jr

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Wonument Unurisy Peregrine

Colorado Springs
Denver
Phoenix

Engineering
Planning
Surveying

MASTER DEVELOPMENT DRAINAGE PLAN

FOR

THE WEST MONUMENT CREEK BASIN

AT PEREGRINE

JANUARY, 1990

PRELIMINARY

Prepared For:

PEREGRINE JOINT VENTURE
7710 North Union Boulevard
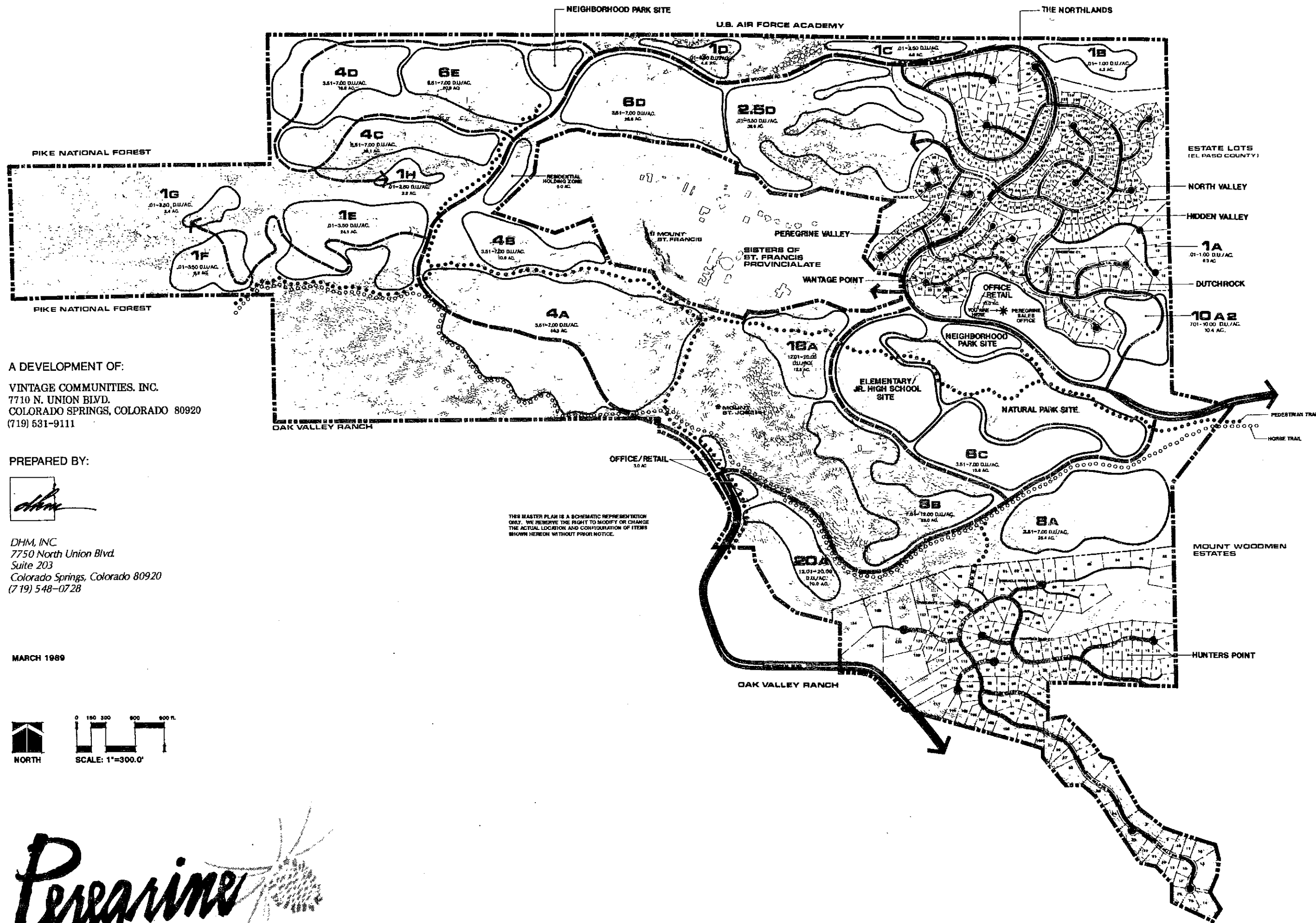Colorado Springs, Colorado 80918
(719) 531-6565

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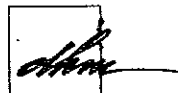(719) 593-2593

Job Number 8030.75

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NEIGHBORHOOD PARK SITE

U.S. AIR FORCE ACADEMY

THE NORTHLANDS

PIKE NATIONAL FOREST

PIKE NATIONAL FOREST

OAK VALLEY RANCH

ESTATE LOTS
(EL PASO COUNTY)

NORTH VALLEY

HIDDEN VALLEY

DUTCHROCK

PEREGRINE VALLEY

RESIDENTIAL
HOLDING ZONE
9.0 AC.

MOUNT
ST. FRANCIS

SISTERS OF
ST. FRANCIS
PROVINCIALATE

VANTAGE POINT

OFFICE
RETAIL

PEREGRINE
SALES
OFFICE

NEIGHBORHOOD
PARK SITE

ELEMENTARY/
JR. HIGH SCHOOL
SITE

NATURAL PARK SITE

MOUNT
ST. JOSEPH

OFFICE/RETAIL
3.0 AC.

THIS MASTER PLAN IS A SCHEMATIC REPRESENTATION
ONLY. WE RESERVE THE RIGHT TO MODIFY OR CHANGE
THE ACTUAL LOCATION AND CONFIGURATION OF ITEMS
SHOWN HEREON WITHOUT PRIOR NOTICE.

PEDESTRIAN TRAIL

HORSE TRAIL
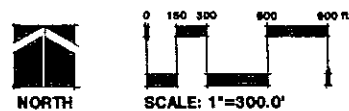
MOUNT WOODMEN
ESTATES

HUNTERS POINT

OAK VALLEY RANCH

A DEVELOPMENT OF:

VINTAGE COMMUNITIES, INC.
7710 N. UNION BLVD.
COLORADO SPRINGS, COLORADO 80920
(719) 531-9111

PREPARED BY:

DHM, INC.
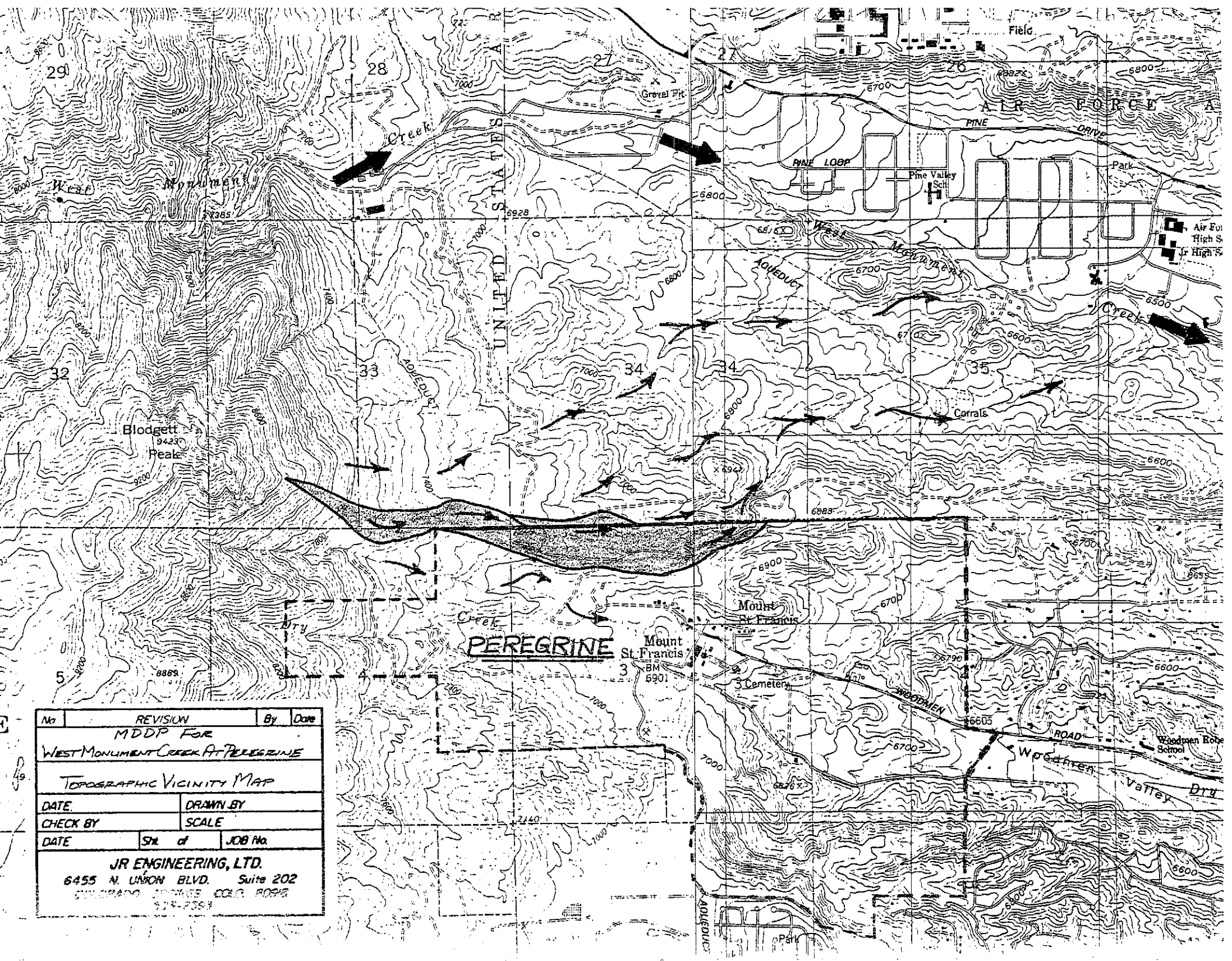7750 North Union Blvd.
Suite 203
Colorado Springs, Colorado 80920
(719) 548-0728

MARCH 1989

NORTH

SCALE: 1"=300.0'

0   150   300   600   900 ft.

Peregrine

PEREGRINE

Blodgett
Peak
9423

Mount
St Francis

Mount
St Francis
BM
6901

Cemetery

Corrals

AIR FORCE A

PINE DRIVE

PINE LOOP

Pine Valley
Sch

Air For
High S
Jr High S

UNITED STATES

AQUEDUCT

WOODMEN ROAD

Woodmen Rob
School

Woodmen Valley Dry

West Monument

Creek

Gravel Pit

UNITED STATES AIR FORCE ACADEMY

MOUNT ST. FRANCIS

WOODMEN VALLEY

MASTER DEVELOPMENT DRAINAGE PLAN
THE WEST MONUMENT CREEK BASIN

INTRODUCTION

The purpose of this report is to present the Master Development Drainage Plan for Peregrine within the West Monument Creek Basin. The Master Development Drainage Plan illustrates the conceptual level layout and sizing of the major storm drainage improvements planned for Peregrine within the West Monument Creek Basin. This report describes the storm drainage patterns of the project area, the design criteria used, and the analysis that has been done. The Master Development Drainage Plan is intended to serve as an overall guide for planning and design of the storm drainage improvements for this basin within Peregrine, and as the basis for the more detailed preliminary and final drainage reports that will be done as the various portions of the project are developed in the future.

GENERAL PROJECT LOCATION AND DESCRIPTION

Peregrine is a 1,112 acre multi-use planned development within Sections 2, 3, 4, 10, and 11, Township 13 South, Range 67 West of the Sixth Principal Meridian, in the City of Colorado Springs, Colorado. The project is bounded by the United States Air Force Academy on the north, Pike National Forest on the west, Oak Valley Ranch and Ptmarigan Valley on the south, and Mount Woodmen Estates and unplatted unincorporated El Paso County on the east.

The portion of the West Monument Creek Basin affecting the Peregrine development is within Sections 33 and 34, Township 12 South, as well as Sections 3 and 4, Township 13 South. Please refer to the enclosed vicinity map which illustrates the general location of the subject study area.

The land uses currently planned for Peregrine include single family residential with densities between 0 and 7 dwelling units per acre, as well as parks and open space. Areas within the project that do not have a land use identification will be open space. The areas planned for these different land uses are shown on the Developed Conditions Basin Map included in the Appendix. This land use information was obtained from the "Peregrine Master Plan" approved by City Council July 10, 1984 per Resolution 227-84.

EXISTING DRAINAGE BASIN DESCRIPTION

The West Monument Creek Basin at Peregrine is tributary to West Monument Creek that flows through and south of existing Air Force Academy improvements. Please refer to the enclosed vicinity map. The 113 acre portion of the basin affecting Peregrine collects surface runoff from Blodgett Peak to flow easterly as sheet flows and natural drainage swales. After leaving the Peregrine development's north property line, the cumulative runoff flows northeasterly to the bottom of West Monument Creek. The study area does not lie within a designated flooplain as shown on the F.E.M.A. map of this area, No. 080060-0134-C, dated March 2, 1989.

The existing terrain varies from steep mountainous terrain at the western extreme of this study area, to rolling foothills with 7% to 12% natural slopes. The mountainous upstream portion is in the Pike National Forest with heavy tree cover. The lower foothills are vegetated with range grass, Gambel oak, and scattered pine trees. The U.S.D.A. Soil Conservation Service designations of soils affecting the site include (#38) Jarre-Tecolote gravelly sandy loam, and (#37) Jarre gravelly sandy loam. Both deposits are categorized as Hydrologic Group B soils.

DRAINAGE CRITERIA

This Master Development Drainage Plan for the West Monument Creek Basin at Peregrine applies the current Drainage Criteria as defined in the October, 1987 Drainage Criteria Manual. The two historic points of discharge have contributing areas of 59 acres and 54 acres. Given that these areas are less than 100 acres, we have applied a Rational Method in our analysis of the 10-year and 100-year frequency storms.

HISTORIC RUNOFF CHARACTERISTICS

To illustrate the following discussion of historic runoff, please refer to the enclosed Existing Condition Basin Map. Pike National Forest flows constitute the offsite flows entering the site at Design Point 10. These flows are carried within a relatively well defined natural drainage swale to Design Point 20 where these historic flows enter the United States Air Force Academy (USAFA) property. An additional small onsite basin also presently discharges to the USAFA property at Design Point 30, but is not included in the routed flow calculations from Design Points 10 to 20. The historic 10-year peak discharges entering the USAFA property from Design Points 20 and 30 are 21.4 CFS and 4.6 CFS. Similarly, the respective 100-year flows are 47.1 CFS and 9.9 CFS.

Historic flows within the balance of the Peregrine property consist of sheet flows that accumulate within deep natural drainage swales before entering the USAFA property. Flow calculations have routed the upper Design Point 40 basin through Design Point 50 before joining the flows from Design Point 60. The cumulative historic runoff into the USAFA property at Design Point 70 is 32.7 CFS for the 10-year storm and 68.6 CFS for the 100-year storm.

DEVELOPED RUNOFF CHARACTERISTICS

As with the previous discussion, please refer to the enclosed
Developed Condition Basin Map that illustrates the following
discussion. The future alignment of Woodmen Road is shown extend-
ing west from the North Basin, crossing the West Monument Creek
Basin, and continuing into the Dry Creek Basin. At Design Point
40, a residential road intersects Woodmen Road and continues west
until it too crosses into the Dry Creek Basin.

Because this future residential road is anticipated to service
residential lots as shown, we have projected the interception of
a 5.6 acre portion of the future Dry Creek Basin residential
development. This basin transfer at Design Point 15 has been
calculated with a 10-year storm flow of 10.5 CFS and a 100-year
storm flow of 18.6 CFS.

East of Design Point 15, a proposed single family residential
development is planned as shown. This preliminary site plan
incorporates the proposed location of a water tank. It also
shows the feasibility of front draining lots west of Design Point
20. The proposed development plan maintains historic flow condi-
tions in the back yards, thereby discharging to the USAFA prop-
erty at (or below) the historic runoff rates.

At Design Point 40, the proposed residential flows are accumu-
lated, including the routed flows from Design Point 15. The main
road through this area is anticipated to be a residential classi-
fication roadway, with a 36' curb width on a 60' right-of-way.
Preliminary design grades vary from a minimum of 4% to a maximum
of 10%. The minimum street capacity during the 10-year storm is
46 CFS. The minimum street capacity during the 100-year storm,
calculated at an 8" gutter depth rather than the allowed 12", is
142 CFS. This compares favorably with Design Point 40's 10-year
storm flow of 35.0 CFS and 100-year storm flow of 69.0 CFS.

- 4 -

Woodmen Road will receive the Design Point 40 surface flows. It is classified as a collector status roadway, with a 40' curb width on a 60' right-of-way. Preliminary design grades vary from a minimum of 4% to a maximum of 8%. With the 100-year storm capacity also calculated with an 8" gutter depth, the minimum street capacities for the 10-year storm is 61 CFS and the 100-year storm is 146 CFS. Storm sewer inlets are anticipated at Design Point 50 with 10-year and 100-year storm flows of 46.8 CFS and 90.2 CFS in Woodmen Road at that point.

The single family residential area received by Design Point 65 is not planned. What is shown is a reasonable expectation of road alignments. The critical issue here is that the existing North Basin detention pond was not designed to receive West Monument Creek flows. Also, the proposed continuous grade of Woodmen Road prohibits interception of all storm waters. Therefore, the 3.8 acre North Basin transfer is proposed to allow an equivalent amount of Woodmen Road storm water to bypass intercepting inlets for a basin transfer to the North Basin. To facilitate this will require a 100% interception of storm flows at Design Point 65. This will most likely be accomplished with a future storm collection system, including sump condition inlets at Design Point 65 to be piped under Woodmen Road.

Woodmen Road interception has been assumed for the purposes of this report. At Design Point 50, sufficient inlets for a 50% interception is assumed for a 10-year storm interception of 23.4 CFS and a 100-year storm interception of 45.1 CFS. At Design Point 60, an additional interception of 13.1 CFS (10-year) and 25.4 CFS (100-year) is assumed. This results in a 10-year storm flow bypass of 11.5 CS and a 100-year strom flow bypass of 22.2 CFS at Design Point 60. The net bypass flows are transferred into the North Basin.

The discharge of the Design Point 50 facilities, which are 17% larger than historic 10-year flows and 7% larger than historic 100-year flows, are anticipated to be carried by the natural drainage swale to Design Point 70 facilities. The discharge of the Design Point 60 facilities, including the 100% interception of Design Point 65, will be carried by pipe or lined channel to the Design Point 70 facilities. Energy dissipation and erosion protection measures will be subject to the review of the City during the preliminary and final drainage report(s).

A detention pond facility is anticipated at Design Point 70 to discharge at (or below) historic rates to the USAFA property. Developed runoff entering the facility is calculated at 76.5 CFS (10-year) and 145.6 CFS (100-year). Historic runoff discharging from the facility is calculated at 32.7 CFS (10-year) and 68.6 CFS (100-year). The preliminary calculation of the detention volume required is 2.9 acre-feet. An assumed 7' average depth is assumed for the preliminary area requirement of an 18,000 square foot detention facility shown on the Basin Map. The detention facility, with its outlet works, impact basin, and erosion protection will be subject to the review of the City during the preliminary and final drainage report(s).

CONSTRUCTION COSTS AND FEES

The West Monument Creek Drainage Basin is currently subject to the City's Miscellaneous Drainage Basin Fees at (1990) $3,341 per acre. Since the ultimate discharge from all proposed development improvements will be at (or below) historic rates, this Master Development Drainage Plan is submitted for approval as a closed basin. The developer will construct required improvements in lieu of fees.

APPENDIX

Channel Flow T_c :

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} = VA \quad , \quad \text{Use } n = 0.040$$

$$V = (37.15 \, R^{2/3}) S^{1/2} \quad , \quad \text{Assume Flow Depth} = 0.5'$$

Side Slope	$R @ D = 0.5$ ($^{2/3}$)	Velocity Equation
3:1	0.38	$V = 14.23 \, S^{1/2}$
5:1	0.39	$V = 14.54 \, S^{1/2}$
10:1	0.40	$V = 14.69 \, S^{1/2}$
20:1	0.40	$V = 14.72 \, S^{1/2}$

✱ USE AVERAGE VELOCITY EQUATION, $V = \boxed{14.5 \, S^{1/2} \text{ FPS} \left(60 \frac{s}{m}\right)}$

$$\boxed{V = 870 \, S^{1/2} \text{ LF/MIN}}$$

DP-10

1200 LF @ S=67% : $T_c = 1.87(1.1-0.10) 1200^{.5} 67^{-.33} = 16.2$ min

600 LF @ S=33% : $T_c = 600/870 (33)^{.5} = 1.2$ min

1100 LF @ S=18% : $T_c = 1100/870 (18)^{.5} = 3.0$ min

1500 LF @ S=11% : $T_c = 1500/870 (11)^{.5} = 5.1$ min

DP-10, $T_c = 25.5$ min

DP-20

2200 LF @ S=10% : $T_c = 2200/870(10)^{.5} = 8.0$ min

DP-20, $T_c = 33.5$ min

DP-30

300 LF @ S=20% : $T_c = 1.87(1.1-.25) 300^{.5} 20^{-.33} = 10.2$ min

DP-30, $T_c = 10.2$ min

_DP-40_

1000 LF @ $S = 10\%$ :: $T_c = 1.87(1.1 - .25)1000^{.5}10^{-.33} = 23.5$ min

1100 LF @ $S = 8\%$: $T_c = 1100/870(.08)^{.5} = 4.5$ min

DP-40, $T_c = 28.0$ min

_DP-50_

1200 LF @ $S = 7\%$: $T_c = 1200/870(.07)^{.5} = 5.2$ min

DP-50, $T_c = 33.2$ min

_DP-60_

1000 LF @ $S = 7\%$: $T_c = 1.87(1.1 - .25)1000^{.5}7^{-.33} = 26.4$ min

800 LF @ $S = 7\%$: $T_c = 800/870(.07)^{.5} = 3.5$ min

DP-60, $T_c = 29.9$ min

_DP-70_

1200 LF @ $S = 12\%$: $T_c = 1200/870(.12)^{.5} = 4.0$ min

(+ DP-50, T_c =)   DP-70 $T_c = 37.2$ min

DP-10

UNCHANGED FROM HISTORIC $T_c = 25.5$ MIN

DP-20

UNCHANGED FROM HISTORIC $T_c = 33.5$ MIN

DP-30

250 LF @ S = 20% : $T_c = 1.87(1.1 - .80)250^{.5} 20^{-.33} = 8.8$ MIN

DP-30, $T_c = 8.8$ MIN

DP-15

200 LF @ S = 15%, $T_c = 1.37(1.1 - .25)200^{.5} 15^{-.33} = 9.2$ MIN

500 LF @ S = 12%, $T_c = 1.87(1.1 - .55)500^{.5} 12^{-.33} = 10.1$ MIN

300 LF @ S = 6.7%, $T_c = 300/(58.65(.067)^{.5} 60) = 0.3$ MIN

300 LF @ S = 10%, $T_c = 300/(58.65(.10)^{.5} 60) = 0.3$ MIN

DP-15, $T_c = 19.9$ MIN

DP-40

835 LF @ S = 9.2%, $T_c = 835/(58.65(.092)^{.5} 60) = 0.8$ MIN

843 LF @ S = 7.3%, $T_c = 843/(58.65(.073)^{.5} 60) = 0.9$ MIN

DP-40, $T_c = 21.6$ MIN

DP-50

245 @ S = 4.8%, $T_c = 245/(58.65(.048)^{.5} 60) = 0.3$ MIN

1245 @ S = 6.2%, $T_c = 1245/(58.65(.062)^{.5} 60) = 1.4$ MIN

DP-50, $T_c = 23.3$ MIN

DP-60

FROM WOODMEN RD DP-50

$T_c = 455/(58.65(.04)^{.5} 60) = 0.6$

DP-60, $T_c = 23.9$ MIN

DP-65

1900' @ S = 5.8%, $T_c = 1900/(58.65(.058)^{.5} 60) = 2.2$

DP65, $T_c = 2.2$ MIN

DP-70 (FROM DP-60 INLETS @ $T_c = 23.9$ MIN)

1200' @ 12%, $T_c = 1200/870(.12)^{.5} = 4.0$ MIN   DP70, $T_c = 27.9$ MIN

$Q = ACi$

A – acres   I – min
I – inches/hr   V – ft/sec
Q – cfs

HISTORIC FLOW
COMPUTATION FORM
DRAINAGE & STORM SEWER DESIGN
RATIONAL METHOD

Project *W. Monument Cr. MDDP*
Comp. by *MH* date *12/87*
Ck by _____ date _____

STREET	FROM	TO	A INCRE-MENT	A TOTAL	C	TIME OF CONCENTRATION TO INLET	TIME OF CONCENTRATION PIPE OR CHANNEL	i	Q	SIZE	SLOPE %	n	CAP. FULL	V	LENGTH FT.	FALL FT.	OTHER LOSSES	UPPER INV. EL.	LOWER INV. EL.
DP-10	OFFSITE		36.60		.10			3.0	$Q_{10} = 11.0$										
					.15		25.5	4.5	$Q_{100} = 24.7$										
DP-20			18.33		.25														
					.35														
DP-20				54.93	.15			2.6	21.4										
					.22		33.5	3.9	47.1										
DP-30			4.04		.25			4.6	4.6										
					.35		10.2	7.0	9.9										
DP-40			19.48		.25			2.8	13.6										
					.35		28.0	4.3	29.3										
DP-50			11.36																
DP-50				30.84	.25			2.6	20.0										
					.35		33.2	3.9	42.1										
DP-60			12.47		.25			2.7	8.4										
					.35		29.9	4.1	17.9										
DP-70			11.17																
DP-70				54.48	.25			2.4	32.7										
					.35		37.2	3.6	68.6										

$$Q = ACi$$

A – acres   I – min
I – inches/hr   V – ft/sec
Q – cfs

<u>DEVELOPED FLOW</u>
COMPUTATION FORM
DRAINAGE & STORM SEWER DESIGN
RATIONAL METHOD

LOCATION			A		C	TIME OF CONCENTRATION		i	Q	DESIGN					PROFILE				
STREET	FROM	TO	INCRE-MENT	TOTAL		TO INLET	PIPE OR CHANNEL			SIZE	SLOPE %	n	CAP. FULL	V	LENGTH FT.	FALL FT.	OTHER LOSSES	UPPER INV EL.	LOWER INV EL.
DP-10	OFFSITE		36.60		.10			3.0	Q5=11.0										
					.15		25.5	4.5	Q100=24.7										
DP-20			16.17		.25														
					.35														
DP-20				52.77	.15			2.6	20.6										
					.21		33.5	3.9	43.2										
DP-30			2.94		.30			4.7	4.1										
					.40		8.8	7.3	8.6										
DP-15	DRY CR		5.60		.55			3.4	10.5										
					.65		19.9	5.1	18.6										
DP-40			19.09		.40														
					.55														
DP-40				24.69	.43			3.3	35.0										
					.57		21.6	4.9	69.0										
DP-50			7.83		.52														
					.66														
DP-50				32.52	.45			3.2	46.8										
					.59		23.3	4.7	90.2										
DP-50 INLETS			16.26		.45			3.2	23.4										
					.59		23.3	4.7	45.1										

Q = ACi
A – acres t – min
I – inches/hr. V – ft/sec
Q – cfs

DEVELOPED FLOW
COMPUTATION FORM
DRAINAGE & STORM SEWER DESIGN
RATIONAL METHOD

Project W Monument Cr. MDDP
Comp. by M.H. date 12/89
Ck by _____ date _____

STREET	FROM	TO	A INCRE-MENT	A TOTAL	C	TO INLET	PIPE OR CHANNEL	i	Q	SIZE	SLOPE %	n	CAP FULL	V	LENGTH FT.	FALL FT.	OTHER LOSSES	UPPER INV EL.	LOWER INV EL.
DP-50 BY PASS			16.26		.45			3.2	23.4										
					.59		23.3	4.7	45.1										
DP-60			.61		.90														
					.95														
DP-60				16.87	.47			3.1	24.6										
					.60		23.9	4.7	47.6										
DP-60 INLETS		60 PIPE	9.00		.47			3.1	13.1										
					.60		23.9	4.7	25.4										
DP-60 BY PASS	TRANSFER	N. BASIN	7.87		.47			3.1	11.5										
					.60		23.9	4.7	22.2										
TRANSFER	N. BASIN	DP-65	3.8		.55			6.0	12.5										
					.65		2.2	9.0	22.2										
DP-65 PIPE		60 PIPE	22.96		.55			6.0	75.8										
					.65		2.2	9.0	134.3										
DP-60 PIPE				31.96	.53			4.5	75.8										
					.63		11.0	6.7	134.3										
DP-70			11.17		.27														
					.37														
DP-70		DETENTION		59.39	.46			2.8	76.5										
					.57		27.9	4.3	145.6										
DP-70 HISTORIC	DETENTION	OFFSITE		54.48	.25			2.4	$Q_{10}=32.7$										
					.35		37.2	3.6	$Q_{10}=62.6$										

Woodmen Road : Collector Street Classification

Cross Section = 40' Face To Face On 60' ROW

Initial Storm Capacity : $Q = 2[151.5(S)^{.5}]$

@ DP-40, $Q = 303(.048)^{.5} = 66$ CFS

@ DP-50, $Q = 303(.062)^{.5} = 75$ CFS

@ DP-60, $Q = 303(.04)^{.5} = 61$ CFS

Major Storm Capacity : Use 8" Max $Q = 731 S^{1/2}$

@ DP-40, $Q = 731(.048)^{.5} = 160$ CFS

@ DP-50, $Q = 731(.062)^{.5} = 182$ CFS

@ DP-60, $Q = 731(.04)^{.5} = 146$ CFS

Pike Forest Drive : Residential Classification

Cross Section = 36' Face To Face On 60' ROW

Initial Storm Capacity : Use $Q = 2[114.4(S)^{.5}]$

@ DP-15, $Q = 228.8(.10)^{.5} = 72$ CFS

@ DP-40, $Q = 228.8(.04)^{.5} = 46$ CFS

Major Storm Capacity : Use 8" Max $Q = 709 S^{1/2}$

@ DP-15, $Q = 709(.10)^{.5} = 224$ CFS

@ DP-40, $Q = 709(.04)^{.5} = 142$ CFS

Calculate Detention Facility For Historic $Q_{100} = 68.6$

With Developed Q_{100} Constant, $[CA = (.57) 59.39 = 33.85]$

TIME (MIN)	CA	INTENSITY	VOL IN (CF)	Q OUT (CFS)	VOL OUT (CF)	DETENTION (CF)
5	33.85	9.0	91,400	68.6	20,600	70,800
10	33.85	7.0	142,200	68.6	41,200	101,000
15	33.85	5.8	176,700	68.6	61,700	115,000
20	33.85	5.1	207,200	68.6	82,300	124,900
25	33.85	4.5	228,500	68.6	102,900	125,600
30	33.85	4.1	249,800	68.6	123,500	126,300
35	33.85	3.8	270,100	68.6	144,100	126,100
40	33.85	3.4	276,200	68.6	164,600	111,600

Preliminary Detention Requirement = 126,300 CF

- Assume 7 Average Depth

- Preliminary Area Required = 18,000 SF