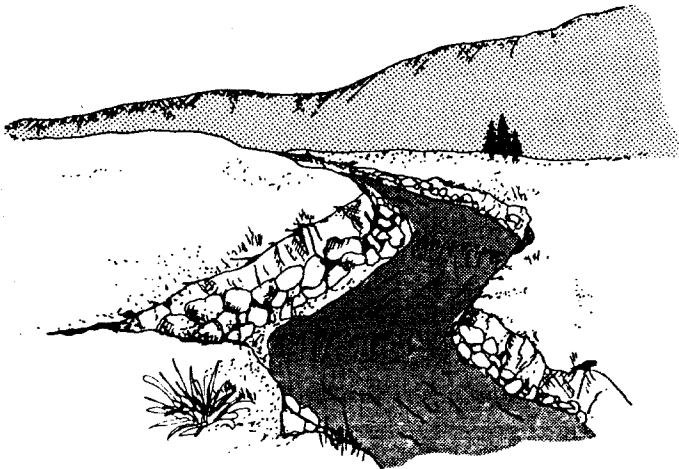


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Monument Branch Drainage Basin Planning Study

City of Colorado Springs
and El Paso County



April, 1987

MONUMENT BRANCH DRAINAGE BASIN
PLANNING STUDY
APRIL 13, 1987
JUNE 22, 1987 (REV.)
AUGUST 6, 1987 (REV.)

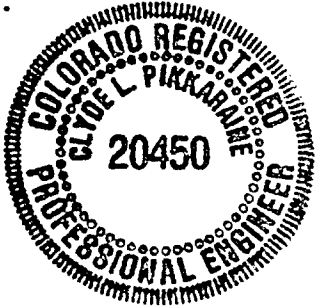
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URS Corporation Project No. 46382

CERTIFICATION

I, Clyde L. Pikkaraine, a Registered Engineer in the State of Colorado, hereby certify that the attached Planning Study for the Monument Branch Drainage Basin was prepared under my direction and supervision and is correct to the best of my knowledge and belief.



Clyde L. Pikkaraine

Clyde L. Pikkaraine, P.E.

APPROVAL

The El Paso County Board of Commissioners and Department of Transportation do hereby approve the contents of the attached Monument Branch Drainage Basin Planning Study. The Study shall be used as a guide for development of all drainage facilities within the study area.

Max L. Rothschild

Department of Transportation
(SEE ALSO ATTACHED MINUTES
OF THE CITY/COUNTY
DRAINAGE BOARD)

(SEE ATTACHED RESOLUTION)

Board of Commissioners
(SEE ALSO ATTACHED MINUTES
OF THE EL PASO COUNTY
PLANNING COMMISSION)

APPROVAL

The City of Colorado Springs City Council and Department of Public Works do hereby approve the contents of the attached Monument Branch Drainage Basin Planning Study. The Study shall be used as a guide for development of all drainage facilities within the study area.

Gary R. Hayes

Department of Public Works
(SEE ALSO ATTACHED MINUTES
OF THE CITY/COUNTY
DRAINAGE BOARD)

(SEE ATTACHED RESOLUTION)

City Council

MONUMENT BRANCH DRAINAGE BASIN PLANNING STUDY

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o Amendments to the County Master Plan Approval
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- o 100 yr. 24-hour
- o 100 yr. 2-hour
- o 10 yr. 24-hour
- o 10 yr. 2-hour

Recommended

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I. PURPOSE AND SCOPE

The purpose of this study is to define the general nature and approximate location of improvements required to meet present (1987) El Paso County and City of Colorado Springs drainage design criteria and to establish drainage and bridge fees for the basin. This study is conceptual in nature and excludes establishing the exact design of required drainage improvements.

The Monument Branch Drainage Basin is located in the northern outskirts of the City of Colorado Springs and in El Paso County. The basin generally lies between Interstate 25 to the west, Northgate Road to the north and State Highway 83 to the east and south.

The Monument Branch Drainage Basin does not have a previously approved Planning Study. The majority of the basin is not developed at this time. This study evaluates the present conditions of the major channels along with providing recommendations for future fully developed conditions. The recommended overall basin plan is considered to be the alternative most compatible with projected land use and environmental concerns and the most cost effective.








II. BASIN DESCRIPTION

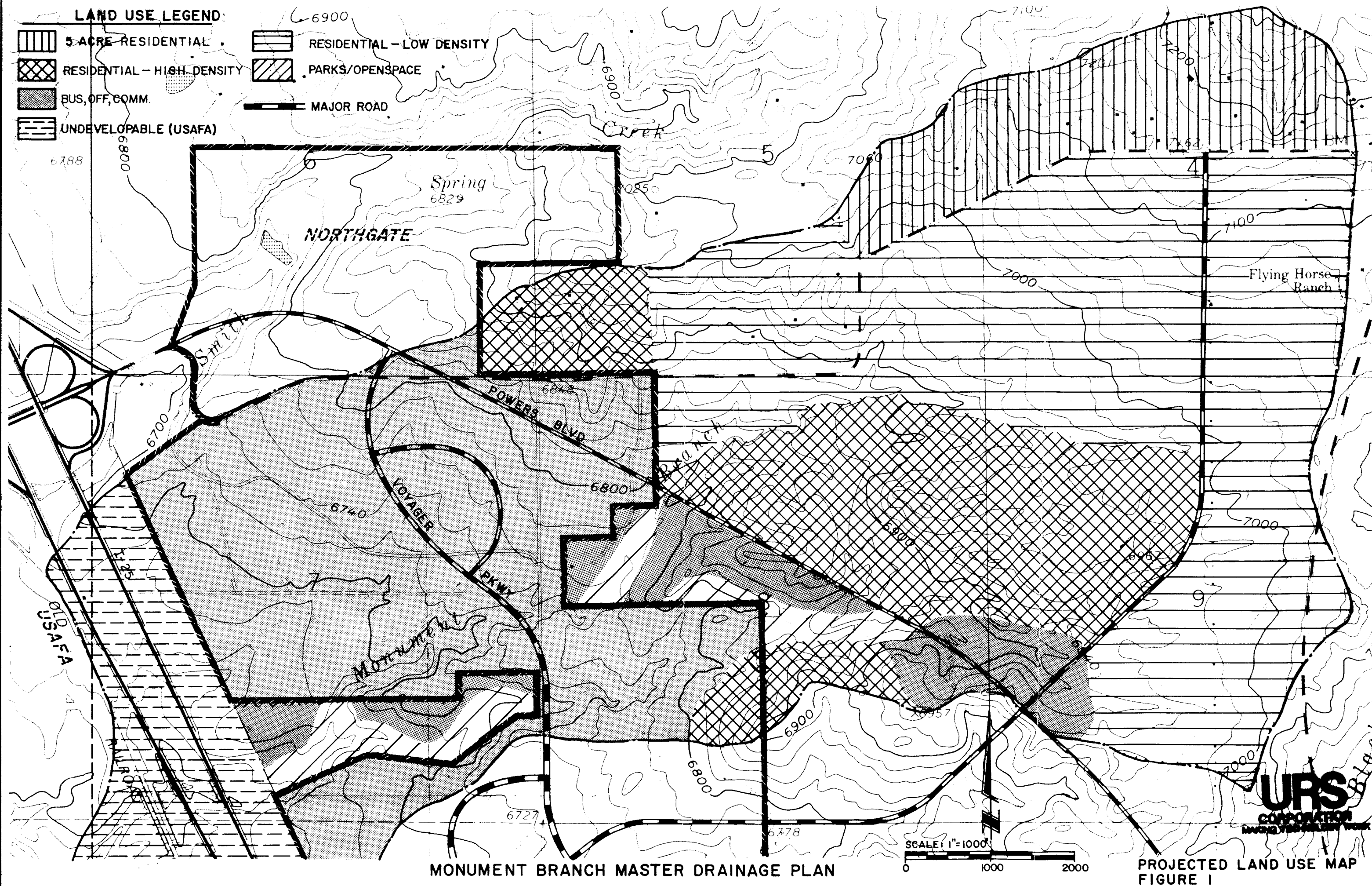
The Project Study Area encompasses the entire Monument Branch Drainage Basin upstream of the outfall into Monument Creek as shown on Figure 3 (attached). The basin generally slopes from east to west and outfalls into Monument Creek on the Air Force Academy property west of Interstate 25. The basin is located in Township 12 South, Range 66 West, Sections 4, 5, 6, 7, 8, 9 and 18, and Township 12 South, Range 67 West, Sections 12 and 13 of the 6th Principal Meridian.

The total basin area consists of 2378 acres (3.7 square miles) and lies in unincorporated El Paso County (1803 acres) and the City of Colorado Springs (575 acres). The U.S. Air Force Academy encompasses approximately 260 acres within El Paso County. Major roads planned within the basin were obtained from the El Paso County Major Transportation Corridors Plan, the City of Colorado Springs Transportation Plan, the Powers Boulevard Corridor Plans, the Northgate Land Use Plan, and meetings with the El Paso County Department of Transportation. The only major roads within the basin at this time are Interstate 25, State Highway 83, and Northgate Road. Presently, the basin is predominantly covered by pasture or rangeland. Historically, the area was sparsely populated, with ranches and farms being the primary use. Less than 5% of the drainage basin area has been platted.

The area within the basin was broken into the following land uses. The area in the city (Northgate) was assumed to be developed into business, commercial and office parks. The area within El Paso County was divided into several land use categories for this study. This was not intended to set land uses in the county, but rather, an attempt to anticipate future hydrologic curve numbers for the basin. The land uses assumed at urban density in the county included: 1) business, office, and commercial; 2) high density residential; 3) low density residential; 4) parks and open space. The 5-acre lot residential area at the northeast edge of the basin was assumed to remain as 5-acre lot residential use. The Air Force Academy land was assumed to remain undeveloped and was not included in the drainage and bridge fee calculations. Significant changes in land use beyond this concept would require a revision to this study. Land use assumptions for the basin are depicted on Figure 1. The Northgate Land Use Plan is included in Appendix A for reference.

LAND USE LEGEND:

- | | |
|---|---|
|  5 ACRE RESIDENTIAL |  RESIDENTIAL - LOW DENSITY |
|  RESIDENTIAL - HIGH DENSITY |  PARKS/OPENSOURCE |
|  BUS, OFF, COMM. |  MAJOR ROAD |
|  UNDEVELOPABLE (USFA) | |



MONUMENT BRANCH MASTER DRAINAGE PLAN

PROJECTED LAND USE MAP
FIGURE 1

III. BASIN GEOLOGY AND SOILS

Basin soil and land use characteristics directly affect the relationship between rainfall and runoff within a basin. The U.S. Soil Conservation Service classifies soils into four hydrologic groups (A, B, C and D) according to a soil's runoff potential. Group A soils exhibit high infiltration rates when thoroughly wetted and are considered to have low runoff potential. Group B soils exhibit moderate infiltration rates when thoroughly wetted. Group C soils exhibit slow infiltration rates when thoroughly wetted. Group D soils exhibit very slow infiltration rates when thoroughly wetted and are considered to have high runoff potential.

Soil types within the Monument Branch Basin are listed in Table 1 and delineated in Figure 2. Hydrologic Group B soils are the only soils found in the Monument Branch Drainage Basin.

The basin soils can be further classified into one general category of soils per the "Soils Survey of El Paso County Area, Colorado" by the Soil Conservation Service. This category is the Kettle-Pring-Peyton group which has evolved from material weathered from arkosic sedimentary rock. Arkosic sedimentary rock is considered a sandstone with granitic source for sand.

The sand-sized feldspar particles are much stronger than the

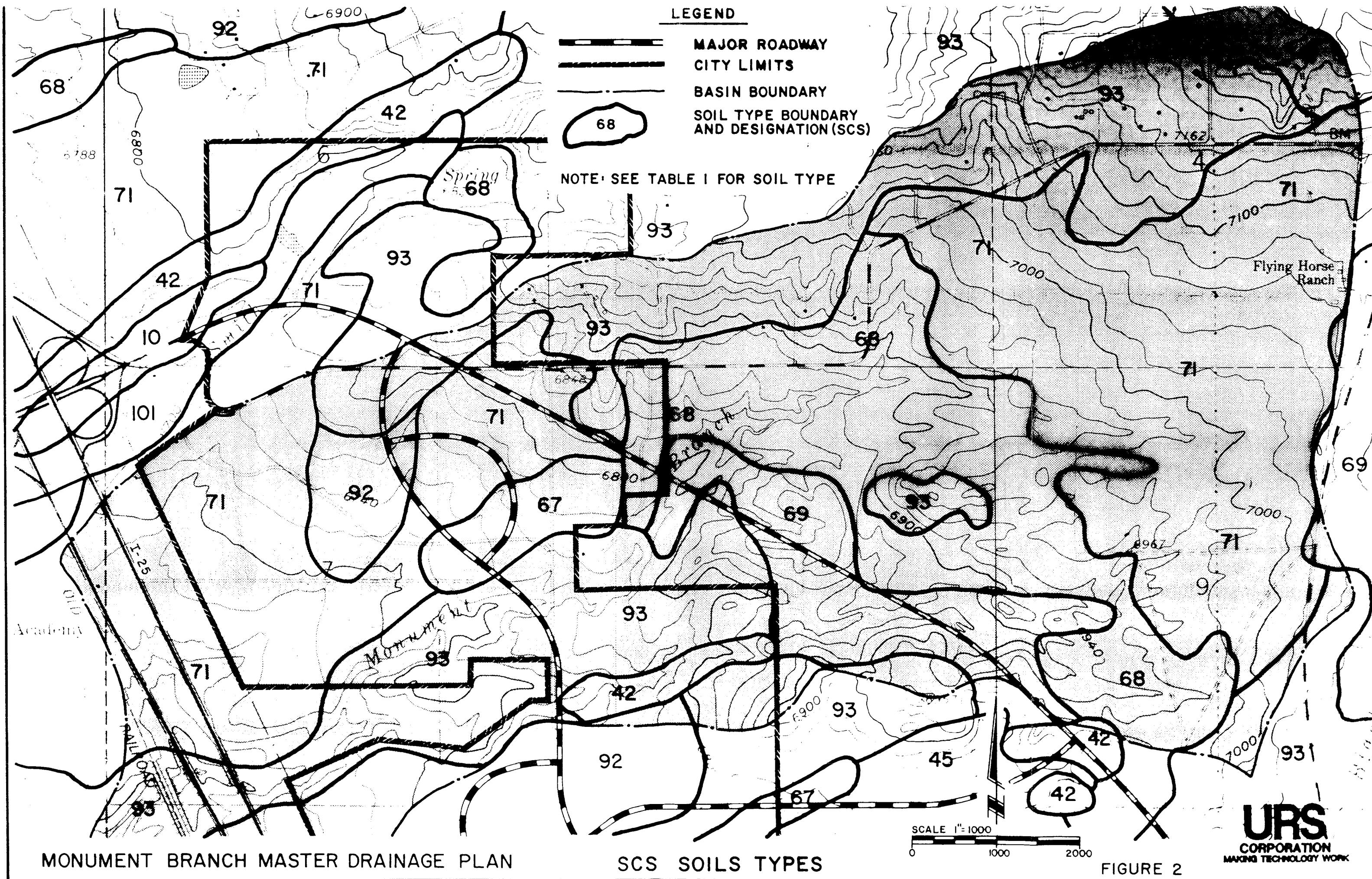
cementing material in the sandstone and remain as discrete particles after loss of cementation in the rock. This results in a granular soil which is easily eroded by surface water runoff.

The soil types within the basin also influence the potential siting locations for reservoirs. All of the soils within the basin are well drained. Water storage reservoirs constructed in the Monument Branch Basin soils may experience seepage and piping. Final design of class 1 detention ponds and embankments (if any) should consider these problems and require detailed soils investigations. In addition, soils types 67, 68, 69, 92 & 93 have potential problems with low strength and many require importation of suitable fill material and/or excavation below the natural ground surface. All of the soils are expected to have moderate potential for frost action.

TABLE 1
MONUMENT BRANCH DRAINAGE BASIN
SOIL TYPES

SOIL I.D. NUMBER	SOIL NAME	HYDROLOGICAL SOIL GROUP	EROSION POTENTIAL
41	KETTLE GRAVELLY LOAM	B	MODERATE
42	KETTLE ROCK OUTCROP	B	SLIGHT-HIGH
67	PEYTON SANDY LOAM	B	MODERATE
68	PEYTON PRING COMPLEX	B	MODERATE
69	PEYTON PRING COMPLEX	B	MODERATE-HIGH
71	PRING COARSE SANDY LOAM	B	MODERATE
92	TOMAH-CROWFOOT LOAMY SAND	B	SLIGHT-MODERATE
93	TOMAH-CROWFOOT LOAMY SAND	B	MODERATE

SOURCE: SOIL SURVEY OF EL PASO COUNTY AREA COLORADO
U.S. SOIL CONSERVATION SERVICE
JUNE 1981



IV. EXISTING DRAINAGE FACILITIES

Existing drainage facilities and historic flows are shown on Figure 3 (attached). Currently major drainage facilities are constructed at the following locations:

- 1) Horseshoe-shaped culvert at old railroad grade (AT&SF)
- 2) One double concrete box culvert at southbound I-25
- 3) One double concrete box culvert, one single concrete box culvert, and one reinforced concrete pipe, all at northbound I-25
- 4) Reinforced concrete and corrugated metal pipes at Northgate Road (6 locations)

The structures at the old railroad grade, southbound I-25, the double concrete box culvert and the reinforced concrete pipe at northbound I-25 are all of adequate size to pass the historic flows. The single concrete box culvert at northbound I-25 is inadequately sized to convey the 100-year storm flows. To accommodate this excess runoff, a diversion has been proposed to carry the flows to the double concrete box culvert which can convey the peak flows. This diversion will be discussed in detail in Section VI.

All of the culverts on Northgate Road are inadequately sized to carry the 100-year storm flows and will have to be upgraded to

pass these flows. In addition, there are numerous small "stockpond" type reservoirs on and off the channels in the basin. After checking with the Colorado State Engineer's Office, it was found that three of these "stockponds" had construction plans on file. These are the Johnson Reservoir (#3209) located in the SW 1/4 of Section 5, the Johnson Reservoir (#5651) located in the NE 1/4 of Section 4 and the Allison Reservoir (#805) located in the SE 1/4 of Section 7, all in Township 12 South, Range 66 West, of the 6th Principal Meridian. Field reconnaissance of all of the "stockpond" reservoirs found that there was no embankment protection or emergency spillway. All "stockpond" reservoirs were therefore assumed to be inadequate. All "stockpond" reservoirs will have to be removed or evaluated and upgraded for use as a detention facility when the surrounding land is developed as part of this basin planning study. For the purpose of this study, all "stockponds" were neglected. However, future site specific studies must incorporate the applicable city, county, state and federal regulations into their design considerations.

The remainder of the existing drainage facilities in the basin consist solely of small culverts beneath roads located throughout the basin. All of the channels in the basin are natural with no improvements.

The geomorphology of the Monument Creek basin in this area has

been studied in conjunction with the construction of the U.S. Air Force Academy site. Geological Survey Professional Paper 551 has the following to say about the origin of the Monument Creek Basin:

"The modern drainage pattern appears to have been formed by capture. During Tertiary time, streams probably flowed eastward from the mountains across the area called the Black Forest (fig. 1), but were captured in early Pleistocene time by small streams having steeper gradients, such as Monument Creek, that were cutting headward across the area, small streams from the east and west were cutting surfaces on bedrock at a gradient to meet the newly formed Monument Creek.

These surfaces, called pediments, are the result of a stable base level that prevailed for a long time along the major streams. The stable base level allowed the small streams to meander laterally and widen their valleys. Lowering of base level, probably as a result of climatic change, resulted in downcutting. At least six cycles of this change of stream regimen from lateral to downcutting are recorded in the dissected pediments and terraces of the Academy site. Because the gradients of the streams from the west were steeper than those of the streams flowing from the east, the stages of pedimentation west of Monument Creek never were completed, and ridges were stranded as most of the energy of the streams was concentrated on downcutting. Streams on the east side apparently completed at least the last stage of pedimentation and possibly also the earlier stages. No ridges or remnants of the older pediments can be found for 3-4 miles east of Monument Creek along Kettle Creek and Black Squirrel Creek. The amount of coarse alluvium added to Monument Creek from the mountains on the west far exceeded the amount of fine alluvium from the Black Forest on the east; therefore, Monument Creek was forced to migrate eastward during the successive stages of downcutting. It now impinges on bedrock at many places along its eastern valley wall, but rarely exposes bedrock along its western valley wall.

The difference in grain size between alluvium composed of granite boulders west of Monument Creek and alluvium composed of sand from the Dawson Arkose east of Monument Creek makes a difference in the shape of the pediments

west and east of the creek. Small buried ridges on the west side were protected from erosion by a mantle of boulders or by trains of boulders in ancient stream valleys. Longitudinal irregularities on the pediments thus resulted from the inability of the small intermittent streams to move the boulders. On the east side of Monument Creek the streams were not restricted by such obstructions; they flowed freely, cutting a smooth gently sloping pediment whose extent was controlled solely by the amount of time available."

Historic conditions for Monument Branch Drainage Basin were taken as present (1987) conditions. Figure 3 (attached) delineates the historic drainage subbasins. The Federal Emergency Management Agency (FEMA) has not incorporated this basin into their flood hazard study. Therefore the 100-year flood plain was not delineated. Tables 3, 5, and 6 show peak flows locally and regionally for historic conditions. As previously stated, the hydrologic studies for this basin did not consider any effect due to "stockponds."

The following discusses design points and reaches along the major channels for current conditions. Refer to the design points and reaches of Figure 3. Channel cross sections were obtained through field reconnaissance and topographic maps (2' contours). Soils information was obtained from the Soil Survey of El Paso County, Colorado. The 100-year 24-hour storm flows are used in the following discussion since it was larger than the 100-year 2-hour storm.

Design Point 14 is located at the confluence of the main channel of Monument Branch and Monument Creek. The historic 100-year 24-hour peak flow at this point is 2459 cfs and the 10-year 24-hour peak flow is 778 cfs.

Reach 12 is a deep, fairly narrow channel with a bare sandy bottom and well vegetated side slopes. The predominant soil type in this reach is Tomah-Crowfoot loamy sand which is moderately erodible. Erosion from the more frequent storm events should occur along the channel bottom due to the lack of vegetation and higher velocities in the low flow channel. Some sloughing of the banks may occur due to undercutting.

Within Reach 12 is the horseshoe culvert at the old railroad grade. This culvert is adequate to pass the 100-year storm. Upstream of this culvert the channel is wider and more vegetated than it is downstream. The 100-year 24-hour and 10-year 24-hour peak flows at this point are 2434 cfs and 770 cfs, respectively.

Design Point 13 is located at the double box culvert under southbound I-25. This culvert is adequate to pass the 100-year storm. No adverse impacts were noticeable during field reconnaissance of this area other than some siltation in the box culvert. Runoff passing through Design Points 11 and 12 join the main channel here. The 100-year 24-hour and the 10-year 24-hour peak flows at this point are 2439 cfs and 772 cfs respectively.

Design Point 12 is located at the reinforced concrete pipe under northbound I-25. This culvert will pass the 100-year storm with slight ponding occurring on the road fill at the inlet. No adverse impacts were noticeable during field reconnaissance of this area. The 100-year 24-hour peak flow is 136 cfs and the 10-year 24-hour peak flow is 45 cfs. Upstream of this point is open rangeland with no defined channel.

Design Point 11 is located at the single concrete box culvert crossing northbound I-25. This culvert is not adequate to pass the 100-year storm. Provisions to divert the excess flow are discussed later in this report. No adverse impacts were noticeable during field reconnaissance of this area. The 100-year 24-hour peak flow is 737 cfs and the 10-year 24-hour peak flow is 264 cfs.

Design point 11A is located at the U.S.A.F.A. boundary. The 100-year 24-hour peak flow is 730 cfs and the 10-year 24-hour peak flow is 261 cfs.

Reach 11 is a shallow slightly defined channel. The reach is primarily vegetated with native grasses. There are "stockponds" on this reach which should be removed as part of this report. The predominant soil type for this reach is a Pring coarse sandy loam

which has a moderate erosion potential. Very little erosion is expected to occur along this reach during the major and minor storms.

Design Point 10 (hist.) is located at the proposed Voyager Parkway crossing at the upper end of Reach 11. A diversion from design point 10 (hist.) to design point 10 (dev.) is proposed and is discussed further in Section VI. The 100-year 24-hour and 10-year 24-hour peak flows at this point are 378 cfs and 141 cfs respectively. Upstream of Design Point 10 (hist.) is a slightly defined channel vegetated with native grasses as in Reach 11.

Design Point 9 is located at the proposed Powers Blvd. crossing. The 100-year 24-hour peak flow is 143 cfs and the 10-year 24-hour peak flow is 58 cfs at this point.

Design Point 8 is located at the double concrete box culvert crossing northbound I-25. This culvert is adequate to pass the 100-year storm and the excess runoff that won't pass through the culvert at Design Point 11. There is some siltation in the culvert and one wingwall on the east face that is fabricated with corrugated metal may require periodic maintenance. The 100-year 24-hour and 10-year 24-hour peak flows at this point are 2289 cfs and 722 cfs respectively.

Design point 8A is located at the U.S.A.F.A. boundary. The 100-year 24-hour peak flow is 2280 cfs and the 10-year 24-hour peak flow is 719 cfs.

Reach 9 is a wide, well defined channel with a bare sandy bottom and well vegetated side slopes. The south bank is generally steep, while the north bank is more flat and gradual. The predominant soil type in this area is Tomah-Crowfoot loamy sand which is moderately erodible. The erosion for this reach should occur in the channel bottom areas with little bank erosion expected.

Design Point 7 is located at the confluence of the main channel of Monument Branch Creek and its south tributary. The two channels are well defined just upstream of the confluence with some side slope vegetation. The combined flows at this point are 2265 cfs for the 100-year 24-hour storm and 717 cfs for the 10-year 24-hour storm.

Reach 8 is the lower reach of the south tributary to Monument Branch Creek. The channel is generally wide and shallow with a sandy low flow channel bottom. It is well vegetated with natural grasses and shrubs in the channel bottom and on the side slopes. The predominant soil type in this reach is Tomah-Crowfoot loamy

sand. Erosion is expected to occur in the channel bottom only during low flows. The major flows are expected to produce slight erosion of the banks, but the vegetation will help to keep this in check. A private road crosses the channel in the upper end of Reach 8. The road acts as a dam, with no apparent outlet works. This dam should be removed as a part of this planning study.

Design Point 6 is located at the proposed Voyager Parkway crossing. Currently there are no facilities at this point. The 100-year 24-hour flow is 797 cfs and the 10-year 24-hour storm is 254 cfs at this design point.

Design point 6A is located at the City/County boundary. The 100-year 24-hour peak flow is 755 cfs and the 10-year 24-hour peak flow is 252 cfs.

Reach 7 is a long, meandering channel with a wide, shallow cross section at its lower end, transitioning to a deep, narrow channel at its upper end. The channel bottom is generally bare and sandy with some natural grasses and shrubs along its sides. The predominant soil in the lower end is Tomah-Crowfoot loamy sand, while the soil in the upper end is a Peyton-Pring complex which has a moderate to high erosion potential. Erosion and side sloughing is expected to occur in the upper end of Reach 7. There are "stockponds" along Reach 7 which should be removed.

Design Point 5 is located at the proposed Powers Blvd crossing. The peak flows are 580 cfs for the 100-year 24-hour storm and 195 cfs for the 10-year 24-hour storm. Upstream of this point the channel is generally wide and not very well defined, with natural grass vegetation.

Reach 6 is a moderately defined channel with natural grasses and some shrubbery. The soil in this reach is, again, the Peyton-Pring complex.

Design Point 4 is located at the upper end of Reach 6 where it crosses the Powers Blvd. proposed alignment. The 100-year peak flow is 124 cfs and the 10-year peak flow is 68 cfs. Upstream of this design point the channel is wide and undefined with natural grass vegetation.

Reach 5 continues upstream along the main channel of Monument Branch Creek from Design Point 7. This reach is characterized by steep, deep banks and some rock outcrops. The channel bottom is generally wide and sandy with shrubs along the banks. The predominant soil type in Reach 5 is Tomah-Crowfoot loamy sand. Some erosion is expected in the channel bottom during low flows and some bank erosion during the higher flows.

Design Point 3 is located at the proposed Voyager Parkway crossing. There are no facilities currently at this point. The peak flow here is 1448 cfs for the 100-year 24-hour storm and 469 cfs for the 10-year 24-hour storm. Just upstream of Design Point 3 is the Allison Reservoir. The detention capability of this "stockpond" was not considered in the hydrologic analysis of this basin. This reservoir should be removed or evaluated and upgraded for use as a detention facility.

Reach 4 is similar to Reach 7 in the fact that it is wide and shallow at its lower end while its upper end has steep sides. Again, the soils in the lower end are Tomah-Crowfoot loamy sands and the soils in the upper end are a Peyton-Pring complex. Erosion and side sloughing is expected in the upper end of this reach. The vegetation consists of natural grasses and shrubs in the channel.

Design Point 2 is located at the proposed Powers Blvd. crossing. The peak flow is 1391 cfs for the 100-year 24-hour storm and 453 cfs for the 10-year 24-hour storm.

Reach 3 is a wide channel with slightly steep banks. The soil in this reach is the Peyton-Pring complex which is moderately erosive. Erosion is expected to be in the channel bottom during low flows and along the sides during the higher flows. There are

"stockponds" along this reach which must be removed. Reaches 3-A, 3-B and 3-C are undefined to slightly defined channels that convey the runoff from the north side of Northgate Road to the main channel. The vegetation in these channels is natural grasses.

Design Point 1 is at the confluence of the two branches of the main channel. The combined flow at this design point is 1124 cfs for the 100-year 24-hour storm and 386 cfs for the 10-year 24-hour storm.

Reach 2 is a deep, narrow channel with substantial erosion in some places. The channel bottom is generally bare, with natural grasses on its side slopes. The soil in this reach is the Peyton-Pring complex.

Reach 1 is a wider less defined channel than Reach 2. Its sides are vegetated with natural grasses. The soil in this reach is the Peyton-Pring complex. Reach 1-A is an undefined to slightly defined channel that conveys runoff from the far northeast corner of the basin to the main channel. The predominant soil type is Pring coarse sandy loam which has a moderate hazard of erosion.

The basin as a whole is generally covered by natural grasses with shrubs and trees along the channels. The erosion hazard of the

soil ranges from slight to high, but moderate erosion hazard is typical. Erosion and gullyng is generally confined to the channels.

V. BASIN HYDROLOGY

Determining runoff for a particular drainage basin needs to consider the effects of many different variables. In the absence of a reliable historic record of rainfall, runoff, and other pertinent variables, it is usually necessary to use a synthetic unit hydrograph method to determine the runoff that will occur for a given rainfall event. The SCS method of determining peak flood flows and hydrographs was used to estimate direct runoff. For an explanation of the procedures used, see the "SCS National Engineering Handbook, Section 4". Due to the number of computations necessary to determine the hydrographs and hydrologic routing of the given storm events, the calculations for the main channel were performed with the aid of the TR-20 computer program.

For this study the City of Colorado Springs/El Paso County Drainage Criteria Manual was used. For the major facilities (basins greater than 130 acres), the design peak flow shall be the greater of the peak flows determined for the 100-year 24-hour storm and the 100-year 2-hour storm. In all cases the 24-hour event produced greater flows. Design of minor facilities (basins less than 130 acres), shall be for the 10-year and 100-year storm in both El Paso County and the City of Colorado Springs upon final adoption of the Manual. Flows for subbasins should be calculated using the Rational Method. Minor facilities shall be designed and planned to integrate with the major drainage system to

provide overflow capability for major storms. The intent of overflow provisions is to safely and economically direct 100-year flow from points of concentration and not impact buildings or structures. The drainage basin boundaries were determined from the topography on USGS 7-1/2 minute quadrangle maps. The subbasin boundaries and design points determined for fully developed conditions are shown on Figure 3 (attached). The hydrologic soil groups were then determined for each subbasin. For historic (present) conditions, a weighted curve number was determined for each subbasin based on soil types, type of cover, and taking into account presently platted areas. For future developed conditions, a weighted curve number was determined based on soil types, type of cover, and taking into account projected development. Time of concentration for the subbasins was determined by the following equation:

$$T = \frac{(11.9 \times L^3)^{0.385}}{H}$$

where

T	= time of concentration in hours
L	= length of longest watercourse in miles
H	= elevation difference in feet

As the calculations proceed downstream, the hydrograph was routed through each subsequent reach and combined with local inflow to produce a composite hydrograph at each design point. Hydrologic

channel routing was performed by inputting flow vs. area vs. elevation for a representative cross section for each reach. The TR-20 computer program uses the Modified Att-Kin routing method for each reach based on the cross section entered. For detention ponds, the hydrologic reservoir routing was performed by inputting outflow vs. storage vs. elevation, for an assumed reservoir and outlet size. These variables were modified by trial and error until the desired volume of the reservoir and peak outflow were obtained.

The rainfall depths of 3.0 and 4.6 inches were obtained from isopluvials for the project area for the 10-year 24-hour and 100-year 24-hour storm events, respectively. Table 2 shows the dimensionless precipitation distribution for the SCS Type IIA storm. The rainfall depths of 2.0 and 3.0 inches were obtained from the "Areawide Urban Runoff Control Manual" for the 10-year 2-hour and 100-year 2-hour storm events, respectively.

TABLE 2
MONUMENT BRANCH DRAINAGE BASIN
RAINFALL DISTRIBUTION

24-Hour Storm		2-Hour Storm	
Time (hrs)	Distribution	Time (min)	Distribution
0	0.000	0	0.00000
2.00	0.010	5	0.00865
4.00	0.030	10	0.03460
4.50	0.050	15	0.07439
5.00	0.060	20	0.14360
5.50	0.100	25	0.26471
6.00	0.700	30	0.48097
6.50	0.750	35	0.60208
7.00	0.780	40	0.67128
8.00	0.820	45	0.72491
9.00	0.840	50	0.76817
9.50	0.850	55	0.80277
10.00	0.860	60	0.83737
10.50	0.865	65	0.87197
11.00	0.870	70	0.88927
11.50	0.885	75	0.90657
11.75	0.888	80	0.91696
12.00	0.890	85	0.92734
12.50	0.900	90	0.93772
13.00	0.905	95	0.94810
13.50	0.910	100	0.95848
14.00	0.915	105	0.96886
16.00	0.940	110	0.97924
20.00	0.980	115	0.98962
24.00	1.000	120	1.00000

TABLE 3
MONUMENT BRANCH DRAINAGE BASIN
HISTORIC SUB-BASIN HYDROLOGY

SUB-BASINS	DRAINAGE AREA (AC)	TIME OF CONC. (MIN)	10-YEAR STORM			100-YEAR STORM		
			C	INTENSITY	FLOW	C	INTENSITY	FLOW
				i (in/hr)	Q (cfs)		i (in/hr)	Q (cfs)
A	61	6	0.30	5.6	102	0.36	8.4	184
B1	128	17	0.28	3.7	133	0.34	5.6	244
B2	59	7	0.28	5.2	86	0.34	8.0	160
C1	120	16	0.28	3.8	128	0.34	5.7	233
C2	63	19	0.28	3.5	62	0.34	5.3	114
D	110	16	0.28	3.8	117	0.34	5.7	213
E	130	20	0.30	3.4	133	0.36	5.1	239
F	73	20	0.28	3.4	69	0.34	5.1	127
G1	69	9	0.28	4.8	93	0.34	7.2	169
G2	130	16	0.28	3.8	138	0.34	5.7	252
H	62	15	0.28	3.9	68	0.34	5.9	124
I	95	8	0.30	5.0	143	0.36	7.5	257
J	160	19	0.28	3.5	157	0.34	5.3	288
K	18	4	0.30	6.0	32	0.36	9.0	58
L1	39	8	0.30	5.0	59	0.36	7.5	105
L2	12	5	0.28	6.0	20	0.34	9.0	37
M1	31	8	0.28	5.0	43	0.34	7.5	79
M2	81	13	0.28	4.1	93	0.34	6.3	174
N1	70	17	0.28	3.7	73	0.34	5.6	133
N2	38	11	0.28	4.4	47	0.34	6.8	88
O1	67	11	0.28	4.4	83	0.34	6.8	155
O2	109	15	0.28	3.9	119	0.34	5.9	219
P1	17	5	0.28	6.0	29	0.34	9.0	52
P2	48	13	0.28	4.1	55	0.34	6.3	103
Q1	22	7	0.28	5.2	32	0.34	8.0	60
Q2	172	14	0.28	4.0	193	0.34	6.0	351
R	48	14	0.28	4.0	54	0.34	6.0	98
S	66	11	0.28	4.4	81	0.34	6.8	153
T1	37	10	0.28	4.7	49	0.34	7.0	88
T2	13	5	0.28	6.0	22	0.34	9.0	40
T3	46	8	0.28	5.0	64	0.34	7.5	117
U	61	14	0.35	4.0	85	0.42	6.0	154
V	123	21	0.28	3.3	114	0.34	5.0	209

NOTE: Hydrologic calculations are based on the Rational Method

VI. PLANNING STUDY RECOMMENDATIONS

The overall recommendation of this drainage planning study is the use of subregional detention facilities in conjunction with partially lined major drainage channels. The plan should be used as a layout for future drainage facilities and take a natural regime approach to drainage. Channels should be designed to be stable under design flow conditions and still retain as many natural features as possible. Elements of the recommended drainage planning study are shown on Figure 3 (attached) and described in this section. This planning study incorporates the City of Colorado Springs/El Paso County drainage criteria manual. In the study process five plan alternatives were analyzed and are as follows:

1. Subregional and onsite detention with partially lined channels.
2. Subregional and onsite detention with earth lined channels.
3. Subregional detention with partially lined channels.
4. One regional detention facility with partially lined channels.
5. One regional detention facility with fully lined channels.

The third alternative was approved by the City and County through two formal submittals of the planning study and various meetings with City and County officials. The recommended

alternative provides several advantages, such as: 1) reduction of facility costs downstream due to reduction in peak flow; 2) reduces the need to channelize the natural channels; 3) maintenance responsibilities for subregional detention facilities are well defined; 4) provides for multiple use opportunities; 5) less risk associated with overtopping, flooding, and erosion problems compared to a regional facility; 6) allows for additional groundwater recharge.

The Monument Branch Drainage Basin was analyzed assuming the types of land use development as shown on Figure 1. The land use considerations are discussed in Section II. The Air Force Academy land was assumed to be undevelopable and was analyzed as rangeland.

Two basin design assumptions were incorporated into this study, 1) subregional off and on stream detention facilities are strategically placed within the basin for the purpose of reducing sub regional developed runoff, and 2) partially lined channels incorporating drop structures and trickle channels for the purpose of stabilizing and maintaining the natural character of the channel.

The use of detention for this basin is required due to the

location of the U.S. Air Force Academy on the downstream part of the basin. Subregional offstream detention facilities are located as shown on Figure 3 (attached). The facilities should be designed to detain the difference between the historic and developed peak flows for both the 10-year and the 100-year, storm events. The bottom of the emergency spillway, in all cases, was assumed to be less than 10 feet high, therefore, forgoing state Engineers jurisdiction. Inflow and outflow hydrographs for detention ponds are shown in Addendum 1. A summary of the flows for historic and developed conditions are shown on Tables 3, 4, 5, and 6.

Major channels to be improved within the basin are proposed to be partially lined. Lining materials used in this study are for cost purposes only. All lining materials are subject to jurisdictional approval. The partially lined channel section should be used where existing channel velocities exceed erosive velocities. Furthermore, drop structures and trickle channels should be extensively implemented in order to stabilize the channel. Developed velocities will range from 6 to 8 fps using the above mentioned channel characteristics. Drop structures and trickle channels are incorporated in all proposed major channels. Trickle channels should be sized to carry frequent storm events generally based on a minimum 3% of the 100-year event. Grouted sloping drops incorporated into the channels are for cost

purposes only. Many other alternatives exist for drop structures and their selection will depend on site specific, jurisdictional and economic factors.

Various assumptions were involved in proposed improvements for the basin. Partially lined channels were assumed to include bank lining, drop structures, and trickle channels. Construction would include riprap, sand filter, earthwork, revegetation by sodding, concrete, and grouting. Detention ponds were assumed to include earthwork, outlet facility, upstream riprap face, grouted riprap overflow with energy dissipator, land area, and revegetation by seeding/mulching. Box culverts were assumed to include the barrel, inlet structure, outlet structure, earthwork, and normal safety appertances.

Shown on figure 3, but not limited to, are reaches requiring an overflow capability for major storms. The purpose of these facilities is to provide additional capacity to safely manage major storm runoff from points where major storm runoff has been concentrated such as at arterial road crossings. These facilities will generally be streets, parking lots and graded landscaping. Future drainage reports shall require overflow provisions incorporated into the planning and design of all initial drainage systems in order to route the major storm safely and economically. These facilities are not to be reimbursable since they are a part of the initial system.

A diversion of the runoff upstream of Design Point 10 (hist.) is proposed because the existing box culvert at Design Point 11 is inadequately sized to pass the 100-year storm. This runoff is routed to Design Point 10 (dev.) via a partially lined channel along Voyager Parkway into a box culvert and finally discharging into Reach 5. Once in Reach 5, this runoff will be conveyed to Design Point 8 where it will be adequately passed under northbound I-25. From here the runoff will join the flows from Design Points 11 and 12 and return to its historic patterns.

A second diversion is proposed at Design Point 12A. This will divert the flows from subbasin P2 through Reach 11A and into the detention pond at Design Point 11A, thus eliminating the need for a detention pond at Design Point 12A. The discharge released from the detention pond at Design Point 11A will be conveyed to Design Point 11 where it will be passed under northbound I25. From here the runoff will join the flows from Design Points 8 and 12 and return to its historic patterns.

An arterial road is expected between Powers Blvd. and State Highway 83 in the future, but the location is unknown at this time. For this reason, the cost of a culvert has been included within subbasin B1 in the drainage fee calculations. This will provide funds for a culvert in the event a major roadway is

constructed.

All channels are to be designed and constructed according to City and County criteria and specifications and are eligible for reimbursement if they are delineated in this study. Channels should be designed by using normal depth and backwater calculations where appropriate. Box culverts should be designed with an appropriate depth ratio for subcritical channels, with appropriate reservoir routing techniques for detention ponds, or with appropriate transitions for supercritical channels.

Tables 7 & 8 include a brief description of proposed improvements for each channel reach and detention pond. Figures 4 thru 7 includes the concept details used for cost estimating purposes.

All major drainage improvements located in the City of Colorado Springs and El Paso County shall be in a public right-of-way and a width acceptable to the City or County. All drainage improvements in the City/County that are in a public right-of-way will be maintained by the City/County. Funding for maintenance of detention ponds could take various forms. Government agencies could fund all of the maintenance, or a public/private split could be made based on safety features for public funding and aesthetic features for private funding.

TABLE 4
MONUMENT BRANCH DRAINAGE BASIN
DEVELOPED SUB-BASIN HYDROLOGY

SUB-BASINS	DRAINAGE AREA (AC)	TIME OF CONC. (MIN)	10-YEAR STORM			100-YEAR STORM		
			C	INTENSITY i (in/hr)	FLOW Q (cfs)	C	INTENSITY i (in/hr)	FLOW Q (cfs)
A	61	6	0.30	5.6	102	0.36	8.4	184
B1	128	7	0.32	5.2	213	0.41	8.0	420
B2	59	3	0.31	6.0	110	0.40	9.0	212
C1	120	6	0.32	5.6	215	0.42	8.4	423
C2	63	8	0.31	5.0	98	0.40	7.5	189
D	110	7	0.43	5.2	246	0.55	8.0	484
E	130	20	0.30	3.4	133	0.36	5.1	239
F	73	10	0.34	4.7	117	0.43	7.0	220
G1	69	4	0.32	6.0	132	0.41	9.0	255
G2	130	7	0.29	5.2	196	0.38	8.0	395
H	62	6	0.32	5.6	111	0.41	8.4	214
I	95	4	0.31	6.0	177	0.40	9.0	342
J	160	8	0.36	5.0	288	0.46	7.5	552
K	18	2	0.30	6.0	32	0.39	9.0	63
L1	39	4	0.30	6.0	70	0.39	9.0	137
L2	12	2	0.72	6.0	52	0.89	9.0	96
M1	31	3	0.72	6.0	134	0.89	9.0	248
M2	81	5	0.72	6.0	350	0.89	9.0	649
N1	70	8	0.56	5.0	196	0.69	7.5	362
N2	38	4	0.72	6.0	164	0.89	9.0	304
O1	67	5	0.47	6.0	189	0.58	9.0	350
O2	109	7	0.50	5.2	283	0.63	8.0	549
P1	17	5	0.28	6.0	29	0.34	9.0	52
P2	48	5	0.72	6.0	207	0.89	9.0	384
Q1	22	7	0.28	5.2	32	0.34	8.0	60
Q2	172	6	0.72	5.6	694	0.89	8.4	1286
R	48	6	0.50	5.6	134	0.63	8.4	254
S	66	5	0.51	6.0	202	0.64	9.0	380
T1	37	10	0.28	4.7	49	0.34	7.0	88
T2	13	2	0.63	6.0	49	0.78	9.0	91
T3	46	3	0.64	6.0	177	0.80	9.0	331
U	61	9	0.35	4.8	102	0.42	7.2	184
V	123	11	0.28	4.4	152	0.34	6.8	284

NOTE: Hydrologic calculations are based on the Rational Method

TABLE 5

MONUMENT BRANCH DRAINAGE BASIN
DESIGN PEAK FLOWS FOR
PRESENT AND RECOMMENDED CONDITIONS
2-HOUR STORM

DESIGN POINT	CONTRIBUTING BASINS	PRESENT CONDITIONS		RECOMMENDED CONDITIONS	
		10-YR (cfs)	100-YR (cfs)	10-YR (cfs)	100-YR (cfs)
1	A,B,E-G	144	484	n/a	n/a
2	A,B,E-G,I-K	204	654	"	"
3	A,B,E-G,I-K,N	220	717	"	"
4	H	68 +	124 +	"	"
5	C,D	65	223	"	"
6A	C,D,H,O1	90	309	"	"
6	C,D,H,O	102	371	"	"
7	A-K,N,O,R,S (L,M) *	328	1136	"	"
8A	A-K,N,O,R,S,T2&3 (L,M) *	332	1154	"	"
8	A-K,N,O,R-T (L,M) *	335	1167	"	"
10B	L1	59 +	105 +	"	"
9	L	70 +	125 +	"	"
10A	M1	43 +	79 +	"	"
10	L,M	40	153	"	"
11A	(L,M) Q2 **	77	287	"	"
11	(L,M) Q **	82	300	"	"
12A	P2	55 +	103 +	"	"
12	P	71 +	130 +	"	"
13	A-U	394	1420	"	"
14	A-V	406	1473	"	"

NOTES:

- 1) Present conditions include routed flows without existing "stockponds" or proposed detention facilities. Present conditions are assumed to represent historic conditions.
- * Present conditions do not include basins L & M; recommended conditions include basins L & M due to proposed diversion.
- ** Present conditions include basins L & M; recommended conditions do not include basins L & M due to proposed diversion.
- + These hydrologic calculations are based on the Rational Method.
- n/a The 24-hour storm was used as the design storm for detention routing.

TABLE 6
MONUMENT BRANCH DRAINAGE BASIN
DESIGN PEAK FLOWS FOR
PRESENT AND RECOMMENDED CONDITIONS
24-HOUR STORM

DESIGN POINT	CONTRIBUTING BASINS	PRESENT CONDITIONS		RECOMMENDED CONDITIONS	
		10-YR (cfs)	100-YR (cfs)	10-YR (cfs)	100-YR (cfs)
1	A,B,E-G	386	1124	521	1305
2	A,B,E-G,I-K	453	1391	453	1290
3	A,B,E-G,I-K,N1	469	1448	469	1312
4	H	68 +	124 +	111 +	214 +
5	C,D	195	580	444	1064
6A	C,D,H,O1	252	755	252	757
6	C,D,H,O	254	797	265	777
7	A-K,N,O,R,S (L,M) *	717	2265	717	2235
8A	A-K,N,O,R,S,T2&3 (L,M) *	719	2280	719	2279
8	A-K,N,O,R-T (L,M) *	722	2289	722	2285
10B	L1	43	106	43	86
9	L	58	143	85	152
10A	M1	33	85	33	80
10	L,M	141	378	141	152
11A	(L,M) Q2 **	261	730	261	384
11	(L,M) Q **	264	737	136	390
12A	P2	42	115	80	267 ++
12	P	45	136	102	135
13	A-U	772	2439	772	2439
14	A-V	778	2459	778	2459

NOTES:

- 1) Present conditions include routed flows without existing "stockponds" or proposed detention facilities. Present conditions are assumed to represent historic conditions.
- 2) Recommended conditions include routed flows through proposed detention facilities.
- * Present conditions do not include basins L & M; recommended conditions include basins L & M due to proposed diversion.
- ** Present conditions include basins L & M; recommended conditions do not include basins L & M due to proposed diversion.
- + These hydrologic calculations are based on the Rational Method.
- ++ Flows in excess of 80 cfs are diverted to DP 11-A.

TABLE 7
 MONUMENT BRANCH DRAINAGE BASIN
 SUMMARY OF
 DETENTION FACILITIES

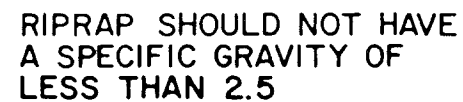
D.P.	LOCATION	TYPE	PEAK INFLOW (cfs)	PEAK OUTFLOW (cfs)	PEAK HISTORIC (cfs)	SURFACE AREA (ac)	VOLUME (ac-ft)
2	POWERS BLVD.	ONSTREAM	2008	1290	1391	6.0	39.9
6A	CITY/COUNTY BNDRY.	ONSTREAM	1384	757	755	4.6	30.4
8ASOUTH	CITY/COUNTY BNDRY.	OFFSTREAM	220	94	116	1.4	5.0
10	VOYAGER PKWY.	OFFSTREAM	817	152	378	5.8	29.2
10A	VOYAGER PKWY.	OFFSTREAM	167	80	85	1.1	3.9
10B	CITY/COUNTY BNDRY.	OFFSTREAM	163	86	106	0.6	2.0
11A	USafa BNDRY.	OFFSTREAM	1046	384	730	5.3	29.9

TABLE 8

MONUMENT BRANCH DRAINAGE BASIN
PROPOSED MAJOR DRAINAGE FACILITIES

DESIGN POINT	REACH	FACILITY (w x h x l)	DESIGN FLOW (cfs)
-	1	30' x 4.5' x 4750' PLC, 16 drops	997
-	1-A	54" dia. x 1650' RCP	363
-	2	60" dia. x 1900' RCP	376
-	3	50' x 4.5' x 2850' PLC, 10 drops	1586
-	3-A	100-YEAR OVERFLOW PROVISION	228
-	3-B	100-YEAR OVERFLOW PROVISION	114
-	3-C	100-YEAR OVERFLOW PROVISION	63
2	-	11' x 10' x 280' CBC	1290
2	-	DETENTION FACILITY	1290 (out)
-	4	40' x 4.5' x 2900' PLC, 6 drops	1312
3	-	12' x 10' x 240' CBC	1312
-	5	50' x 4.5' x 3300' PLC, 8 drops	1460
4	-	6' x 5' x 240' CBC	214 *
-	6	100-YEAR OVERFLOW PROVISION	214 *
5	-	13' x 8' x 240' CBC	1064
-	7A	30' x 4.0' x 2050' PLC, 5 drops	642
-	7	40' x 3.5' x 5800' PLC, 16 drops	777
6A	-	DETENTION FACILITY	757 (out)
6	-	10' x 8' x 160' CBC	777
-	8	30' x 4.0' x 3100' PLC, 7 drops	775
-	9	60' x 5.0' x 900' PLC, 5 drops	2279
-	10-A	100-YEAR OVERFLOW PROVISION	152
9	-	5' x 4' x 240' CBC	152
-	10-B	100-YEAR OVERFLOW PROVISION	586
-	10	15' x 5.5' x 1750' PLC, 0 drops	656
10A	-	DETENTION FACILITY	80 (out)
10B	-	DETENTION FACILITY	86 (out)
10 (DEV)	-	5' x 4' x 250' CBC	152
10 (DEV)	-	DETENTION FACILITY	152 (out)
8A South	-	DETENTION FACILITY	94 (out)
8	-	EXIST. (10' - 10') x 11' x 181' CBC	2285
11A	-	DETENTION FACILITY	384 (out)
11	-	EXIST. 6' x 7' x 79' CBC	390
12A	-	DIVERSION STRUCTURE	80 pass, 187 divert
-	11A	5' x 4.5' x 1750' PLC, 0 drops	187
12	-	EXIST. 48" dia. x 87' RCP	135
13	-	EXIST. (12' x 12') x 10' x 93' CBC	2439
-	-	EXIST. HORSESHOE CULVERT	2434
14	-	CONFLUENCE W/ MONUMENT CREEK	2459
BASIN B1	-	(8' - 8') x 5' x 240' CBC	598
BASIN A	-	5' x 5' x 130' CBC	184
BASIN E	-	6' x 5' x 130' CBC	239
BASIN I (E)	-	6' x 5' x 130' CBC	228
BASIN I (W)	-	48" dia. x 130' RCP	114
BASIN K	-	36" dia. x 130' RCP	63
BASIN L1	-	42" dia. x 130' RCP	86

* These hydrologic calculations are based on the Rational Method.



nts

1. ALL FINAL DESIGN AND CONSTRUCTION SHALL BE TO CURRENT CITY OF COLORADO SPRINGS AND EL PASO COUNTY STANDARDS AND SPECIFICATIONS.
2. FINAL CHANNEL SIZING, TRANSITIONS, AND SUPERELEVATIONS ARE SUBJECT TO DETAILED DRAINAGE REPORTS OF THE SUBJECT AREA.
3. THIS DETAIL WAS USED FOR COST ESTIMATING PURPOSES FOR THIS MASTER PLAN ONLY.
4. TOPSOIL AND REVEGETATION ABOVE RIP-RAP ASSUMED TO BE NON-REIMBURSABLE.

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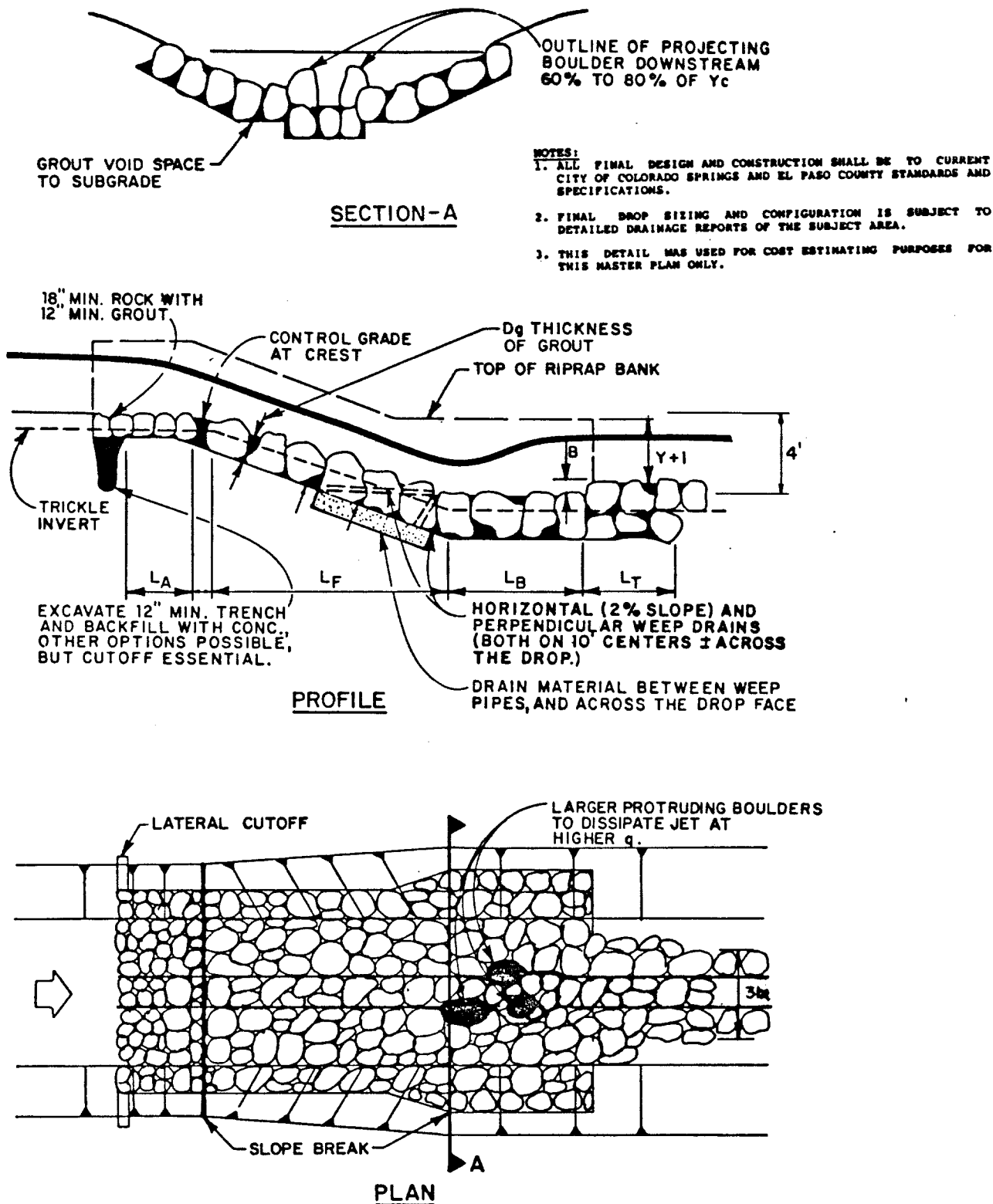


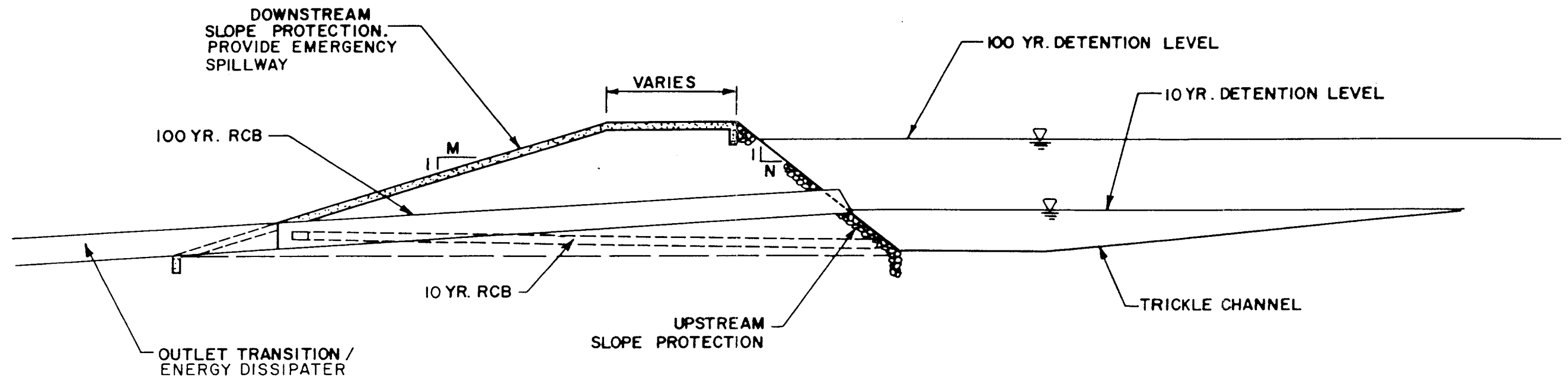
FIGURE 5

GSB-GROUTED SLOPING

BOULDER DROP

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Reference: Urban Drainage & Flood Control District,
Drop Structures in the Denver Metropolitan
Area, Dec. 1986



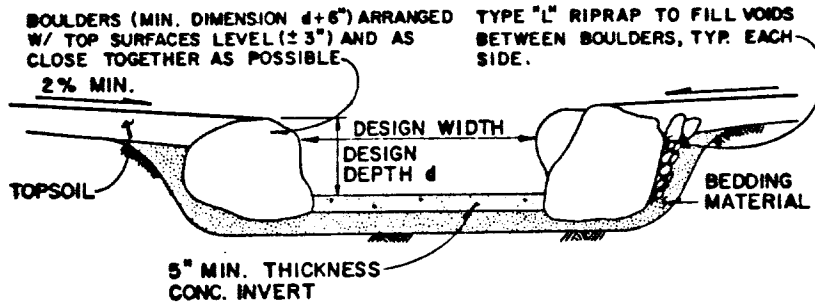
NOTES:

1. THIS SECTION WAS USED FOR COST ESTIMATING PURPOSES (THIS STUDY ONLY).
2. M & N SUBJECT TO GEOTECHNICAL DESIGN.
3. ALL FINAL DESIGN AND CONSTRUCTION SHALL BE TO CURRENT CITY OF COLORADO SPRINGS, EL PASO COUNTY, AND STATE OF COLORADO SPECIFICATIONS WHERE APPLICABLE.

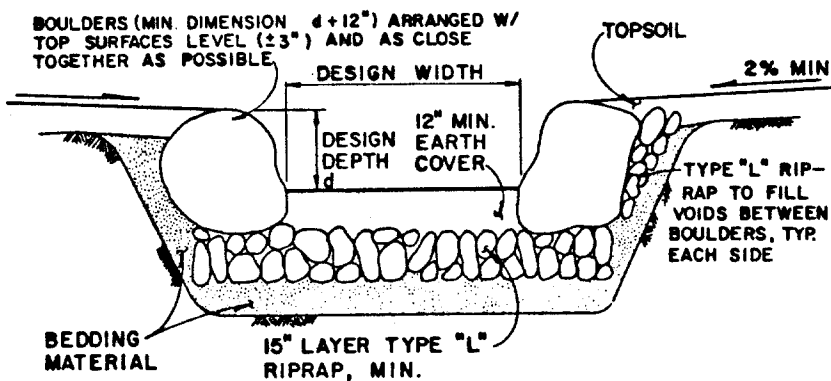
CONCEPTUAL DAM SECTION

NOT TO SCALE

FIGURE 6



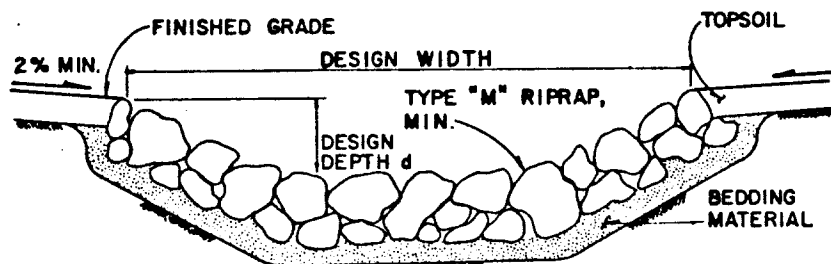
Trickle channel with boulders edge and concrete invert.



Trickle channel with boulder edge and rock/soil invert.

NOTES:

1. ALL FINAL DESIGN AND CONSTRUCTION SHALL BE TO CURRENT CITY OF COLORADO SPRINGS AND EL PASO COUNTY STANDARDS AND SPECIFICATIONS.
2. FINAL DROP SIZING AND CONFIGURATION IS SUBJECT TO DETAILED DRAINAGE REPORTS OF THE SUBJECT AREA.
3. THIS DETAIL WAS USED FOR COST ESTIMATING PURPOSES FOR THIS MASTER PLAN ONLY.
4. EARTH COVER AND REVEGETATION OVER RIP-RAP ASSUMED TO BE NON-REIMBURSABLE.



Rock riprap trickle channel.

FIGURE 7

TRICKLE CHANNELS

Reference: Urban Drainage & Flood Control District,
Drop Structures in the Denver Metropolitan
Area, Dec. 1986

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VII. ESTIMATED PLANNING STUDY COSTS

Estimated 1987 Planning Study Costs are presented in Table 9. All line item costs corresponds to an improvement shown on Figure 3 (attached). Only those items specified in Table 9 are eligible for reimbursement. Initial drainage systems are required in this basin but are not reimbursable.

Unit construction costs used in estimating major improvements are referred to in Table 10. These costs were then spread out through the entire basin to determine the overall cost to the basin for site drainage. The subtotal for drainage improvements was then multiplied by 1.05 to provide a 5 percent allowance for construction contingency. This total was then multiplied by 1.10 to provide a 10 percent allowance for engineering. Also included in the reimbursable costs is the cost of preparing this Planning Study.

Land costs for detention ponds are to be reimbursed at \$15,600 per acre in the City and in the County. This land fee corresponds to the City's current park land fee. These land costs will be adjusted in subsequent years to reflect the park land value that year. The land to be reimbursed for detention ponds will be the difference between the detention pond area and the area required for a full flow through channel.

The estimated annual maintenance costs for major channels and detention ponds include sediment and debris removal, inspection, crack sealing, mowing, and other minor repair work, and are shown in Table 11. Assuming a total developed scenario for the basin, the total estimated maintenance cost for the basin is \$50,000 per year. However, this cost will vary from initial facility construction phases through the design life of the facilities.

TABLE 9

MONUMENT BRANCH DRAINAGE BASIN
ESTIMATED CONCEPTUAL DESIGN IMPROVEMENT COSTS & FEES

DESIGN POINT	REACH	DESIGN FLOW (cfs)	LENGTH (ft)	COMMENTS	PROPOSED IMPROVEMENT (w x d x l)	UNIT COST (\$)	ESTIMATED 1987 CONSTRUCTION COSTS		
							DRAINAGE CONSTRUCTION COST (\$)	DRAINAGE LAND COST (\$)	BRIDGE COST (\$)
-	1	997	4750	PART. LINED CHAN. DROP STRUCTURES	30' x 4.5' x 4750' PLC 16 DROPS	\$80.32 lf 16,700 ea	\$381,500 267,200		\$0
-	1A	363	1650	REINF. CONC. PIPE	54" dia. x 1650' RCP	148.60 lf	245,500		
-	2	376	1900	REINF. CONC. PIPE	60" dia. x 1900' RCP	157.20 lf	298,700		
-	3	1586	2850	PART. LINED CHAN. DROP STRUCTURES	50' x 4.5' x 2850' PLC 10 DROPS	79.12 lf 23,700 ea	225,500 237,000		
2	-	1290	280	POWERS BLVD.	11' x 10' x 280' CBC	445.28 lf	124,700		
2	-	-	-	DETENTION FACILITY	39.9 AC-FT STORAGE	8,213 af	327,690	\$84,240	
-	4	1312	2900	PART. LINED CHAN. DROP STRUCTURES	40' x 4.5' x 2900' PLC 6 DROPS	80.48 lf 20,400 ea	233,400 122,400		
3	-	1312	240	VOYAGER PKWY.	12' x 10' x 240' CBC	484.54 lf	116,300		
-	5	1460	3300	PART. LINED CHAN. DROP STRUCTURES	50' x 4.5' x 3300' PLC 8 DROPS	81.36 lf 22,200 ea	268,500 177,600		
4	-	214	240	POWERS BLVD.	6' x 5' x 240' CBC	176.12 lf	42,300		
5	-	1064	240	POWERS BLVD.	13' x 8' x 240' CBC	479.48 lf	115,100		
-	7	777	5800	PART. LINED CHAN. DROP STRUCTURES	40' x 3.5' x 5800' PLC 16 DROPS	70.41 lf 14,000 ea	408,400 224,000		
-	7A	642	2050	PART. LINED CHAN. DROP STRUCTURES	30' x 4.0' x 2050' PLC 5 DROPS	71.46 lf 12,400 ea	146,500 62,000		
6	-	777	160	VOYAGER PKWY.	10' x 8' x 160' CBC	372.77 lf	59,600		
6A	-	-	-	DETENTION FACILITY	30.4 AC-FT STORAGE	8,257 af	251,000	64,584	
-	8	775	3100	PART. LINED CHAN. DROP STRUCTURES	30' x 4.0' x 3100' PLC 7 DROPS	76.84 lf 14,000 ea	238,200 98,000		
-	9	2279	900	PART. LINED CHAN. DROP STRUCTURES	60' x 5.0' x 900' PLC 5 DROPS	80.67 lf 32,000 ea	72,600 160,000		
8A South	-	-	-	DETENTION FACILITY	5.0 AC-FT STORAGE	9,000 af	45,000	19,656	
9	-	152	240	POWERS BLVD.	5' x 4' x 240' CBC	143.70 lf	34,500		
-	10	656	1750	PART. LINED CHAN. DROP STRUCTURES	15' x 5.5' x 1750' PLC 0 DROPS	113.49 lf 0 ea	198,600 0		
10	-	152	240	VOYAGER PKWY.	5' x 4' x 250' CBC	143.70 lf	34,500		
10	-	-	-	DETENTION FACILITY	29.2 AC-FT STORAGE	8,254 af	241,020	81,432	
10A	-	-	-	DETENTION FACILITY	3.9 AC-FT STORAGE	9,254 af	36,090	15,444	
10B	-	-	-	DETENTION FACILITY	2.0 AC-FT STORAGE	10,350 af	20,700	8,424	
-	11A	187	1750	PART. LINED CHAN. DROP STRUCTURES	5' x 4.5' x 1750' PLC 0 DROPS	94.51 lf 0 ea	165,400 0		
11A	-	-	-	DETENTION FACILITY	29.9 AC-FT STORAGE	8,251 af	246,690	74,412	
12A	-	-	-	DIVERSION STRUCTURE	60" x 36" wye	20,000 ea	20,000		
BASIN B1	-	598	240	ASSUMED FUTURE ARTERIAL CROSSING	(8'-8') x 5' x 240' CBC	470.11 lf	112,800		
BASIN A	-	184	130	REPL. EX. CULVERT @ NORTHGATE RD.	5' x 5' x 130' CBC	156.26 lf	20,300		
BASIN E	-	239	130	REPL. EX. CULVERT @ NORTHGATE RD.	6' x 5' x 130' CBC	176.12 lf	22,900		
BASIN I (E)	-	228	130	REPL. EX. CULVERT @ NORTHGATE RD.	6' x 5' x 130' CBC	176.12 lf	22,900		
BASIN I (W)	-	114	130	REPL. EX. CULVERT @ NORTHGATE RD.	48" dia. x 130' RCP	139.20 lf	18,100		
BASIN K	-	63	130	REPL. EX. CULVERT @ NORTHGATE RD.	36" dia. x 130' RCP	104.40 lf	13,600		
BASIN L	-	86	130	REPL. EX. CULVERT @ NORTHGATE RD.	42" dia. x 130' RCP	124.80 lf	16,200		
SUBTOTAL							\$6,172,990	\$348,192	\$0
TOTAL BASIN ACREAGE: 2378							\$6,172,990		
ASSESSED ACREAGE: 1924							CONSTRUCTION COSTS		
							CONSTRUCTION CONTINGENCY @ 5%	308,650	0
							ENGINEERING FEES @ 10%	648,164	0
							MASTER PLAN COST	60,000	0
DETENTION LAND AREA COST/ACRE:							LAND COSTS	-	\$348,192
WITHIN CITY \$15,600									
WITHIN COUNTY \$15,600									
GRAND TOTAL							\$7,189,803	\$348,192	\$0
FEE/ACRE (1924 ACRES)							\$3,737	\$181	\$0

* Land costs not included in const. contingency and eng. fees calculations.

TABLE 10

MONUMENT BRANCH DRAINAGE BASIN
ESTIMATED UNIT CONSTRUCTION COSTS

ITEM	UNIT	UNIT COST
=====		
CONSTRUCTION		

RIP-RAP	CUBIC YARD	\$ 25.00
RIP-RAP (GROUTED EMBANKMENT)	SQUARE YARD	30.00
DETENTION FACILITY EMBANKMENT	CUBIC YARD	3.00
EXCAVATION & EMBANKMENT	CUBIC YARD	1.50
GRANULAR BEDDING FOR RIP-RAP	CUBIC YARD	12.00
PARTIALLY LINED CHANNEL (AVG)	LINEAR FOOT	68.00
TRICKLE CHANNEL	LINEAR FOOT	14.00
DROP STRUCTURES (AVG)	EACH	18,500.00
REVEGETATION (non-reimbursible when placed over rip-rap)	ACRE	5,000.00
REINFORCED CONCRETE BOXES		
CONCRETE	CUBIC YARD	180.00
STEEL	POUNDS	0.50
TRANSITIONS - SINGLE CELL (AVG)	EACH	9,900.00
TRANSITIONS - DOUBLE CELL (AVG)	EACH	18,800.00
REINFORCED CONCRETE PIPE		
15" Dia.	LINEAR FOOT	40.00
18" Dia.	LINEAR FOOT	48.00
24" Dia.	LINEAR FOOT	61.00
30" Dia.	LINEAR FOOT	76.00
36" Dia.	LINEAR FOOT	87.00
42" Dia.	LINEAR FOOT	104.00
48" Dia.	LINEAR FOOT	116.00
54" Dia.	LINEAR FOOT	124.00
60" Dia.	LINEAR FOOT	131.00

* 20% of barrel cost should be added to culverts for transitions.

TABLE 11

MONUMENT BRANCH DRAINAGE BASIN
ESTIMATED ANNUAL MAINTENANCE COSTS

ITEM	UNIT	UNIT COST
Detention Ponds		
Sediment Removal*	Cubic Yards	5.00
Annual Inspection	Each Pond	150.00
Mowing	Per Acre	240.00
Debris Removal	Each Pond	500.00
Channels		
Lined*	Per 1000 LF	780.00
Unlined*	Per 1000 LF	250.00

* Per Sand Creek Master Drainage Study, 1985

VIII. DRAINAGE BASIN FEE DETERMINATION

Monument Branch Basin encompasses a total drainage area of 2378 acres. Excluding the U.S. Air Force Academy land, the ROW for Interstate 25, SH 83 and Northgate Rd., and the presently platted acreage within the basin, there is approximately 2077 acres of unplatted developable acreage within the basin. Of this area, 575 acres are within the City of Colorado Springs and 1502 acres are within El Paso County.

Per 1987 El Paso County criteria, drainage fees for residential subdivisions having a lot size of 1.0 acres or greater shall be assessed only for the first acre of each lot. Since the area in the northeast part of the basin (subbasins A and E) was assumed to have an average lot size of 5 acres, the total acres that would pay fees in this area would be 191 acres divided by 5 acres per lot or 38 acres. The recommended drainage fee presented herein was computed by dividing the sum of the estimated costs to complete the planned storm drainage system plus the estimated cost to prepare this planning study by the total area within the basin paying fees upon future platting.

Monument Branch Drainage Fee:

Costs	=	\$7,189,803	=	\$3,737
<hr/>				

Area (1886 + 38) acres

Detention Land Fee:

\$348,192	=	\$181
<hr/>		

(1886 + 38) acres

IX. BRIDGE FEE DETERMINATION

All arterial road crossings are designated as culverts and cannot be regarded as bridges, therefore, bridge fees are not established for this basin.

X. BIBLIOGRAPHY

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El Paso County, Board of County Commissioners
March 1985

General and Engineering Geology of the
United States Air Force Academy Site Colorado
Geological Survey Professional Paper 551
1967

Drop Structures in the Denver Metropolitan Area
McLaughlin Water Engineers, Ltd.
December 1986

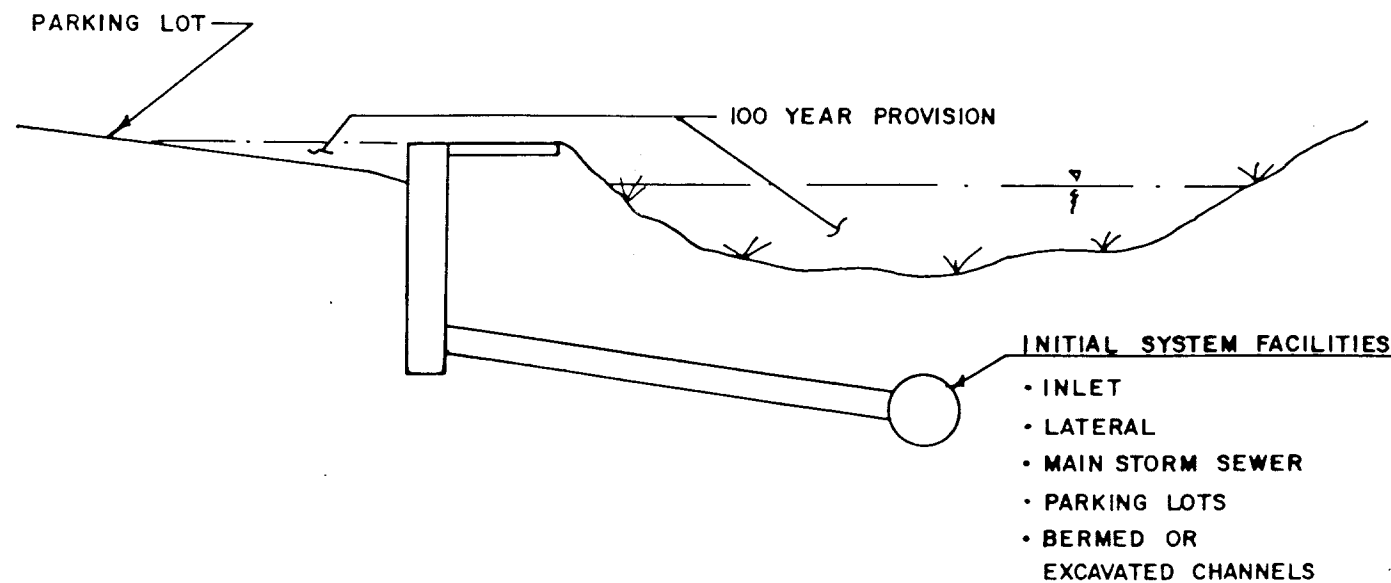
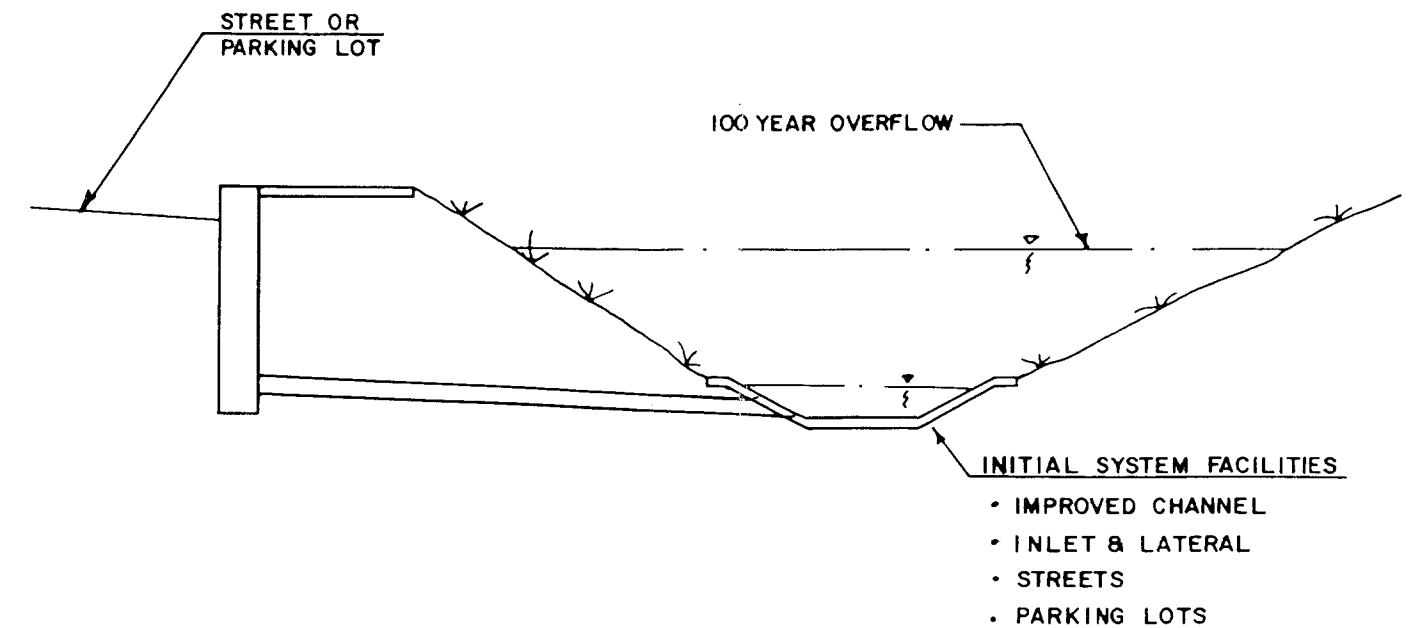
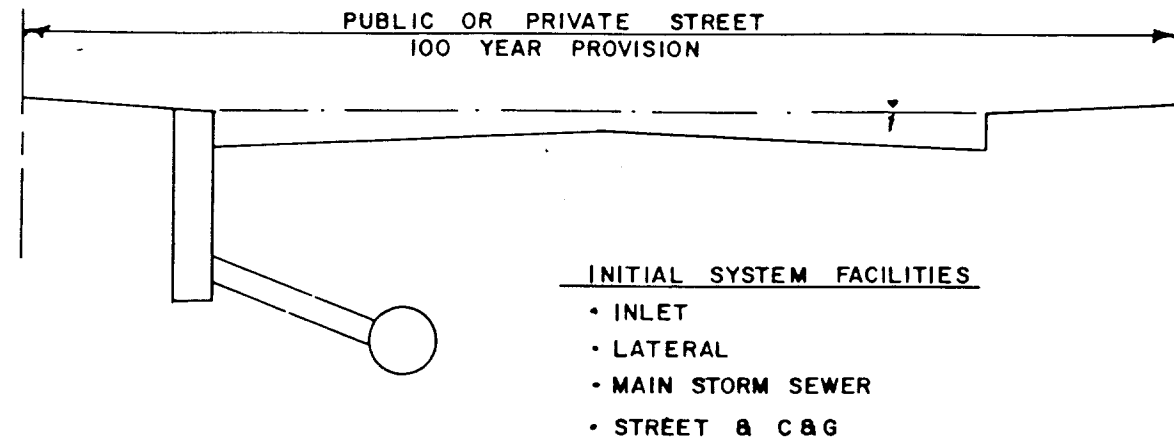
Design of Channels with Wetland Bottoms
Ben Urbonas
December 1986

The City of Colorado Springs/El Paso County
Drainage Criteria Manual
May 1987

APPENDIX A:

CONCEPTUAL INITIAL SYSTEM DETAILS

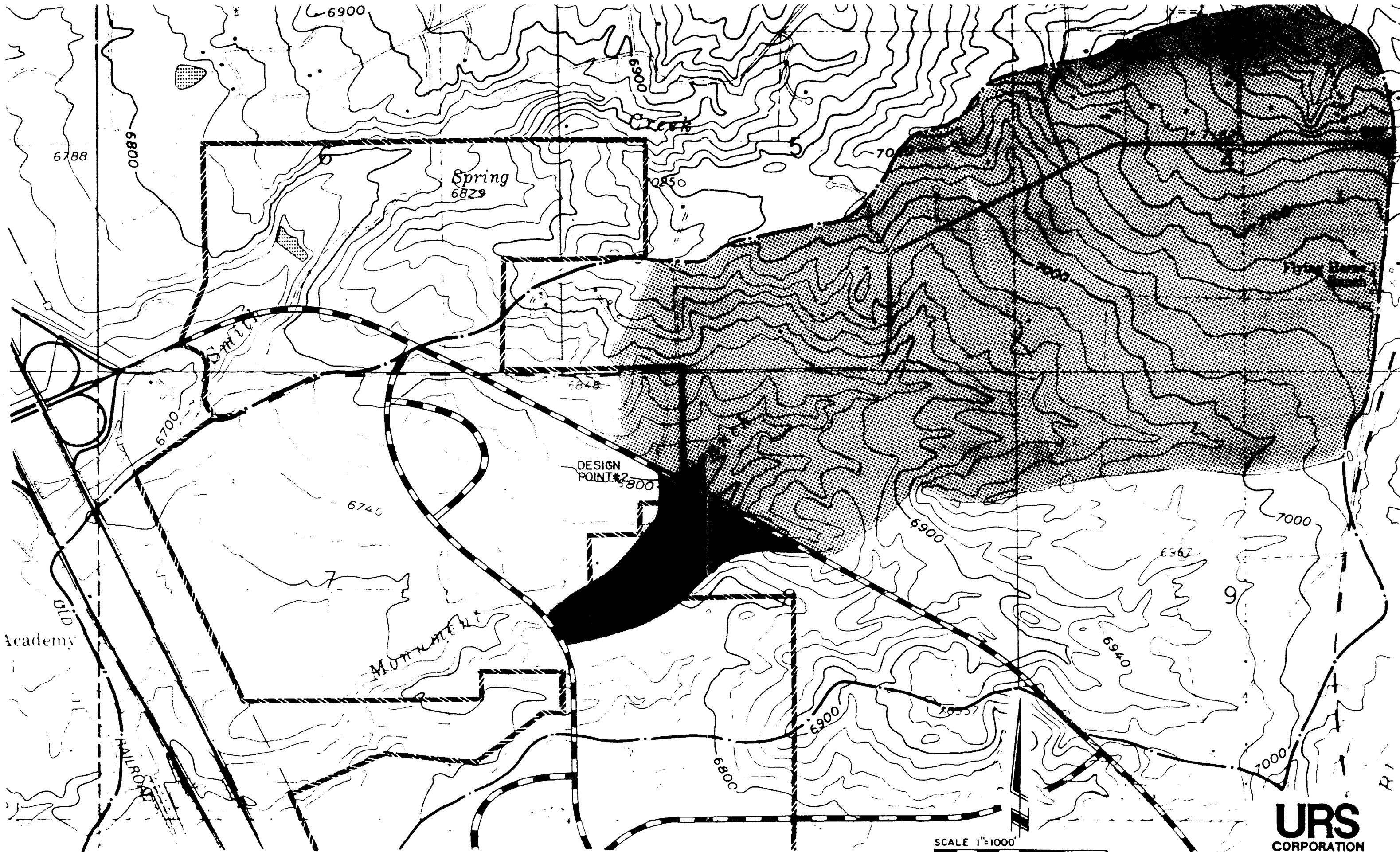
NTS



NOTES:

1. ALL FINAL DESIGN AND CONSTRUCTION SHALL BE TO CURRENT CITY OF COLORADO SPRINGS AND EL PASO COUNTY STANDARDS AND SPECIFICATIONS.
2. ALL IMPROVEMENTS ON BASINS GREATER THAN 130 ACRES SHALL BE DESIGNED FOR THE 100-YR., 24-HR. STORM.

FIGURE 8



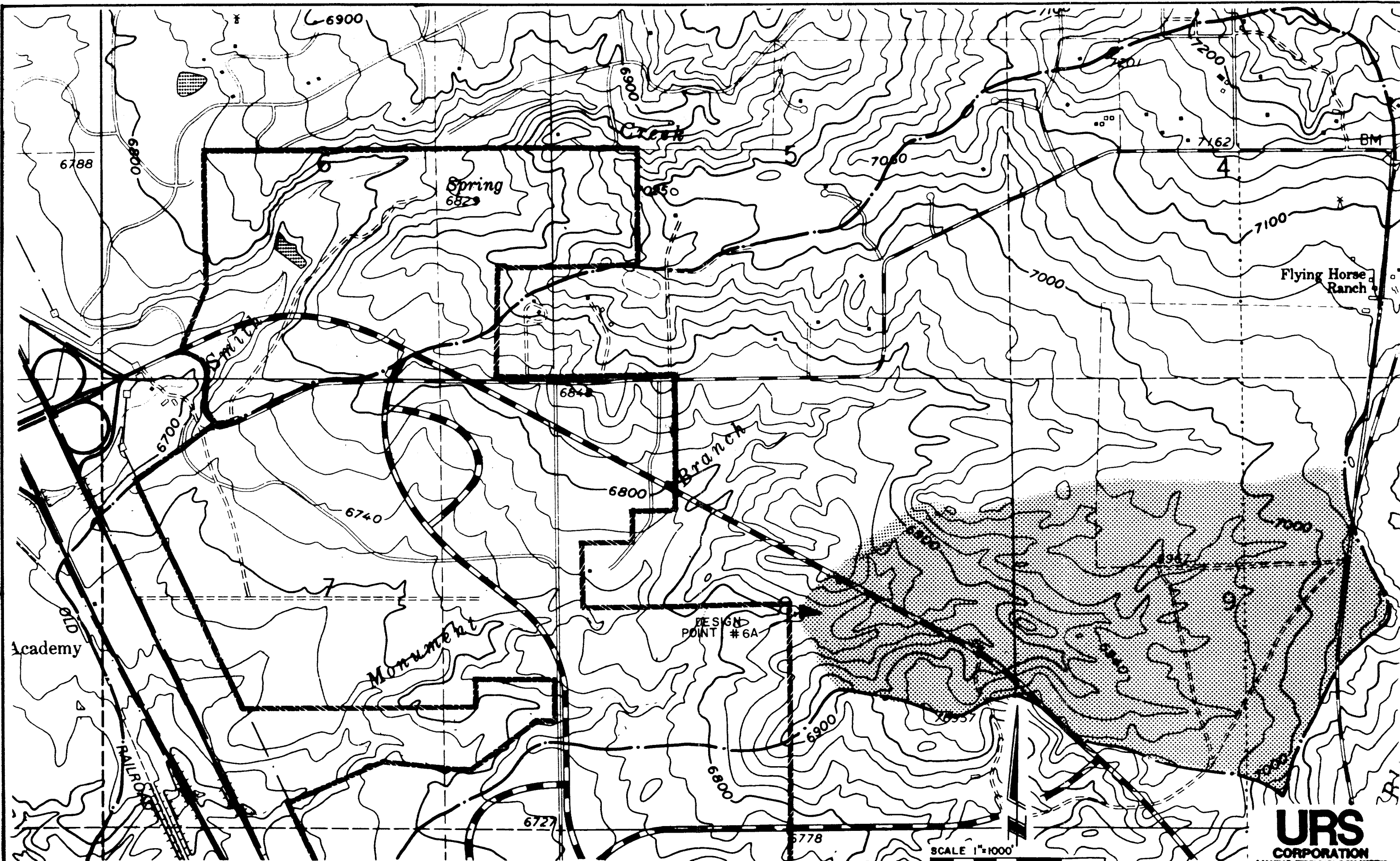
DESIGN POINT 2

STIPPLED: DIRECT DETENTION SUB-BASIN A,B,E,F,G,I,J,K
SOLID BLACK: AREA OVER-DETAILED SUB-BASIN NI

CONCEPTUAL DETENTION POND TRIBUTARY AREA

URS
CORPORATION
MAKING TECHNOLOGY WORK

FIGURE 9



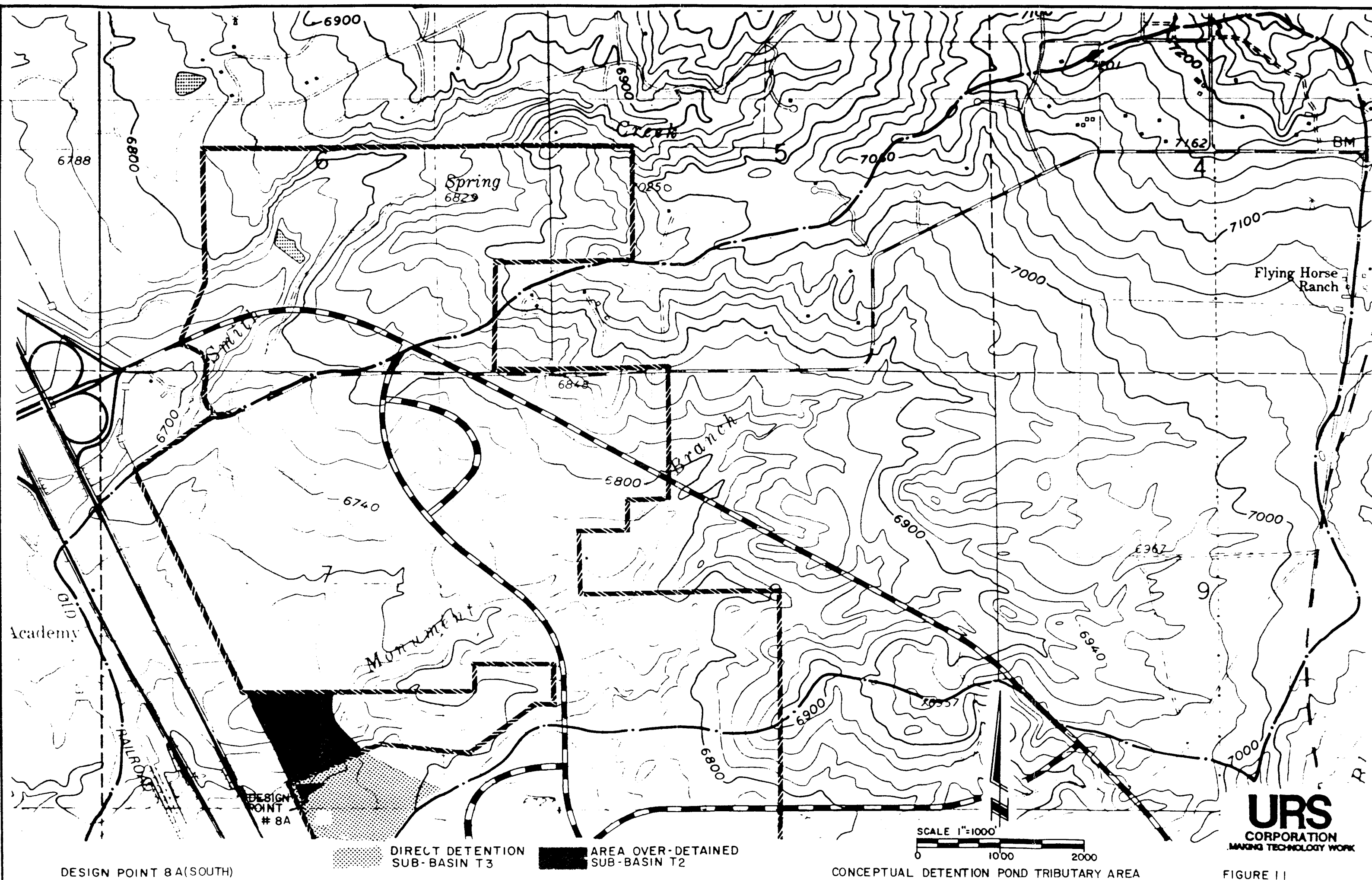
DESIGN POINT 6A

■ DIRECT DETENTION
SUB-BASIN C,D,H,OI

CONCEPTUAL DENTENTION POND TRIBUTARY AREA

URS
CORPORATION
MAKING TECHNOLOGY WORK

FIGURE 10



DESIGN POINT 8 A(SOUTH)

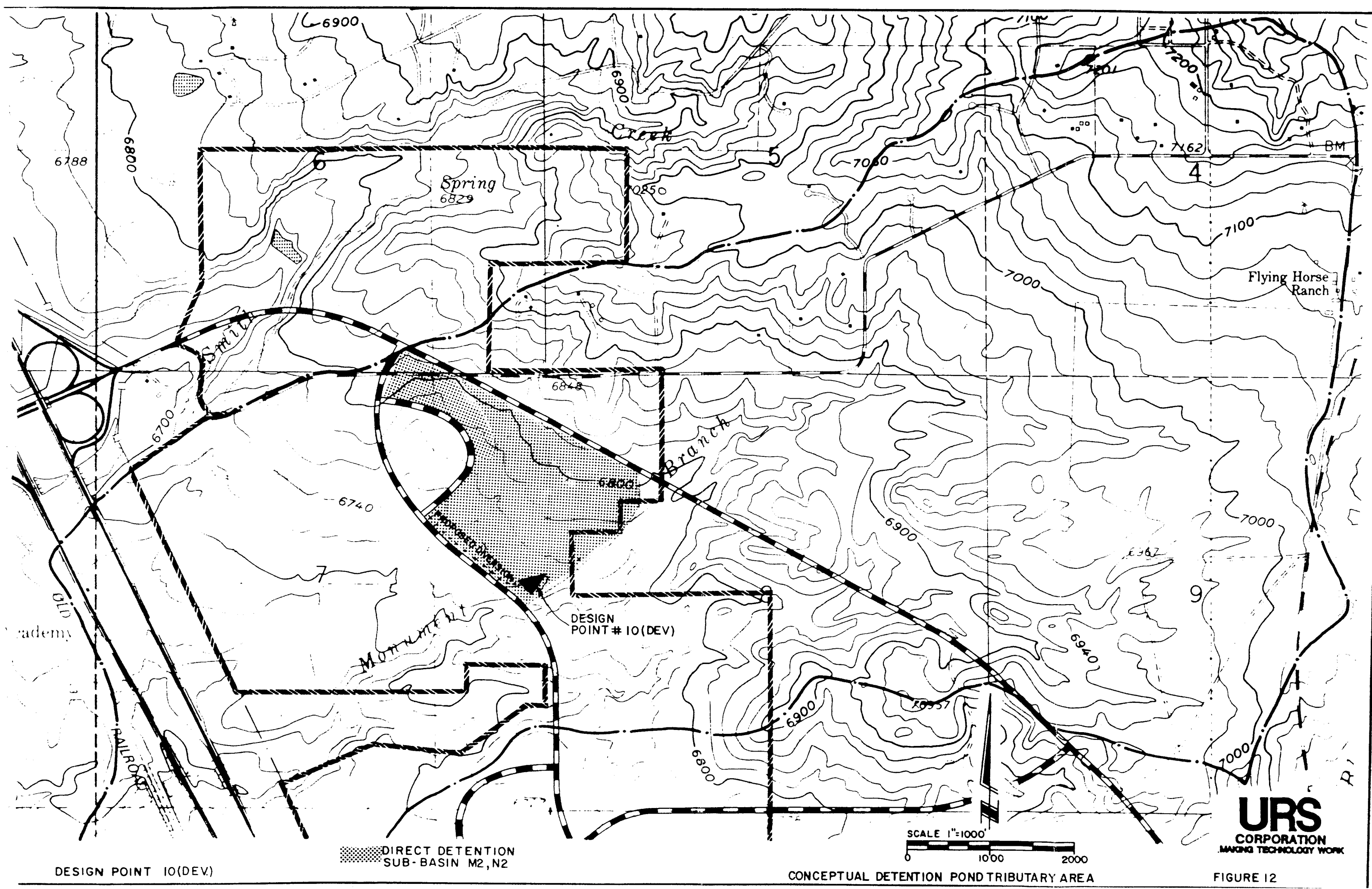
DIRECT DETENTION
SUB-BASIN T3

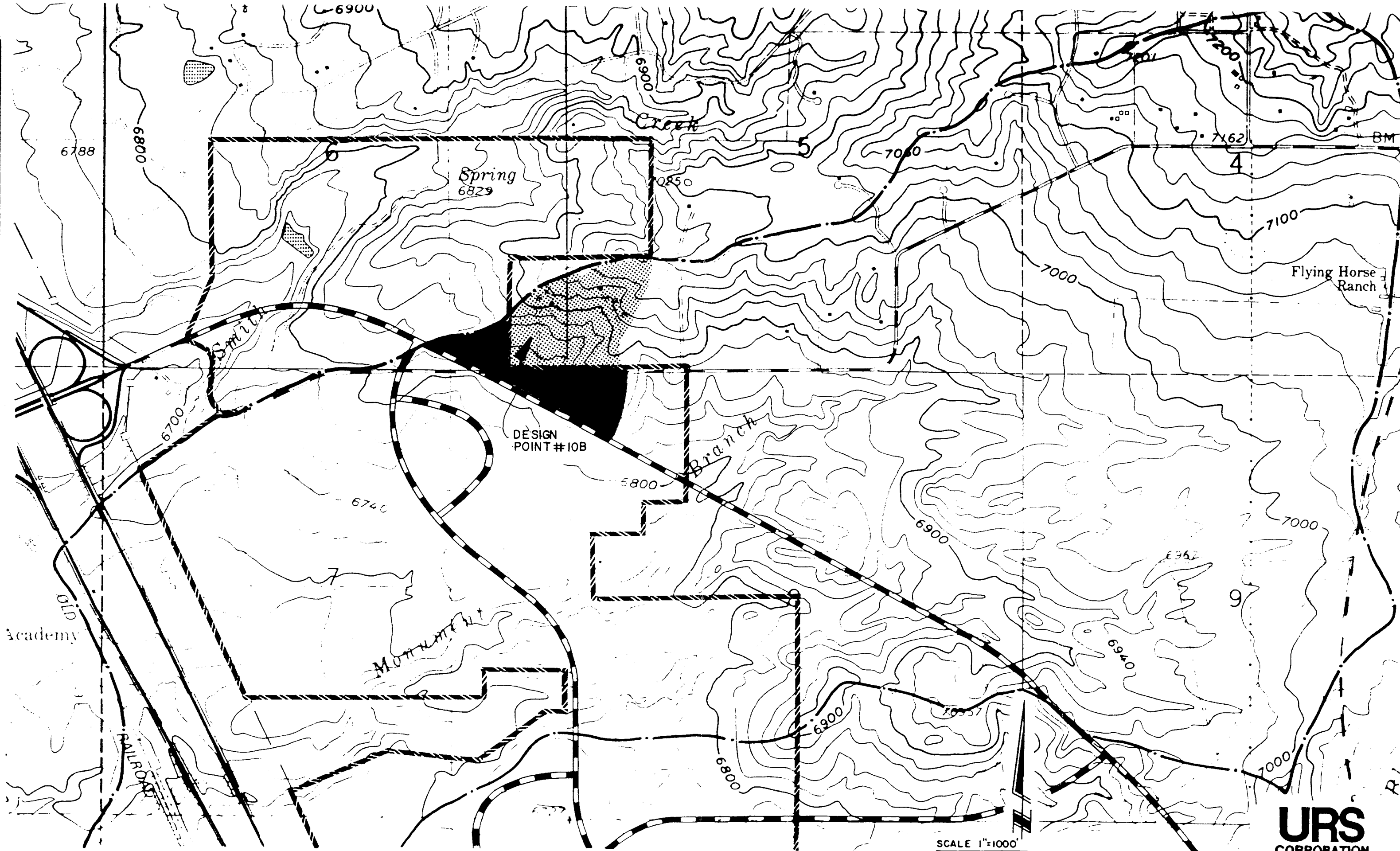
AREA OVER-DETAINED
SUB-BASIN T2

CONCEPTUAL DETENTION POND TRIBUTARY AREA

URS
CORPORATION
MAKING TECHNOLOGY WORK

FIGURE 11





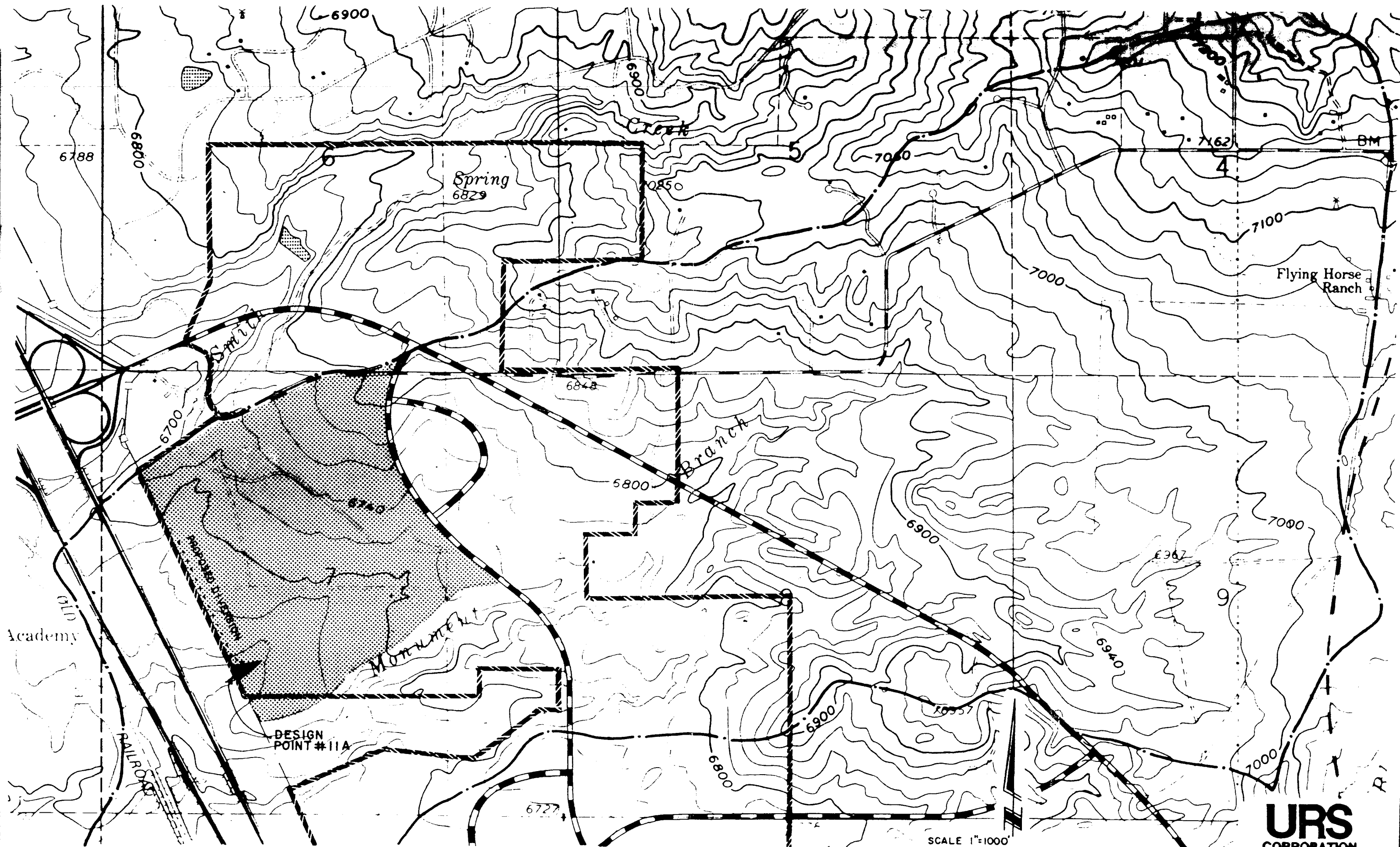
DESIGN POINT 10B

● DIRECT DETENTION SUB-BASIN L1
■ AREA OVER-DETAILED SUB-BASIN L2

SCALE 1"=1000'
0 1000 2000
CONCEPTUAL DETENTION POND TRIBUTARY AREA

URS
CORPORATION
MAKING TECHNOLOGY WORK

FIGURE 14



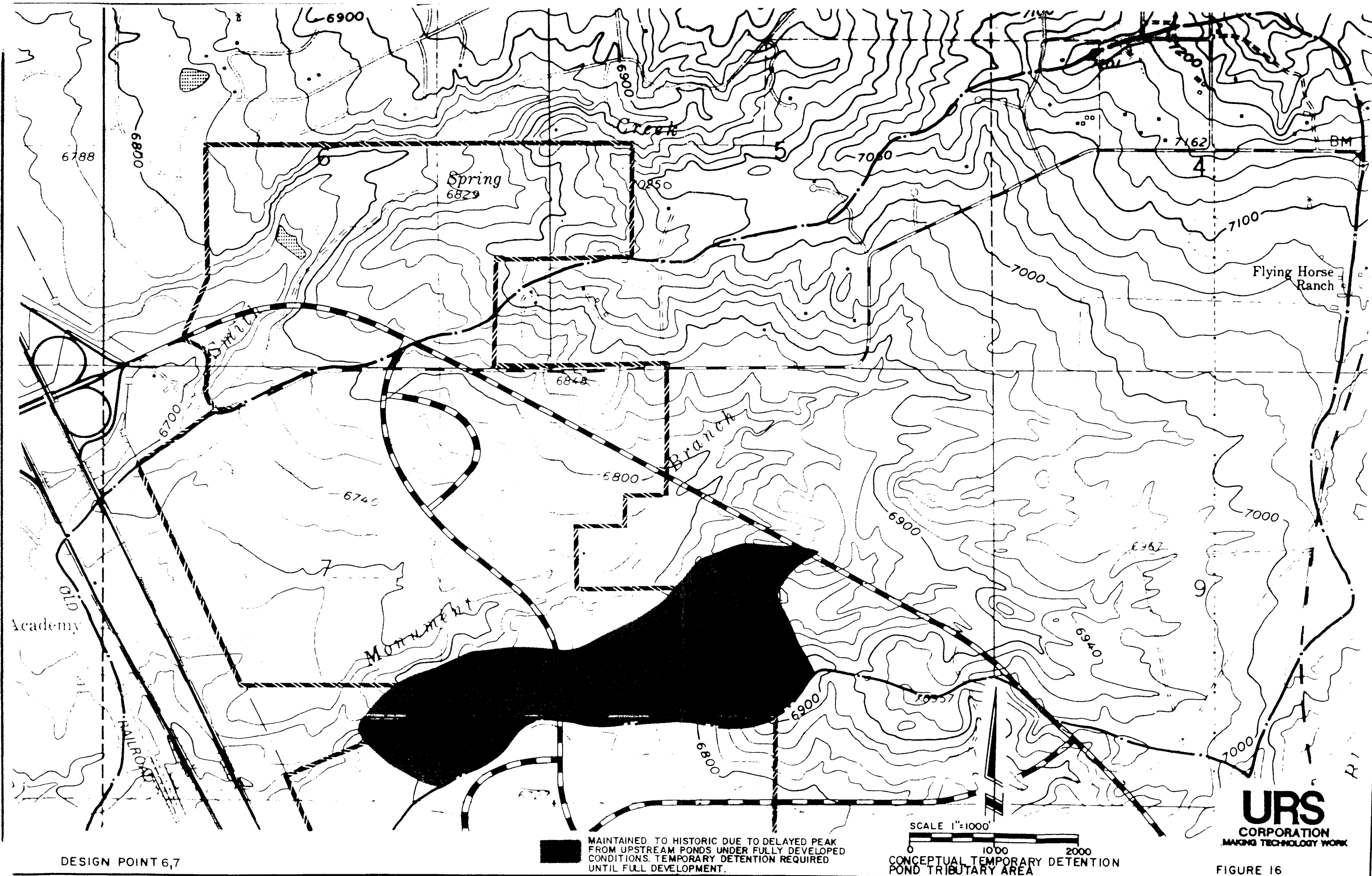
DESIGN POINT 11A

DIRECT DETENTION
SUB-BASIN P2, Q2

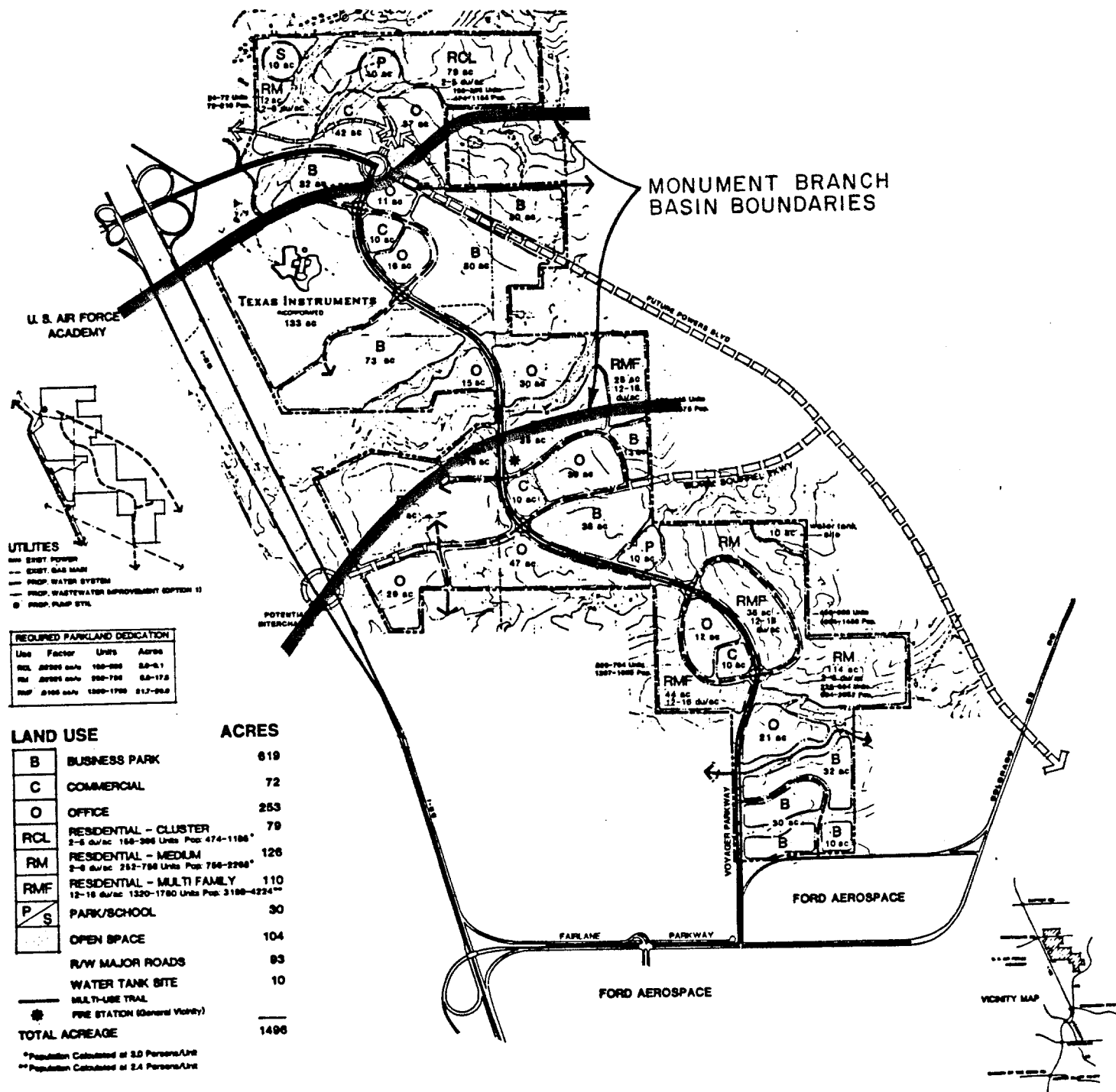
CONCEPTUAL DETENTION POND TRIBUTARY AREA

URS
CORPORATION
MAKING TECHNOLOGY WORK

FIGURE 15



LAND USE PLAN



NORTHGATE
THE OLIVE COMPANY

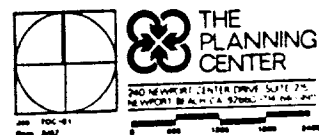


FIGURE 17

MONUMENT BRANCH DRAINAGE BASIN PLANNING STUDY

APPENDIX B:



DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY

COLORADO SPRINGS, COLORADO 80840 -5546

RECEIVED NOV 3 1987

2 NOV 1987

REPLY TO
ATTN OF:

DE

SUBJECT:

Monument Branch and Middle Tributary Drainage Basins Planning Study

TO:

Mr Clyde L. Pikkaraine
URS Corporation
1040 South 8th Street
Colorado Springs CO 80906

USAF Academy engineers have reviewed subject planning studies and concur with the plans as written. We reserve the right to review the drainage plans when they are submitted to the City of Colorado Springs for approval.

WILLETT R. STALLWORTH, Colonel, USAF
DCS/Civil Engineering



Commitment To Excellence

RECEIVED NOV 15 1987

STATE OF COLORADO

DEPARTMENT OF HIGHWAYS

District II
905 Erie - P.O. Box 536
Pueblo, Colorado 81002
(303) 544-6286



November 12, 1987

Mr. Clyde L. Pikkaraine, PE
URS Corporation
1040 South 8th Street
Colorado Springs, CO 80906

Dear Mr. Pikkaraine:

The Colorado Department of Highways has reviewed the drainage report for the Monument Branch Drainage Basin, and it is acceptable. Please notify us if any changes occur to the drainage which might affect I-25.

Sincerely,

A handwritten signature in cursive script, reading "David L. Miller".

David L. Miller
District Design Engineer

DLM/lrs

THE C F HOECKEL CO. DENVER 369164

13. MP-87-7 and AMENDMENTS TO THE COUNTY
MP-87-8 MASTER PLAN
MIDDLE TRIBUTARY AND
MONUMENT BRANCH DRAINAGE BASIN PLANNING STUDIES

A request by the El Paso County Department of Public Works for approval of the Middle Tributary and Monument Branch Drainage Basin Planning Studies as amendments to the Master Plan for the Development of El Paso County.

SPEAKING FOR: Alan Morrice with the Public Works Department who said Kevin Walker (with the Olive Company) and Clyde Pickering (with U.R.S.) who had worked on the plans were present.

SPEAKING FOR: Kevin Walker who explained the location of the Basins and planned facilities (detention ponds, etc.). Design details have not been included. Public maintenance of the ponds is planned.

He said City Council will be hearing this matter next month since minor changes to the City Ordinance were required before they could approve the requests. There are no major issues remaining before they grant approval.

There was discussion regarding fee calculations.

SPEAKING AGAINST: None.

After further discussion Mr. Hyland made a motion for approval of Standard Resolution No. MP-87-7 regarding approval of the Middle Tributary Drainage Basin Planning Study as an amendment to the County's Master Plan. Mr. Breuning seconded the motion and, upon voting, it was adopted by a unanimous vote of 9-0. This Resolution is found in Book P, Page 4689 or the Resolutions of the El Paso County Planning Commission.

Mr. Hyland then made a motion for approval of Standard Resolution MP-87-8 regarding approval of the Monument Branch Drainage Basin Planning Study as an amendment to the County's Master Plan. Mr. Breuning seconded the motion and, upon voting, it was adopted by a unanimous vote of 9-0. This Resolution is found in Book P, Page 4690 or the Resolutions of the El Paso County Planning Commission.

ADDED ITEM:

PBC-87-5
522.08

PLOT PLAN REVIEW
PONDEROSA VILLAGE

A request by Bill Wewee/Larry Maton for review of a plot plan for Ponderosa Village, zoned PBC (Planned Business Center), located on the north side of Shoup Road and approximately 630 feet east of Black Forest Road.

LAND USE DEPARTMENT commented, pointing out it is unprecedented to bring a Plot Plan before the Planning Commission/Board of County Commissioners but the following note on the Plat requires Board of County Commissioner approval:

"Plot Plans for the development of each of these two lots must be submitted to the El Paso County Land Use Department and approved by the Board of County Commissioners prior to any building thereon."

There was discussion regarding the reason for the Plat note, access, landscaping, removal of trees, concerns of the Black Forest Land Use Committee.

SPEAKING FOR: Bill Petersilie and Larry Maton, who said a minimum number of trees will be removed and they will reseed any disturbed areas. They intend to utilize natural earth tones and blend in with the surroundings. They will cooperate with the Black Forest Land Use Committee.

AMENDMENT TO THE COUNTY PLAN (Approved)

Commissioner Hyland moved that the following Resolution be adopted:

BEFORE THE PLANNING COMMISSION

OF THE COUNTY OF EL PASO

STATE OF COLORADO

RESOLUTION NO. MP-87-8

WHEREAS, the El Paso County Public Works Department requests approval of and amendment to the Master Plan for the Development of El Paso County by approval of the Monument Branch Drainage Basin Planning Study, within the designated areas of the unincorporated area of El Paso County; and

WHEREAS, a public hearing was held by this Commission on October 20, 1987; and

WHEREAS, based on the evidence, testimony, exhibits, study of the master plan for the unincorporated area of the county, comments of the El Paso County Land Use Department, comments of public officials and agencies, and comments from all interested parties, this Commission finds as follows:

1. That proper posting, publication and public notice was provided as required by law for the hearing of the Planning Commission.
2. That the hearing before the Planning Commission was extensive and complete, that all pertinent facts, matters and issues were submitted and that all interested parties were heard at that meeting.
3. That all data, surveys, analyses, studies, plans, and designs as are required by the State of Colorado and El Paso County have been submitted, reviewed, and found to meet all sound planning and engineering requirements of the El Paso County Subdivision Regulations.
4. That the proposal shall amend the Master Plan for El Paso County.
5. That for the above-stated and other reasons, the proposal is in the best interests of the health, safety, morals, convenience, order, prosperity and welfare of the citizens of El Paso County.

WHEREAS, Section 30-28-108, C.R.S. provides that a county planning commission may adopt, amend, extend, or add to the County Master Plan.

NOW, THEREFORE, BE IT RESOLVED that the Master Plan for the Development of El Paso County be amended by the adoption of the Monument Branch Drainage Basin Planning Study for the following described unincorporated area of El Paso County:

(See attached Map)

BE IT FURTHER RESOLVED that the Resolution and recommendations be forwarded to the Board of County Commissioners of El Paso County for their consideration.

Commissioner Breuning seconded the adoption of the foregoing Resolution.








The roll having been called, the vote was as follows:

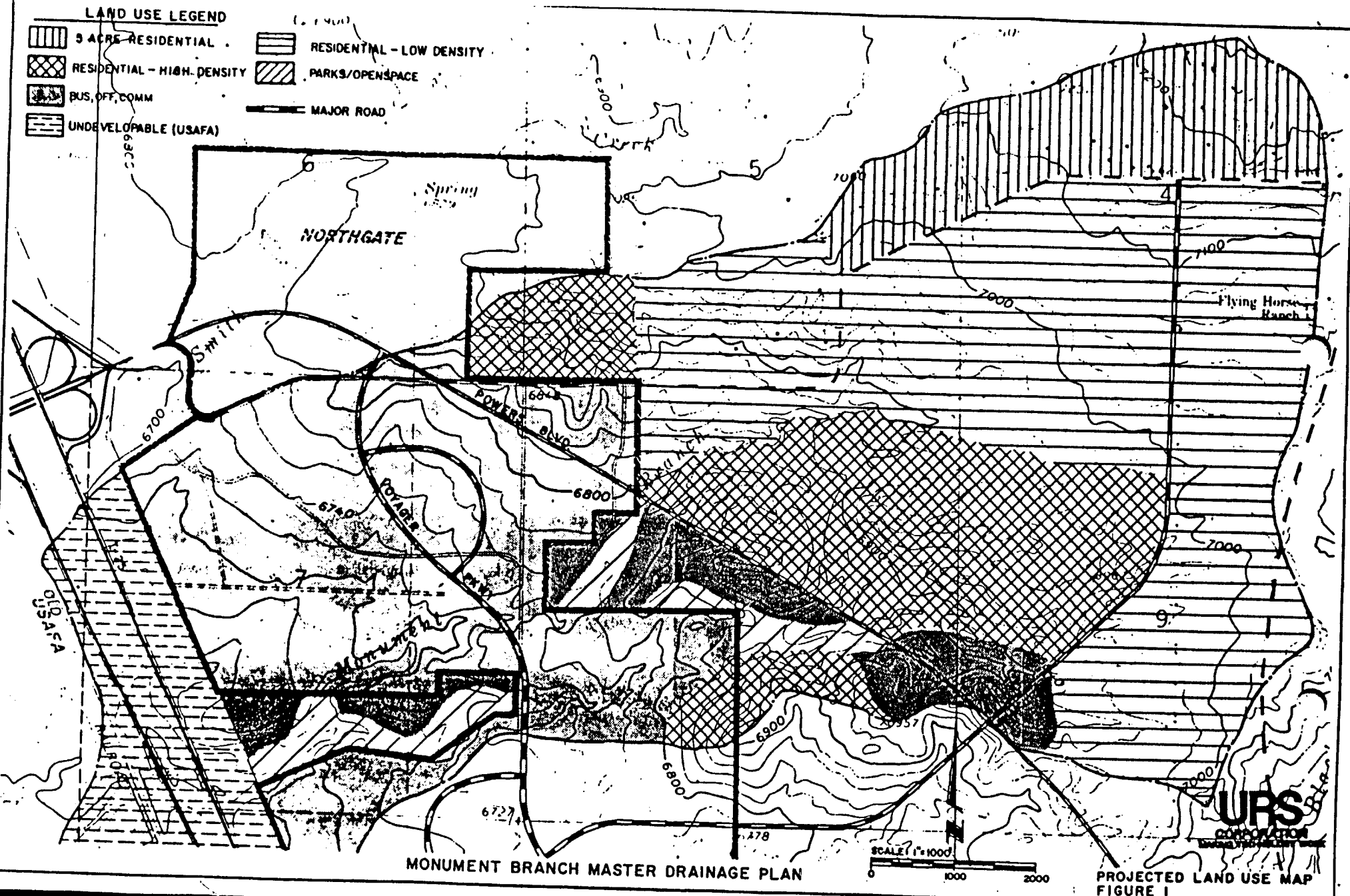
Commissioner Martin	aye
Commissioner Lipskin	aye
Commissioner Royal	aye
Commissioner Hyland	aye
Commissioner Breuning	aye
Commissioner Routh	aye
Commissioner Rixon	aye
Commissioner Hyer	aye

The Resolution was adopted by a unanimous vote of 8 to 0 by the Planning Commission of the County of El Paso, State of Colorado.

DATED: October 20, 1987.

LAND USE LEGEND

-  3 ACRE RESIDENTIAL
-  RESIDENTIAL - HIGH DENSITY
-  BUS, OFF, COMM
-  UNDEVELOPABLE (USAF)
-  RESIDENTIAL - LOW DENSITY
-  PARKS/OPENSOURCE
-  MAJOR ROAD



MONUMENT BRANCH MASTER DRAINAGE PLAN

SCALE 1"=1000'
0 1000 2000

PROJECTED LAND USE MAP
FIGURE 1

URS
CORPORATION
UNIVERSITY MICROFILMS

12-10

A RESOLUTION ADOPTING THE MONUMENT BRANCH DRAINAGE BASIN STUDY AND ESTABLISHING A MONUMENT BRANCH DRAINAGE BASIN DRAINAGE FEE FOR 1987 AND 1988.

WHEREAS, the City of Colorado Springs, Department of Public Works has reviewed the hydrologic study of the Monument Branch Drainage Basin prepared by URS Corporation and dated August 6, 1987; and

WHEREAS, the City/County Drainage Board has recommended approval of the above document;

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF COLORADO SPRINGS:

Section 1, That the Monument Branch Drainage Basin Master Drainage Study prepared by URS Corporation and dated August 6, 1987 be adopted for use.

Section 2, That the Monument Branch Drainage Basin Drainage Fee as recommended by the City/County Drainage Board at their September 17, 1987 meeting be established for the remainder of 1987 and all of 1988 as follows:

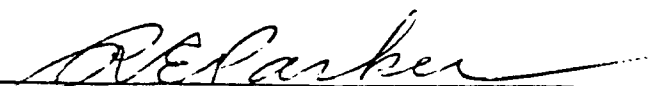
Monument Branch Basin Fee \$3,918.00 per acre
(the fee is comprised of two components; drainage construction costs of \$3,737.00 per acre and a detention pond land cost of \$181.00 per acre.)

Dated at Colorado Springs, Colorado this 8th day of December, 1987.



Mayor

ATTEST:



City Clerk

VED JAN 8 1988

Commissioner Meier moved adoption of the following Resolution:

BEFORE THE BOARD OF COUNTY COMMISSIONERS
OF THE COUNTY OF EL PASO, STATE OF COLORADO

Resolution No. 87-388, Transportation-46

WHEREAS, section 30-28-133(11), C.R.S., as amended, authorizes counties to adopt subdivision regulations providing for the payment of a sum of money or proof of a line of credit or other fees in connection with a subdivision on a per-acre basis, to represent an equitable contribution to the total costs of the drainage facilities in the drainage basin in which the subdivision is located; and

WHEREAS, section 49.3(D) of the El Paso County Subdivision Regulations provides for the assessment of drainage basin fees and for the repayment to a subdivider, from any surplus basin funds available, of costs he incurs because of compliance with the plans for the development of drainage basins in excess of the sum of the drainage basin fees assessed against his acreage; and

WHEREAS, a plan for the development of drainage basins of mutual concern was adopted by the El Paso County Planning Commission as part of the County Master Plan on December 17, 1984; and revised August 19, 1985; and revised December 16, 1985; and revised September 10, 1986; and revised October 20, 1987; and

WHEREAS, the El Paso County Department of Public Works recommends that the County drainage fee resolution as adopted by the Board of County Commissioners, Resolution No. 87-229, Transportation-25, dated August 13, 1987, be amended; and

WHEREAS, The City of Colorado Springs ("City") and the Board of County Commissioners ("County") entered into an agreement, dated November 22, 1983, in which a joint city and county subdivision storm drainage board was established for those drainage basins of mutual concern; and

WHEREAS, the City and County have agreed to adopt subdivision regulations for drainage and control of flood and surface water as similar as practicably possible; and

WHEREAS, the County wishes to adopt, where practicable, the same drainage basin fee schedule as adopted by the City;

NOW, THEREFORE, BE IT RESOLVED by the Board of County Commissioners of El Paso County, Colorado:

1. Drainage basin fees shall consist of a drainage fee and where applicable, a bridge fee. Drainage basin fees shall be paid prior to the time of the recording of the plat. The fees to be paid shall be those in effect at the time of the final plat approval and adjusted as needed to the time of facility construction bid opening.

2. The schedule attached hereto and incorporated by reference herein as Exhibit "A" is hereby adopted as the drainage basin fee on a per-acre basis for residential subdivisions having lot sizes of less than 1.0 acre and for all other non-residential subdivisions regardless of the size of lots.

3. Drainage basin fees for residential subdivisions having lot sizes of 1.0 acre or greater with one dwelling unit per lot shall be assessed only for the first acre of each lot.

4. The bridge fee, to be assessed only for arterial road, freeway, or expressway bridges, shall be determined on the following basis:

$$a. \text{ Bridge Fee} = \frac{(\text{Improvement Cost} - \text{County Participation})}{(\text{County Undeveloped Basin Acreage})}$$

b. The minimum county participation, provided funds exist, for existing, inadequate bridge structures shall equal the following:

$$\left[\frac{\text{Improvement Cost}}{\text{Cost}} \right] \times \left[\frac{\text{Historic Flow} - \text{Existing Flow Capacity}}{\text{Ultimate Developed Flow}} \right]$$

c. An inadequate bridge structure shall be one in which its flow capacity is less than the historic flow.

5. For vacations and replats, drainage fees assessed shall be dependent upon whether drainage fees have been previously paid.

a. If drainage basin fees have been previously paid, the fees assessed shall equal fees in effect at the time of vacation and replat minus the previous drainage fees paid; however, drainage basin fees shall not be assessed if the number of lots and the total acreage are unchanged, and a rezoning of the property in question has not occurred since the previous plat.

b. If drainage basin fees have not been previously paid, the drainage basin fees shall be the fees in effect at the time of vacation and replat assessed to a portion of the total acreage. Such fees shall be assessed if any of the following occur: There is an increase in the number of lots replatted, additional acreage is included in the replat, or a rezoning has occurred since the previous plat. For replats of subdivisions resulting in additional lots, but no additional total acreage, the assessed acreage shall equal the acreage of those additional lots comprising the largest of all the replatted lots. For those replats including previously unplatted acreage, such acreage shall be assessed the fees in effect at the time of vacation and replat.

6. Interest earned by the investment of surplus funds that may temporarily accumulate in the storm drainage fund shall be allocated to a drainage contingency fund which may be used to make up deficits in existing sub-funds for the purposes of reimbursement or for such other drainage purposes as determined by the Drainage Board with the prior approval of the Board of County Commissioners.

DONE THIS 28th day of December, 1987, at Colorado Springs Colorado.

ATTEST:

BOARD OF COUNTY COMMISSIONERS
OF EL PASO COUNTY, COLORADO

Doris Hardy
Deputy County Clerk

By: Mary Morrison
Chairman

Commissioner Shupp seconded the adoption of the foregoing Resolution. The roll having been called, all five Commissioners voted "aye," and the Resolution was unanimously adopted by the Board of County Commissioners of the County of El Paso, State of Colorado.

EXHIBIT A

EL PASO COUNTY DRAINAGE BASIN FEES

<u>BASIN_NUMBER</u>	<u>BASIN_NAME</u>	<u>1988 DRAINAGE FEE</u> <u>---(per acre)---</u>	<u>1988 BRIDGE FEE</u> <u>---(per acre)---</u>
FOFO4000	Sand Creek	\$5,445.	\$620.
FOFO4200	Spring Creek	\$4,196.	-
FOMO1200	Templeton Gap	\$2,767.	\$ 30.
FOMO1000	Douglas Creek	\$4,883.	\$112.
FOFO5600	19th Street*	\$1,593.	-
FOMO1400	Popes Bluff*	\$1,620.	\$276.
FOFO5800	Camp Creek	\$ 898.	-
FOFO3400	Peterson Field	\$4,102.	\$237.
FOMO1600	South Rockrimmon*	\$1,902.	-
FOMO2000	Pulpit Rock*	\$2,681.	-
FOMO2400	Dry Creek	\$2,306.	-
FOMO1800	North Rockrimmon*	\$2,433.	-
FOMO2200	Cottonwood Creek	\$3,562.	\$163.
	Miscellaneous:		
FOFO2000	a. Jimmy Camp Creek	\$3,184.	-
FOFO2200	b. Fort Carson	\$3,184.	-
FOFO2600	c. Big Johnson	\$3,184.	-
FOFO3200	d. Little Johnson	\$3,184.	-
FOFO3600	e. Fishers Canyon	\$3,184.	-
FOFO3800	f. Stratton	\$3,184.	-
FOFO4400	g. Shook's Run	\$3,184.	-
FOFO5000	h. Midland	\$3,184.	-
FOFO6000	i. Palmer Trail	\$3,184.	-
FOFO6600	j. Balanced Rock*	\$3,184.	-
FOFO6800	k. Black Canyon	\$3,184.	-
FOMO0200	l. Monument Valley	\$3,184.	-
FOMO0600	m. Papeton*	\$3,184.	-
FOMO0800	n. Roswell*	\$3,184.	-
FOMO2800	o. Pine Creek	\$3,184.	-
FOMO3000	p. Kettle Creek	\$3,184.	-
FOMO3400	q. Elkhorn	\$3,184.	-
FOMO3600	r. Black Squirrel Creek	\$3,184.	-
FOMO4000	s. Smith Creek	\$3,184.	-
FOMO0400	Mesa*	\$4,231.	-
FOFO5400	21st Street	\$2,433.	-
FOFO4800	Bear Creek	\$1,566.	\$146.
FOFO4600	Southwest Area	\$5,297.	-
FOFO3000	Windmill Gulch	\$4,843.	\$ 63.
FOMO3700	Middle Tributary	\$2,994	-
FOMO3800	Monument Branch	\$3,918	

* Basin in which El Paso County has no jurisdiction since the basin is entirely within City incorporated limits.

M I N U T E S

City of Colorado Springs/El Paso County

Drainage Board

for September 17, 1987

The City of Colorado Springs/El Paso County Drainage Board held its regularly scheduled meeting at 2:20 PM on September 17, 1987 in the City Council Chambers, City Administration Building, 30 South Nevada Avenue.

MEMBERS PRESENT

Richard Dailey,
Chairman
Roland Obering
Ron Waldthausen
Mike Mallon
Rick Brown
Guenther Polok

MEMBERS ABSENT

Fred Gibson

OTHERS PRESENT

Gary Haynes
Chris Smith
Tom Woodbury
Alan Morrice
Kevin Walker,
The Olive Co.
Tom Taylor,
Peregrine
JR Engineering

Mr. Dailey informed the Board that Item 8 has been withdrawn by the applicant for action at this meeting. Mr. Dailey also informed the Board that Item 10 on the agenda will be moved up and replace Item 8 as listed on the agenda. Items 9 and 11 as shown on the agenda would be heard after Item 10. Items 2 through 7 as listed on the agenda would still be heard as consent items.

Item 1

Approval of the minutes of the August 20, 1987 Board Meeting. The minutes were previously mailed out. Mr. Waldthausen stated to the Board that the minutes of the August 20, 1987 Board Meeting accurately reflected his motion on Item 5. The motion, as presented by Mr. Waldthausen, was to approve the agreement per staff recommendation.

Mr. Waldthausen made a motion to approve the minutes as presented. Mr. Obering seconded the motion. The motion passed with a unanimous vote.

Items 2 through 7 were heard as consent items by the Board.

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Mr. Mallon abstained from discussion and voting on Items 3 and 7.
Mr. Obering abstained from discussion and voting on Items 5, 6
and 7.

Item 2

Request for cash reimbursement for construction of drainage facilities within Auto Center Filing No. 1, Bear Creek Basin, Langford-Delay & Associates, Inc., Developer, 5360 North Academy Boulevard, Colorado Springs, CO, 80918.

Item 3

Request for cash reimbursement for construction of drainage facilities within Mount Washington Industrial Park Filings 1 through 4, Miscellaneous Basin, Fifteen Limited, Developer, 2110 Hollowbrook Drive, Colorado Springs, CO, 80918.

Item 4

Request for cash reimbursement for construction of drainage facilities within Old Farm Center Subdivision, Templeton Gap Basin, Langford-Delay & Associates, Inc., Developer, 5360 North Academy Boulevard, Colorado Springs, CO, 80918.

Item 5

Request for cash reimbursement for construction of drainage facilities within Pinehurst Station Filings 1 through 4 and 6, Miscellaneous Basin, RMC Corporation, Developer, P. O. Box 908, Colorado Springs, CO, 80901.

Item 6

Request for cash reimbursement for construction of drainage facilities within Pinehurst Station Filings 1, 3, 4, 5, & 7, Peterson Field Basin, RMC Corporation, Developer, P. O. Box 908, Colorado Springs, CO, 80901.

Item 7

Request for cash reimbursement for construction of drainage facilities within Briargate Subdivision Filing No. 37, Cottonwood Drainage Basin, Briargate Joint Venture, 7710 North Union Boulevard, Colorado Springs, CO, 80918.

Mr. Brown made a motion to approve the staff recommendations for Items 2 through 7. Mr. Waldthausen seconded the motion. The motion passed with a unanimous vote.

Item 8 was postponed per request of the applicant.

Item 10

Presentation to the Board for action of the Middle Tributary and Monument Branch Master Drainage Basin Reports as prepared by URS Corporation for The Olive Company.

Mr. Morrice recommended to the Board that concurrence of the Colorado State Highway Department and the adjacent landowners be obtained for both the Middle Tributary and Monument Branch Drainage Studies prior to County Board action. County staff also recommended that the City park land dedication fee be used as a basis for the detention pond land reimbursement.

City staff recommendations were the same as the County staff recommendations.

City staff recommended to the Board that the Middle Tributary Master Drainage Basin Study and Monument Branch Master Drainage Basin Study be acted upon separately.

Mr. Kevin Walker, representing The Olive Company, stated to the Board that only two remaining issues required discussion for both the Monument Branch and the Middle Tributary Basin Studies. The first issue was that of reimbursement for land used in connection with detention pond facilities. Mr. Walker stated that he has revised the land fee discussion in both the Middle Tributary and Monument Branch Drainage Studies to reflect a fee reimbursement based upon the City park land dedication fee of \$15,600 per acre. The second item remaining to be resolved was the concurrence of the major property owners adjacent to the Northgate Development in both the Middle Tributary and Monument Branch Basins. Mr. Walker presented to the Board Members a letter from Thomas W. Blake, a major landowner to the east of the Northgate Development, concurring with the two drainage reports on the agenda today (see attachments). Mr. Walker also introduced Mr. Bob Stout, private landowner in the Monument Branch Basin, who was present at the meeting to answer any questions the Board may have concerning this item. Mr. Stout owns approximately 60 acres of ground downstream of the Northgate property within the Monument Branch Basin. Mr. Walker also stated that the United States Air Force Academy is reviewing the study at present and indicated that they would accept historic flows only onto their property. Mr. Walker also informed the Board that Mr. Ray Brown of the Colorado State Highway Department indicated that they are reviewing both master drainage basin studies and that they will accept only historic flows onto the right-of-way. Both the Monument Branch and the Middle Tributary use detention to assure that no flow over historic enters the state right-of-way or the United States Air Force Academy.

Mr. Bob Stout, representative and part owner of the 60 acres of land adjacent to the Northgate Development, addressed the Board

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concerning master drainage basin studies. Mr. Stout stated that he concurred with the master drainage basin study with the stipulation that no flow over historic enters his property.

At the staff's request, Mr. Kevin Walker stated that no flow over historic would enter the 60 acres of ground presently owned by Mr. Bob Stout.

Mr. Tom Woodbury, from the City Attorney's Office, and Mr. Gary Haynes indicated to the Board that a revision to the drainage ordinance regarding reimbursement for land used for public detention ponds would have to precede both the Monument Branch and Middle Tributary Studies prior to Council action. Specifically, an ordinance amending the existing drainage ordinance approving the reimbursement for land for detention ponds must precede the Council actions on the approval of the Monument Branch and Middle Tributary Drainage Studies. All three items can be heard at the same Council meeting.

Mr. Walker agreed that the ordinance change needs to precede Council approval of both Monument Branch and Middle Tributary Drainage Basin Studies. Mr. Walker stated that he understood this may entail a time delay on the submittals of the two drainage reports to Council.

City/County Drainage Board and staff discussed the collection, accounting, and reimbursement of the proposed land fee used in connection with detention ponds. Both the Board Members and staff agreed that the fees for the detention pond land and the drainage fee would be calculated and adjusted as separate items, but would be collected and deposited as a single fee. Reimbursements for the total of land and drainage structures would be disbursed on a prorata basis dependent upon the funds available in the basin accounts.

Mr. Brown made a motion to approve the Middle Tributary Master Drainage Basin Report with the drainage basin fee comprised of two components; drainage construction costs set at \$2,766.00 per acre and drainage land costs at \$228.00 per acre, for a total of \$2,994.00 per acre. Mr. Polok seconded the motion. Mr. Brown amended the motion to include the condition that City Council and the Board of County Commissioners change their respective ordinance and resolution to include the reimbursement of land for detention facilities. Mr. Polok seconded the amended motion. The motion passed with a unanimous vote. The Board heard a motion by Mr. Brown to approve the Monument Branch Master Drainage Study with the drainage fee at \$3,737.00 per acre and a land fee set at \$181.00 per acre, resulting in a total fee of \$3,918.00 per acre conditioned on City Council and the Board of County Commissioners' approval of a new ordinance and/or resolution allowing for the reimbursement of land costs for detention facilities. Mr. Polok seconded the motion. The motion

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passed with a unanimous vote.

The Board then heard a motion by Mr. Obering that as part of the ordinance change for the City and resolution change for the County the drainage land category be established in addition to the unit drainage fee; that they be separately collected on a per acre basis, deposited in one account, and disbursed from that account on a priority, funds-available, prorated basis. Mr. Mallon seconded the motion. The motion passed with a unanimous vote.

Item 9

Mr. Mallon and Mr. Obering excused themselves from the meeting for Items 9 and 11 as shown on the agenda.

Presentation to the Board for action of the North Basin Master Drainage Plan as prepared by JR Engineering, Ltd. for Peregrine Joint Venture.

Mr. Tom Taylor, representing Vintage Properties, addressed the Board and requested that the North Basin be a closed basin. Vintage Properties proposes to use regional detention within the North Basin to insure that flows leaving the site are at or below historic. The concept of regional detention is in conformance with the KKBNA master basin drainage report and the revision to the KKBNA master drainage report as prepared by JR Engineering.

Mr. Morrice stated to the Board that he has at this time not had an opportunity to review the study. Based upon the information presented at this meeting, Mr. Morrice was in general agreement with the concept of detaining to historic levels within this basin provided County staff has an opportunity to review the study including the detailed plans for the pond and outfall structure.

After further discussion, the Board heard a motion by Mr. Waldthausen to approve the staff's recommendation for this item with the condition that the County staff has an opportunity to review and approve the construction plans for the detention pond to include the outfall rate and form. The motion was seconded by Mr. Guenther Polok. The motion passed with a unanimous vote.

Item 11

Presentation to the Board for action of the Pine Creek Master Drainage Basin Report as prepared by Obering, Wurth & Associates for Briargate Development Group.

Mr. Haynes stated to the Board that two policy issues were in contention at this time. The first issue relates to the use of 35% on-site detention and the second issue was the proposed

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Academy Boulevard box culvert crossing funding as shown in the Pine Creek Master Drainage Report. Mr. Haynes stated that, in the staff's opinion, neither of these two issues were Drainage Board responsibilities. Mr. Haynes stated that the 35% on-site detention and the Academy Boulevard box culvert crossing funding are administrative and City Council responsibilities. Mr. Haynes indicated to the Board that, if the two items in contention were removed from the Pine Creek Master Drainage Report, staff could support the technical merits of the study.

Mr. Waldthausen asked City staff if the two major issues discussed were omitted from the plan, what impact on the study would this have?

Mr. Haynes stated that the facilities as shown on the existing master plan would have to be enlarged to handle the new design flows and that the funding for the Academy Boulevard box culvert could be resolved separately. Mr. Haynes stated that the staff is in agreement with the use of the five year criteria for this master drainage study due to the fact that the study was initiated over two years ago prior to the introduction of a new ten year criteria.

Mr. Morrice addressed the Board and stated it was the County staff's opinion that the proposed 35% on-site detention should not be utilized because it is not in conformance with present policies. The County staff recommended that any ponds used be in general conformance with the new City/County Drainage Manual which proposes regional detention. Mr. Morrice also stated that the County has concerns regarding the proposed funding for the box culvert crossing under Academy Boulevard.

Mr. Dailey, Board Chairman, stated, in his opinion, he believed the issues as brought forth by both City and County staff and developer should at least be heard by the Board at this time. Mr. Dailey stated the Board may or may not take action on the item dependent upon presentation and any legal advice presented by the City Attorney's Office. All Board Members concurred with Mr. Dailey's opinion.

Mr. Lew Christiansen, President of Vintage Communities, addressed the Board and presented a brief description of the Pine Creek Master Drainage Basin and its impact on the Cottonwood Creek Master Drainage Basin as well as the United States Air Force Academy. Mr. Christiansen stated that the United States Air Force Academy has been very specific in their review of the Pine Creek Master Drainage Study to the extent that, if any flow over historic crosses their property, adequate facilities to convey this flow would have to be constructed prior to the issuance of any building permits that would increase the flow over historic.

Mr. Christiansen stated that it was Briargate's opinion that the

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Drainage Board gave concept approval of the 35% on-site detention and detention at five public ponds in the March 1986 Board Meeting. Mr. Christiansen explained to the Board that Briargate's position on this issue regarding the 35% on-site detention was that any reduction in flow saves dollars downstream throughout the basin. Mr. Christiansen stated their hydrologic studies indicate that the 100 year developed flow without any detention at all within the Pine Creek Basin would be 4,753 cfs at the Academy box culvert crossing. If only the five public detention ponds were incorporated in the master drainage study, a flow of 2,759 cfs would reach the Academy box culvert. Utilizing the five public ponds plus 35% on-site detention, the flow at the Academy box culvert would be 2,094 cfs. Per their study, this indicates that a reduction of 665 cfs, or 24%, would be detained at the Academy box culvert if the 35% on-site detention was utilized.

Mr. Haynes stated to the Board that it was his understanding that the annexation agreement for Briargate indicated that no flow over historic was to enter the Air Force property.

The Board, City staff, and Briargate representatives had a general discussion regarding the existing Birtcher-Kraus drainage system located at the Briargate Business Campus, the box culvert funding proposed by Briargate at the Academy Boulevard intersection, and the Briargate Annexation Agreement as it relates to flows entering the United States Air Force Academy.

Mr. Waldthausen stated to the Board that he felt he would be able to support the drainage plan if the 35% on-site detention was omitted.

Mr. Christiansen replied that is not what they wish to happen today but, if that were to be the case, it would allow them to move forward with that portion of the plan through the City administration and on to City Council if necessary.

Board Members, City/County staff, and a developer then held a general discussion regarding the use of the old five year criteria for the minor systems within Pine Creek versus the new ten year storm criteria for minor systems as outlined in the new City/County Drainage Criteria Manual. It was noted that the effective date for use of the new criteria manual is October 1, 1987. Mr. Haynes and Mr. Christiansen both relayed to the Board that, as the separate plats for subdivisions within the Pine Creek Drainage Basin are submitted to the City after the effective date of the new criteria manual, they will be designed in accordance with the new City/County Drainage Criteria Manual for the minor systems.

Mr. Haynes again stated to the Board that it was the staff's opinion that the Drainage Board does not have jurisdiction over

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the 35% on-site detention issue and that this matter must be forwarded through the City administration and on to City Council if necessary.

Mr. Christiansen stated to the Board that, if the Pine Creek Master Drainage Report is approved deleting the 35% on-site detention, modifications to the report would be necessary. Mr. Christiansen suggested to the Board that an action be taken on the item either approving it with on-site detention or approving it with modifications deleting it to enable them to proceed further either administratively or to Council if necessary. After further discussion, the Board heard a motion by Mr. Waldthausen to approve the Pine Creek Master Drainage plan as a closed basin subject to the deletion of the private 35% on-site detention. Mr. Brown seconded the motion. The vote was 2 to 1 in favor of the motion. Mr. Brown and Mr. Waldthausen voting for the motion; Mr. Polok voting against the motion.

There being no further business, the meeting adjourned at 4:15 PM.

DeWitt Miller
Director of Public Works

DM/CS/dg

Attachments

cc: Drainage Board Members
Larry Blick, City Manager
Jim Colvin, City Attorney
Jack Smith, Asst. City Attorney
DeWitt Miller, Director of Public Works
Hugh King, Deputy Director of Public Works for
Planning and Administration
Max Rothschild, County Dir. of Transportation
Alan Morrice, County Drainage Engineer
Chris Smith, Subdivision Administrator
Bev Dustin, Land Development Specialist
Public Relations
Bob Brockman, Planning
Bill Ruskin, Park & Recreation
Don Steger, HBA, 3730 Sinton Road, #110, COS, 80907
Berge/Brewer & Associates, 6755 Earl Drive, Suite 100,
COS, 80918
Langford-Delay, Attn: Donn Hume, 5360 North Academy Blvd.,
COS, 80918
Mallon Development, Attn: Ron O'Canna, 3455 Briargate Blvd.,
COS, 80918
cc: (Continued on Page Nine)

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cc: (cont.)

Leigh Whitehead & Associates, Attn: David Whitehead, 5 West
Las Vegas, COS, 80903

Mallon Development, Attn: Bill Wier, 3455 Briargate Blvd.,
COS, 80918

Briargate Joint Venture, Attn: Joe Kostka, 7710 North Union
Blvd., COS, 80918

RMC Corporation, Attn: Allyn Brown, P. O. Box 908, COS,
80901

The Olive Company, Attn: Kevin Walker, 5450 Tech Center
Drive, Suite 400, Colorado Springs, CO, 80919