Jerry

MASTER DRAINAGE STUDY

FOR

MOUNTAIN SHADOWS DEVELOPMENT

COLORADO SPRINGS, COLORADO

WEISS
CONSULTING
ENGINEERS, INC.
COLORADO SPRINGS, COLORADO

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COLORADO SPRINGS, COLORADO

WEISS CONSULTING ENGINEERS, INC.

1815 North Tejon Colorado Springs, Colo. 80907 (303) 634-0373

July 16, 1979

Mr. Dewitt Miller
Director of Public Works
P. O. Box 1575
Colorado Springs, CO 80901

Dear Mr. Miller:

Transmitted herewith is a DRAINAGE STUDY FOR MOUNTAIN SHADOWS DEVELOPMENT, located in northwest Colorado Springs. This proposed development lies west of Wilson Road and mostly north from Garden of the Gods Road. The Flying W Ranch lies within the study area.

The drainage plan outlines the drainage basins flowing into and across the proposed development. Drainage flows have been calculated for both the 5-year and 100-year frequency storms.

No drainage structures have been designed in this report but the accumulative flows and general location for channels have been shown. This information can be utilized in the final planning and platting process to insure that adequate provisions have been made for the drainage.

I would be glad to go over this study in detail with your staff and answer any questions they may have.

Sincerely,

WEISS CONSULTING ENGINEERS, INC.

G. J. Weiss P.E. 4124

SCOPE AND PURPOSE OF THE STUDY

This report is intended to furnish the basis for an overall plan for placing and sizing the major drainage channels within the proposed development. The intent of this study is not to establish the exact design of a storm sewer, or channel, or drainage appurtenances in a definite area.

The basin flows and the accumulative flows are shown at various points in the proposed development to allow the planner some flexibility in laying out the development and still provide the required location and facilities for the drainage. The size and final location of the major facilities will be determined at time of platting and will be dependent upon final grades and type of facility. This study will provide the information on total flows and general location for the required facilities.

BASIN DESCRIPTION

This study falls within two major drainage basins within Colorado Springs.

Basins A, B and C fall within Douglas Creek Drainage Basin. This basin was originally studied in June of 1964 by United Western Engineers. The latest study was by Lincoln Devore dated June, 1974.

Basin D falls within the Camp Creek Drainage Basin. A study was made in this basin in October, 1964 by United Western Engineers.

Reference is made to all of the above studies in this report. The drainage criteria has changed since the early reports were made and more data is now available on the proposed use of the land. The drainage flows in this report will vary from the old reports because of this.

The Pike National Forest contains approximately 3 square miles of the Douglas Creek Basin and a major portion of the Camp Creek Basin. The forest land is considered to be undevelopable as far as subdivision or other construction is concerned.

Approximately the western third of the Douglas Creek Basin is mountainous with a slow transition through the foothills to lower ground. Due to the geology of the area, several water gaps exist along the standing formations on the east edge of the mountains. The has the effect of concentrating water at these points and forming the main streams.

GEOLOGIC FORMATION, SOILS TYPES

The upper or western portion of the basin is along the east slope of the front range and consists of Pikes Peak Granites, either in a solid state or in decomposed gravel condition. Although the slopes are very steep in this area, infiltration is high and bank storage is high. Runoff through the Pike National Park portion of the site is low compared to the remainder of the development.

At a point near the eastern limit of the Front Range hills, one major fault line and several minor faults are found. These are all a part of the Front Range fault which extends along nearly the entire front range. The presence of these facults influences the amount of water which reaches the lower alluvium. It indirectly affects the flow of water by raising the sedimentary layers found east of the faults.

Immediately east of the faults and extending for approximately 2 miles to the east, many sedimentary formations are found. This is the same geologic series which is found in the Garden of the Gods area and it is found in a quite similar condition.

Along the east line of these echelon formations is the Pierre Shale. This material has a shallower dip than the other formations near the fault zone. This formation, in fact, is more or less flattened out and extends beneath the entire City of Colorado Springs. It is found on the surface of the ground over a fairly large area of the basin. This material weathers easily upon exposure to air and water, but even when highly weathered is resistant to infiltration and increases the runoff from any given rainfall to a considerable degree. The geology of this basin almost guarantees very high runoff in any major rainstorm.

An SCS soils map is included with this report showing the classification for the various areas along with the Hydrologic Group for each. Curve numbers for the computations are determined by the soil group number and type of proposed development. Composite curve numbers were calculated for the sub basins where different soil types and land uses occur.

METHOD OF RUNOFF COMPUTATIONS

The method of runoff computation utilized in this report is the MODIFIED SCS METHODOLOGY outlined in the manual for Determination of Storm Runoff Criteria by the City of Colorado Springs dated March, 1977.

The calculations were based upon two different frequencies. A five-year frequency, six-hour duration storm was used with 2.1 inches of precipitation. Calculations were also made for the one hundred year frequency, six-hour duration storm using 3.5 inches of precipitation.

The flow arrows on the drainage map show the accumulative flows at various points along the basin. The upper figure in the box indicates the flow based upon the 5-year frequency storm. The lower figure in the box indicates the flow based upon the 100-year frequency storm.

The City criteria states that all drainage structures shall be designed for the 5-year storm up to and including the 500 c.f.s. peak flows for a 100 year storm; thereafter all structures shall be designed to carry the 100-year frequency storm.

Both the 5-year and 100-year storms were routed along the lines of the greenbelts through the basin. These greenbelts, in general, follow the existing streambeds. In some areas, the physical location of the streambed is not precise with the existing flow being a sheet flow across a wide area.

For the purpose of this study, it was assumed that the storm occurred over the entire basin at the same time and the water from the sub basin was routed along the main stream using this assumption.

MAIN CHANNELS GREENBELTS

This report shows the general location for the major channels along with the accumulative flows. No attempt has been made at this point to show the required minor structures or storm sewer for the individual basins since the final platting and street layout will determine these needs. In many cases, the streets within the subdivision can be designed to carry most of the flow to the major channel.

The open channel will be the most economical system to handle the drainage. In some areas where the ditches run through the Pierre Shale Formation, paving may not be needed on the bottom. In other areas, the full section of the ditch may need to be paved. The type of channel improvement can be concrete lining, gunite lining, gabions, rock rip-rap, etc. The type of development and soil conditions will control the type of lining which is best for the area. Where the channel flows through an area being left as open space or park system, a wide shallow natural ditch may be more appropriate than a paved concrete ditch. All bridges or box culverts must be fully paved to avoid scour.

SUMMARY AND RECOMMENDATIONS

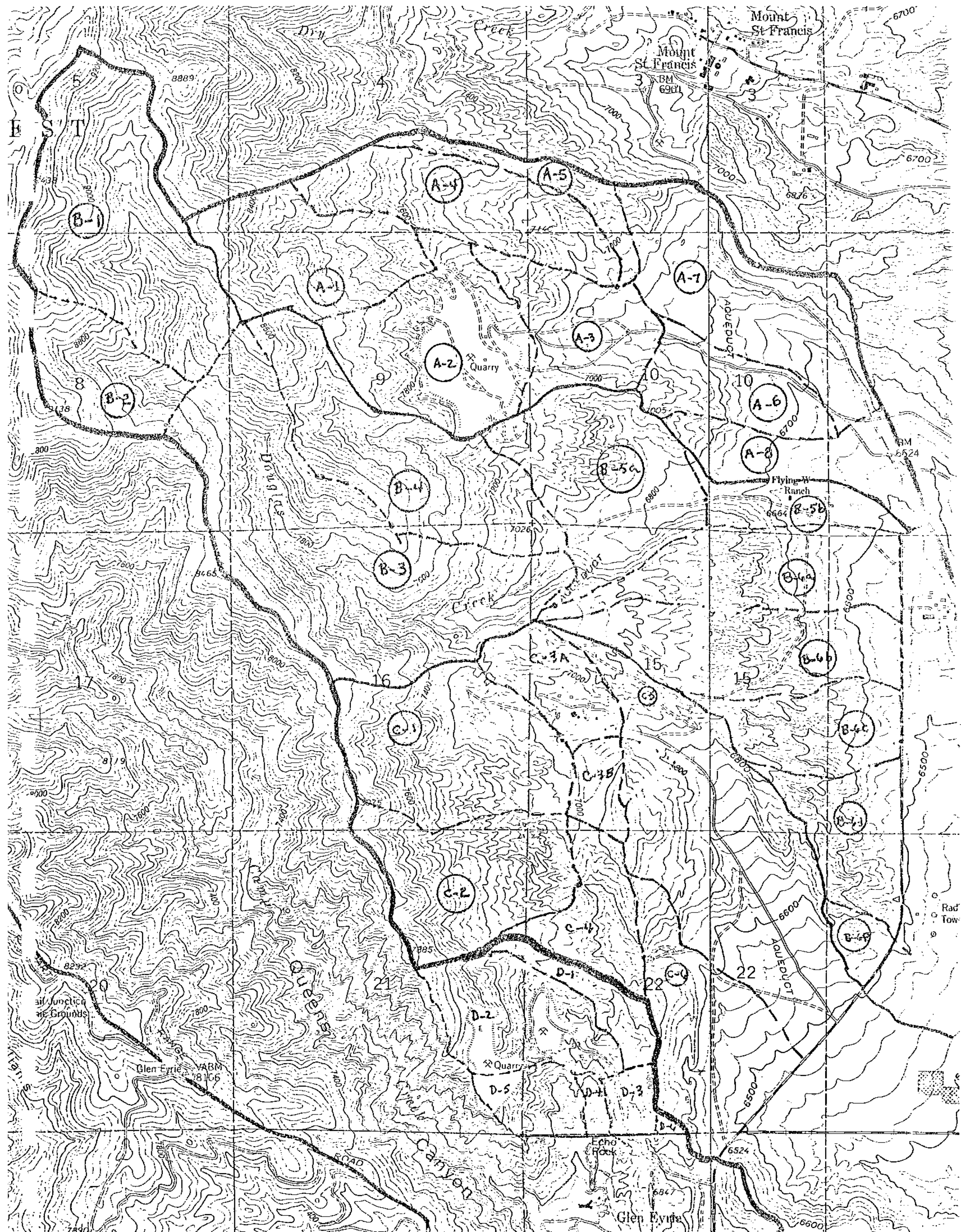
Experience in and around the City of Colorado Springs has shown the fulitity of trying to control storm runoff with street drainage alone. Streets will carry large quantities of water under favorable conditions, but will not contain the high flood peaks common during the intense local storms in this area. However, the streets should be utilized to the fullest extent possible to reduce the use of storm sewers.

It is also uneconomic to design ditches of sufficient width that the velocities are reduced and paving is not required except in areas that may be open space or park land. It is recommended that fairly narrow paved ditches be used throughout the area where land use is restrictive to space.

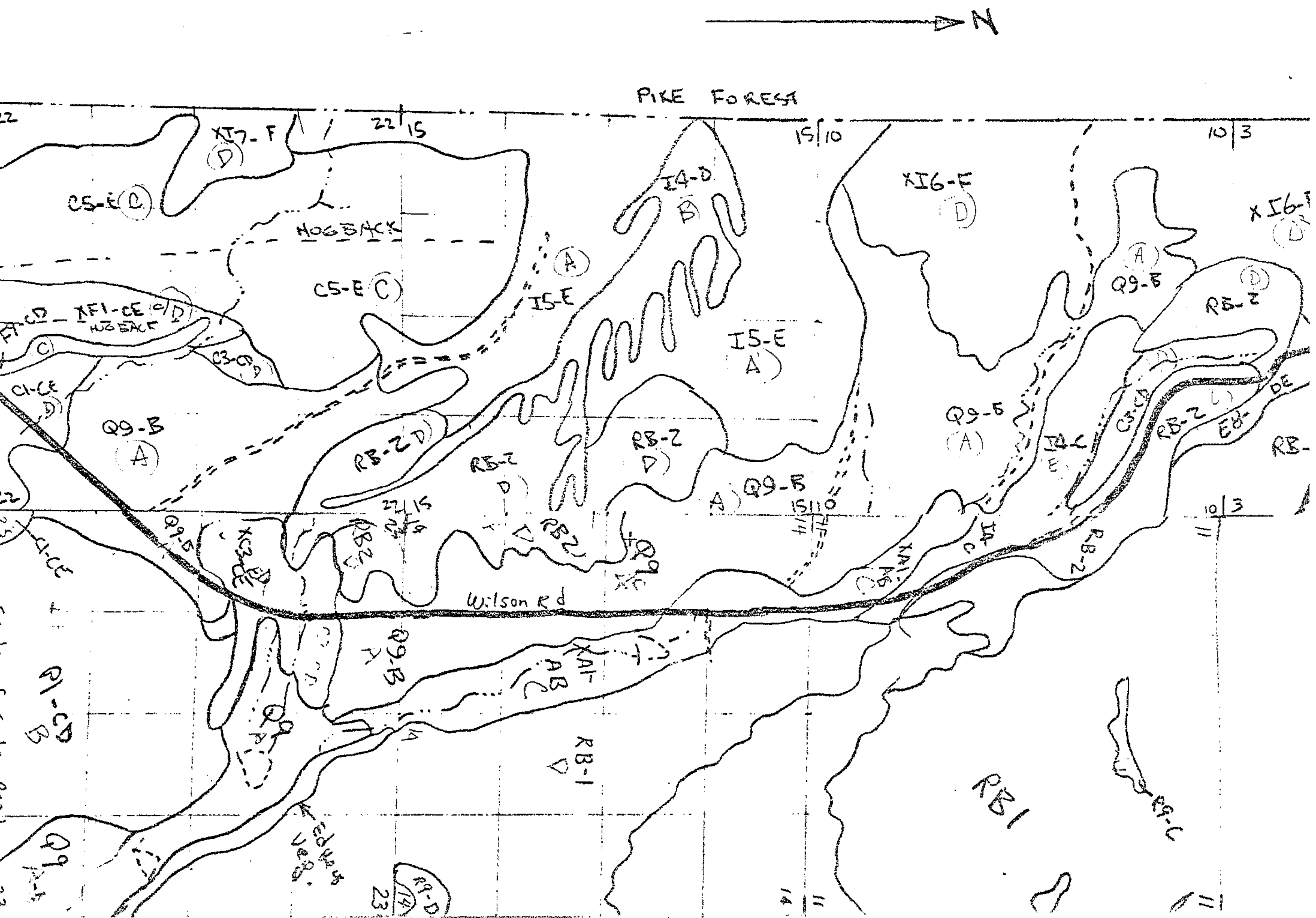
The general recommendation of this study is that final planning and platting of the developable areas allocate the space required for the drainage flows in a location compatible with the development and within the confines of the topography.

The flows from Basins C-5 and C-6 indicate separate ditches on the plan up to Wilson Road and then combining them east of Wilson Road before crossing Garden of the Gods Road. Due to the wide shallow natural channels in this area, it may be desireable to combine the ditches west of Wilson Rd.

Since no cost estimates are included with this report, the City Engineer has requested that no reimbursement for over-expenditures be made to the developer until after a total cost has been determined for the entire sub-basin. These costs can be estimated after the preliminary plats have been prepared and the final drainage routing has been determined.



Mount St Francis
Mount St Francis
BM 6901
Dry
Creek
8889
A-4
A-5
B-1
A-1
A-7
A-3
A-2
Quarry
AQUEDUCT
A-6
A-8
BM 6524
Flying W Ranch
6664
B-5a
B-5b
B-4
B-2
B-3
Creek
B-4a
B-4b
B-4c
B-4d
B-4e
C-3A
C-1
C-2
C-3B
C-4
C-5
C-6
D-1
D-2
D-3
D-4
D-5
Quarry
Queens
Canyon
Glen Eyrie
VABM 8166
Echo Rock
Glen Eyrie
AQUEDUCT
ROAD
Rail Junction
Grounds
Radio Tower
6524
6847
8292
7885
8465
8375
7026
7005
6876



N
PIKE FOREST
XI7-F (D)
C5-E (C)
HOGBACK
C5-E (C)
XF1-CE (D)
HOGBACK
C3-CD
C1-CE (D)
Q9-B (A)
I5-E (A)
I4-D (B)
I5-E (A)
RB-2 (D)
RB-2 D
RB-2 D
RB2 D
Q9-B A
XI6-F (D)
Q9-B (A)
RB-2 (D)
Q9-B (A)
I4-C E
C3-CD
RB-2
EB-
DE
RB-2
I4 C
XA1-AB C
Q9-D
XC3-ED CE
RB2
Wilson Rd
Q9-B A
XA1-AB C
Q9 A
RB-1 D
RB1
R9-C
P1-CD B
Q9 A-E
Edge of Veg.
R9-D

MAJOR BASIN	SUB BASIN	AREA Planim. Read	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	CN	FLOW Q 5yr	FLOW Q 100	FLOW qp	q 5yr	q 100
A	1	161	0.25	4400	1500	0.13				60	0.08	0.53	1200	24	159
	2	197	0.308	4000	1400	0.12				68	0.23	0.90	1240	88	343
	3	127	0.1980	4000	550	0.17				80	0.62	1.64	1130	139	367
	4	168	0.2625	6000	1400	0.19				66	0.18	0.80	1080	51	227
	5	56	0.0875	5600	900	0.20				70	0.28	1.01	1090	27	96
	6	99	0.15496	4400	350	0.21				74	0.40	1.24	1050	65	202
	7a	96	0.14922	3200	400	0.14				86	0.92	2.10	1190	163	373
	7b	99	0.15496	4000	300	0.20				86	0.92	2.10	1490	155	355
	8	77	0.12052	4400	225	0.25				88	1.05	2.27	1000	124	273

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: MASTER DRAINAGE PLAN
MOUNTAIN SHADOWS DEVELOPMENT

By: D. Jones
Date: 1-12-79

WEISS CONSULTING ENGINEERS, INC.

MAJOR BASIN	SUB BASIN	AREA Planim. Read AC	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	COMPOSITE CN	FLOW Q 5yr	FLOW Q 100yr	FLOW qp	q 5yr	q 100yr
A	1 & 2	358	0.5594	9000′	1880′	0.20				64	0.14	0.71	1080	85	429
	1,2,3,4 & 5	709	1.1073	9200	2080	0.26				69	0.26	0.95	970	279	1020
	4 & 5	224	0.35	6000	1400	0.19				68	0.23	0.90	1090	88	343
	7a & 7b	195	0.3042	6600	520	0.30				86	0.92	2.10	920	258	588
	1 thru 6	808	1.2625	12,800	2245	0.38				70	0.28	1.01	840	297	1071
	1 thru 8	1080	1.6875	15,200	2330	0.45				74	0.40	1.24	770	520	1611

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: MASTER DRAINAGE PLAN
MOUNTAIN SHADOWS DEVELOPMENT

By: D.J. Weiss
Date: 1-23-79

WEISS CONSULTING ENGINEERS, INC.

MAJOR BASIN	SUB BASIN	AREA Planim. Read Ac.	AREA SQ MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	CN	FLOW Q 5yr	FLOW Q 100	FLOW qp	q 5yr	q 100
B	1	296	0.4625	6000	1250	0.20				60	0.08	0.53	1080	40	265
	2	104	0.1625	3000	1050	0.09				60	0.08	0.53	1280	17	110
	3	424	0.6625	9000	1800	0.27				60	0.08	0.53	960	51	337
	4	230	0.3594	7200	1800	0.21				60	0.08	0.53	1060	31	202
	5a	182	0.2841	4400	600	0.18				80	0.62	1.64	1100	194	512
	5b	103	0.1607	5200	375	0.25				74	0.40	1.24	1000	64	199
	6a	167	0.26113	7200	550	0.30				70	0.28	1.01	920	67	243
	6b	170	0.2654	6200	525	0.28				74	0.40	1.24	940	100	309
	6c	107	0.1664	4000	350	0.20				86	0.92	2.10	1080	165	377
	6d	88	0.1377	3000	300	0.14				88	1.05	2.27	1180	171	369
	6e	29	0.0459	1700	196	0.10				88	1.05	2.27	1280	62	133

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: MASTER DRAINAGE PLAN
MOUNTAIN SHADOWS DEVELOPMENT

By: [signature]
Date: 1-12-79

WEISS CONSULTING ENGINEERS, INC.

MAJOR BASIN	SUB BASIN	AREA Planim Read AC.	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	COMPOSITE CN	FLOW Q 5yr	FLOW Q 100yr	FLOW qp	q 5yr	q 100yr
B	1,2,3 & 4	1054	1.6469	15,000'	2500'	0.42				60	0.08	0.53	780	103	681
B	1 thru 5a	1236	1.9313	17,800	2650	0.51				63	0.125	0.67	720	174	932
B	1 thru 5b	1339	2.0922	21,800	2825	0.60				64	0.16	0.71	670	196	995
A B	1-8 1-5b	2419	3.7797	21,800	2825	0.60				68	.23	0.90	670	582	2280

HYDROLOGIC COMPUTATION – BASIC DATA

PROJ: MASTER DRAINAGE PLAN MOUNTAIN SHADOWS DEVELOPMENT

By: [signature]

Date: 1-23-79

WEISS CONSULTING ENGINEERS, INC.

										5yr	100yr		5yr	100yr
C	1	220	[illegible]	3200	1200	[illegible]			60	0.08	053	1100	29	195
	2	169	0.264	4400	1200	0.14			(65)	[illegible]	[illegible]	1180	25	165
	3A	94.5	0.0147	3800	425	0.18			56	0.03	0.38	1100	5	62
	3B	43.3	0.0677	2500	350	0.11			80	0.62	1.64	1260	53	140
	4	90.4	0.01412	3200	525	0.13			78	.54	1.50	1200	92	254
	5a	55.1	0.0861	3400	300	0.17			80	.62	1.64	1110	58	157
	5b	110.2	0.1722	3800	425	0.18			76	.47	1.36	1100	89	258
	5c	61.7	0.0964	2800	400	0.12			88	1.05	2.27	1220	123	247
	5d	46.6	0.0729	2400	125	0.17			78	.54	1.50	1110	44	121
	5e	51.4	0.08035	4200	300	0.21			94	1.49	2.84	1050	126	240
	5f	16.5	0.0258	1500	170	0.08			92	1.33	2.64	1280	44	87
	6a	45.9	0.0717	3000	500	0.12			80	.62	1.64	1220	56	149
	6b	29.4	0.04914	1600	300	0.08			84	.82	1.94	1280	52	122
	6c	28.6	0.0448	1800	300	0.08			92	1.33	2.64	1280	76	151
	6d	90.0	0.1406	2680	250	0.14			90	1.18	2.45	1180	196	406
	7a	18.0	0.0281	1400	40	0.13			94	1.49	2.84	1200	50.3	95.6
	7b	9.0	0.01406	1300	50	0.12			94	1.49	2.84	1220	25.6	48.7
	7c	18.0	0.0281	1600	30				94	1.49	2.84	1280	53.6	102.2

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: MASTER DRAINAGE PLAN
MOUNTAIN SHADOWS DEVELOPMENT

By: [signature] Date: 1-12-79

WEISS CONSULTING ENGINEERS, INC.

Page 5 of 7 Pages

MAJOR BASIN	SUB BASIN	AREA Planim Read Ac	AREA SQ MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	WEIGHTED CN	FLOW Q 5yr	FLOW Q 100yr	FLOW qp	q 5yr	q 100yr
C	1,3a & 3b	358	0.5591	7200	1315	.25				61	.095	.575	1000	53	321
	1, 3a, 3b & 5a	413	0.6453	8200	1380	.28				64	.14	.71	960	87	440
	1, 3a, 3b, 5a & 5b	523	0.8172	10,900	1530	.37				66	.18	.80	850	125	5[illegible]
	1, 3a, 3b, 5a, 5b & 5c	585	0.91406	11,800	1580	.40				69	.255	.955	820	191	715
	1, 3a, 3b, 5a 5b, 5c & 5d	631	0.98594	13,600	1700	.45				70	.28	1.01	770	212	767
	1, 3a, 3b, 5a, 5e, 5d & 5b, 5c, 5f	699	1.0926	13,600	1700	.45				72	.34	1.12	770	286	942
C	2 & 4	259	0.4047	6500	1350	.22				66	.18	.80	1040	76	337
	2, 4 & 6a	305	0.47656	8200	1450	.27				68	.23	.90	960	105	412
	2, 4, 6a 6b, 6c & 6d	453	0.7083	10,400	1550	.37				75	.435	1.30	850	262	782
C	TOTAL	1152	1.800	15,400	1725	.52				73	.37	1.18	720	480	1529

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: MASTER DRAINAGE PLAN MOUNTAIN SHADOWS DEVELOPMENT

By: [signature]

Date: 1-12-79

WEISS CONSULTING ENGINEERS, INC.

MAJOR BASIN	SUB BASIN	AREA Planim. Read	AREA MILE	BASIN LENGTH	BASIN HEIGHT	Tc	DITCH LENGTH	DITCH SLOPE	V	CN	FLOW Q 5yr	FLOW Q 100yr	FLOW qp	q 5yr	q 100yr
D	1	52.89	0.08264	5200	1150	0.18				80	.62	1.64	1100	56	149
	2	126.72	0.19800	4800	1150	0.16				84	.82	1.94	1150	187	441
	3	19.83	0.03098	1500	250	0.07				80	.62	1.64	1280	25	65
	4	9.18	0.01434	1000	250	0.05				78	.54	1.50	1280	10	28
	5	50.69	0.0792	3120	830	0.10				82	.71	1.78	1280	54	137
	6	2.94	0.00459	450	160	0.03				78	.54	1.50	1280	3	9
D	1&2	179.6	0.2806	5200	1150	0.18				83	.765	1.86	1100	236	574
	1,2&3	199.4	0.3116	6300	1230	0.21				83	.765	1.86	1050	250	609

HYDROLOGIC COMPUTATION — BASIC DATA

PROJ: MASTER DRAINAGE PLAN
MOUNTAIN SHADOWS DEVELOPMENT

By: G. Juarez
Date: 1-12-79

WEISS CONSULTING ENGINEERS, INC.