

MASTER DEVELOPMENT DRAINAGE PLAN

DIGITAL EQUIPMENT CORPORATION

DRENNAN ROAD SITE
COLORADO SPRINGS, COLORADO

Prepared By:

Anderson & Hastings,
Consulting Engineers, Inc.
2059 Bryant Street
Denver, Colorado 80211

JANUARY 25, 1991

revised

MARCH 22, 1991

Purpose and Scope

The purpose of this Master Development Plan is to identify all major drainage ways and facilities within the Digital Equipment Corporation (DEC) Drennan Road Master Plan. The DEC Property is located in southeast Colorado Springs and is bounded by Drennan Road and the city limits on the south, the proposed Chelton Road extension on the west, the proposed Hancock Road extension on the north, and the Colorado Springs airport on the east. The property contains 254 acres that is currently undeveloped and covered with native grass. Slopes within the property vary between 1% and 28% with the majority of the slopes less than 5%. Elevations within the area range from 5930 to 6030 feet.

The site lies within three major drainage basins, Peterson Field, Little Johnson and Windmill Gulch which we have named Basin A, B and C respectively. All three basins have Drainage Basin Planning Studies. The Windmill Gulch study is currently being updated by Wilson and Company, and we obtained a draft copy of the Wilson study dated January 1991. Conversations with the County staff indicate this study will most likely be adopted by the County in the near future.

The northern portion of the site lies within the Peterson Field basin and drains towards the northwest corner of the property. The main channel of the Peterson Field drainage basin crosses the northwest corner of the site and a Federal Emergency Management Agency (FEMA) 100 year flood plain has been designated for this area. The Little Johnson basin lies at the southwest corner of the site and drains west towards Hancock Expressway (future Chelton Road). The Digital property forms the headwaters of the Little Johnson basin. The Windmill Gulch basin lies in the southeast portion of the site and drains south towards Drennan Road.

The majority of on site soils consists of Blakeland loamy sand, with a small amount of Truckton loamy sand located in the southwest portion of the site. (See Figure 3). The Blakeland soils are within hydrologic soils group "A" with high infiltration rates. The Truckton soils are within hydrologic soils group "B" with moderate infiltration rates. Type B soils were assumed for all drainage calculations since overlot grading will occur.

Existing Facilities

Two large concrete box culverts currently cross under Powers Boulevard near the north property line. The culverts and a concrete channel on the east side of Powers were installed after 1984 as part of the Broadway Business Park development.

The city has recently extended an earthen channel 200-300 feet to the west. According to the Peterson Field Drainage Basin Master Plan Update (August 1984) the 100 year fully developed runoff at the culverts is 2700 cubic feet per second (cfs). We understand more detention storage has been added to the Airport Master Plan and the 100 year flow rate has been reduced to 2,225 cfs on the west side of Powers. The culverts serve the main branch of the Peterson Field Basin.

Runoff from the Windmill Gulch basin is directed to a 43" x 27" inch culvert under Drennan Road. The culvert was totally plugged and runoff from major storms overtopped Drennan until the City recently opened it. No drainage facilities currently exist in the Little Johnson basin. It appears runoff is ponded on the west side of the site next to the existing Hancock Expressway where it leaches into the ground.

Proposed Public Facilities

The following facilities will be constructed as part of the Powers Boulevard extension. Three new culverts will be constructed with the first being a 5 ft. by 4 ft. concrete box under the Powers - Hancock intersection. The culvert will drain the property northeast of the site. Another culvert which serves Offsite Basin E will be installed at the low point in the highway between Hancock and Drennan. The last culvert which serves offsite basin D will be provided under the Powers - Drennan intersection to drain the airport property to the east. (See figure 2)

The proposed Hancock road extension on the north side of the site is currently being designed by URS Consultants and we understand their plans are nearing completion. URS has designed a storm drainage system consisting of several curb inlets in the road that will be connected to a new 40 foot wide concrete lined channel. The channel will begin where the existing concrete box culverts daylight at the proposed intersection of Powers and Hancock and will extend 1/2 mile to the west to the proposed Chelton Road. The channel will cross under Hancock at the future Mason Drive.

The proposed Chelton Road extension is currently being designed by Obering-Wurth Consulting Civil Engineers. Preliminary plans we obtained from Obering-Wurth indicate extending the Peterson Field channel under Chelton in double 11' x 8' concrete box culverts with a 100 year flow of 2,350 cfs. Curb inlets and storm drains are proposed on the north Chelton Road frontage that will drain into the Peterson Field channel. On the south Chelton Road frontage curb inlets have been proposed that will drain into Digital property on the east.

Hancock and Chelton are proposed arterial streets and the City has undertaken the design responsibilities for them.

Drennan Road is also proposed as a minor arterial and it will also require substantial rebuilding and storm drainage systems. The runoff carrying capacity of the Drennan Road curb and gutter is limited to a 100 year depth of 8 inches with no curb overtoppings. The new storm drainage system for Drennan will carry storm flows in excess of the 100 year street capacity.

The developer of the Digital property will be required to finance or construct 1/2 of the proposed street and drainage improvements in Hancock, Chelton and Drennan. If the Digital site develops before the adjacent property the Digital developer will be required to construct the full street width with eventual reimbursement for 1/2 of the cost from adjacent developers. Any construction the developer performs to satisfy recommendations of the Drainage Basin Planing Studies is reimbursable from the respective Drainage Basin Funds. The cost of constructing these public facilities is also deducted from the drainage fees required for development.

Drainage Design Criteria

The drainage plan was prepared in accordance with the City of Colorado Springs and El Paso County Drainage Criteria Manual (October 1987). The Peterson Field and Little Johnson drainage basins were analyzed using the rational method to determine runoff peaks for the 10 and 100 year storms. Since the Windmill Gulch basin exceeds 100 acres it was analyzed using the Soil Conservation Service Method. Runoff peaks within the Windmill Gulch were determined for the 10 and 100 year 24 hour storms.

Drainage Facilities

Drainage of the Digital property can be accomplished by a series of curb and gutter, curb inlets, storm drains and concrete lined channels as depicted on the drainage plan.

Curb inlets on the interior loop road and access drives will be provided where the street storm flow capacity is exceeded. Developments within the property will connect their underground storm drains to the drains in the road system.

Basin A will drain into the proposed Peterson Field channel. URS Consultants has provided stubs for future storm drain connections at Blake and Mason Drives. No detention storage will be required for Basin A. Once the proposed Peterson Field concrete channel is constructed in Hancock the developer must request a letter of map revision from FEMA to redefine the extent of the flood plain.

Basin B will drain southwest to the Chelton-Drennan intersection where a culvert will be required under Drennan Road. The Little Johnson/Security Creek Drainage Basin Plan Study (DBPS) calls for a 6' x 4' concrete box culvert at this point with a capacity of 300 cfs. We estimate the 100 year developed flow from Basin B at 196 cfs. The Little Johnson/Security Creek DBPS states the 100 year 24 hour flow at this point is 251 cfs.

The developer will be required to construct the 6' x 4' culvert under Drennan Road, and extend 1,300 feet of concrete lined channel on the east side of Hancock to an existing 72 inch culvert under the Hancock Expressway.

Dependent upon how much of the downstream facilities have been constructed by others, the developer may have to construct a temporary detention pond for basin B. The detention pond will be required to limit runoff to the historic rate until the downstream facilities have been constructed.

Basin C will drain to the low point in Drennan Road (at the existing 43" x 27" culvert) where a regional detention pond is proposed in the draft Windmill Gulch DBPS. The pond is planned to be "park-like" which is a suitable land use since no sanitary sewer service without pumping is available for this area. The outlet of this pond is proposed to be an 84" concrete culvert. The pond discharge rate will need to be limited to the historic rate until downstream facilities are constructed in accordance with the DBPS. Runoff from Offsite Basin E that enters through the culvert between Hancock and Drennan will be routed in the Powers Boulevard roadside ditch to the south. Runoff from offsite Basin D will be combined with the Basin E flow into a concrete channel that directs the flow east to the regional pond. It should be noted that the large flow from Basin D will be reduced once the airport runoff is directed south of Drennan to a new airport detention pond. Calculations for the determination of runoff peaks are included in the appendix of this report.

SUMMARY RUNOFF INFORMATION

<u>BASIN</u>	<u>DESIGN POINT</u>	<u>BASIN AREA (ACRES)</u>	<u>DEVELOPED FLOWS</u>	
			<u>Q10 CFS</u>	<u>Q100 CFS</u>
A	1	57.4	106	174
B	2	59.8	118	196
C	3	133.1	252	426
OFF SITE BASINS:				
D	4	165	65	169
E	5	40.4	100	175

References:

1. Drainage Criteria Manual, City of Colorado Springs and El Paso County
October 1987
2. Soil Survey El Paso County, Colorado
USDA, Soil Conservation Service
In cooperation with Colorado Agricultural Experiment Station
June 1981
3. Procedures for Determining Peak Flows in Colorado,
USDA, Soil Conservation Service
March 1980
4. Peterson Field Drainage Basin Master Plan Update
URS/NES
September 1984
5. Little Johnson / Security Creek
Drainage Basin Planning Study
Simons, Li and Associates, Inc.
April 1988
6. Windmill Gulch Drainage Basin Planning Study
Wilson and Company
Draft January, 1991

Engineers 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.

James V. Hastings
James V. Hastings, P.E.



Developer's Statement:

The Developer has read and will comply with all of the requirements specified in this drainage report and plan. The Digital Equipment Corporation.

BY: [Signature]
TITLE: Property & Development Center - West 12/2/91
Manager Date

City of Colorado Springs:

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

[Signature] for: 12/26/91
City Engineer Date

El Paso County:

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

* [Signature] 12/13/91
Director of Public Works Date

*Conditional upon the review and approval of any preliminary or final drainage report and construction drawing submittals.

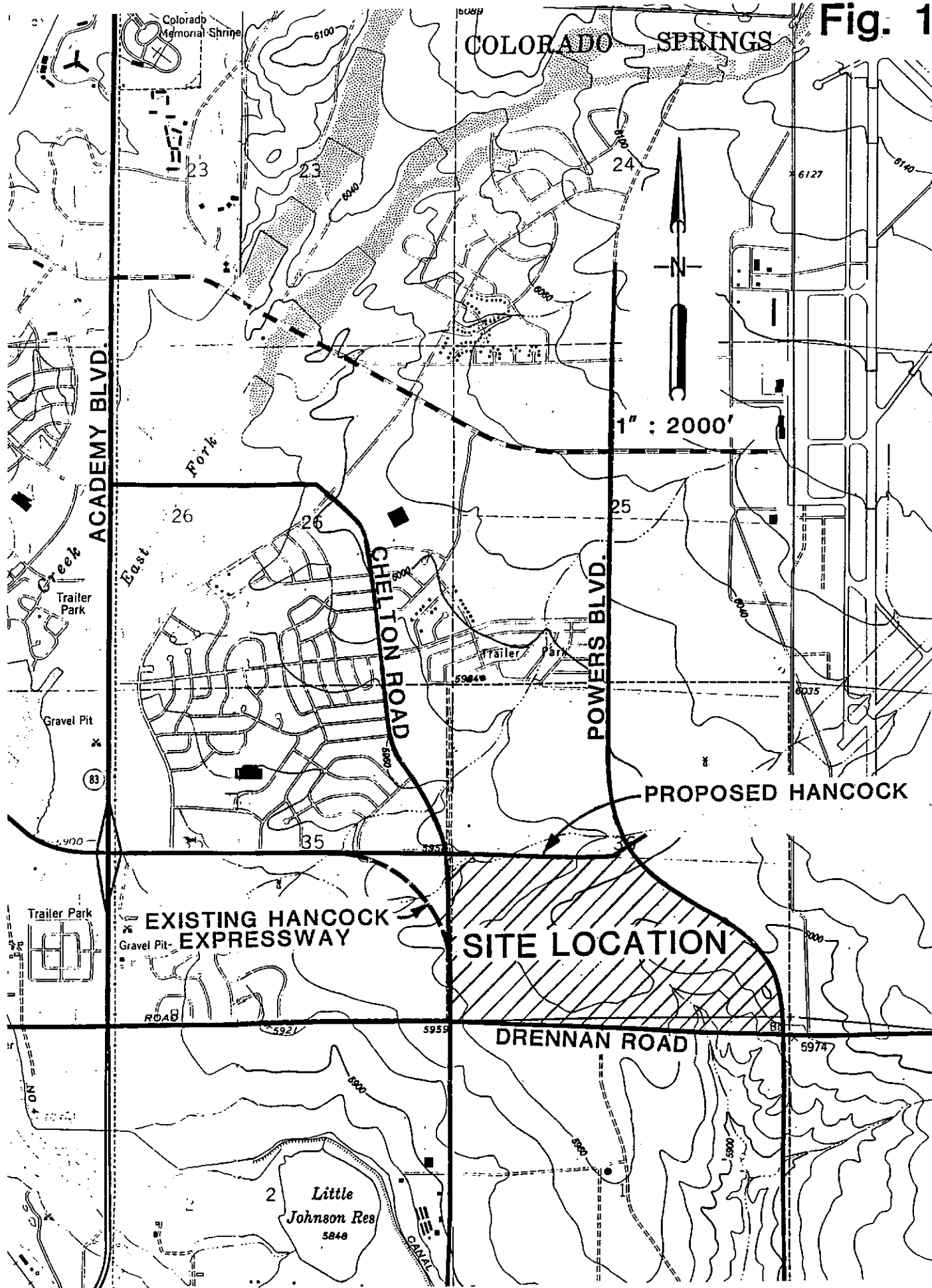
Drainage Basin Fees:

The current drainage and bridge fees for the development are as follows:

<u>Basin</u>	<u>Area (ac).</u>	<u>Drainage Fee/ac.</u>	<u>Bridge Fee/ac.</u>	<u>Drainage Fee</u>	<u>Bridge Fee</u>
Peterson Field	57.4	\$4,184	\$ 242	\$ 240,162	\$13,891
Windmill Gulch	133.1	\$4,940	\$ 136	\$ 657,514	\$18,102
Little Johnson	59.8	\$5,612	_____	<u>\$ 335,598</u>	_____

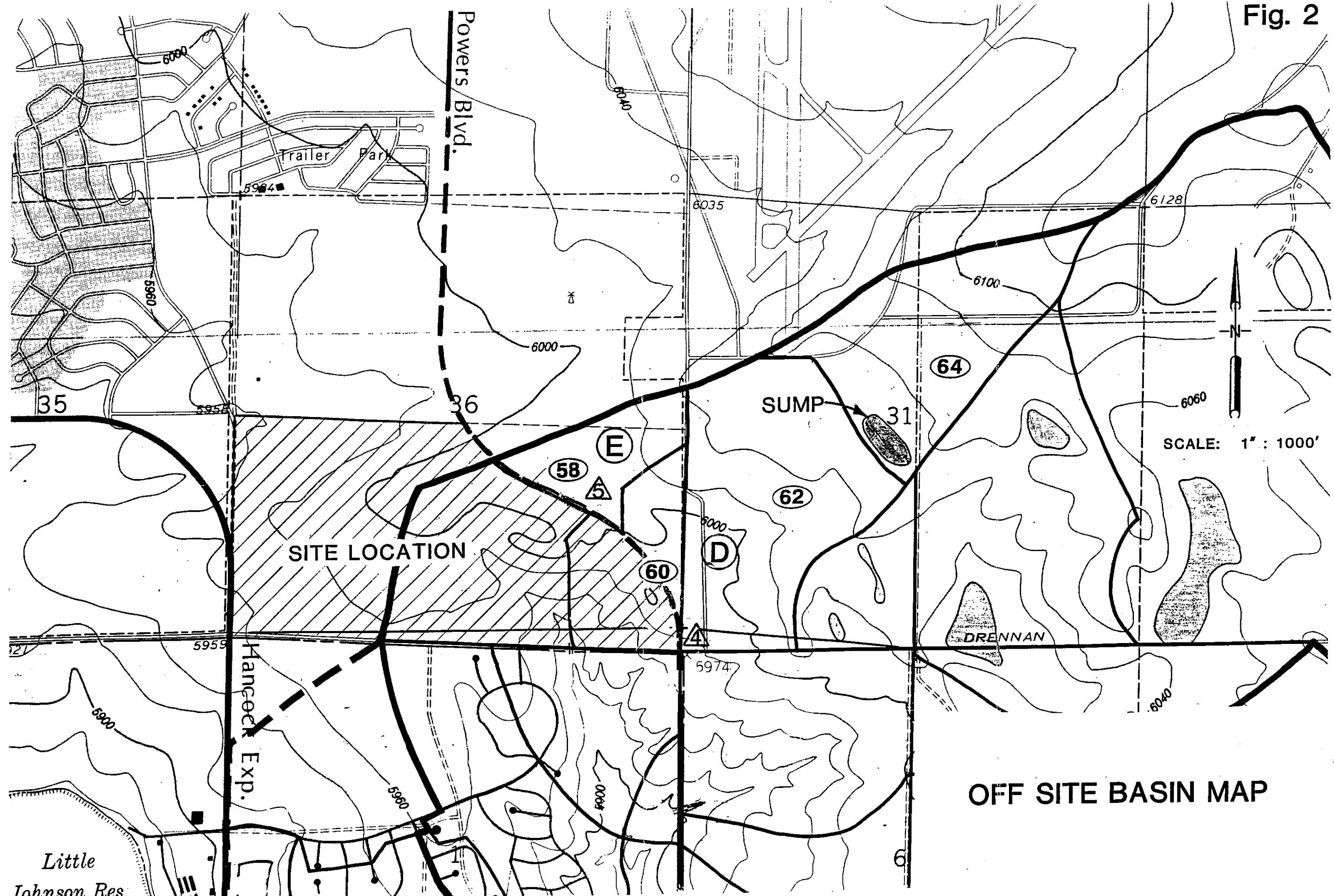
			<u>Drainage Fee</u>	<u>Bridge Fee</u>
Total	=		\$1,233,274.00	\$31,993.00

Fig. 1



VICINITY MAP

Fig. 2



SITE LOCATION

SUMP

DRENNAN

OFF SITE BASIN MAP

SCALE: 1" : 1000'

Little Johnson Res

Hancock Exp.

Powers Blvd.

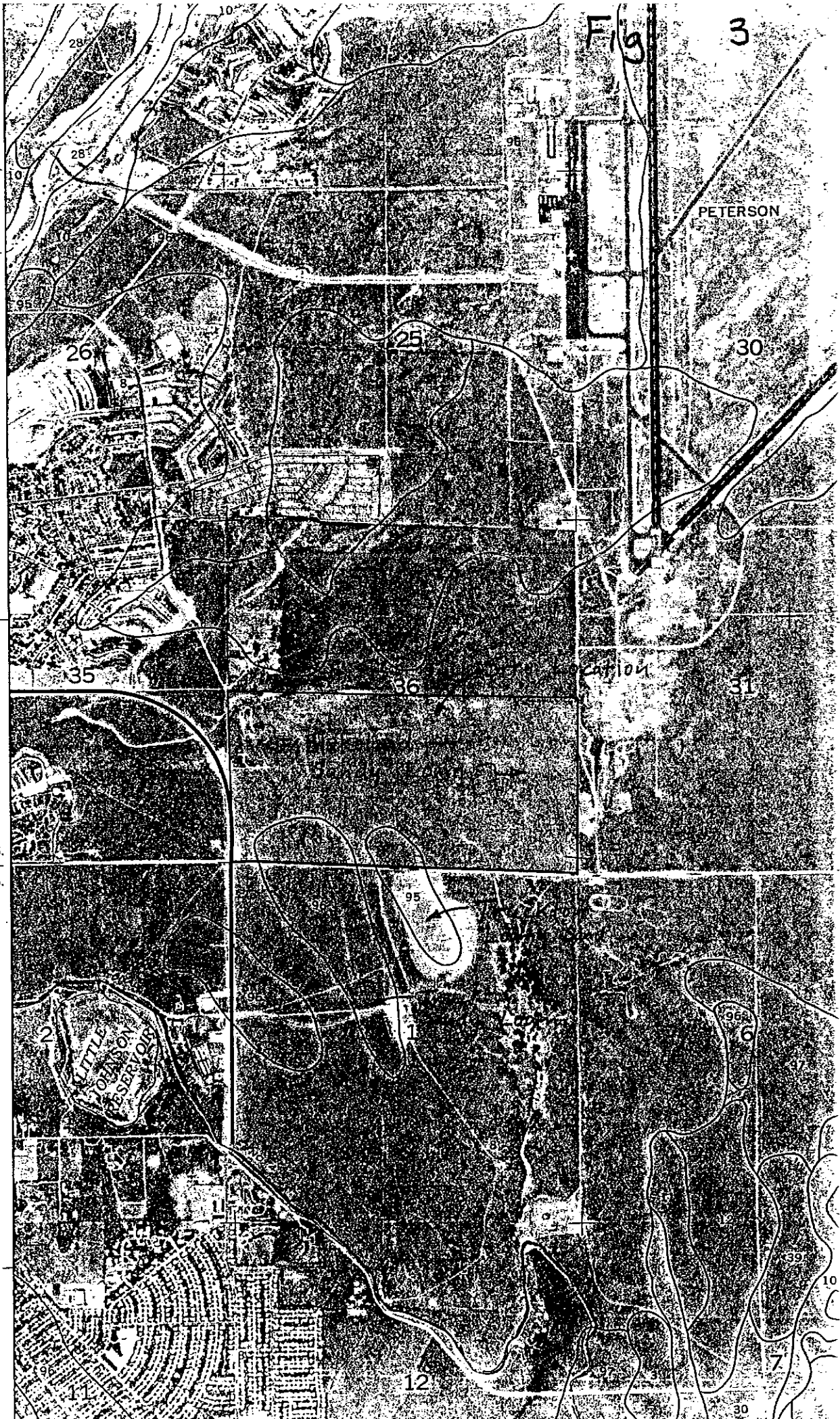
Trailer Park

(Joins sheet 16)

Fig 3

PETERSON

T. 14 S.
T. 15 S.



APPENDIX

Determine Storm Runoff:

Peterson Field Basin

Basin A (West of Powers Blvd.)

Area = 57.4 ac.

31.8 ac. Residential

3.9 ac. Roads

21.7 ac. General Office

Determine Composite C For Basin

$$C_{10} = \frac{31.8 \times .55 + 3.9 \times .90 + 21.7 \times .75}{57.4} = 0.65$$

$$C_{100} = \frac{31.8 \times .65 + 3.9 \times .95 + 21.7 \times .80}{57.4} = .72$$

Time of Concentration:

$$T_c = t_i + t_t$$

$$t_i = 1.87(1.1 - C_o) L^{1/2} S^{1/3}$$

$$L = 500' @ 3\%$$

$$C_o = .25$$

$$\therefore t_i = 24.6 \text{ min.}$$

t_t : $L = 1200'$, storm drain

$$V = 7 \text{ Fps}$$

$$\therefore t_t = 1200 / 7 \times 60 = 2.9 \text{ min.}$$

$$T_c = 24.6 + 2.9 = 27.5 \text{ min.}$$

$$I_{10} = 2.85 \text{ \%/hr.}, \quad I_{100} = 4.30 \text{ \%/hr.}$$

$$Q = CIA$$

$$Q_{10} = (.65)(2.85)(57.4) = 10.6 \text{ cfs}$$

$$Q_{100} = (.72)(4.30)(57.4) = 17.8 \text{ cfs}$$

Little Johnson Basin (Basin B):

Area = 59.8 ac.
10.7 ac. Residential
3.7 ac. Roads
45.4 ac. General Office

Determine Composite C =

$$C_{10} = \frac{10.7 \times .55 + 3.7 \times .90 + 45.4 \times .75}{59.8} = .72$$

$$C_{100} = \frac{10.7 \times .65 + 3.7 \times .95 + 45.4 \times .80}{59.8} = .78$$

Time of Concentration:

t_c : L = 500' @ 3.3% $C_{10} = .25$
 $t_c = 23.9$ min.

t_c : L = 2000' @ 2% storm drain
V = 7 Fps
 $t_c = \frac{2000}{7 \times 60} = 4.8$ min.

$\therefore T_c = 28.7$ min.

$I_{10} = 2.75$ "/hr. , $I_{100} = 4.2$ "/hr.

$Q_{10} = (.72)(2.75)(59.8) = 118$ cfs

$Q_{100} = (.78)(4.2)(59.8) = 196$ cfs

Table 2. Summary of Discharge.

Page 18
Little Johnson/Security Creek

Basin ① = Digital Property

Design Point	Design Point	Drainage Area (sq.mi.)	Location (Group)	TR-20 24-Hour Storm (Type II-A)			
				100-Yr Peak Flow (cfs)		10-Yr Peak Flow (cfs)	
Basin No.	Point No.			Existing Condition	Future Condition	Existing Condition	Future Condition
1		0.09	A	6	251	0	140

Windmill Gulch Basin

Basin C (West of Powers Blvd.)
Area = 133.1 ac. (0.21 mi²)
117.5 ac. Office
9.6 ac. Roads
6 ac. Detention Pond

Since area > 100 acres use SCS method

Time of Concentration:

$L = 350'$ @ 2.67% $C_{10} = .25$
 $\therefore t_c = 1.87 (1.1 - .25) (350)^{1/2} (2.67)^{1/3} = 21.4 \text{ min.}$

t_c : $L = 3100'$ @ $S_{avg} = 1.0\%$
Storm Drain - $V_{avg} = 7 \text{ Fps}$ (24" @ 1.0%)

$t_c = 3100 / 7 \times 60 = 7.4 \text{ min.}$

$\therefore T_c = 21.4 + 7.4 = 28.8 \text{ min} = 0.48 \text{ hr.}$

24 hour storm, AMC condition II

General Office CN = 92
Roads CN = 98
Open Space CN = 61

Weighted CN = $\frac{117.5 \times 92 + 9.6 \times 98 + 6 \times 61}{133.1} = 91$

10 yr. 24 hr. Rainfall = 3.0"
100 yr. 24 hr. " = 4.5"

From SCS chart

$Q_{10} = 2.07$, $Q_{100} = 3.5'$

From Fig. S-1

$q_p = 580 \text{ csm/in}$

$q = q_p A Q$
10 yr. 24 hr.

$q = 580 (0.21) (2.07) = 252 \text{ cfs}$

100 yr. 24 hr.

$q = 580 (0.21) (3.5) = 426 \text{ cfs}$

Offsite Flows

Determine Peak Flow at Culvert - Powers + Drennan:
Offsite Basin D

From Windmill Gulch DBPS

- Flow at culvert combines basins 64, 62 + Portion of 60

$$\text{Drainage Area Basin 60 to Culvert} = \frac{9.1}{25.2} \times 53.42 = 19.29 \text{ ac.}$$

$$= 36.1 \%$$

Basin 64 is in natural sump condition and has no outflow

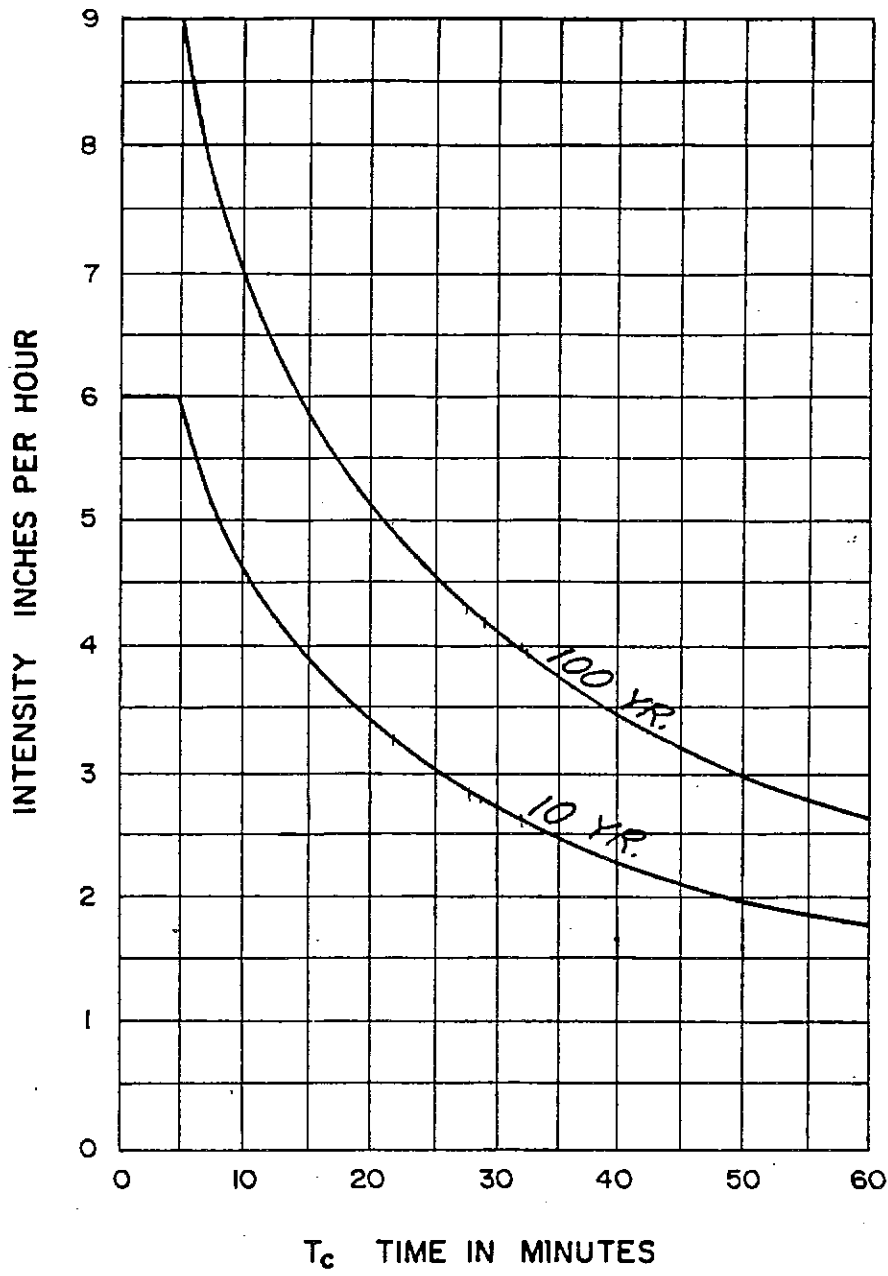
Subbasin No.	Exist. Flows (cfs)				Future Flows			
	24-hr.		2-hr.		24 hr.		2-hr.	
	100 yr.	10-yr.	100 yr.	10 yr.	100 yr.	10 yr.	100 yr.	10 yr.
64	No outflow (in Sump)							
62	90	20	155	80	Airport land = Exist.			
60	$\frac{.361 \times 40}{= 14}$	4	23	11	79	45	79	54
Combined Flow	104	24	178	91	169	65	234	134

Peak Flow @ Culvert Midway Between Hancock + Drennan under Powers
= Basin 58 Windmill Gulch DBPS
Offsite Basin E

TABLE 5
SUMMARY OF DISCHARGES

Windmill Gulch DBPS
Page 18

Subbasin No.	Existing Conditions Peak Flows (CFS)				Future Conditions Peak Flows (CFS)			
	24-Hour		2-Hour		24-Hour		2-Hour	
	100-Yr	10-Yr	100-Yr	10-Yr	100-Yr	10-Yr	100-Yr	10-Yr
58	25	5	45	20	175	100	180	120
60	40	10	65	30	220	125	220	150
62	90	20	155	80	---	---	---	---



RE: Based upon Pikes Peak area council of governments/
areawide urban runoff control manual.



HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual
Storm Rainfall
Time Intensity-Frequency Curves

Date
OCT. 1987
Figure
5 - 1

TABLE 5-1
 RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

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

* Hydrologic Soil Group

Figure S-1

Peak Discharge in
csm Per inch of Runoff
Versus
Time of Concentration, T_c
Type II Storm Distribution
Type II-A Storm Distribution

