



**J·R ENGINEERING**  
A Subsidiary of Westrian

**PRELIMINARY/FINAL DRAINAGE REPORT  
FOR  
RESEARCH PARKWAY  
(SCARBOROUGH DR. TO POWERS BLVD.)  
INCLUDING  
RESEARCH PARKWAY SUB. FILING No. 6**

January 2000

Prepared For:  
**LP47, LLC**  
**dba LA PLATA INVESTMENTS**  
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Job No. 8715.00

**FINAL DRAINAGE REPORT  
FOR  
RESEARCH PARKWAY  
(SCARBOROUGH DR. TO POWERS BLVD.)  
INCLUDING RESEARCH PARKWAY SUB. FILING No. 6**

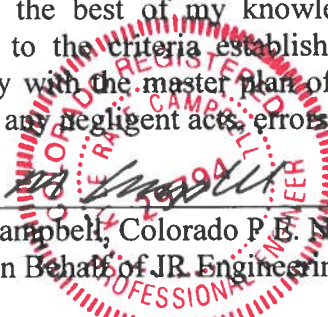


**J·R ENGINEERING**  
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**DRAINAGE REPORT STATEMENT**

**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 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.

  
*Kyle R. Campbell*  
Kyle R. Campbell, Colorado P.E. No. 29794  
For and On Behalf of JR Engineering

3/16/00  
Date

**DEVELOPER'S STATEMENT:**

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

Business Name: LP47, LLC  
dba La Plata Investments

By: *Bob Ingels*  
Bob Ingels

Title: Director of Land Development

Address: 2315 Briargate Parkway, Suite 100  
Colorado Springs, CO 80920

**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.

*Tim [Signature]*  
City Engineer

April 27, 2000  
Date

Conditions:

**FINAL DRAINAGE REPORT  
FOR  
RESEARCH PARKWAY  
(SCARBOROUGH DR. TO POWERS BLVD.)  
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**FINAL DRAINAGE  
FOR  
RESEARCH PARKWAY  
(SCARBOROUGH DR. TO POWERS BLVD.)  
INCLUDING RESEARCH PARKWAY SUB. FILING No. 6**

**PURPOSE**

This is the Final Drainage Report for the portion of Research Parkway that extends east from the intersection with Scarborough Drive to the east side of the proposed intersection with Powers Boulevard. The purpose of this report is to identify existing and future developed condition drainage patterns within and in the upstream watershed adjacent to the subject portion of Research Parkway and to identify the drainage infrastructure that is required in the subject portion of street to safely route storm water runoff to adequate outfall facilities.

**GENERAL DESCRIPTION**

The included portion of Research Parkway is located within the Cottonwood Creek Drainage Basin. It extends between the northeast corner of Section 2, Township 13 South, and ends in the southeast quarter of Section 36, Township 12 South, Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso, State of Colorado.

The site is bounded on the west by the intersection with Scarborough Drive, on the north by unplatted land and future Powers Boulevard, on the south by Fairfax at Briargate Filing No. 12, unplatted land, Channel Drive and future Powers Boulevard, on the east by future Research Parkway beyond Powers Boulevard.

Street and drainage improvements have been completed in the western half of the subject area. Curb and gutter and asphalt paving have been completed between Scarborough Drive and the east side of the Channel Drive intersection. Existing drainage improvements within the subject area include: a two cell, 10' x 8' box culvert at Fairfax Channel, a 30" diameter storm drain between Scarborough Drive and the existing box culvert, two curb inlets located in the low point of the street over the existing box culvert, one curb inlet in the east bound lanes between the box

culvert and Scarborough Drive, and a 42" diameter R.C.P. storm drain between the box culvert and the eastern limit of the existing paving improvements.

## **EXISTING DRAINAGE CONDITIONS**

As indicated in the previous section, drainage and paving improvements have been constructed in the western half of the subject area. These improvements accept both surface and storm drain flow generated in an area located north and west of the intersection of Research Parkway and Scarborough Drive.

This upstream area was studied in the "Drainage Report and Plan for Research Parkway Subdivision Filing No. 5", by Leigh Whitehead and Associates, dated March 1986. According to the Whitehead report, surface flows in the westbound lanes of Research Parkway at the eastern side of the Scarborough intersection are estimated at  $Q_5 = 6.7\text{cfs}$  and  $Q_{100} = 51.5\text{cfs}$ . The Whitehead Report indicates that the eastbound lanes of Research Parkway will not receive runoff from upstream of the Scarborough intersection. The Whitehead report also indicates that the existing 30" storm drain will convey peak flow rates of  $Q_5 = 37.1\text{cfs}$  and  $Q_{100} = 39.4\text{cfs}$  as it leaves the intersection with Scarborough Drive. The flow rates were estimated by use of the SCS Method. The flow rates were converted to CA equivalent values with times of concentration of 14.3 minutes for compatible use in the current analysis (see appendix ). The equivalent CA values used are  $CA_5 = 1.91$ ,  $CA_{100} = 8.73$  for surface flow,  $CA_5 = 10.6$ ,  $CA_{100} = 6.68$  for storm drain flow.

The surface flows from the Scarborough Dr. intersection are conveyed in the westbound lanes of Research Parkway along with the flow from the westbound lanes (a portion of Basin 8) to an existing 20' long inlet at Design Point DP-3, constructed in a sump condition, located above and connected to the existing Fairfax Channel box culvert. Storm drain flows from the Scarborough Drive intersection are conveyed through the existing 30" storm drain along with nuisance flows picked up by an existing inlet placed along the high side of the super elevated east bound lanes to the existing Fairfax Channel box culvert. The surface flows generated on the constructed portion

of the super elevated eastbound lanes (Basin 7) is conveyed along the median curb to an existing 5' long inlet at Design Point DP-2, located above and connected to the existing Fairfax Channel box culvert.

East of the intersection with Channel Drive a portion of the Research Parkway right of way has been rough graded for street construction and the south curb and gutter along the eastbound lanes has been constructed to future Powers Boulevard. Flow generated on and intercepted by this portion of the subject area is conveyed within the future street section to the existing inlets at Design Points DP-2 and DP-3.

According to the "Soil Survey of El Paso County Area", prepared by the S.C.S. the following soils are contained on the site. The western portion of the site contains Bresser Loamy Sand and the eastern portion of the site contains Stapleton Sandy loam. Off-site contributing basins contain these two soils as well as a small area of Tructon Sandy Loam. These soils belong to the hydrological soil group "B". A copy of the area soils map is included in the appendix of this report.

The subject area was included in the "Cottonwood Creek Drainage Basin Planning Study", by URS Consultants, dated June 1994, and the "Master Development Drainage Plan for Fairfax at Briargate", by JR Engineering, dated July 1993.

### **PROPOSED DRAINAGE CHARACTERISTICS**

After construction of Research Parkway to the east side of future Powers Boulevard the portion of the subject area that is located west of the Fairfax Channel box culvert will continue to function as described in the previous section. East of the box culvert drainage patterns will be modified as described below. The off-site area that is located northeast of the subject area was analyzed in both the existing undeveloped condition and in an assumed fully developed condition in order obtain design flow rates for the facilities that will be constructed in the subject area.

### **Off-Site Interim Condition**

As shown on the plan titled "Interim Plan for Off-site Runoff" contained in the appendix of this report it is expected that the off-site area that contributes runoff to the subject area will be undeveloped at the time that the improvements within the subject area are completed. In this condition runoff from Interim Basin I-2 ( $Q_5 = 10$  cfs,  $Q_{100} = 23$  cfs) will be diverted into Interim Basin I-1 ( $Q_5 = 34$  cfs,  $Q_{100} = 75$  cfs). The combined peak rates from these Interim Basins are estimated to be  $Q_5 = 41$  cfs and  $Q_{100} = 91$  cfs. This flow will be collected by a temporary berm to be located at the northeast corner of the Research Parkway/Powers Boulevard intersection. A temporary 42" storm drain will be constructed to convey this flow from the berm to the proposed permanent 54" diameter storm drain to be constructed in Research Parkway. The intercepted flow will then be conveyed through the proposed 54" diameter storm drain to the existing Fairfax Channel box culvert. This flow is substantially less than the flow that the storm drain will be designed for so a full routing of this flow to the box culvert was not performed. In the interim, condition runoff from Interim Basin I-3 will sheet flow to the westbound lanes of Research Parkway and be conveyed to the existing inlet at the Fairfax Channel box culvert.

### **Fully Developed Condition**

In the assumed fully developed condition in the watershed, flow from the area located upstream of Basins 1 and 3 (as shown on the plan titled "Fully Developed Condition" contained in the appendix of this report) will be diverted directly to the Fairfax Channel and will not impact the subject area. This diversion is in accordance with the approved "MDDP for Fairfax at Briargate", by JR Engineering, dated July 1993. It is assumed that a storm drain system will be constructed in Research Parkway to intercept runoff from Basin 1 ( $Q_5 = 55$  cfs,  $Q_{100} = 110$  cfs) above Design Point SD-1 and convey it to Design Point SD-2 at the intersection with Powers Boulevard. At or near Design Point SD-2 it is assumed that runoff from Basins 2 and 3 will be collected and added to the future storm drain in Research Parkway. The estimated peak flow rates in the storm drain at Analysis Point SD-2 are  $Q_5 = 99$  cfs and  $Q_{100} = 187$  cfs.

Design Point SD-2 represents the end of the permanent Research Parkway storm drain system that will be constructed with the subject project. The flow at Analysis Point SD-2 will be routed downstream in the 54" diameter storm drain to Analysis Point SD-3. The "MDDP for Fairfax at Briargate" assumed that runoff from a 16.5 acre basin located south and east of the Research Parkway/Powers Boulevard intersection would also be added to the proposed Research Parkway storm drain at this point. Due to changes in the proposed vertical alignment of future Powers Boulevard this is not practical. Runoff from the area south of Research Parkway will be conveyed directly to Cottonwood Creek in drainage conveyances to be located in the Powers Boulevard corridor. Analysis of the area south of Research Parkway and adjacent to Powers Boulevard will be included in a separate drainage report for Powers Boulevard.

At Design Point SD-3 runoff from Basin 4 ( $Q_5 = 10$  cfs,  $Q_{100} = 18$  cfs) will enter the 54" diameter storm drain system via an inlet in the future Powers Boulevard roadside ditch and a 24" diameter storm drain lateral. The current project will provide the lateral. The inlet will be designed and constructed with the extension of Powers Boulevard north of Research Parkway. The estimated peak flow rates at Design Point SD-3 are  $Q_5 = 107$  cfs and  $Q_{100} = 202$  cfs. The flow at Analysis Point SD-3 will be routed to Design Point SD-4 in the proposed 54" diameter storm drain.

At Design Point SD-4 runoff from Basin 5 ( $Q_5 = 6$  cfs,  $Q_{100} = 11$  cfs) will enter the 54" diameter storm drain system via an inlet in the future Powers Boulevard roadside ditch and a 18" diameter storm drain lateral. The current project will provide the lateral. The inlet will be designed and constructed with the extension of Powers Boulevard north of Research Parkway. The estimated peak flow rates at Design Point SD-4 are  $Q_5 = 111$  cfs and  $Q_{100} = 211$  cfs. The flow at Design Point SD-4 will be routed to Design Point SD-5 in the 54" diameter storm drain.

Runoff from Basin 6 ( $Q_5 = 5$  cfs,  $Q_{100} = 10$  cfs) will concentrate at Design Point DP-1. A proposed 6' long on-grade curb inlet placed in the median curb of the super elevated street section at this point will intercept nuisance flows and estimated peak flow rates of  $Q_5 = 3$  cfs and



$Q_{100} = 4$  cfs. Estimated peak flow rates of  $Q_5 = 2$  cfs and  $Q_{100} = 6$  cfs will flow by the proposed inlet to Design Point DP-3. The flow intercepted by the proposed inlet will be conveyed to Design Point SD-5 via a proposed 18" diameter storm drain lateral. At Design Point 5 the intercepted flow will be combined with the routed flow from Design Point SD-4 in the 54" storm drain for combined estimated peak flow rates of  $Q_5 = 111$  cfs and  $Q_{100} = 209$  cfs. The flow from Analysis Point SD-5 will be routed to an existing 42" diameter storm drain stub that extends from the existing Fairfax Channel box culvert then on to the existing box culvert in the existing 42" diameter storm drain. The existing 42" diameter stub is laid at 5.46% grade and is approximately 200' long. A portion of this stub will be removed in order to connect the proposed 54" diameter storm drain at a point where the 100-year hydraulic grade line (HGL) will be maintained below the proposed finished ground surface. A copy of the preliminary HGL calculation is contained in the appendix of this report.

Runoff from Basin 7 ( $Q_5 = 7$  cfs,  $Q_{100} = 13$  cfs) will concentrate at the low point located above the Fairfax Channel box culvert (Design Point DP-2). An existing 5' long curb inlet constructed in the median curb of the super elevated street section at this point will intercept the estimated peak flow from Basin 7. The existing inlet is connected directly to the Fairfax Channel box culvert. Thus, the flow from Basin 7 will be released directly to Fairfax Channel.

Runoff from Basin 8 ( $Q_5 = 15$  cfs,  $Q_{100} = 29$  cfs) will concentrate at the low point located above the Fairfax Channel box culvert (Design Point DP-3). Surface flow from the Scarborough Drive/Research Parkway intersection ( $Q_5 = 6.7$  cfs,  $Q_{100} = 51.5$  cfs) as well as the flow-by from Design Point DP-2 will also concentrate at Design Point DP3. The combined estimated flow rates at Design Point DP-3 will be  $Q_5 = 18$  cfs and  $Q_{100} = 72$  cfs. An existing 20' long curb inlet constructed in the outside curb of the super-elevated street section at this point will intercept this flow. The existing inlet is connected directly to the Fairfax Channel box culvert. Thus, the flow will be released directly to Fairfax Channel. The inlet capacity calculation performed for this report indicates that the ponding depth above normal flow line will be 1.2' when the 100-year peak flow rate is present. It is recommended that the adjacent sidewalk be constructed 1.2'

above the normal flow line of the street to prevent the flow from leaving the street section and eroding adjacent slopes.

As described in the "Existing Drainage Condition" section of this report estimated peak flow rates of  $Q_5 = 37.1$  cfs and  $Q_{100} = 39.4$  cfs will be conveyed in an existing 30" storm drain from the Scarborough Drive/Research Parkway intersection to the existing Fairfax Channel box culvert. Design Point DP-4 represents the estimated combined peak flow rate ( $Q_5 = 169$  cfs,  $Q_{100} = 325$  cfs) from all of the runoff planned to enter the Fairfax Channel within the Research Parkway right-of-way.

### **HYDROLOGIC CALCULATIONS**

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

### **HYDRAULIC CALCULATIONS**

Storm drain flow were analyzed using Mannings Equation in Flow Master V5.10, Software by Haestad Methods, Inc. and a spreadsheet HGL calculation. Copies of the data sheets are included in the appendix of this report.

### **EROSION CONTROL PLAN**

The City of Colorado Springs Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request that the Erosion Control Plan be submitted in conjunction with the Overlot Grading Plan and construction assurances be posted prior to obtaining a grading permit for the site.

## FLOODPLAIN STATEMENT

A portion of this site (the Fairfax Channel Crossing) is within a designated F.E.M.A. floodplain, as determined from Flood Insurance Rate Maps Community Panel Numbers 08041C0528 F, effective date March 17, 1997. A copy of the portion of the map showing the site is included in the appendix of this report. The existing Fairfax Channel box culvert has eliminated the physical flood hazard from the Research Parkway right-of-way.

## CONSTRUCTION COST OPINION

Proposed facilities only, Existing and future facilities omitted

<u>Item</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit Cost</u>	<u>Cost</u>
1.	18" R.C.P.	185 L.F.	\$ 30/L.F.	\$ 5,550.00
2.	24" R.C.P.	120 L.F.	\$ 40/L.F.	\$ 4,800.00
3.	54" R.C.P.	980 L.F.	\$ 110/L.F.	\$ 107,800.00
4.	42" C.M.P.	75 L.F.	\$ 50/L.F.	\$ 3,750.00
5.	42" x 54" R.C.P. Reducer	1 EACH	\$1,400/EA	\$ 1,400.00
6.	54" x 18" Tee	2 EACH	\$1,000/EA	\$ 2,000.00
7.	54" x 24" Tee	1 EACH	\$1,000/EA	\$ 1,000.00
8.	Type III Manhole	2 EACH	\$2,200/EA	\$ 4,400.00
9.	18" R.C.P. Plug	1 EACH	\$ 400/EA	\$ 400.00
10.	6' Long Inlet	1 EACH	\$ 4,000/EA	\$ 4,000.00
11.	42" C.M.P. FES	1 EACH	\$ 400/EA	\$ 400.00
			Sub-Total	\$ 135,500.00
			15% Engineering and Contingencies	\$ 20,325.00
			<b>TOTAL</b>	<b><u>\$ 155,825.00</u></b>

JR Engineering, LLC 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 design professionals familiar with the construction industry and this development in particular.

## **DRAINAGE AND BRIDGE FEES**

This area lies within Cottonwood Creek Drainage Basin. The area that the improvements proposed by this report will be constructed in will not be platted at this time. The area contained in the Final Plat for Research Parkway Subdivision Filing No. 6 is 3.738 acres.

## **SUMMARY**

Construction of the proposed improvements as outlined in this report will not adversely effect surrounding developments under the conditions assumed in this study.

PREPARED BY:

**JR Engineering**

Vancel S. Fossinger, P.E.  
Senior Project Engineer

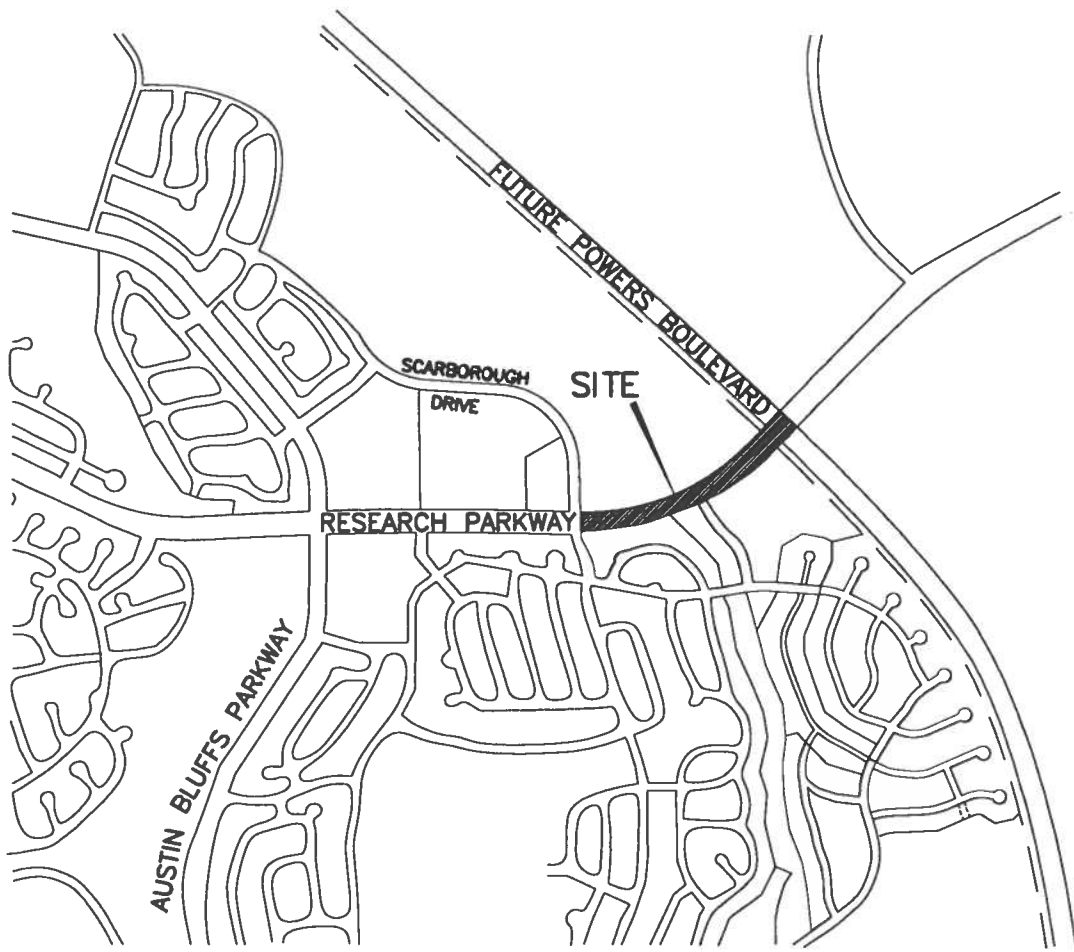
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**REFERENCES:**

1. "City of Colorado Springs/County of El Paso Drainage Criteria Manual," dated November 1991.
2. "Soils Survey of El Paso County Area", Colorado Soil Conservation Service.
3. "Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas", Federal Emergency Management Agency, revised March 17, 1997.
4. "Cottonwood Creek Drainage Basin Planning Study", by URS Consultants, dated June 1994.
5. "Master Development Drainage Plan for Fairfax at Briargate", by JR Engineering, Ltd. dated July 1993.
6. "Drainage Report and Plan for Research Parkway Subdivision Filing No. 5", by Leigh Whitehead & Associates, dated March 1986.

**APPENDIX**

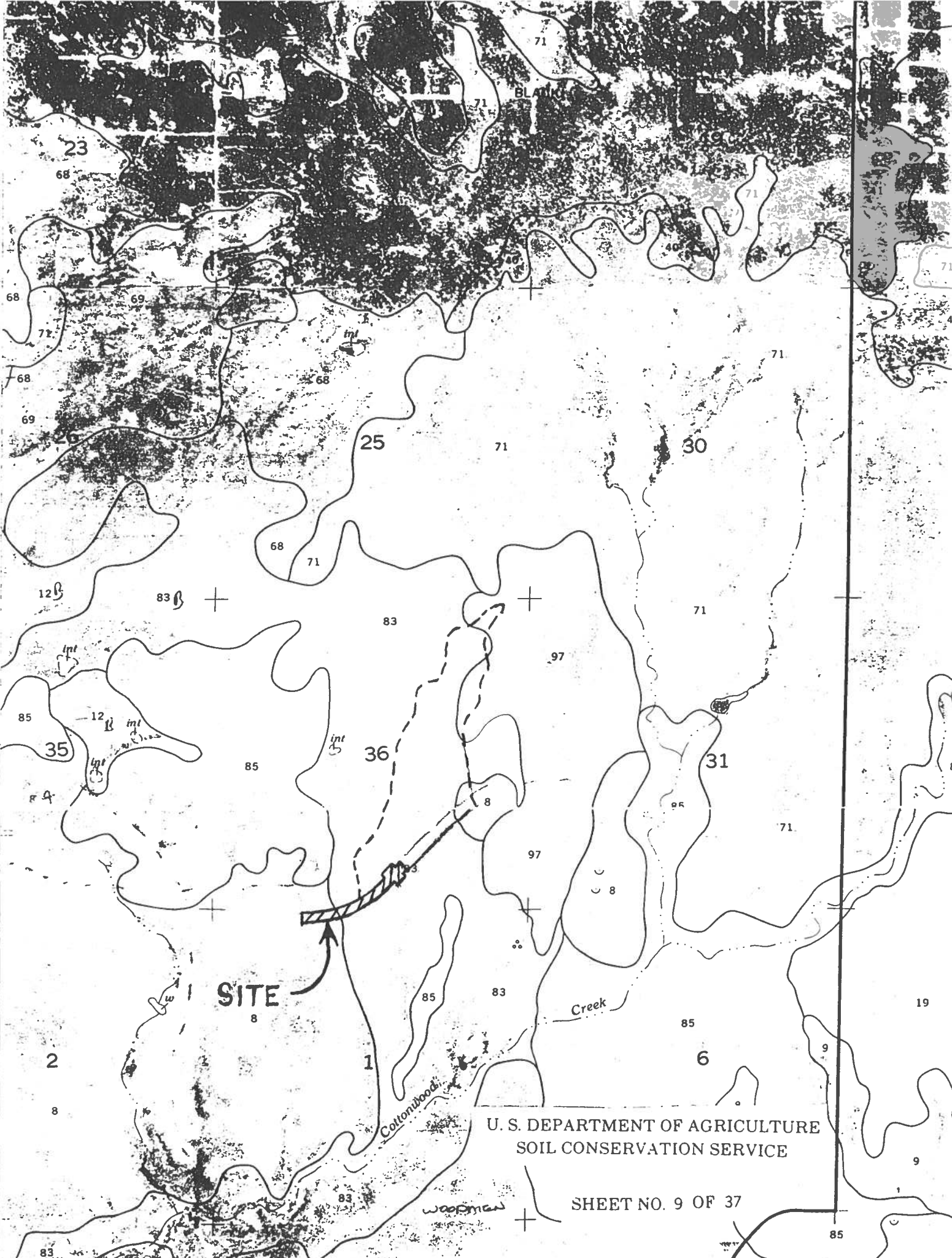
**VICINITY MAP**



VICINITY MAP  
N.T.S.



**S.C.S. MAP**



U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

SHEET NO. 9 OF 37

**F.E.M.A. FLOODPLAIN MAP**

ZONE A

SITE

CITY OF COLORADO  
080060

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO AND  
INCORPORATED AREAS

PANEL 528 OF 1300  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS CITY OF	080000	528	F
EL PASO COUNTY INCORPORATED AREAS	282000	0528	F

MAP NUMBER  
08041C0528 F

EFFECTIVE DATE:  
MARCH 17, 1997



Federal Emergency Management Agency

Fairfax Creek

1 ZONE A

ZONE X

ZONE AE

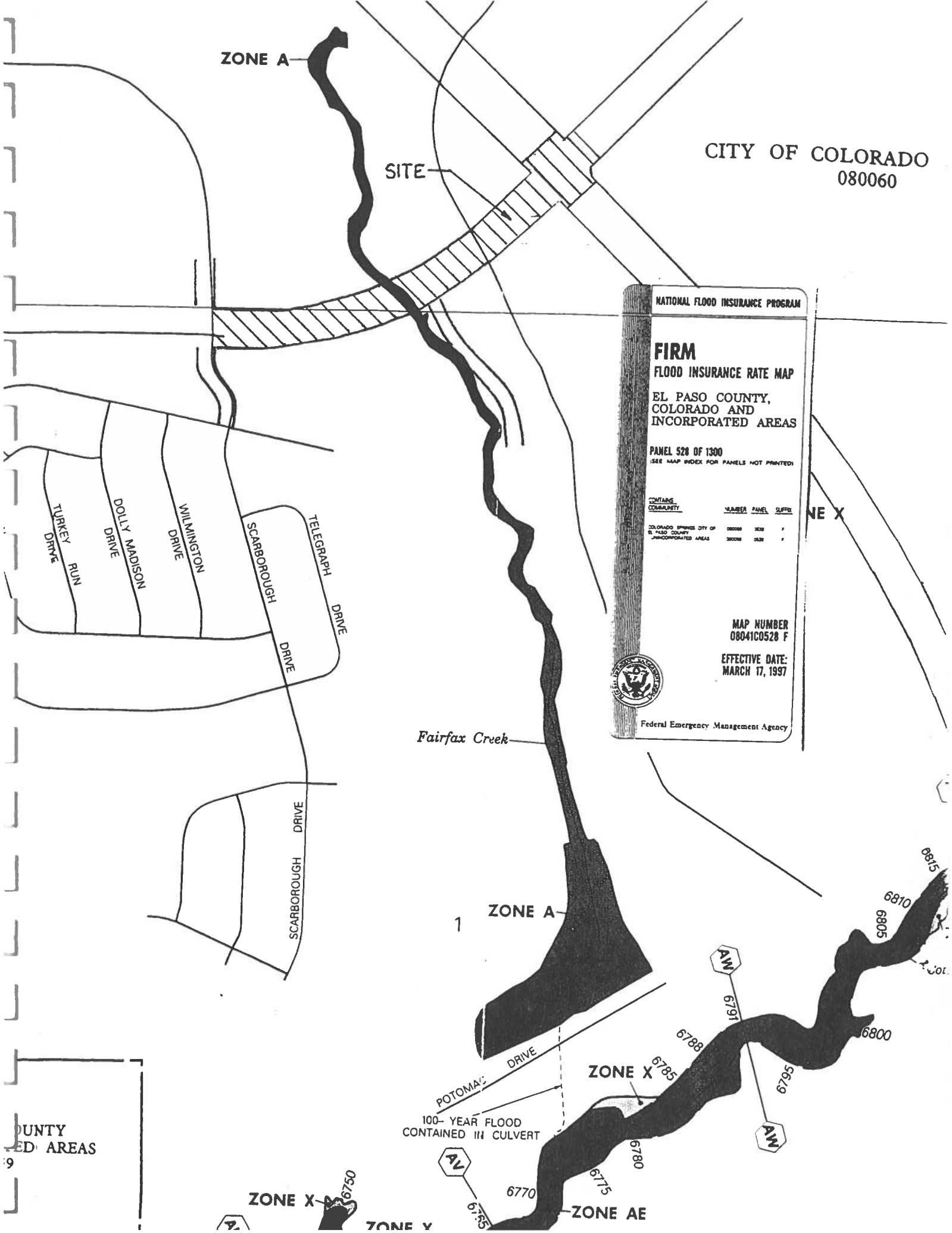
ZONE X

ZONE Y

100-YEAR FLOOD  
CONTAINED IN CULVERT

COUNTY  
BORDERED AREAS

9



**HYDROLOGIC CALCULATIONS**

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING  
RESEARCH PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Area Runoff Coefficient Summary)**

BASIN	TOTAL AREA (Acres)	RESIDENTIAL 3.5-25 DU/AC			RESIDENTIAL 2-3.5 DU/AC			ART. STREETS & COMMERCIAL			WEIGHTED	
		AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>
1	28.70	15.80	0.52	0.62	7.10	0.40	0.55	5.80	0.80	0.85	0.55	0.65
2	4.60							4.60	0.80	0.85	0.80	0.85
3	11.40	3.20	0.70	0.75				8.20	0.90	0.90	0.84	0.86
4	5.90							5.90	0.80	0.85	0.80	0.85
5	1.30							1.30	0.80	0.85	0.80	0.85
6	3.40							3.40	0.80	0.85	0.80	0.85
7	1.80							1.80	0.80	0.85	0.80	0.85

Calculated by: VSF  
 Date: 1/17/00  
 Checked by: \_\_\_\_\_

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING RESEARCH  
PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Area Drainage Summary)**

BASIN	AREA TOTAL (Acres)	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				STREET / CHANNEL FLOW				T <sub>c</sub>	INTENSITY			TOTAL FLOWS	
		C <sub>s</sub>	C <sub>100</sub>	C <sub>s</sub>	Length (ft)	Slope (%)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>1</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>1</sub> (min)	TOTAL (min)	I <sub>s</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>s</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)	
1	28.7	0.55	0.65	0.25	100	2.0	12.6	750	2.5%	5.5	2.3	800	3.0%	6.1	2.2	14.9	3.5	5.9	55	110	
																		CA=	15.79	18.66	
2	4.6	0.80	0.85	0.25	15	2.0	2.6	900	1.5%	4.3	3.5					6.1	4.7	8.5	17	33	
																		CA=	3.68	3.91	
3	11.4	0.84	0.86	0.25	25	2.5	3.7	1100	2.5%	5.5	3.3	560	2.0%	4.9	1.9	8.9	4.2	7.4	41	73	
																		CA=	9.58	9.80	
4	3.6	0.70	0.75	0.25	100	5.0	9.3	800	5.0%	7.8	1.7					11.0	3.9	6.8	9.9	18	
																		CA=	2.52	2.70	
5	2.3	0.70	0.75	0.25	100	4.0	10.1	800	4.0%	7.0	1.9					12.0	3.8	6.5	6	11	
																		CA=	1.61	1.73	
6	1.3	0.80	0.85	0.25	15	2.0	2.6	600	1.5%	4.3	2.3					5.0	5.0	9.1	5	10	
																		CA=	1.04	1.11	
7	1.7	0.80	0.85	0.25	15	2.0	2.6	700	3.4%	6.5	1.8					5.0	5.0	9.1	7	13	
																		CA=	1.36	1.45	
8	3.8	0.80	0.85	0.25	15	2.0	2.6	900	5.0%	7.8	1.9					5.0	5.0	9.1	15	29	
																		CA=	3.04	3.23	
<b>TOTAL</b>	57.4																				

Calculated by: VSF  
Date: 1/15/00

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING RESEARCH  
PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Surface Routing Summary)**

DESIGN POINTS	CONTRIBUTING BASINS AND DESIGN POINTS	CA EQUIVALENT		Initial Tc	ROUTING				Tc	INTENSITY		TOTAL FLOWS	
		CA <sub>5</sub>	CA <sub>100</sub>	For Basin/ Design Pt	Length	Slope	Velocity	T <sub>i</sub>	TOTAL	I <sub>5</sub>	I <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
		* For Table 3 see Routing Summary		(min)	(ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(c.f.s.)	(c.f.s.)
DP-1	BASIN 6	1.04	1.11	5.0					5.0	5.0	9.1	5	10
	TOTAL	1.04	1.11								CA=	1.04	1.11
DP-2	BASIN 7	1.36	1.45	5.0					5.0	5.0	9.1	7	13
	TOTAL	1.36	1.45								CA=	1.36	1.45
DP-3	FLOW BY FROM INLET AT DP-1	0.51	0.73	5.0	200.0	2.0%	4.9	0.7	16.4	3.3	5.6	18	72
	FLOW FROM THE SCARBOROUGH INT	1.91	8.73	14.3	750.0	3.0%	6.1	2.1					
	FLOW FROM BASIN 8	3.04	3.23	5.0									
	TOTAL	5.46	12.69								CA=	5.46	12.69
DP-4	FLOW FROM SD-5	33.64	37.32	16.6					16.6	3.3	5.6	169	325
	FLOW FROM SD-6	10.57	6.61	15.1									
	FLOW FROM INLET AT DP-2	1.36	1.45	5.0									
	FLOW FROM INLET AT DP-3	5.46	12.69	16.4									
	TOTAL	51.03	58.07								CA=	51.03	58.07

Calculated by: VSF  
Date: 1/15/00



**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING RESEARCH  
PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Storm Drain Routing Summary)**

DESIGN POINTS	CONTRIBUTING BASINS AND DESIGN POINTS	CA EQUIVALENT		Initial Tc For Basin/ Design Pt (min)	ROUTING				Tc TOTAL (min)	INTENSITY		TOTAL FLOWS	
		CA <sub>5</sub>	CA <sub>100</sub>		Length (ft)	Slope (%)	Velocity (fps)	T <sub>t</sub> (min)		I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
		* For Values See Runoff Summary											
SD-1	BASIN 1	15.79	18.66	14.9					14.9	3.5	5.9	55	110
	TOTAL	15.79	18.66								CA=	15.79	18.66
SD-2	SD-1	15.79	18.66	14.9	600.0	3.2%	15.0	0.7	15.6	3.4	5.8	99	187
	BASIN 2	3.68	3.91										
	BASIN 3	9.58	9.80										
	TOTAL	29.05	32.37								CA=	29.05	32.37
SD-3	SD-2	29.05	32.37	15.6	120.0	3.2%	15.0	0.1	15.7	3.4	5.8	107	202
	BASIN 4	2.52	2.70										
	TOTAL	31.57	35.07								CA=	31.57	35.07
SD-4	SD-3	31.57	35.07	15.7	180.0	3.2%	15.0	0.2	15.9	3.4	5.7	112	211
	BASIN 5	1.61	1.73										
	TOTAL	33.18	36.80										
SD-5	SD-4	33.18	36.80	15.9	600.0	1.5%	15.0	0.7	16.6	3.3	5.6	111	209
	FLOW FROM INLET @DPI	0.33	0.40										
	TOTAL	33.51	37.20										
SD-6	FLOW FROM SCARBOROUGH	10.60	6.68	14.3	750.0	3.0%	16	0.8	15.1	3.5	5.9	37	39

Calculated by: VSF  
Date: 1/15/00

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING RESEARCH  
PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Area Drainage Summary)**

BASIN	AREA TOTAL (Acres)	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS	
		C <sub>s</sub>	C <sub>100</sub>	C <sub>s</sub>	Length (ft)	Slope (%)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>1</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>1</sub> (min)	TOTAL (min)	I <sub>s</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>s</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)	
I-1	67.8	0.25	0.35	0.25	300	2.0	21.9	3800	3.1%	2.8	22.6					44.5	2.0	3.2	34	75	
																			CA=	16.95	23.73
I-2	16.7	0.25	0.35	0.25	300	3.6	18.0	2350	3.0%	2.8	14.0					32.0	2.4	3.9	10	23	
																			CA=	4.18	5.85
I-3	9.0	0.25	0.35	0.25	300	4.6	16.6	700	3.7%	3.0	3.9					20.5	3.0	5.0	7	16	
																			CA=	2.25	3.15

Calculated by: VSF  
Date: 1/18/00

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING RESEARCH  
PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Surface Routing Summary)**

DESIGN POINTS	CONTRIBUTING BASINS AND DESIGN POINTS	CA EQUIVALENT		Initial Tc	ROUTING				Tc	INTENSITY		TOTAL FLOWS	
		CA <sub>5</sub>	CA <sub>100</sub>	For Basin/ Design Pt	Length	Slope	Velocity	T <sub>1</sub>	TOTAL	I <sub>5</sub>	I <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
		* For Table 1 See Routing Summary		(min)	(ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(c.f.s.)	(c.f.s.)
DP-11	BASIN I1	16.95	23.73	44.5	500.0	3.2%	3.9	2.1	46.6	1.9	3.1	41	91
	BASIN I2	4.18	5.85	32.0									
	TOTAL	21.13	29.58								CA=	21.13	29.58

Calculated by: VSF  
Date: 1/15/00

PROJECT Research/Powers BY ZSF CHK. BY \_\_\_\_\_ DATE 1-15-2000  
 SUBJECT 'K' + Equivilent 'CA' for runoff from SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_  
NW of Research; Scarborough

\* Drainage Report & Plan for Research Parkway Sub Filing No. 5 Calculated flow rates in to the onsite area from the intersection of Research + Scarborough. These calculations were done with scs method. Estimated peak flow rates were  $Q_5 = 43.8 \text{ cfs}$   $Q_{100} = 90.9 \text{ cfs}$  from 20.65 ac

\* The Tc used was 0.16 hrs. = 9.6 min in the SCS calculation

\* Check this Tc for consistency with runoff calculation done for other basins in the current analysis

\* Longest Flow path will originate on - Medium to High Residential area. Assume overland flow @ 3% for 100' over  $C_5 = 0.25$

$$\text{Overland } T_T = 1.87(1.1 - C_{10})L^{0.5} = 11.1$$

Remaining flow path is  $\approx 1200 \text{ LF}$  @ avg 3.2%

$$T_T = (1200 \div 6.3) \div 60 = 3.2 \text{ min}$$

$$* T_c = 11.1 + 3.2 = 14.3 \text{ min}$$

$$* T_c = 14.3 \text{ min Per CSDM } I_5 = 3.5 \quad I_{100} = 5.9$$

\* This would imply C values of

$$C_{100} = Q_{100} \div A \div I_{100} = 90.9 \div 20.65 \div 5.9 = 0.75$$

$$C_5 = Q_5 \div A \div I_5 = 43.8 \div 20.65 \div 3.5 = 0.61$$

The implied 'C' values look reasonable for medium to high residential areas

Use  $T_c = 14.3$

Equivilent CA values for the offsite flow are:

$$CA_{100} = 90.9 \div 5.9 = 15.36$$

$$CA_5 = 43.8 \div 3.5 = 12.51$$

In the street

$$CA_{100} = 51.5 \div 5.9 = 8.73$$

$$CA_5 = 6.7 \div 3.5 = 1.91$$

In the SD

$$CA_{100} = 39.4 \div 5.9 = 6.68$$

$$CA_5 = 37.1 \div 3.5 = 10.60$$

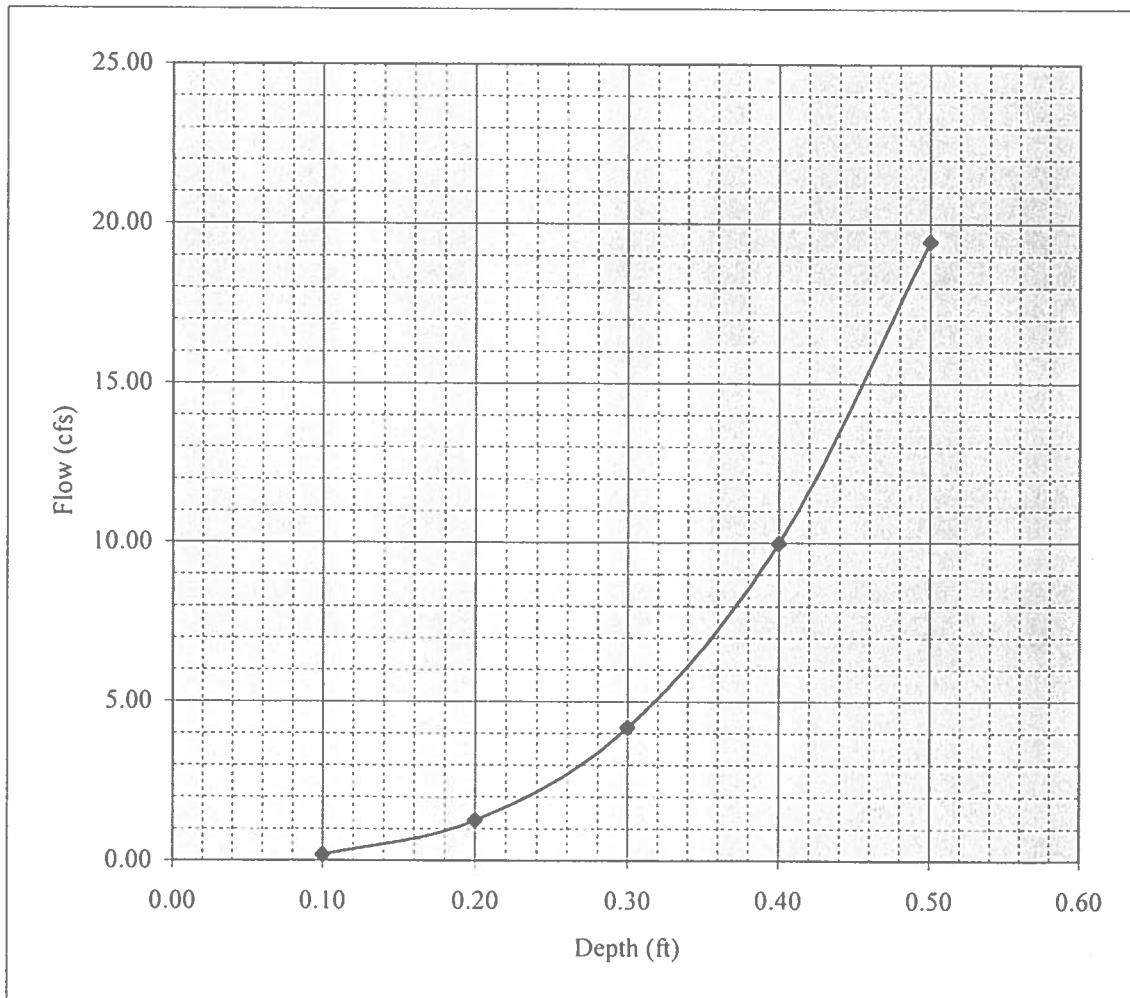
**HYDRAULIC CALCULATIONS**

**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING  
RESEARCH PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Inlet Calculations - At-Grade)**

$Q = 0.56 (z/n) d^{(8/3)} s^{(1/2)}$   
slope (s) = 0.015 ft/ft

z = 1/s                      zA = 16  
nb = 0.013                zB = 40  
na = 0.016

Total Depth dT (ft)	Depth of A dA (ft)	Depth of B dB (ft)	Depth of C dC (ft)	Flow Q (cfs)
0.10	----	0.10 <sup>8/3</sup>		0.18
0.20	0.07 <sup>8/3</sup>	0.20 <sup>8/3</sup> - 0.07 <sup>8/3</sup>		1.26
0.30	0.17 <sup>8/3</sup>	0.30 <sup>8/3</sup> - 0.17 <sup>8/3</sup>		4.18
0.40	0.27 <sup>8/3</sup>	0.40 <sup>8/3</sup> - 0.27 <sup>8/3</sup>		9.98
0.50	0.37 <sup>8/3</sup>	0.50 <sup>8/3</sup> - 0.37 <sup>8/3</sup>		19.44



**RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.) INCLUDING  
RESEARCH PARKWAY SUB. FILING No. 6  
PRELIMINARY/FINAL DRAINAGE REPORT  
(Inlet Calculations - At-Grade)**

**Proposed 6' Type D-10-R Inlet at DP-1**

<b>100-YR. FLOW</b>					
Q(100)	10	I(100)	9.1		
DEPTH	0.40	Fr	1.63	Inlet size ? L(i) =	6
SPREAD	13.5	L(1)	18.1	If Li < L(2) then Qi =	3
CROSS SLOPE	2.5%	L(2)	11.4	If Li > L(2) then Qi =	5
STREET SLOPE	1.5%	L(3)	36.3	FB =	7
				CA(eqv.)=	0.73

<b>5-YR. FLOW</b>					
Q(5)	5	I(5)	5.0		
DEPTH	0.32	Fr	1.53	Inlet size ? L(i) =	6
SPREAD	9.8	L(1)	12.2	If Li < L(2) then Qi =	2
CROSS SLOPE	2.5%	L(2)	7.7	If Li > L(2) then Qi =	3
STREET SLOPE	1.5%	L(3)	24.5	FB =	3
				CA(eqv.)=	0.51

**RESEARCH PARKWAY (SCARBOROUGH DR. TO  
 POWERS BLVD.) INCLUDING RESEARCH PARKWAY  
 SUB. FILING No. 6  
 PRELIMINARY/FINAL DRAINAGE REPORT  
 (Inlet Calculations - Sump Condition)**

*Design Point DP-3*

<b>Total Flow:</b>	$Q_5$	=	18 cfs
	$Q_{100}$	=	72 cfs
 <b>Ponding depth at sump:</b>			
	$D_5$	=	0.43
	$D_{100}$	=	1.20
	$Q_i$	=	$1.7(L_i + 1.8(W))(d_{max} + w/12)^{1.85}$
	Clogging Factor	=	1.25
	$L_i (1.25)$	=	Length of inlet opening
<b>5-Year Event:</b>	20		foot inlet constructed
<b>100-Year Event:</b>	20		foot inlet constructed

Calculated by: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Checked by: \_\_\_\_\_



**RESEARCH PARKWAY (SCARBOROUGH DR. TO  
 POWERS BLVD.) INCLUDING RESEARCH PARKWAY  
 SUB. FILING No. 6  
 PRELIMINARY/FINAL DRAINAGE REPORT  
 (Inlet Calculations - Sump Condition)**

*Design Point DP-2*

<b>Total Flow:</b>	$Q_5$	=	7	cfs
	$Q_{100}$	=	13	cfs
 <b>Ponding depth at sump:</b>				
	$D_5$	=	0.40	
	$D_{100}$	=	0.63	
	$Q_i$	=	$1.7(L_i + 1.8(W))(d_{max} + w/12)^{1.85}$	
	Clogging Factor = 1.25			
	$L_i (1.25)$ = Length of inlet opening			
 <b>5-Year Event:</b>	 5	 	 foot inlet constructed	
 <b>100-Year Event:</b>	 5	 	 foot inlet constructed	

Calculated by: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Checked by: \_\_\_\_\_

**RESEARCH PARKWAY  
STORM DRAIN  
PRELIMINARY W/ 48" & 54" DIA RCP  
HGL CALCULATION  
1/21/00 15:38**

MANNINGS n = 0.013

STATION	PIPE SIZE (inches)	PEAK RATE (cfs)	AREA (sf)	VELOCITY (fps)	CONV. K	FRICTION SLOPE (ft/ft)	JUNCTION DATA				FRICTION LOSS (ft)	BEND LOSS (ft)	JUNCTION LOSS (ft)	M.H. LOSS (ft)	CONTRACT LOSS (ft)	TOTAL LOSS (ft)	ENERGY GRADE LINE (elevation)	VELOCITY HEAD (ft)	HYDRAULIC GRADE LINE (elevation)
							LENGTH (ft)	LATERAL SIZE (inches)	LATERAL ANGLE (degrees)	BEND LOSS K									
100	42	213	9.616	22.15	1005	0.045					0.00	0.00	0.00		0.00	899.62	7.62	892.00	
252	42	213	9.616	22.15	1005	0.045	152.00				6.83	0.00	0.00		6.83	907.92	7.62	900.30	
252	54	213	15.896	13.40	1966	0.012	0.00				0.00	0.00	0.00	0.65	0.65	908.57	2.79	905.78	
302	54	213	15.896	13.40	1966	0.012	50.00				0.59	0.00	0.00		0.59	908.16	2.79	906.37	
302	54	211	15.896	13.27	1966	0.012	0.00	18	90		0.00	0.00	0.05		0.05	909.21	2.74	906.47	
450	54	211	15.896	13.27	1966	0.012	148.00				1.71	0.00	0.00		1.71	910.91	2.74	908.18 VPI	
770	54	211	15.896	13.27	1966	0.012	320.00				3.69	0.00	0.00		3.69	917.34	2.74	914.60 VPI	
910	54	202	15.896	12.71	1966	0.011	140.00	18	90		0.00	0.00	0.23		0.23	922.77	2.51	920.26	
1090	54	202	15.896	12.71	1966	0.011	180.00				1.90	0.00	0.00		1.90	924.67	2.51	922.16	
1090	54	187	15.896	11.76	1966	0.009	0.00	24	90		0.00	0.00	0.36		0.36	925.03	2.15	922.88	
1180	54	187	15.896	11.76	1966	0.009	90.00				0.81	0.00	0.00		0.81	925.84	2.15	923.69	
1180	42	110	9.616	11.44	1005	0.012	0.00	42	45		0.00	0.00	1.20		1.20	927.04	2.03	925.01	

OUTLET TO CBC  
JUNCTION W/ 18" LATERAL  
JUNCTION W/ 24" LATERAL  
FUTURE JUNCTION UPSTREAM

**DRAINAGE MAPS**

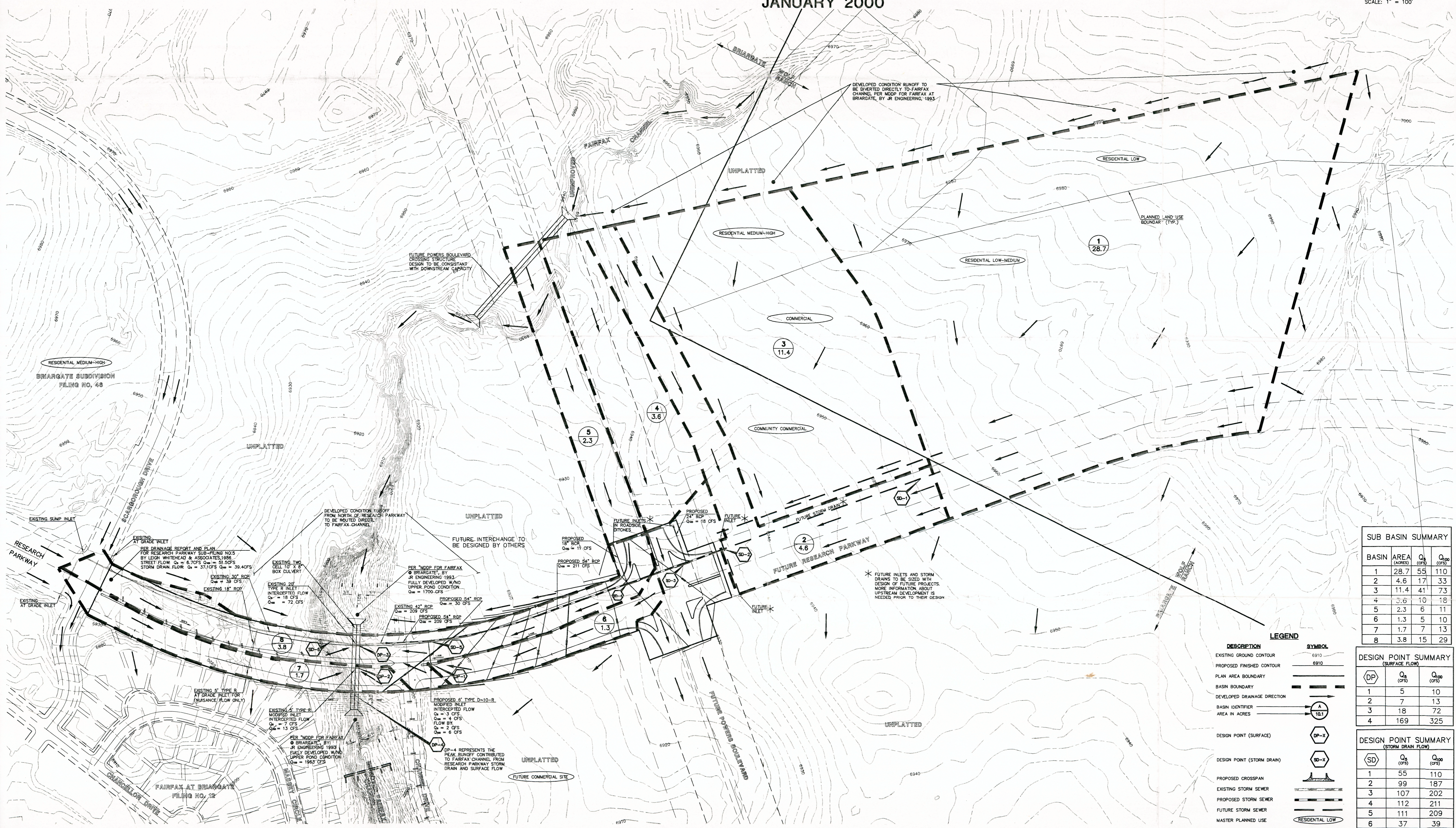
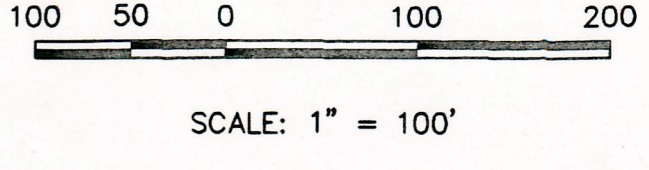
# RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.)

## INCLUDING RESEARCH PARKWAY SUBDIVISION FILING NO. 6

### PRELIMINARY/FINAL DRAINAGE PLAN

FULLY DEVELOPED CONDITION

JANUARY 2000



**SUB BASIN SUMMARY**

BASIN	AREA (ACRES)	Q <sub>5</sub> (CFS)	Q <sub>100</sub> (CFS)
1	28.7	55	110
2	4.6	17	33
3	11.4	41	73
4	3.6	10	18
5	2.3	6	11
6	1.3	5	10
7	1.7	7	13
8	3.8	15	29

**DESIGN POINT SUMMARY (SURFACE FLOW)**

DP	Q <sub>5</sub> (CFS)	Q <sub>100</sub> (CFS)
1	5	10
2	7	13
3	18	72
4	169	325

**DESIGN POINT SUMMARY (STORM DRAIN FLOW)**

SD	Q <sub>5</sub> (CFS)	Q <sub>100</sub> (CFS)
1	55	110
2	99	187
3	107	202
4	112	211
5	111	209
6	37	39

**LEGEND**

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
PLAN AREA BOUNDARY	---
BASIN BOUNDARY	---
DEVELOPED DRAINAGE DIRECTION	→
BASIN IDENTIFIER	(A)
AREA IN ACRES	(10.1)
DESIGN POINT (SURFACE)	DP-X
DESIGN POINT (STORM DRAIN)	SD-X
PROPOSED CROSSSPAN	≡
EXISTING STORM SEWER	≡
PROPOSED STORM SEWER	≡
FUTURE STORM SEWER	---
MASTER PLANNED USE	(RESIDENTIAL LOW)

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY AGENCIES, JR ENGINEERING, APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

48 HOURS BEFORE YOU DIG,  
CALL UTILITY LOCATORS  
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CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
GAS, ELECTRIC, WATER AND WASTEWATER

**JR Engineering, LLC**  
4310 ArrowsWest Drive  
Colorado Springs, CO 80907-3449  
(719) 583-2385 • FAX (719) 528-6613

NO.	DATE	REVISION	BY	DATE

RESEARCH PARKWAY (SCARBOROUGH DRIVE TO POWERS BOULEVARD) INCLUDING RESEARCH PARKWAY SUB FILING NO. 6 PRELIMINARY/FINAL DRAINAGE PLAN

SHEET 1 OF 2  
JOB NO. 8715.00

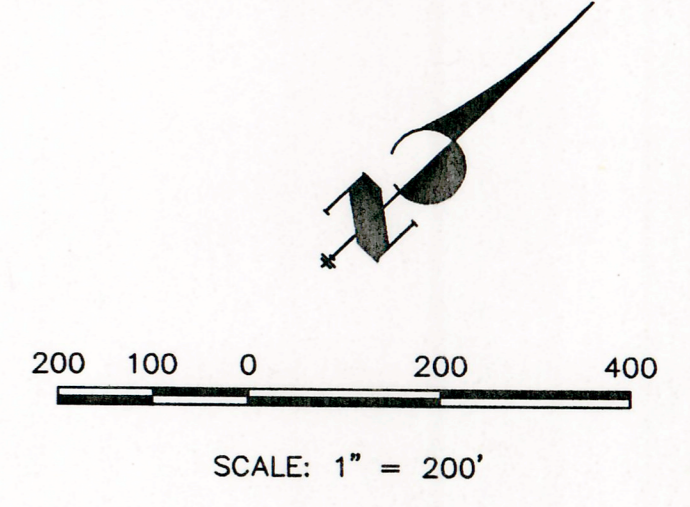
# RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.)

INCLUDING RESEARCH PARKWAY SUBDIVISION FILING NO. 6

## PRELIMINARY/FINAL DRAINAGE REPORT

INTERIM PLAN FOR OFF-SITE RUNOFF

JANUARY 2000



BASIN	AREA (ACRES)	Q <sub>5</sub> (CFS)	Q <sub>100</sub> (CFS)
1	67.8	34	75
2	16.7	10	23
3	9.0	7	16

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
SUBDIVISION BOUNDARY	---
BASIN BOUNDARY	---
DEVELOPED DRAINAGE	---
BASIN IDENTIFIER	(A) 10.1
AREA IN ACRES	(A) 10.1
EXISTING STORM SEWER	---
PROPOSED STORM SEWER	---
FUTURE STORM SEWER	---

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 4310 ArrowsWest Drive  
 Colorado Springs, CO 80907-3449  
 (719) 593-3593 • FAX (719) 528-6613

NO.	REVISION	BY	DATE

RESEARCH PARKWAY (SCARBOROUGH DR. TO POWERS BLVD.)  
 INCLUDING RESEARCH PARKWAY SUBDIVISION FILING NO. 6  
 PRELIMINARY/FINAL DRAINAGE REPORT  
 INTERIM PLAN FOR OFF-SITE RUNOFF  
 SHEET 2 OF 2  
 JOB NO. 8715.00

X:\870000-a11\871500\DRAWINGS\text\title\research-powers\ddp2.dwg Tue Jan 25 15:57:27 2000 JR Engineering

XREFS: 871500EC-DP-RP

SCANNED