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MASTER DRAINAGE PLAN

FOR

BROADMOOR SOUTH - NEAL RANCH

DRAINAGE BASIN

PREPARED FOR: DAVID R. SELLON & CO.

PREPARED BY : K L H ENGINEERING CONSULTANTS, INC.
724 S. TEJON STREET
COLORADO SPRINGS, CO.

JANUARY 1982

A. PURPOSE AND SCOPE:

The purpose of this report is to estimate storm runoff at various locations throughout the Broadmoor South-Neal Ranch Drainage Basin, and to present a Master Plan of proposed drainage structures which will be required in these areas, as development progresses. This Master Plan is not intended to be used as an inflexable design, but rather, should be used to demonstrate the approximate size and character of drainage structures required throughout the basin.

In certain portions of the Broadmoor South area, some so called, "debris flows" have occured simultaneously with high runoff flows. Examination of these debris flows is beyond the scope of this report. Prior to final design of drainage structures in affected areas, however, impact of potential debris flows must be considered. Two engineering reports have been written by other engineers, which discuss this debris flow hazard. These debris flow reports were written by Chen & Associates (September, 1980), and Lincoln DeVore (February, 1981). The reader is referred to these reports for information concerning the debris flow hazard.

Flow estimates which were made for previous drainage reports for existing downstream subdivisions are shown on the drainage plan. These values can be compared with the runoff values estimated in this report.

B. BASIN DESCRIPTION:

The Broadmoor South-Neal Ranch Drainage Basin consists of a collection of parallel basins which collectively comprise approximately 2845 acres. The basins are located south of Colorado Springs, in portions of Sections 1, 2, 11, 12, 13 and 14, Township 15 South, Range 67 West, and Sections 6, 7 and 18, Township 15 South, Range 66 West.

The basins are characteristically long and slender, with extreme to moderate slopes from West to East. The Western boundary of the basin is a ridge which runs North-South, along and across the summit of Cheyenne Mountain. The east boundary of the basin is the east property line of the Neal Ranch.

The basin is presently relatively undeveloped, with the exception of the Broadmoor South Golf Course, the Cheyenne Mountain Zoo, and a number of single family residences. Pines, scrub oak, and native grasses are the predominant vegitation in the undeveloped areas.

As a general rule, the natural drainage channels located throughout the basin are steep and well developed, with large rock and native vegitation providing a stable channel lining. There are a few specific locations, however, where the channels lack definition, and it becomes difficult to determine direction of flow for storm events of different magnitudes. This condition presents the possibility for high runoff flows to breach from one basin into another. This basin jumping can produce runoff flows at downstream facilities significantly different from the values expected. For the purpose of calculating runoff flows herein, it has been assumed that remedial measures will be taken to prevent basin jumping, and that runoff flows will remain in their low flow basins, as delineated on the Drainage Plan.

C. BASIN SOILS:

A variety of soil types are found in the Broadmoor South-Neal Ranch Drainage Basin. The hydrologic groupings of these soils range from Group "A" through Group "D". The Soil Conservation Service Map numbers and the hydrologic group assumed for purposes of runoff calculations, are a shown in Figure II at the end of this report. Please note that for purposes of calculations, a composite curve number was assumed for soil types 46 and 77 (along the Western 1/3 of the basin), since this area contains Group "B" through Group "D" soils. A curve number of 80 was assumed for portions of this area to remain in a natural state. In the Fishers Canyon Basin, where rock outcrops appear to be proportionally fewer in number than along the remainder of the Eastern slopes of Cheyenne Mountain, a weighted curve number of 78 was assumed.

D. FUTURE BASIN DEVELOPMENT:

Runoff quantities for the Broadmoor South-Neal Ranch Drainage Basin were calculated assuming full development of the areas. The Broadmoor South area will be developed primarily into one acre single family residential units. Cluster homes, condominiums and a small commercial area will also be developed. A significant portion of the Broadmoor South area shall remain in its natural condition. The specific land uses assumed in the Broadmoor South area are shown on the Drainag Plan.

Developed land uses for the Northerly most 100 acres of the Neal Ranch area were assumed to be as per a tentative plan of the area, furnished by the developer. This tentative development plan calls for the majority of the area to be developed into 1/2 to 1 acre single family building sites, with single family units, having a density of 3 to 4 units per acre, occupying the rest of the 100 acre parcel. The remainder of the Neal Ranch is assumed to be as follows:

1/2 to 1 Ac. SFU - 70%
1/4 to 1/3 Ac. SFU - 20%
Streets and Walks - 10%

E. METHOD OF COMPUTATIONS:

Runoff quantities were calculated using the Modified SCS Methodology as approved by the City of Colorado Springs Engineering Division. Runoff from both 5 year and 100 year storms were computed. Drainage structures were sized to accomodate the 5 year storm, unless the estimated 100 year peak exceeds 500 cfs, in which case, structures were sized to accomodate the 100 year storm. Times of concentration were calculated assuming natural channel flow and open channel flow. Times of concentration for natural channel flow were calculated using Figure II as printed in "City of Colorado Springs Determination of Storm Runoff Criteria". The Manning Equation was used to calculate times of concentration for open channel flow.

Flow quantities were calculated where drainage ways cross existing roads, and proposed future streets. It is assumed that minor residential streets, not shown on the Drainage Plan, will be placed in a manner such that drainage structures required for those streets will be minimal, if any. Runoff quantities were also calculated where flow exits the Broadmoor South property and the Neal Ranch property.

F. PROPOSED DRAINAGE IMPROVEMENTS:

The proposed drainage improvements for the Broadmoor South-Neal Ranch Drainage Basin consists primarily of culverts and concrete box culvert type bridge structures, which shall pass flows beneath proposed streets. All natural drainage channels in the basin shall remain unimproved, to preserve the natural beauty of the area. For this reason, adequate open space must be provided between the building sites and the natural drainage channels. Care should be taken during construction to keep heavy equipment from disturbing the natural drainage channels.

In locations where major drainage structures are required (for crossing channels with peak 100 year flows in excess of 500 cfs), it was assumed that concrete box type bridge structures would be used. Other types of structures, such as properly sized CMP structures could be used. For cost estimate purposes, this report assumes concrete box structures will be used.

In locations where a potential hazard exists for a debris flow, use of a clear span bridge structure should be considered, since it could more easily pass a debris flow with less likelihood of damage, than could a box culvert structure. Of course, this is dependant upon what mitigation efforts are taken to contain the debris flow, and is mentioned here merely to point out an additional alternative which should be considered prior to final design.

There are several locations throughout the basins where it appears that high runoff flows leave their low flow channels, and cross back and forth into adjacent basins. In basins and sub-basins where this problem exists, one of two philosophies must be implemented. Either all downstream facilities must be sized to accomodate combined peak flows from both (or all effected) adjacent basins,...or, upstream channel improvements must be undertaken to the extent that potential for basin crossover is eliminated. It is possible that in some of the smaller basins, it will be cost effective to design adjacent basins for cross-over flow, and allow the crossover flow to occur. This is an alternative which can be considered prior to final designs. In calculating flows for this drainage report, it was assumed that channel improvements will be constructed to contain peak flows in their original basins.

The upstream channel improvements to contain the high flows in their original basins, would consist basically of clearing and excavating the channel in locations where the channel is not well defined, then placing rip-rap, and/or other stabilization devices in the newly excavated portion of the channel, to prevent erosion.

In this report we have delineated four locations where channelization structures may be required. A more detailed examination of the sub-basins may reveal other locations where these channelization structures are required. Prior to developing final drainage designs at any specific location within the Broadmoor South-Neal Ranch Drainage Basin, a closer examination should be made of the basins tributary to that location, to determine if any channelization structures will be required.

The culvert and box culvert sizes called for in this report are approximate, and should be verified at the time of final design of each individual structure. The designing engineer should use a hydraulic grade line analysis to insure proper culvert sizing. Each culvert crossing should be designed with ample inlet control measures to prevent silt build-up.

Culverts and storm sewers within Public Right-of-Ways shall be publicly maintained; all other drainage channels and facilities shall be privately maintained.

G. DRAINAGE STRUCTURE COST ESTIMATE:

Cost estimates shown for the C.M.P. culvert crossings assume the crossings each to be 60 feet in length, and includes a price for rip-rap protection at the outlet end of each culvert.

The cost estimates for the concrete box bridge structures include a price for the box structure, gabion protection on the inlet side, and rip-rap protection on the discharge side of the box culverts.

CMP Culvert Crossings:

24" CMP Crossing,	3 ea.	@ $1940.	= $ 5,820.
30" CMP Crossing,	6 ea.	@ $2300.	= $13,800.
36" CMP Crossing,	1 ea.	@ $2660.	= $ 2,660.
42" CMP Crossing,	4 ea.	@ $3270.	= $13,080.
48" CMP Crossing,	5 ea.	@ $3630.	= $18,150.
Twin48" CMP Crossing,	3 ea.	@ $7260.	= $21,780.

Box Bridge Structures:

Twin 9' x 6' dp. Box	4 ea.	@$32,000.	= $128,000.
Twin 9' x 8' dp. Box	3 ea.	@$34,000.	= $102,000.
Channelization Structures,	4 ea.	@$25,000.	=$100,000.

= $405,300.

Drainage and bridge fees will be offset by drainage structures for the Broadmoor South & Neal Ranch Master Drainage Plan Basin, and therefore no drainage or bridge fees will be collected or reimbursed.

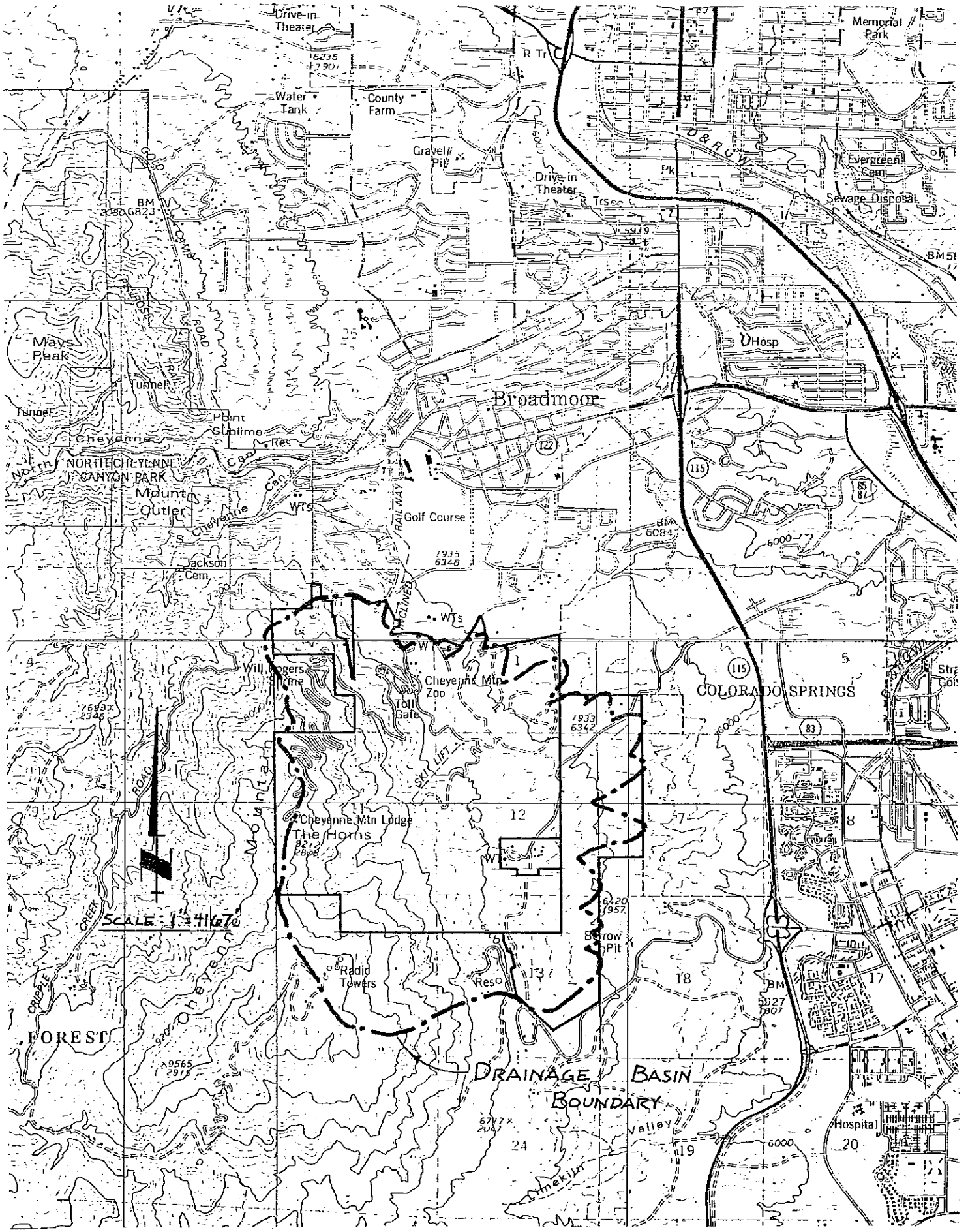
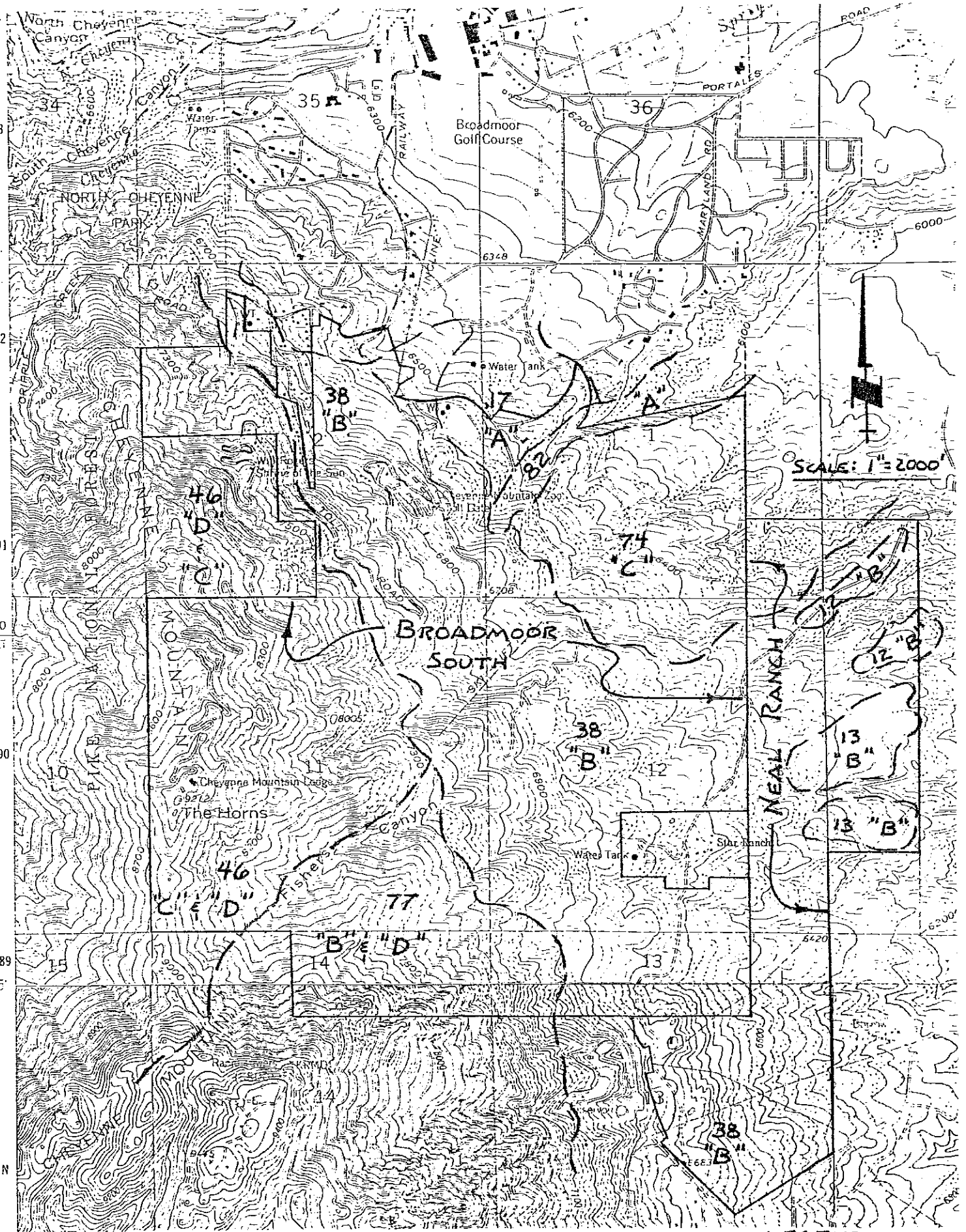


FIGURE I - VICINITY MAP



LEGEND

SCS MAP SYMBOL — 38

HYDROLOGIC CLASS — "B" ASSUMED

FIGURE II - SOILS CLASSIFICATION MAP

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
A-1	158.9		Forest	61	80	4874		2750	1550	Nat. Channel	0.072		
	73.1		Forest	28	66	1850		1500	350	Nat. Channel	0.064		
	17.3		1/2 Ac. Res.	6	70	464		500	45	Nat. Channel	0.039		
	7.2		1/2 Ac. Res.	3	54	149							
	4.3		Streets & Walks	2	98	162	0.43(5yr)						193 (5yr)
	260.8	0.408		100	75.0	7499	1.30 (100yr)	4750	1945		0.175	1100	583 (100yr)
A-1,2	158.9		Forest	58	80	4603		1000	90	Open Channel	0.023		
	73.1		Forest	26	66	1747							
	17.3		1/2 Ac. Res.	6	70	438							
	7.2		1/2 Ac. Res.	3	54	141							
	3.6		1 Ac. Res.	1	51	66							
	9.7		1/4 Ac. Res.	4	75	263							
	6.4		Streets & Walks	2	98	227	0.43 (5yr)						195 (5yr.)
	276.2	0.432		100	74.9	7485	1.29 (100yr)	5750	2035		0.198	1060	591 (100yr)
B-1	39.7		Zoo	85	69	5866		1000	640	Nat. Channel	0.032		
	7.0		Streets & Walks	15	98	1469	0.38(5yr)	1550	380	Nat. Channel	0.064		35.7(5yr)
	46.7	0.073		100	73.4	7335	1.20(100yr)	2550	1020		0.096	1300	114(100yr
B1,2	6.6		Forest	12	66	817		730	75	Open Channel	0.026		
	39.7		Zoo	75	69	5139							
	7.0		Streets & Walk	13	98	1287	0.35(5yr)						35.3 (5yr
	53.3	0.083		100	72.4	7244	1.15(100yr)	3280	1095		0.122	1210	116 (100yr)
C	8.6		Forest	33	45	1483		1800	230	Nat. Channel	0.092		
	3.5		1 Ac. Res.	13	51	684							
	10.4		1 Ac. Res.	40	68	2710							
	2.1		Lake	8	98	789							
	1.5		Streets & Walks	6	98	563	0.11(5yr)						6.0(5yr)
	26.1	0.041		100	62.3	6228	0.63(100yr)	1800	230		0.092	1300	33.3(100yr)
D-1	69.6		Forest	71	80	5693		3300	1840	Nat. Channel	0.083		
	28.2		Forest	29	66	1903	0.46(5yr)	1500	322	Open Channel	0.034		87.4 (5yr)
	97.8	0.153		100	76.0	7597	1.36(100yr)	4800	2162		0.117	1230	256 (100yr)
D-2	16.5		Forest	34	80	2756		3000	1440	Nat. Channel	0.082		
	31.4		Forest	66	66	4327	0.30 (5yr)						31.6 (5yr)
	47.9	0.075		100	70.8	7083	1.05(100yr)	3000	1440		0.082	1400	110 (100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
D-1,2	86.1		Forest	43	80	3470		4800	2162		0.117		
&3	40.3		Forest	20	66	1340		2650	370	Open Channel	0.064		
	47.5		1 Ac. Res.	24	68	1627							
	17.1		Zoo	9	69	594							
	7.5		Streets & Walk	4	98	370	0.40(5yr)						136 (5yr)
	198.5	0.310		100	74.0	7402	1.24(100yr)	7450	2532		0.181	1100	423 (100yr)
D-4	4.1		Forest	14	77	1108		2100	390	Nat. Channel	0.090		
	20.4		Golf Course	72	74	5297							
	3.4		1/3 Ac. Res.	12	81	966							
	0.6		Streets & Walk	2	98	206	0.46(5yr)						28.5(5yr)
	28.5	0.045		100	75.8	7577	1.35(100yr)	2100	390		0.090	1400	84.2(100yr
D-4,5	4.1		Forest	13	77	980		700	80	Open Channel	0.026		
	21.9		Golf Course	68	81	1333							
	5.3		1/3 Ac. Res.	16	81	1333							
	0.9		Street & Walks	3	98	274	0.47(5yr)						29.1 (5yr.)
	32.2	0.050		100	76.2	7620	1.38(100yr)	2800	470		0.116	1230	85.4 (100yr)
E-1	152.8		Forest	56	80	4512		4000	2140	Nat. Channel	0.098		
	108.0		Forest	40	66	2631		2750	400	Open Channel	0.058		
	4.5		1/8 Ac. Res.	2	85	142							
	3.1		Commercial	1	92	105							
	2.5		Streets & Walks	1	98	90	0.42 (5yr)						205 (5yr)
	270.9	0.423		100	74.8	7481	1.29 (100yr)	6750	2540		0.156	1140	622 (100yr)
E-1,2	152.8		Forest	40	80	3234		3900	430	Open Channel	0.092		
	108.0		Forest	29	66	1886							
	4.5		1/8 Ac. Res.	1	85	101							
	8.5		Commercial	2	92	207							
	18.7		1/3 Ac. Res.	5	72	356							
	9.3		1 Ac. Res.	3	68	167							
	6.8		Forest (Good)	2	70	126							
	60.8		Golf Course	16	74	1190							
	8.6		Streets & Walks	2	98	223	0.39 (5yr)						232 (5yr)
	378.0	0.591		100	73.9	7389	1.23(100yr)	10,650	2970		0.248	1000	728 (100yr)
F-1	4.2		Forest	17	66	1104		2950	540	Nat. Channel	0.118		
	18.8		1 Ac. Res.	75	68	5093							
	2.1		Streets & Walks	8	98	820	0.28(5yr)						13.7(5yr)
	25.1	0.039		100	70.2	7017	1.02(100yr)	2950	540		0.118	1230	49.1(100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
F-1,2	4.2		Forest	5	66	371		2350	330	Open Channel	0.071		
	28.9		1 Ac. Res.	39	68	2631							
	15.5		1/3 Ac. Res.	21	81	1681							
	20.2		Golf Course	27	74	2001							
	5.9		Streets & Walks	8	98	774	0.42(5yr)						52.9 (5yr)
	74.7	0.117		100	74.6	7458	1.28(100yr)	5300	870		0.189	1080	161 (100yr)
F-3	5.2		1/3 Ac. Res.	18	81	1467		2050	140	Nat. Channel	0.130		
	22.6		Golf Course	79	74	5827							
	0.9		Streets & Walks	3	98	307	0.47(5yr)						25.1(5yr)
	28.7	0.045		100	76.0	7602	1.37(100yr)	2050	140		0.130	1200	73.5(100yr)
F-1,2,	4.2		Forest	3	66	209		5300	870		0.189		
3&4	28.9		1 Ac. Res.	22	68	1484		1450	280	Open Channel	0.036		
	33.5		1/3 Ac. Res.	25	81	2050							
	10.0		1/2-1 Ac. Res.	8	80	604							
	45.6		Golf Course	35	74	2549							
	10.2		Streets & Walks	7	98	755	0.48 (5yr)					102	(5yr)
	132.4	0.207		100	76.5	7651	1.40 (100yr)	6750	1150		0.225	1020	295 (100yr)
G-1	3.5		Forest	15	66	983		1900	265	Nat. Channel	0.093		
	18.0		1 Ac. Res.	77	68	5208							
	2.0		Streets & Walks	8	98	834	0.29(5yr)						13.7(5yr)
	23.5	0.037		100	70.2	7025	1.02(100yr)	1900	265		0.093	1300	48.8(100yr)
G-1,2	3.5		Forest	11	66	724		1350	140	Open Channel	0.058		
	22.3		1 Ac. Res.	70	68	4754							
	3.1		1/3 Ac. Res.	10	72	700							
	3.0		Streets & Walks	9	98	922	0.31(5yr)					17.9	(5yr)
	31.9	0.050		100	71.0	7100	1.06(100yr)	3250	405		0.151	1160	61.3 (100yr)
G-1,2	3.5		Forest	7	66	435		1150	145	Open Channel	0.040		
&3	22.3		1 Ac. Res.	42	68	2856							
	3.1		1/3 Ac. Res.	6	72	420							
	10.2		1/2-1 Ac. Res.	19	69	1325							
	8.4		¼, 1/3 Ac.Res.	16	82	1297							
	5.6		Streets & Walks	10	98	1034	0.39 (5yr)					34.7	(5yr)
	53.1	0.083		100	73.7	7367	1.22(100yr)	4400	550		0.191	1080	109 (100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
G-1,2	3.5		Forest	5	66	323		1300	140	Open Channel	0.045		
3&4	22.3		1 Ac. Res.	31	68	2121							
	3.1		1/3 Ac. Res.	4	72	312							
	11.2		1/2-1 Ac. Res.	16	80	1253							
	10.2		1/2=1 Ac. Res.	14	69	984							
	13.5		1/4-1/3 Ac. Res.	19	82	1548	0.47 (5yr)						52.0 (5yr)
	7.7		Streets & Walks	11	98	1055	1.36 (100yr)	5700	690		0.236	1000	152 (100yr)
	71.5	0.112		100	76.0	7597							
H-1	317.2		Forest	97	78	7571		6100	2240	Nat. Channel	0.157		
	8.6		1 Ac. Res.	3	68	179		1650	225	Open Channel	0.032		
	1.0		Streets & Walks	0	98	30	0.53 (5yr)						292 (5yr)
	326.8	0.511		100	77.8	7780	1.49 (100yr)	7750	2465		0.189	1080	822 (100yr)
H-2	16.2		Forest	43	78	3334		2200	990	Nat. Channel	0.066		
	19.5		1 Ac. Res.	51	68	3499							
	2.2		Street & Walks	6	98	569	0.40 (5yr)						33.2 (5yr)
	37.9	0.059		100	74.0	7401	1.24 (100yr)	2200	990		0.066	1400	103 (100yr)
H-2,3	16.2		Forest	18	78	1442		2600	320	Open Channel	0.079		
	48.1		1 Ac. Res.	55	68	3734							
	7.5		Forest	9	66	565							
	6.2		1/3 Ac. Res.	7	72	510							
	3.1		Lake	4	98	347							
	6.5		Streets & Walk	7	98	727	0.38 (5yr)						60.9 (5yr)
	87.6	0.137		100	73.3	7325	1.20 (100yr)	4800	1310		0.145	1170	192 (100yr)
H-2,3	16.2		Forest	16	78	1251		1100	140	Nat. Channel	0.033		
&4	60.2		1 Ac. Res.	60	68	4053							
	7.5		Forest	7	66	490							
	6.2		1/3 Ac. Res.	6	72	442							
	3.1		Lake	3	98	301							
	7.8		Streets & Walks	8	98	747	0.37 (5yr)						64.2 (5yr)
	101.0	0.158		100	72.9	7294	1.17 (100yr)	5900	1450		0.178	1100	203 (100yr)
H-1,5	317.2		Forest	94	78	7392		7750	2465	Nat. Channel	0.189		
	15.7		1 Ac. Res.	5	68	319		1450	200	Open Channel	0.028		
	1.8		Streets & Walks	1	98	53	0.53 (5yr)						285 (5yr)
	334.7	0.523		100	77.6	7764	1.47 (100yr)	9200	2665		0.217	1030	792 (100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
H-1,5	317.2		Forest	82	78	6420		2750	316	Nat. Channel	0.057		
&6	49.6		1 Ac. Res.	13	68	875							
	11.1		1/3 Ac. Res.	3	72	207							
	7.5		Streets & Walks	2	98	191	0.50 (5yr)						286 (5yr)
	385.4	0.602		100	76.9	7693	1.42 (100yr)	11950	2981		0.274	950	812 (100yr)
H-7	15.0		1/2-1Ac. Res.	70	69	4814		2600	350	Nat. Channel	0.120		
	4.3		1/4-1/3 Ac. Res.	20	73	1460							
	2.2		Streets & Walks	10	98	1003	0.36 (5yr)						14.7 (5yr)
	21.5	0.034		100	72.8	7277	1.17 (100yr)	2600	350		0.120	1220	47.8 (100yr
H-1,2,	333.4		Forest	58	78	4560		11950	2981		0.274		
3,4,5,	109.8		1 Ac. Res.	19	68	1309		3150	210	Open Channel	0.080		
6,7 &8	7.5		Forest	1	66	87							
	17.3		1/3 Ac. Res.	3	72	218							
	3.1		Lake	1	98	53							
	58.7		1/2-1 Ac. Res.	10	69	710							
	16.8		1/4-1/3 Ac. Res.	3	73	215	046 (5yr)						353 (5yr)
	23.7		Streets & Walks	5	98	407	1.34 (100yr)	15100	3191		0.354	860	1027 (100yr)
	570.3	0.891		100	75.6	7560							
I-1								3950	450	Nat. Channel	0.177		
	47.9		1 Ac. Res.	90	68	6123							
	5.3		Streets & Walks	10	98	976	0.31 (5yr)						28.0 (5yr)
	53.2	0.083		100	71.0	7099	1.06 (100yr)	3950	450		0.177	1100	97.2 (100yr)
I-1,2	47.9		1 Ac. Res.	71	68	4804		1000	140	Open Channel	0.034		
	10.2		1/2-1 Ac. Res.	15	69	1038							
	2.9		1/4-1/3 Ac. Res.	4	73	312							
	6.8		Streets & Walks	10	98	983	0.32 (5yr)						35.0 (5yr)
	67.8	0.106		100	71.4	7137	1.08 (100yr)	4950	590		0.211	1040	120 (100yr)
	7.9		1 Ac. Res.	37	68	2546							
I-3	8.6		1/2-1 Ac. Res.	41	69	2812		2000	210	Nat. Channel	0.108		
	2.5		1/4-1/3 Ac. Res.	12	73	865							
	2.1		Streets & Walks	10	98	975	0.34 (5yr)						13.9 (5yr)
	21.1	0.033		100	72.0	7199	1.12 (100yr)	2000	210		0.108	1260	46.5 (100yr)
I-1,2,	55.8		1 Ac. Res.	42	68	2862		4950	590		0.211		
3 &4	49.4		1/2-1 Ac. Res.	37	69	2571		1700	200	Open Channel	0.053		
	14.1		1/4-1/3 Ac. Res.	11	73	776							
	13.3		Streets & Walks	10	98	983	0.33 (5yr)						66.2 (5yr)
	132.6	0.207		100	71.9	7191	1.12 (100yr)	6650	790		0.264	960	222 (100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
J-1	51.4		Forest	71	80	5656		3700	1900	Nat. Channel	0.094		
	17.1		Forest	23	66	1552		2350	440	Open Channel	0.060		
	3.8		1 Ac. Res.	5	68	355							
	0.4		Streets & Walks	1	98	54	0.47 (5yr)						61.7 (5yr)
	72.7	0.114		100	76.2	7617	1.38 (100yr)	6050	2340		0.154	1150	180 (100yr)
J-2	30.7		Forest	72	80	5779		2750	1140	Nat. Channel	0.081		
	10.6		1 Ac. Res.	25	68	1696							
	1.2		Streets & Walks	3	98	277	0.52 (5yr)						48.6 (5yr)
	42.5	0.066		100	77.5	7751	1.46 (100yr)	2750	1140		0.081	1400	136 (100yr)
J-2,3	30.7		Forest	42	80	3355		1550	220	Open Channel	0.045		
	38.2		1 Ac. REs.	52	68	3549							
	4.3		Streets & Walks	6	98	576	0.42 (5yr)						58.2 (5yr.)
	73.2	0.114		100	74.8	7479	1.29 (100yr)	4300	1360		0.126	1200	177 100yr)
J-1,2	82.1		Forest	44	80	3486		6050	2340				
3&4	17.1		Forest	9	66	599		2350	250	Open Channel	0.154		
	77.3		1 Ac. Res.	41	68	2790							
	2.8		1/3 Ac. Res.	1	72	107							
	9.1		Street & Walks	5	98	473	0.42 (5yr)						126 (5yr)
	188.4	0.294		100	74.6	7455	1.27 (100yr)	8400	2590		0.219	1030	386 (100yr)
J-5	79.0		Forest	96	80	7717		3200	1880	Nat. Channel	0.080		
	2.6		1 Ac. Res.	3	68	216		2250	440	Open Channel	0.055		
	0.3		Streets & Walks	1	98	36	0.61 (5yr)						93.8 (5yr)
	81.9	0.128		100	79.7	7969	1.61 (100yr)	5450	2320		0.135	1200	248 (100yr)
J-5,6	79.0		Forest	84	80	6723		1800	200	Open Channel	0.052		
	9.9		1 Ac. Res.	10	68	716							
	3.4		1/3 Ac. Res.	4	72	260							
	1.7		Streets & Walks	2	98	177	0.57 (5yr)						91.6 (5yr)
	94.0	0.147		100	78.8	7877	1.55 (100yr)	7250	2520		0.187	1090	248 (100yr)
J-1,2,	161.1		Forest	53	80	4223		8400	2590		0.219		
3,4,5,	17.1		Forest	6	66	370		750	70	Open Channel	0.021		
6 &7	99.1		1 Ac. Res.	32	68	2208							
	8.1	1/4-	1/3 Ac. Res.	3	73	194							
	6.7		1/2-1 Ac. Res.	2	69	152							
	13.1		Streets & Walk	4	98	421	0.45 (5yr)						217 (5yr)
	305.2	0.477		100	75.7	7567	1.34 (100yr)	9150	2660		0.240	1000	641 (100yr)

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
	13.4		1 Ac. Res.	56	68	3845							
J-8	1.8		1/4-1/3 Ac. Res.	8	73	554		2600	290	Nat. Channel	0.129		
	6.2		1/2-1 Ac. Res.	26	69	1805							
	2.3		Streets & Walks	10	98	951	0.32 (5yr)						14.3 (5yr)
	23.7	0.037		100	71.6	7155	1.10 (100yr)	2600	290		0.129	1200	48.7 (100yr
J-1,2,	161.1		Forest	46	80	3685		9150	2660		0.240		
3,4,5,	17.1		Forest	5	66	323		650	60	Open Channel	0.016		
6,7,8	112.5		1 Ac. Res.	32	68	2188							
&9	14.1		1/4-1/3 Ac. Res.	4	73	294							
	27.4		1/2-1 Ac. Res.	8	69	541							
	17.5		Streets & Walks	5	98	490	0.44 (5yr)						235 (5yr)
	349.7	0.546		100	75.2	7521	1.31 (100yr)	9800	2720		0.256	980	704 (100yr)
K-1	5.8		1 Ac. Res.	46	68	3155		2300	240	Nat. Channel	0.120		
	4.3		1/2-1 Ac. Res.	34	69	2374							
	1.2		1/4-1/3 Ac. Res.	10	73	701							
	1.2		Streets & Walks	10	98	941	0.33 (5yr)						7.8 (5yr)
	12.5	0.020		100	71.7	7170	1.10 (100yr)	2300	240		0.120	1220	26.3 (100yr)
K-1,2	5.8		1 Ac. Res.	15	68	1033		2000	180	Open Channel	0.090		
	22.3		1/2-1 Ac. Res.	58	69	4028							
	6.3		1/4-1/3 Ac. Res.	17	73	1204							
	3.8		Streets & Walks	10	98	975	0.35 (5yr)						21.6 (5yr)
	38.2	0.060		100	72.4	7239	1.14 (100yr)	4300	420		0.210	1040	71.0 (100yr)
L-1	93.5		Forest	54	80	4329		3000	1820	Nat. Channel	0.075		
	36.5		Forest	21	66	1394		3300	500	Open Channel	0.081		
	38.5		1 Ac. Res.	22	68	1515							
	4.3		Streets & Walks	3	98	244	0.42 (5yr)						131 (5yr)
	172.8	0.270		100	74.8	7482	1.29 (100yr)	6300	2320		0.156	1140	397 (100yr)
L-1,2	93.5		Forest	48	80	3876		900	80	Open Channel	0.025		
	36.5		Forest	20	66	1248							
	46.1		1 Ac. Res.	24	68	1624							
	8.3		1/2-1 Ac. Res.	4	69	297							
	2.3		1/4-1/3 Ac. Res.	1	73	87	0.41 (5yr)						138 (5yr)
	6.3		Streets & Walks	3	98	320	1.27 (100yr)						422 (100yr)
	193.0	0.302		100	74.5	7452		7200	2400		0.181	1100	

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
	93.5		Forest	47	80	3740							
L-1,2,	36.5		Forest	18	66	1205		500	60	Open. Channel	0.013		
&3	46.1		1 Ac. Res.	23	68	1567							
	13.2		1/2-1 Ac. Res.	7	69	455							
	3.7		1/4-1/3 Ac. Res.	2	73	135							
	7.0		Streets & Walks	3	98	343	0.41 (5yr)						138 (5yr)
	200.0	0.313		100	74.5	7446	1.27 (100yr)	7700	2460		0.194	1070	424 (100yr)
M-1	202.9		Forest	93	80	7466		5050	2330	Nat. Channel	0.125		
	14.5		Forest	7	66	440	0.58 (5yr)	2050	400	Open Channel	0.039		222 (5yr)
	217.4	0.340		100	79.1	7906	1.57 (100yr)	7100	2730		0.164	1120	597 (100yr
	202.9		Forest	83	80	6658							
M-1,2	14.5		Forest	6	66	393		2500	280	Open Channel	0.058		
	18.5		1/2-1 Ac. Res.	8	69	524							
	5.3		1/4-1/3 Ac. Res.	2	73	159							
	2.6		Streets & Walks	1	98	105	0.56 (5yr)						218 (5yr)
	243.8	0.381		100	78.4	7837	1.52 (100yr)	9600	3010		0.222	1030	598 (100yr)
	202.9		Forest	77	80	6158							
M-1,2	14.5		Forest	6	66	363		400	60	OpenChannel	0.008		
&3	32.3		1/2-1 Ac. Res.	12	69	846							
	9.3		1/4-1/3 Ac. Res.	3	73	258							
	4.6		Streets & Walks	2	98	171	0.54 (5yr)						227 (5yr)
	263.6	0.412		100	78.0	7795	1.49 (100yr)	10,000	3070		0.230	1020	628 (100yr)
N-1	7.9		1/3-1/4 Ac. Res.	20	73	1467		2950	400	Nat. Channel	0.132		
	27.5		1/2-1 Ac. Res	70	69	4828							
	3.9		Streets & Walks	10	98	973	0.36 (5yr)						26.0 (5yr)
	39.3	0.061		100	72.7	7268	1.16 (100yr)	2950	400		0.132	1190	84.8 (100yr
N-1,2	8.6		1/3-1/4 Ac. Res.	20	73	1460		400	20	Open Channel	0.021		
	30.1		1/2-1 Ac. Res.	70	69	4830							
	4.3		Streets & Walks	10	98	980	0.36 (5yr)						27.5 (5yr)
	43.0	0.067		100	72.7	7270	1.16 (100yr)	3350	420		0.153	1150	89.8 (100yr)
O-1	12.7		Forest	47	80	3763		1300	1200	Nat. Channel	0.034		
	14.3		Forest	53	66	3496	0.35 (5yr)	2050	520	Open Channel	0.062		19.1 (5yr)
	27.0	0.042		100	72.6	7259	1.16 (100yr)	3350	1720		0.096	1280	63.4 (100yr

DRAINAGE CALCULATIONS

BASIN	ACREAGE	SQ.MI.	LAND USE	%	CN	% x CN	RUNOFF Q(IN.)	L (ft.)	H (FT.)	FLOW TYPE	tc (hrs.)	qP (CSM/In.)	q (cfs)
O-1,2	8.3		1/4-1/3 Ac. Res.	12	73	882		1950	240	Open Channel	0.068		
	12.7		Forest	19	80	1479							
	14.3		Forest	21	66	1374							
	29.2		1/2-1 Ac. Res.	42	69	2933							
	4.2		Streets & Walks	6	98	599	0.36(5yr.)						42.7(5yr)
	68.7	0.107		100	72.7	7267	1.16(100yr)	5300	1960		0.164	1120	139(100yr)
O-1,2 &3	10.3		1/4-1/3 Ac. Res.	13	73	949		650	40	Open Channel	0.028		
	12.7		Forest	16	80	1283							
	14,3		Forest	18	66	1192							
	36.6		1/2-1 Ac. Res.	46	69	3189							
	5.3		Streets & Walks	7	98	656	0.36(5yr)						47.6(5yr)
	79.2	0.124		100	72.7	7268	1.16(100yr)	5950	2000		0.192	1080	155(100yr)

CERTIFICATIONS AND APPROVALS:

Registered Engineer

I, Thomas C. Little, a registered engineer in the State of Colorado, hereby certify that the attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. I further certify that said drainage report is in accordance with all City of Colorado Springs ordinances and specifications and criteria.

Thomas C. Little, Registered Professional Engineer, 10929

THOMAS C. LITTLE REGISTERED 10929 PROFESSIONAL ENGINEER STATE OF COLORA

Developer

The developer has read and will comply with all of the requirements specified in the drainage report, as approved by the City Engineer.

By: David R Sellen

Title _____

Complete ~~Approved~~

City of Colorado Springs, Department of Public Works

Date June 25, 1982

Comments:

Outlet peak flow from Basin H shall be limited to the capacity with adequate freeboard of downstream structures.

Based upon best available information, there are no designated floodplains within the Broadmoor South & Neal Ranch Master Drainage Plan Basin.