ROCKWELL MINCHOW CONSULTANTS, INC.

ENGINEERING • SURVEYING
5908 TTHAY LANE, SUITE A-12
COLORADO SPRINGS, CO 80907
(719) 475-2575 • FAX (719) 475-2571

TITLE:	COTTONWOOD COMMONS DEVELOPED DRAINAGE PLAN		
SCALE:	1"=60'	DRAWN BY: FC	97-090
DATE:	10/15/98	CHECKED BY: KDR	JOB NO.