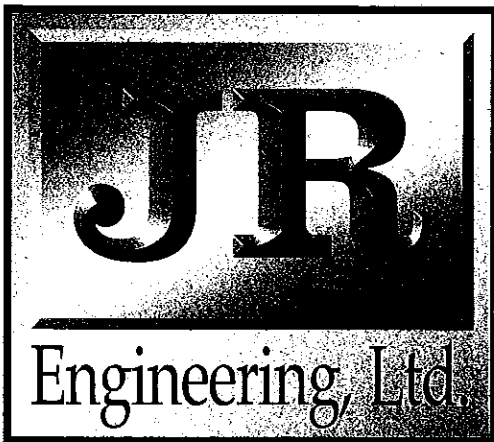


**MASTER DEVELOPMENT DRAINAGE PLAN
FOR
NORTHGATE SOFTWARE CAMPUS
(Monument Branch and Middle Tributary Basins)**



RETURN WITHIN 2 WEEKS TO:
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FOR
NORTHGATE SOFTWARE CAMPUS
(Monument Branch and Middle Tributary Basins)**

February 1998
Revised March 20, 1998
Revised August 14, 1998
Revised October 5, 1998
Revised January 28, 1999

Prepared For:

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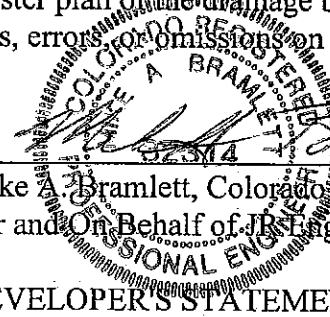
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MASTER DEVELOPMENT DRAINAGE PLAN FOR NORTHGATE SOFTWARE CAMPUS

DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.


Mike A. Bramlett, Colorado P.E. #32314
For and On Behalf of JR Engineering, Ltd.

2/11/99
Date

DEVELOPER'S STATEMENT:

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Picolan, Inc.

By: Steve T. Day

Title: Vice Pres

Address: 90 South Cascade, Suite 1300

Colorado Springs, CO 80903

CITY OF COLORADO SPRINGS ONLY:

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

Timothy R. White
City Engineer

Feb. 15, 1999
Date

Conditions:

MASTER DEVELOPMENT DRAINAGE PLAN FOR NORTHGATE SOFTWARE CAMPUS

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MASTER DEVELOPMENT DRAINAGE PLAN FOR NORTHGATE SOFTWARE CAMPUS

PURPOSE

This document is the Master Development Drainage Plan for Northgate Software Campus. The purpose of this report is to identify major drainageways, culvert, storm sewer, and inlet locations, and areas tributary to this site. This report will analyze overall routing for developed flows based upon the previously approved drainage studies and recommend outfall locations to transfer these flows to their respective discharge points. In addition, the general location of regional detention facilities will be discussed. This report does not attempt to size or locate the minor storm facility system due to the unknown nature of the ultimate land use and street configuration.

GENERAL DESCRIPTION

The Northgate Software Campus is located in a portion of Sections 7, 8, 17 and 18, Township 12 South, Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso. The site is bounded to the north, south, east and west by unplatted land, with the exception of the existing Times Mirror (formerly the Shepard's/McGraw-Hill) commercial complex at the southwest corner of the site. More specifically, the site is bounded to the north by the existing Monument Branch Tributary, which is partially within the city limits (Zone "PIP-I with high rise overlay") and partially within the El Paso County limits. The land to the east is currently zoned "PIP-I with high rise overlay" and is vacant. The future proposed Voyager Parkway extension will define the easterly boundary of the site. The property to the south is currently vacant and is not within the city limits. As mentioned, the Times Mirror (formerly Shepard's/McGraw-Hill) site is located at the southwest corner of the site and is zoned "OC/CR." The land to the west of the site is not in the city limits is owned by the US Air Force Academy and is currently vacant.

The entire site currently being submitted for master plan approval is approximately 231 acres. This study area does not include Middle Creek Parkway as it is part of an approved Final Drainage Report entitled "Northgate Filing No. 5, Voyager and Black Squirrel Parkways, Phase 2B, Preliminary and

Final Drainage Reports,” by URS, dated August 1989. This report will be updated by our office and submitted with the revised Middle Creek Parkway plans. The majority of the site is currently zoned “PIP-I with high rise overlay.” The proposed use is for a mixed use of office-industrial park/research and development with open space per the 1997 Northgate Master Plan Amendment.

The average soil condition reflects Hydrologic Group “B” (Tomah-Crowfoot Loamy Sands and Cruckton Sandy Loam), and “D” (Kettle-Rock Outcrop Complex) as determined by the “Soil Survey of El Paso County Area,” prepared by S.C.S. (see map in Appendix). The majority of the site (approx. 95%) is classified as the Tomah. Therefore, Hydrologic Group “B” was assumed for the calculations in this report.

Overhead utility lines currently run north and south across the property dividing it into an easterly and westerly portion. In addition, the existing Middle Creek Parkway runs east and west through the property dividing it into a northerly and southerly portion. The south half of Middle Creek Parkway is the only portion that has been constructed at the time of this report.

EXISTING DRAINAGE CHARACTERISTICS

The Northgate Software Campus is located within the Monument Branch and Middle Tributary Drainage Basins. The majority of the site (approximately 179 acres) is located within the Middle Tributary Drainage Basin, which encompasses the southern and eastern portion of the project. The “Middle Tributary Drainage Basin Planning Study (D.P.B.S.)” by URS, Inc., 1987, and the “Northgate Master Development Drainage Plan (M.D.D.P.)” by URS, Inc., 1987 (revised 1988) have previously studied this area. In addition, the Times Mirror site (previously Shepard’s/McGraw-Hill) was studied in the Anderson & Hastings, 1989 report entitled “Shepard’s/McGraw-Hill Filing No. 1.”

Monument Branch Basin

The existing stormwater runoff within the Monument Branch Basin currently flows overland in a north – northwesterly direction to the existing south tributary to Monument Branch. The existing slopes vary from approximately 5% to 25% near the existing channel. Exhibit 1, Existing Condition Drainage Map in the Appendix identifies ten (10) sub-basins, which are tributary to the Monument Branch Basin and which are located within the subject site.

The following detailed explanation of the existing drainage sub-basins begins at the westerly property line and continues easterly to the proposed Voyager Parkway right-of-way.

Basin No. 32 is 13.11 acres in size and drains by overland flow from the east to the west where the water exits the site at Design Point “W” and flows overland on the adjacent U.S.A.F.A. property to the existing northbound I-25 lanes where the water is then carried via an existing ditch to the north and into the main channel of Monument Branch. The existing 5 and 100-year historic flows are: $Q_5 = 7.9$ cfs and $Q_{100} = 17.8$ cfs.

Basin No. 31 is 16.72 acres in size and flows overland from the east to the northwest where the water exits the site at Design Point “V” and flows overland across the adjacent unplatted, vacant county property to the north and then into the main channel of Monument Branch. The existing 5 and 100-year historic flows are: $Q_5 = 10.0$ cfs and $Q_{100} = 22.7$ cfs.

Basins No. 30, 34, 28, 27, 23, 24, 25, and 26 are all located at the northerly edge of the site and all are directly tributary via overland flow to the existing south tributary of the Monument Branch. Chart No. 1 (See the Appendix) clearly illustrates the existing flow characteristics of these eight (8) sub-basins in addition to the characteristics of the previously discussed sub-basins.

Another noteworthy on-site existing drainage characteristic is the existing south tributary of the Monument Branch, which traverses the northeasterly corner of the site. The Northgate M.D.D.P. indicated that the existing channel carries a $Q_{100} = 779$ cfs in the present, undeveloped condition. This flow is the flow from the south tributary as shown on Figure 4 of Northgate M.D.D.P. The off-site, downstream drainage structures consist of an existing double 10' x 10' concrete box structure

located at the intersection of the main channel of Monument Branch and the existing northbound lanes of I-25 just west of the property, an existing double 12' x 10' concrete box culvert at the southbound lanes of I-25, and an existing 24' x 15.9' horseshoe culvert at the existing railroad crossing. Per the Monument Branch D.B.P.S., these structures are adequate to convey the 100-year storm event.

The Monument Basin D.B.P.S. and the Northgate M.D.D.P. also analyzed this area in the existing condition, however, the sub-basin boundaries, C factors, and times of concentration varied from those used in this report. The information provided below is for the convenience of the reviewer and should not be directly compared with the results of this study without reviewing the studies from which they were obtained:

Please note that $C_5 = 0.15$ and $C_{100} = 0.20$ are used in this study and that the formula for the time of concentration from the Drainage Criteria Manual was not used in this study because it produced times that were not consistent with the times from the past studies. In an attempt to be consistent with the times of concentration used in the previous studies, the SCS-TR55 method was used to calculate both existing and proposed times of concentration. In addition, due to the realignment of the proposed Voyager Parkway extension and the relocation of the Middle Creek Parkway, the existing and proposed basin areas have changed from those shown on previous reports.

Middle Tributary Basin

Existing flows within this portion of the site located in the Middle Tributary Basin, currently flow overland from the northeast to the southwest and into several defined swales and then eventually flow into the Middle Tributary. The existing slopes of the site vary from 3% to 20%. Exhibit 1 (Existing Condition Drainage Map) in the Appendix identifies nine (9) sub-basins, which are tributary to the Middle Tributary Basin and which are located within the subject site.

The following detailed explanation of the existing drainage sub-basins begins at the westerly property line and continues easterly to the proposed Voyager Parkway right-of-way first starting with the property north of Middle Creek Parkway and then continuing on the south side of Middle Creek Parkway.

Basin No. 33 is 5.74 acres in size and drains by overland flow from the east to the west where the water exits the site at Design Point "X" and flows overland on the adjacent US Air Force Academy property to the existing northbound I-25 lanes where the water is then carried via an existing ditch to the south and then into the Middle Tributary. The existing 5 and 100- year historic flows are: $Q_5 = 3.7$ cfs and $Q_{100} = 8.5$ cfs. It was this Basin No. 33 that was shown as part of the Monument Branch Basin on the Monument Branch D.B.P.S. and the Middle Tributary D.B.P.S. and the Northgate M.D.D.P. It appears as though this area is actually tributary to the Middle Tributary Basin. Our study was able to determine this due to the availability of 2' contour topographic information that was not available in the past. It is therefore recommended that this area and an additional 8 acres to the north of this area be brought into the Middle Tributary Drainage Basin in order to facilitate a single, self contained, privately owned and maintained detention facility within the proposed Oracle site at this location. This issue will be further discussed under the Proposed Drainage Characteristics portion of this report.

Basin No. 29 is 97.55 acres in size and flows overland from the east to the southwest where the water exits the site at Design Point "T" and flows overland across the adjacent Times Mirror site in an existing channel and then across the U.S.A.F.A. property to the east and under the northbound lanes of I-25. The existing five and one hundred year historic flows are: $Q_5 = 39.5$ cfs and $Q_{100} = 91.7$ cfs. The existing Times Mirror site (previously the Shepard's/McGraw-Hill site) has been developed and contains several detention basins. In addition, the existing Middle Tributary Drainage Channel has been realigned to allow for the construction of the existing drive. The "Shepard's/McGraw-Hill Filing No.1 Preliminary/Final Drainage Report," indicates that the improvement of this swale was deferred to a later date. In the interim, the owners have agreed to maintain the channel until the improvements are made. The terms of this agreement and the timing of these improvements should be discussed with the city. In addition, this basin currently contains an existing temporary Detention Pond "D" which currently overdetains water from this basin in order to compensate for unrestricted runoff from the existing Middle Creek Parkway (See "Northgate Filing No. 5, Final Drainage Report").

Basin No. 39 is 4.60 acres in size and flows overland from the north to the south where it is currently taken under the existing Middle Creek Parkway via an existing 30" R.C.P. culvert. The flow is then carried along with flows from the existing Middle Creek Parkway to an existing temporary Detention Pond "C" (See "Northgate Filing No. 5, Final Drainage Report"), which currently detains water for the existing Middle Creek Parkway. The existing 5 and 100- year historic flows are: $Q_5 = 3.6$ cfs and $Q_{100} = 8.3$ cfs.

Basin No. 22 is 14.7 acres in size and flows overland to an existing drainage swale that runs from east to west along the center of this basin to Design Point "M". The existing 5 and 100-year flows from this basin are: $Q_5 = 9.4$ cfs and $Q_{100} = 11.9$ cfs. These flows are for the area from this basin only and do not include upstream flows to this basin. This swale also carries flows from approximately 92.23 acres of upstream land (Basins No.1, 2, 7, 8, 9 and 21). Basins 1 and 2 are used to describe the existing Voyager Parkway right-of-way. For a description of Basins No. 1, 2, 7, 8, and 9, please see the Preliminary/Final Drainage Report for Voyager Parkway Filing No. 6, Phase I. It is anticipated that this upstream area will be developed for single-family residential and commercial uses in the future. The cumulative, historic flows at Design Point M for the entire 106.93 acres in the 5 and 100-year storm event are: $Q_5 = 53.0$ cfs and $Q_{100} = 123.0$ cfs. This swale eventually crosses the southeast corner of Basin No. 39 and then passes under the existing Middle Creek Parkway in an existing 54" R.C.P. culvert.

Basin No. 21 is 3.33 acres in size and flows overland to an existing drainage swale that runs from east to west along the center of this basin. This swale also carries flows from approximately 78.08 acres upstream land (Basins No.1, 2, 7, 8, and 9) and is the site of a proposed temporary Detention Basin No. 9 (See the "Preliminary/Final Drainage Report for Voyager Parkway Filing No.6, Phase I"). The cumulative, historic flows at Design Point L for the entire 81.41 acres in the 5 and 100-year storm event are: $Q_5 = 42.2$ cfs and $Q_{100} = 98.6$ cfs. This swale directs flows into Basin No. 22 at Design Point "M".

Basin No. 37 is 11.70 acres in size and flows overland to a low point (Design Point “BB”) located at the westerly edge of the subject site. This low point is adjacent to the existing Times Mirror site. The “Shepard’s/McGraw-Hill Filing No. 1, Preliminary/Final Drainage Report” identifies this area as 10.5 acres in size with existing runoff for the 10 and 100-year storms as: $Q_{10} = 5.4$ cfs, $Q_{100} = 10.7$ cfs. The flows within the Times Mirror site are conveyed from east to west via an existing 18” pipe under the existing site drive. The flows then continue to the southwest in the existing, relocated, unimproved Middle Tributary Drainage Channel that was previously discussed. The existing 5 and 100-year flows from this basin as calculated for this report are: $Q_5 = 7.2$ cfs and $Q_{100} = 16.4$ cfs.

Basins No. 36 and 38 are all located at the southerly edge of the site, south of the existing Middle Creek Parkway. Both basins are directly tributary via overland flow to the existing Middle Tributary south of the site. Chart No. 2 (See the Appendix) clearly illustrates the existing flow characteristics of these three sub-basins in addition to the characteristics of the previously discussed sub-basins. Basin No. 36 has an area of 20.95 acres and an existing flow of $Q_5 = 14.1$ cfs and $Q_{100} = 32.7$ cfs at Design Point “AA”. Basin No. 38 has an area of 4.9 acres and an existing flow of $Q_5 = 4.0$ cfs and $Q_{100} = 9.2$ cfs at Design Point “CC”.

Basin No. 35 has an area of 15.14 acres and an existing flow of $Q_5 = 8.4$ cfs and $Q_{100} = 19.10$ cfs. Design Point 2 has a cumulative upstream area of 135.15 acres (Basins 35, Middle Creek Parkway, Basins 39, 22, 21, 2, 1, 7, 8, and 9). As noted previously, Basin No. 35 contains an existing temporary Detention Pond “C” (See the “Northgate Filing No. 5, Final Drainage Report”). The allowable estimated historic flows at Design Point Z are $Q_5 = 61$ cfs and $Q_{100} = 202$ cfs, from the Northgate Filing No. 5, Final Drainage Report.

At the southeasterly corner of the site, the existing Middle Tributary crosses the site flowing in a southwesterly direction. The Northgate M.D.D.P. identified the Q_{100} of the Middle Tributary as 546 cfs in the present, undeveloped condition.

The off-site, downstream drainage structures consist of an existing 48" C.M.P. culvert located at the existing northbound lanes of I-25 just west of the property, an existing 12' x 8' concrete box culvert at the northbound lanes of I-25, and an existing 12' x 8' horseshoe culvert at the existing railroad crossing. Per the Middle Tributary D.B.P.S., these structures are adequate to convey the 100-year historic storm event. These structures are indicated on Exhibit 1 in the Appendix.

The Middle Tributary Basin D.B.P.S. and the Northgate M.D.D.P. also analyzed this area in the existing condition, however, the sub-basin boundaries, C factors, and times of concentration varied from those used in this report.

Please note that $C_5 = 0.15$ and $C_{100} = 0.20$ are used in this study and that the formula for the time of concentration from the Drainage Criteria Manual was not used in this study because it produced times that were not consistent with the times from the past studies. In an attempt to be consistent with the times of concentration used in the previous studies, the SCS-TR55 method was used to calculate both existing and proposed times of concentration.

PROPOSED DRAINAGE CHARACTERISTICS

The proposed land use for this site is Office-Industrial Park/Research & Development. This is consistent with the "Northgate Master Plan Amendment," dated March 1997 by N.E.S., Inc. It is anticipated that the development will take place in phases, thus necessitating the construction of temporary detention facilities in order to maintain the existing, historic flows from the site. As the actual phasing of the development is not known at this time, this report will not address the location and sizing of these temporary basins.

The Northgate M.D.D.P. and the Middle Tributary D.B.P.S. both identified the use of regional detention basins in order to maintain the existing, historic flows from the site. In addition, channel improvements were indicated to be required for the Middle Tributary and the south tributary to the

Monument Branch in both of the previous reports. Although this report will further define and identify the location and size of the regional detention basins and the location of the channel improvements, detailed design of the detention facilities and channel improvements will be necessary as part of the individual site drainage reports.

Monument Branch Basin

The proposed flows within the Monument Branch Basin will generally follow the existing drainage patterns and flow overland in a north – northwesterly direction to the existing South Tributary to Monument Branch. Exhibit 2, proposed Conditions Drainage Map in the Appendix identifies three (3) proposed sub-basins located within the subject site which are tributary to the Monument Branch Basin.

The following detailed explanation of the proposed drainage sub-basins begins at the westerly property line and continues easterly to the proposed Voyager Parkway right-of-way.

Basin No. 19 will consist of 24.3 acres of office/industrial space that will include buildings, parking and a Regional Detention Facility (Pond “A”). This proposed basin will have a $C_5 = 0.68$ and $C_{100} = 0.74$. The proposed storm water runoff will be collected in a series of sump inlets and storm sewer pipe and directed to the proposed Pond “A”. Using the modified rational method to estimate the size of this regional detention facility resulted in a 2.30 ac-ft basin with a 100-year restricted release rate of 33 cfs. This restricted release rate is equal to the historic runoff rate from this sub-basin. It is further estimated that approximately 0.75 ac of land will be required to accommodate this regional detention facility (See Calculation #1 in the Appendix). The size of this regional detection facility is considerably smaller than the 5.0 ac-ft regional detention facility indicated on both the Monument Basin D.B.P.S. (Basin 8A) and the Northgate M.D.D.P. (Basin at Design Point 21). This is due to the decrease in the sub-basin size. The decrease in the sub-basin size is a result of the proposed redefined Middle Tributary-Monument Branch Basin boundary, which will divert approximately 8.0 acres from the Monument Branch Basin to the Middle Tributary Basin. This is requested in order

to locate a single, privately owned and maintained, self-contained detention facility within the proposed Oracle site (See Exhibit 2 and Basin 18 description). It is anticipated that "Pond A" will be constructed at the time Basin 19 is developed, and that it will be a public facility, maintained and owned by the City of Colorado Springs.

Basin No. 21 will consist of 7.5 acres of open space that will flow unrestricted to the existing Monument Branch following the existing, historic drainage patterns. The flow in this sub-basin will not be detained on-site as it will not increase flows from the site. The proposed 5 and 100-year flows are: $Q_5 = 11.70$ cfs and $Q_{100} = 26.5$ cfs.

Basin No. 22 will consist of 5.0 acres of open space, which will contain a possible channel realignment and a possible partial lining of the existing south tributary to the Monument Branch. The Monument Basin D.B.P.S. and the Northgate M.D.D.P. identified this section of the Monument Branch as requiring a 40' x 4' partially lined channel with developed flows of 777 cfs. It is anticipated that the channel realignment and improvements will need to take place prior to the development of the area just south of the proposed channel.

Chart No. 3 (See the Appendix) summarizes the proposed flows from the above referenced sub-basins.

Middle Tributary Basin

The Middle Tributary basin includes the Middle Creek Parkway right of way. Only the southerly portion of this roadway is constructed at the present time. The "Northgate Filing No. 5, Voyager and Black Squirrel Parkways, Phase 2B Preliminary and Final Drainage Report," August 1989 was approved for this roadway. It is not within the scope of our report to reanalyze the previous report for the Middle Creek Parkway. However, suggestions will be made on revisions to the proposed Middle Creek storm sewer system. Portions of the storm sewer system within the Middle Creek Parkway have not yet been constructed. Where the revised land use dictates a change in the proposed storm sewer system within Middle Creek Parkway, the changes will be outlined in this report.

The proposed flows within the Middle Tributary Basin will generally follow the existing drainage patterns and flow overland in a south-southwesterly direction to the existing Middle Tributary. Exhibit 2, Proposed Conditions Drainage Map in the Appendix identifies ten (10) proposed sub-basins within the subject site, which are tributary to the Monument Branch Basin.

The following detailed explanation of the proposed drainage sub-basins begins at the westerly property line and continues easterly to the proposed Voyager Parkway right-of-way and first discusses the area north of and including Middle Creek Parkway and then discusses the area south of Middle Creek Parkway.

Basin No. 18, the proposed Oracle site, will consist of 36.5 acres of office/industrial space, which will include buildings, parking and a self contained, privately owned and maintained Detention Facility (Pond "B"). This proposed basin is more fully defined in the Final Drainage Report for Oracle Boulevard Phase I and Oracle Colorado Campus Subdivision No. 1. The proposed storm water runoff will be collected in a series of sump inlets and storm sewer pipe and directed to the proposed Pond "B". Pond "B" will have a restricted release of $Q_5 = 11$ cfs and $Q_{100} = 25$ cfs. In addition, unrestricted release, from flow from the west side of the proposed landscape berm, will contribute a $Q_5 = 2$ cfs and a $Q_{100} = 5$ cfs to the Air Force Academy. The original regional detention basin as indicated on the Monument Basin D.B.P.S. and the Northgate M.D.D.P. was relocated to the north side of Middle Creek Parkway when the Shepard's/McGraw Hill site was developed, thus excluding the area from Basin 13 and creating the need for an additional basin. The new location of the relocated Regional Detention Facility Pond "E" will now accept flows from Basin 13, 14, 20, and the proposed Middle Creek Parkway, and Basin 20.

Basin No. 20 will consist of 84.5 acres of office/industrial space that will include buildings, parking, a regional detention facility, open space, and a minor roadway for the internal traffic generated by the office/industrial space. This proposed sub-basin will have a $C_5 = 0.80$ and $C_{100} = 0.88$. The proposed storm water runoff will be collected in a series of sump inlets and storm sewer pipe and directed to the proposed Pond "E". Using the Modified Rational Method to estimate the size of this regional detention facility resulted in a 15.3 ac-ft pond with a 100-year restricted release rate of 67 cfs and a 5-year restricted release rate of 23 cfs. This restricted release rate is equal to the historic

runoff of $Q_5 = 50.1$ cfs and $Q_{100} = 123$ cfs minus the unrestricted and restricted runoff from the Oracle site and Middle Creek Parkway. Pond "E" will need to be constructed when Basins 20, 13, and 14 are developed. A temporary detention facility will be required when Middle Creek Parkway is built. This temporary basin will be privately owned and maintained until the permanent regional detention facility is built. The permanent Regional Detention Facility Pond "E" will be owned and maintained by the City of Colorado Springs.

Basin No. 11 will consist of 14.2 acres of office/industrial space that will include buildings, parking, and open space. This proposed sub-basin will have a $C_5 = 0.80$ and $C_{100} = 0.88$. The proposed storm water runoff will be collected in a sump inlet in the parking lot and directed to the existing 42" R.C.P. culvert under Middle Creek Parkway. This water will then be detained in future Regional Detention Basin "D" and released at the historic rate. (See Basin No. 12 for a description of this pond) Pond "D" will be owned and maintained by the City. Pond "D" was previously shown at Design Point 9 on the Northgate M.D.D.P. and at Design Point 10 on the Middle Tributary D.B.P.S.

Basin No. 10 will consist of 5.5 acres of open space and a proposed Regional Detention Pond "9". Basin "9" will be used to replace the regional detention facility recommended at Design Point 9 as shown on the Middle Tributary D.B.P.S. by URS, dated August 6, 1987. In addition, Basin 9 will be used to replace the regional detention facility recommended at Design Point 7 as shown on the "Northgate M.D.D.P.," by URS dated December 1987. Due to the nature of the existing topography and the realignment of Voyager Parkway and Middle Creek Parkway, it is requested that this regional detention facility be relocated to the northwest corner of Voyager and Middle Creek Parkways as shown on the proposed Conditions Drainage Map in the Appendix. This proposed sub-basin will have a $C_5 = 0.90$ and $C_{100} = 0.95$. Approximately 40.5 acres of offsite area will also be detained in this basin, along with approximately 69 cfs of bypass release from upstream Detention Ponds "7" and "8". The total tributary area to this detention facility (including the Pond "9" area) is 46.01 acres, resulting in a 100-year historic, restricted release rate of 45.0 cfs. Using the Modified Rational Method to estimate the size of this pond resulted in a 5.1 ac-ft pond that will occupy approximately 1.5 ac of land. The proposed storm water runoff from this sub-basin will flow directly into the proposed pond, and then be restricted to the historic flows and released into the storm sewer system within Middle Creek Parkway eventually outletting at the south property line of the site. This

system will need to be designed when the upstream area is developed and when Basin 9 is designed. Routing this flow of approximately 114.0 cfs to the storm sewer within Middle Creek Parkway will need to be addressed when the plans for Middle Creek Parkway are revised to reflect the decrease in right-of-way. As the cross section of Middle Creek Parkway is proposed to change, so are the design plans for Middle Creek Parkway and it is anticipated that a new Final Drainage Report will be required for Middle Creek Parkway. When the new drainage report is done, the outlet pipe from Pond "9" will be designed.

Basin No. 13 will consist of 10.0 acres of office/industrial space that will include buildings, parking, open space, and a Detention Pond "E". This proposed sub-basin will have a $C_5 = 0.80$ and $C_{100} = 0.88$. The proposed storm water runoff will be collected in a sump inlet in the parking lot and directed to the proposed Detention Pond "E". Using the Modified Rational Method to estimate the size of this pond resulted in a 15.3 ac-ft pond with a 100-year restricted release rate of 67.0 cfs that will occupy approximately 5.75 ac of land. This proposed basin is necessary in order to restrict the flows from this sub-basin to the existing Times Mirror site, and ultimately to the U.S.A.F.A. boundary. Once the flows leave the site they will cross the existing Times Mirror site and flow under the existing driveway in a proposed 48" culvert. Pond "E" will need to be constructed when Basins 13, 14, and 20 are developed and will be owned and maintained by the City of Colorado Springs.

Basin No. 12 will consist of 31.3 acres of office/industrial space that will include buildings, parking, open space and a Regional Detention Facility Pond "D". Pond "D" will also detain storm water runoff from Basin No. 16 and Basin No. 11. The total area tributary to this regional detention facility will be 58.7 acres with an allowable release rate of 88 cfs. Using the Modified Rational Method to estimate the size of is pond resulted in a 4.9 ac-ft pond. This pond will have a surface area of approximately 2.8 ac. In addition to the 88 cfs restricted release from this sub-basin, the release from Basin "9" and the release from offsite Basins "7" and "8" will bypass these basins. The total release at design point RR will be 202.0 cfs, as indicated in the Northgate M.D.D.P. Pond "D" will need to be constructed when Basins 11 and 12 are developed and will be owned and maintained by the City of Colorado Springs.

The existing Middle Tributary Channel, located within Sub-basin No. 15, is to be partially lined per the Middle Tributary D.B.P.S. The Northgate M.D.D.P. identified that this reach is to be lined with a 25' wide x 4' deep partially lined channel. Both previous studies identified the 100-year developed flow as ($Q_{100} = 560$ cfs).

Basin 15 will maintain historic flow rates due to the fact that no impervious improvements are proposed in this area. Chart No. 4 (See the Appendix) illustrates the anticipated flows from this area along with detailed information on the previously discussed sub-basins. If development takes place in Basin 15 flows will be directed to Regional Pond "D" where the stormwater will be detained.

The majority of the existing flows generated by this site travel in a westerly direction towards the undeveloped US Air Force Academy property and the ultimate discharge into either the Monument Branch or the Middle Creek. For discussion purposes, this report will discuss the area within the Monument Branch and Middle Creek Basins separately.

TABLE I
Proposed Detention Facilities

<u>Location</u>	<u>Peak Inflow (cfs)</u>	<u>Peak Outflow (cfs)</u>	<u>Peak Historic Flow (cfs)</u>	<u>Surface Area (AC)</u>	<u>Volume (ac-ft)</u>	<u>On-site Tributary (Sub-basin)</u>
"A"	107.5	30	30	0.75	2.06	19
"B"	74.31	25	29	1.30	3.58	18
"D"	127.67	88	88	2.80	4.90	11, 16, 12, 15
"E"	232.76	67	67	5.75	15.30	20, 17, 13, 14
"9"	100.0	45	45	1.50	5.10	10

BASIN SUMMARY

Please note that this M.D.D.P. has relocated the Regional Detention Facility (Pond "E") as a result of the Oracle site having one self-contained private basin that will only detain water from its site. The additional basin on the Oracle site will be privately owned and maintained. In addition, the relocation of Regional Detention Basin No. 9 (formerly called Design Point 4 on Northgate M.D.D.P. and Design Point 9 on the Middle Tributary Drainage Basin D.B.P.S.) to the northwest corner of Middle Creek and Voyager Parkways is due to topographic constraints and due to the realignment of both Middle Creek Parkway and Voyager Parkway.

All detention facilities with the exception of Pond "B" (on the Oracle site) will be owned and maintained by the City of Colorado Springs. They will need to be built prior to the development of the upstream tributary area.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence interval. All facilities calculated in this report are designed to accept both 5-year and 100-year flows.

FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain as determined by Flood Insurance Rate Map Community Panel Numbers 080060-0040B, effective December 18, 1986. See the Appendix for a Floodplain Information Map, which shows the location of the site.

DRAINAGE FEES

Drainage fees shall be calculated at the time of final drainage reports.

SUMMARY

Based upon the preliminary analysis of the overall Northgate Master Plan area, it appears that the developed flows generated by this site can be handled with the facilities as detailed in the Middle Tributary and Monument Branch D.B.P.S. and the Northgate M.D.D.P. as outlined within this report. The developed basin configuration, as defined in the D.B.P.S. remain, generally intact in this new analysis. Upon final drainage analysis of this site, extreme detail must be taken to direct flows to proper collection facilities and to limit the overall flows to the existing US Air Force Academy site to historic levels. This should include keeping discharge velocities to non-erosive levels and meeting current city street capacity criteria. Due to the schematic nature of this analysis, the facilities recommended in this Master Development Drainage Plan are only approximations and are subject to revisions upon final drainage analysis. At the time of Development Plan and Final Plat submittal, a Preliminary and/or Final Drainage Report will be submitted that details all required storm facilities and outfalls.

Based upon the analysis in this report, the peak developed flows leaving the site will remain relatively unchanged from existing conditions experienced today, due to the proposed detention ponds which will restrict peak outfall flows to levels equal to or less than existing conditions.

PREPARED BY:

JR Engineering

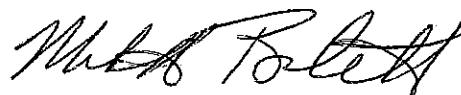


Luanne D. Rubey, P.E.
Senior Project Engineer

hw/889615/mddp-rpt.aug98

REVIEWED BY:

JR Engineering



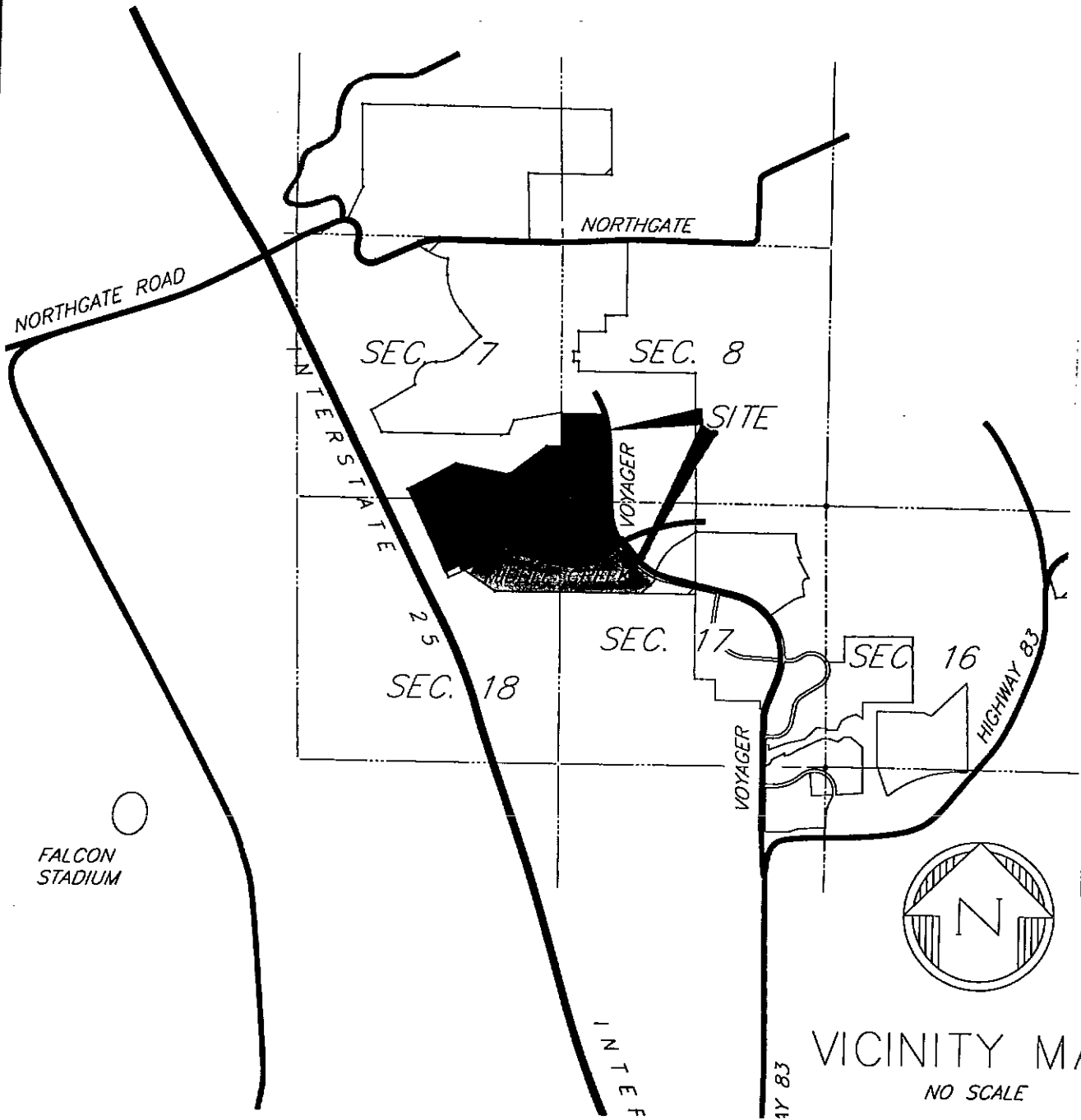
Mike A. Bramlett, P.E.
Division Manager
Land Development

REFERENCES

1. "Monument Branch Drainage Basin Planning Study," URS, Inc., April 1987, revised August 6, 1987.
2. "Middle Tributary Drainage Basin Planning Study," URS, Inc., April 1987, revised August 6, 1987.
3. "Northgate Master Development Drainage Plan (Monument Branch and Middle Tributary Basins)," URS, Inc., December 1987, revised June 27, 1988.
4. "Northgate Filing No. 5, Voyager and Black Squirrel Parkways – Phase 2B Preliminary and Final Drainage Report," URS, Inc., August 1989.
5. "Shepard's/McGraw-Hill Filing No. 1," Anderson & Hastings, Consulting Engineers, Inc., September 26, 1989.
6. "Final Drainage Report for Northgate Detention Pond 1," JR Engineering, May 1997, revised July 7, 1997.
7. "Northgate Phase 1 Drainage Plan," URS, Inc., October 6, 1987 (addendum date).
8. "Preliminary/Final Drainage Report for Voyager Parkway Filing No. 6 – Phase 1," JR Engineering, January 1988.
9. City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated November 1991.
10. Soils Survey of El Paso County Area, Colorado Soil Conservation Service.
11. "Northgate Master Plan Amendment," NES, Inc., March 1997.

APPENDICES

VICINITY MAP



VICINITY MAP

JR Engineering, Ltd.
 4935 North 30th Street
 Colorado Springs, Colorado 80919
 (719) 593-2593 • FAX (719) 528-6613

SOIL MAP (S.C.S. SURVEY)

Hydrological
Soil Group

Name

Soil ID
Number

B

Tomah

92/93

D

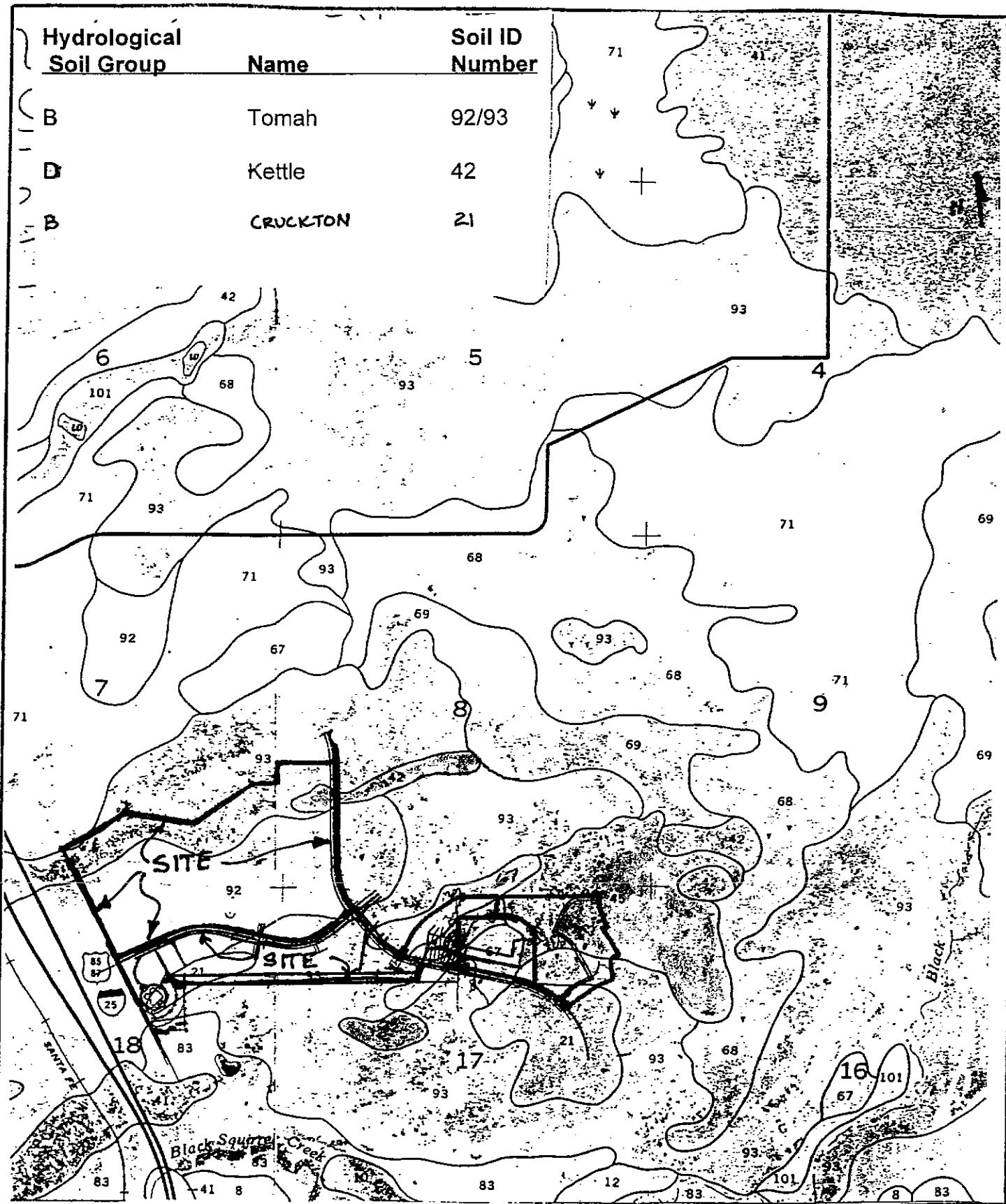
Kettle

42

B

CRUCKTON

21



SCS SOIL
SURVEY

JR

Engineering, Ltd. ^{1"=2,000'}

4935 North 30th Street
Colorado Springs, Colorado 80919
(719) 593-2593 • FAX (719) 528-6613

F.E.M.A. MAP

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
COLORADO SPRINGS,
COLORADO
EL PASO COUNTY

PANEL 40 OF 625
(SEE MAP INDEX FOR PANELS NOT PRINTED)

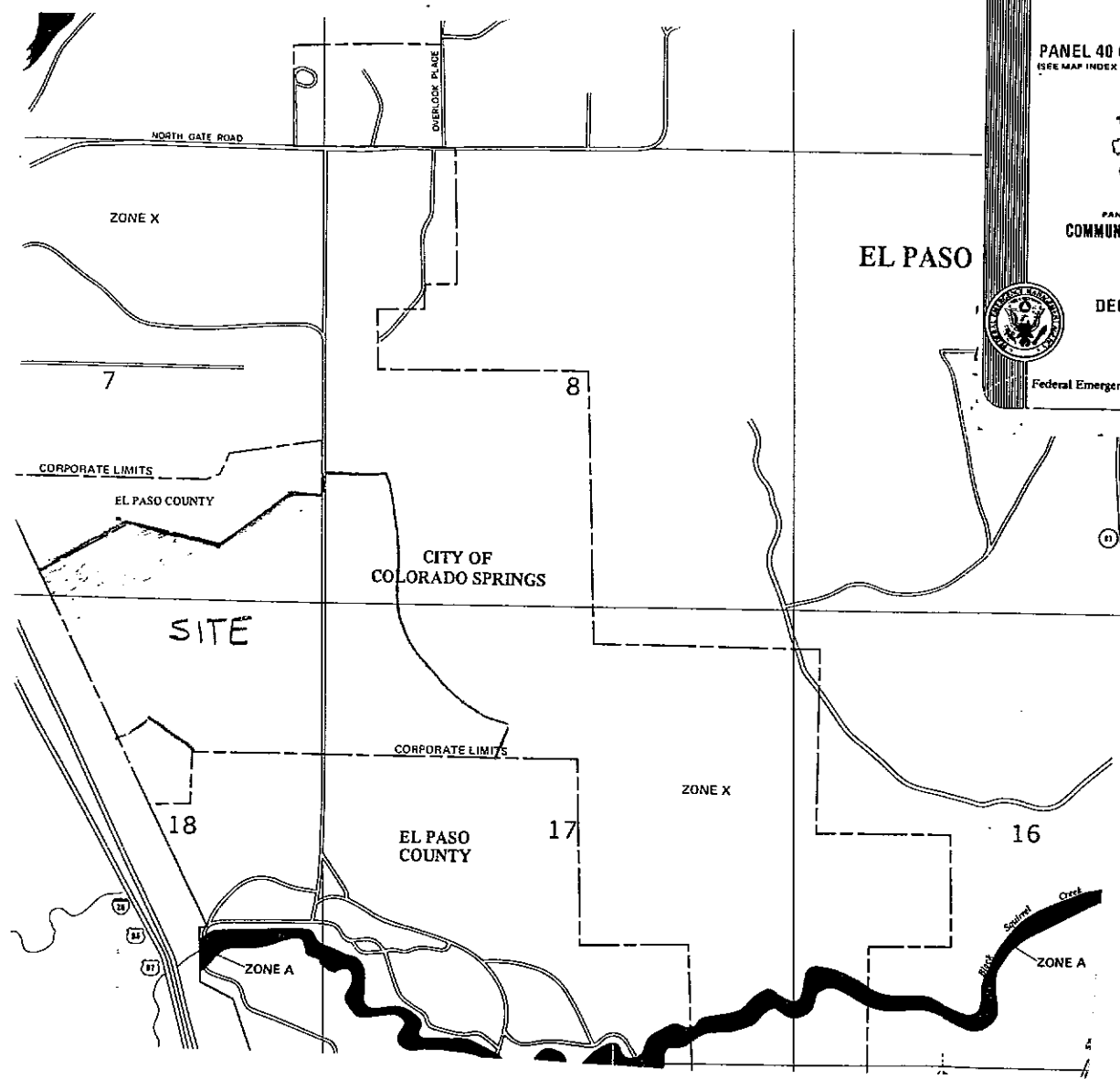


PANEL LOCATION
COMMUNITY-PANEL NUMBER
080060 0040 B

EFFECTIVE DATE:
DECEMBER 18, 1986



Federal Emergency Management Agency



FEMA FIRM

JR Engineering, Ltd.
4835 North 30th Street
Colorado Springs, Colorado 80919
(719) 583-2593 • FAX (719) 528-6613

HYDROLOGIC CALCULATIONS

Proposed Conditions Time of Concentration

Basin Number	Time of Concentration	I_s	I_{100}
10	4 min	5.4	9.4
11	18 min	3.1	5.4
12	15 min	3.4	5.9
13	12 min	3.8	6.6
14	4 min	5.4	9.4
15	4 min	5.4	9.4
16	16 min	3.3	5.7
17	8 min	4.5	7.8
18	12 min	3.1	5.4
19	12 min	3.0	5.3
20	25 min	2.6	4.5
21	2 min	6.0	9.8
22	5 min	5.2	9.0

$$T_c = 1.87(1.1 - 0.25) L^{0.55} S^{-0.3}$$

t undeveloped ground

PRELIMINARY DETENTION POND CALCULATIONS

PROJECT Northgate Software Campus

CHK. BY _____

DATE 8-14-98

SUBJECT POND "A"

SHEET NO. 1 OF 6

CALCULATION #1

FUTURE Detention POND "A"

TRIBUTARY AREA = 24.30 AC

HISTORIC FLOWS; $T_c = 11 \text{ MIN}$

$$Q_5 = 24.3 \times 15 \times 4.0 = 14.6 \text{ cfs}$$

$$Q_{100} = 24.3 \times 20 \times 6.8 = 33.0 \text{ cfs}$$

HISTORIC FLOWS: (PREVIOUS REPORTS)

Monument Branch DBPS' $Q_{10} = 64 \text{ cfs}$ $Q_{100} = 117 \text{ cfs}$
(BASIN 8A) $A = 46 \text{ AC}$ Northgate MDDP $Q_{10} = 71 \text{ cfs}$
(BASIN 21)

Basin Volume = 3.30 AC-FT

$$\text{Basin Area} = 3.30 \text{ AC-FT} \times \frac{1}{4.5 \text{ ft}} \times 0.70 = 0.73 \text{ AC}$$

Quick TR-55 Ver.5.46 S/N:
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MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

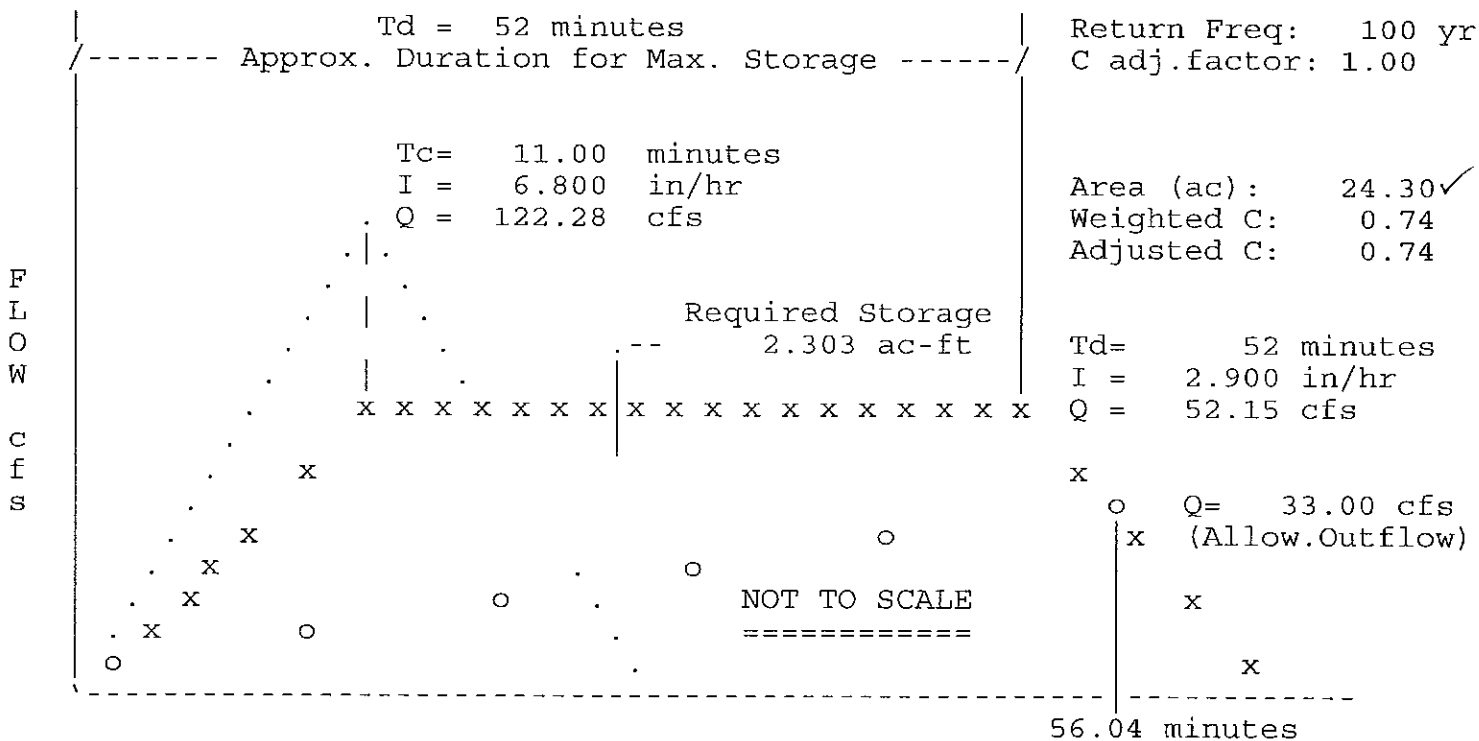
First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN A

```

*****
* RETURN FREQUENCY: 100 yr      | Allowable Outflow: 33.00 cfs *
* 'C' Adjustment: 1.000        | Required Storage: 2.303 ac-ft *
*-----*
* Peak Inflow: 52.15 cfs        | Inflow .HYD stored: NONE STORED *
*****

```



Quick TR-55 Ver.5.46 S/N:
Executed: 16:05:29 08-14-1998

NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN A

**** Modified Rational Hydrograph ****

Weighted C = 0.740 Area= 24.300 acres Tc = 11.00 minutes

Adjusted C = 0.740 Td= 52.00 min. I= 2.90 in/hr Qp= 52.15 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00

Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time increment = 0.017 Hours
Time on left represents time for first Q in each row.

Time Hours	0.00	4.74	9.48	14.22	18.96	23.70	28.44
0.000	0.00	4.74	9.48	14.22	18.96	23.70	28.44
0.117	33.18	37.93	42.67	47.41	52.15	52.15	52.15
0.233	52.15	52.15	52.15	52.15	52.15	52.15	52.15
0.350	52.15	52.15	52.15	52.15	52.15	52.15	52.15
0.467	52.15	52.15	52.15	52.15	52.15	52.15	52.15
0.583	52.15	52.15	52.15	52.15	52.15	52.15	52.15
0.700	52.15	52.15	52.15	52.15	52.15	52.15	52.15
0.817	52.15	52.15	52.15	52.15	47.41	42.67	37.93
0.933	33.18	28.44	23.70	18.96	14.22	9.48	4.74
1.050	0.00						

Quick TR-55 Ver.5.46 S/N:
Executed: 16:05:29 08-14-1998

NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN A

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
A	0.740	24.30	11.00	0.740	0.740	6.800	24.30	122.28

Quick TR-55 Ver.5.46 S/N:
Executed: 16:05:29 08-14-1998

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN A

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 33.00 cfs

Hydrograph file: NONE STORED

Tc = 11.00 minutes

.....

VOLUMES

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (ac-ft)	Storage (ac-ft)
0.740	0.740	11	6.800	24.30	122.28	1.853	1.353
0.740	0.740	15	5.900	24.30	106.09	2.192	1.601
0.740	0.740	20	5.100	24.30	91.71	2.526	1.822
0.740	0.740	30	4.100	24.30	73.73	3.047	2.115
0.740	0.740	40	3.367	24.30	60.54	3.336	2.176
0.740	0.740	50	2.967	24.30	53.35	3.674	2.288

***** Storage Maximum

0.740	0.740	52	2.900	24.30	52.15	3.735	2.303
-------	-------	----	-------	-------	-------	-------	-------

0.740	0.740	60	2.600	24.30	46.75	3.864	2.250
-------	-------	----	-------	-------	-------	-------	-------

POND 9 SIZING - Preliminary

AREA Tributary

Location	Area	C_{100}	T_c	
10	5.5	0.95	5min	5.2
05-4	4.11	0.90	7min	3.7
2	4.3	.71	10	3.1
1	4.0	.74	10	3.0
(05-3) 9	24	0.70	12min	16.8
H	1.82	0.70	13.8min	1.27
N	2.28	0.70	7.1min	1.60
	46.01	0.75	10min	34.66

$$\text{BYPASS FLOW} = 30 \text{ cfs} + 39 \text{ cfs} = 69 \text{ cfs}$$

$$\text{Allowable release rate } Q_{100} = 46.01 \times 0.20 \times 4.9 = 45.09 \text{ cfs}$$

use 45 cfs

5.1 AC-FT STORAGE

$$5.1 \div 5 \div 1.7 = 1.5 \text{ AC}$$

$$Q_5 = 42.23 \times 0.15 \times \frac{1}{2.8} = 17.7 \text{ cfs}$$

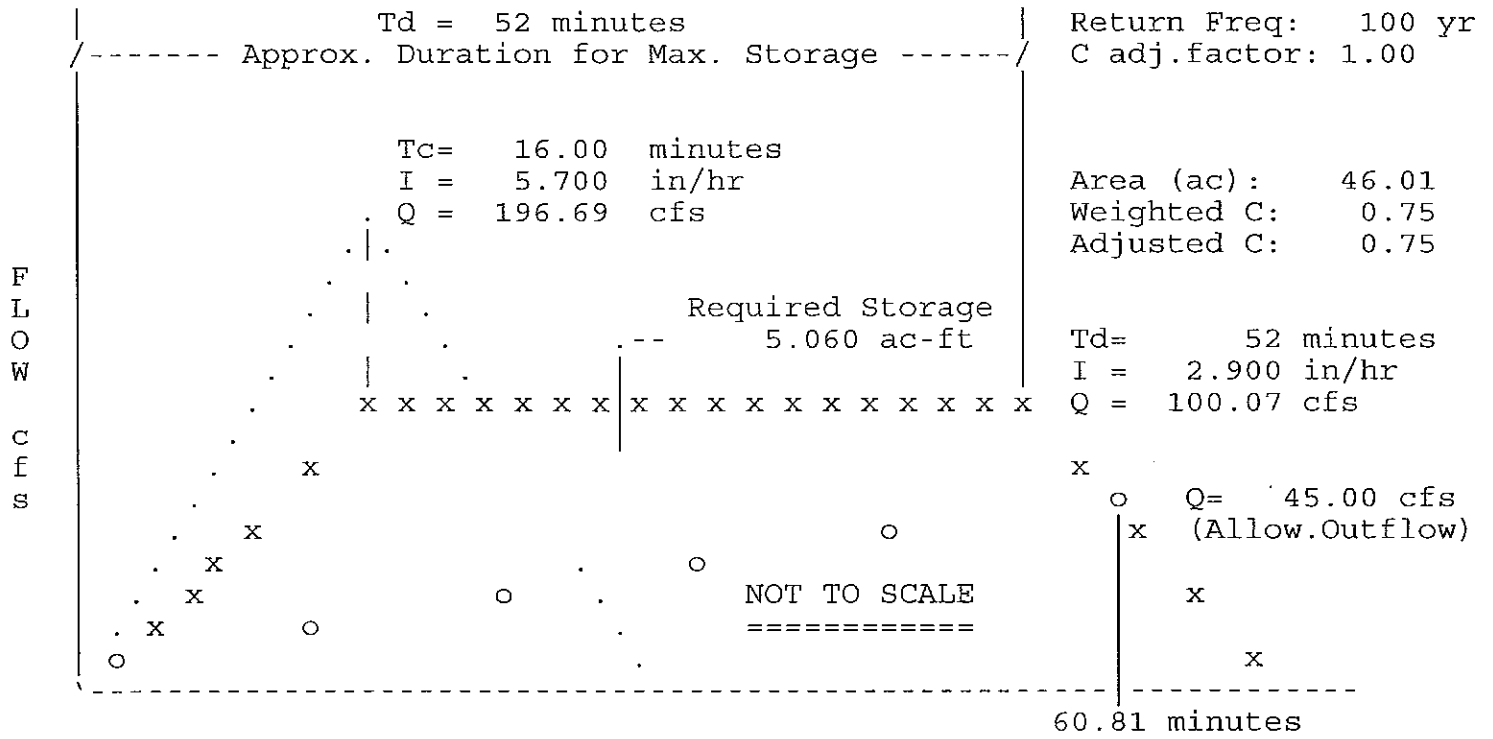
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 8-98
 DETENTION BASIN 9

```

*****
* RETURN FREQUENCY: 100 yr      | Allowable Outflow: 45.00 cfs *
* 'C' Adjustment: 1.000        | Required Storage: 5.060 ac-ft *
*-----*
* Peak Inflow: 100.07 cfs      | Inflow .HYD stored: NONE STORED *
*****
  
```



Quick TR-55 Ver.5.46 S/N:
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NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN 9

**** Modified Rational Hydrograph ****

Weighted C = 0.750 Area= 46.010 acres Tc = 16.00 minutes

Adjusted C = 0.750 Td= 52.00 min. I= 2.90 in/hr Qp= 100.07 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00

Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time Hours	Time increment = 0.017 Hours						
	Time on left represents time for first Q in each row.						
0.000	0.00	6.25	12.51	18.76	25.02	31.27	37.53
0.117	43.78	50.04	56.29	62.54	68.80	75.05	81.31
0.233	87.56	93.82	100.07	100.07	100.07	100.07	100.07
0.350	100.07	100.07	100.07	100.07	100.07	100.07	100.07
0.467	100.07	100.07	100.07	100.07	100.07	100.07	100.07
0.583	100.07	100.07	100.07	100.07	100.07	100.07	100.07
0.700	100.07	100.07	100.07	100.07	100.07	100.07	100.07
0.817	100.07	100.07	100.07	100.07	93.82	87.56	81.31
0.933	75.05	68.80	62.54	56.29	50.04	43.78	37.53
1.050	31.27	25.02	18.76	12.51	6.25	0.00	

Quick TR-55 Ver.5.46 S/N:
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NORTHGATE SOFTWARE CAMPUS MDDP
 8-98
 DETENTION BASIN 9

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
 'C' adjustment, k = 1
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BASIN 9	0.750	46.01	16.00	0.750	0.750	5.700	46.01	196.69

Quick TR-55 Ver.5.46 S/N:
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```
*****
*****
*
*
*           MODIFIED RATIONAL METHOD           *
*   ---- Grand Summary For All Storm Frequencies ----   *
*
*
*****
*****
```

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
8-98
DETENTION BASIN 9

Area = 46.01 acres Tc = 16.00 minutes

.....

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES	
						Inflow (ac-ft)	Storage (ac-ft)
100	0.750	52	2.900	100.07	45.00	7.168	5.060

Quick TR-55 Ver.5.46 S/N:
 Executed: 13:43:17 08-26-1998

MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 8-98
 DETENTION BASIN 9

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 45.00 cfs

Hydrograph file: NONE STORED Tc = 16.00 minutes
 ::

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES	
						Inflow (ac-ft)	Storage (ac-ft)
0.750	0.750	16	5.700	46.01	196.69	4.335	3.343
0.750	0.750	20	5.100	46.01	175.99	4.848	3.732
0.750	0.750	30	4.100	46.01	141.48	5.846	4.421
0.750	0.750	40	3.367	46.01	116.18	6.401	4.665
0.750	0.750	50	2.967	46.01	102.37	7.050	5.005
***** Storage Maximum							
0.750	0.750	52	2.900	46.01	100.07	7.168	5.060

0.750	0.750	60	2.600	46.01	89.72	7.415	5.059

PATRINELLI SITE STORM SEWER SIZING

AREA # 20

84.5 AC

 $T_c = 20 \text{ min}$

2500' storm sewer

 $C_s = .64 \times 1.25 = 0.80$

@ 2%

 $C_{100} = .71 \times 1.25 = 0.88$

6.4 ft/sec

 $I_s = 2.9$ $I_{100} = 5.1$ $Q_{100} = 379 \text{ cfs}$

@ 2.5% need a 5' DIA PIPE

 $Q_5 = 196 \text{ cfs}$

Area # 20 breakdown

27.3 AC

 $T_c = 15 \text{ min}$ $C_s = 0.80$ $I_s = 3.4$ $Q_5 = 75 \text{ cfs}$ $C_{100} = 0.88$ $I_{100} = 5.9$ $Q_{100} = 142 \text{ cfs}$

42" DIA @ 2.00%

7.1 AC

 $T_c = 10 \text{ min}$ $C_s = 0.80$ $I_s = 4.1$ $Q_5 = 23 \text{ cfs}$ $C_{100} = 0.88$ $I_{100} = 7.0$ $Q_{100} = 44.0 \text{ cfs}$

24" DIA @ 1.5%

50 AC

 $T_c = 20 \text{ min}$ $C_s = 0.80$ $I_s = 2.9$ $Q_5 = 116 \text{ cfs}$ $C_{100} = 0.88$ $I_{100} = 5.1$ $Q_{100} = 225 \text{ cfs}$

54" DIA @ 1.5%

77.3 AC + 2 = 79.30 AC

 $T_c = 25 \text{ min}$ $C_s = 0.8$ $I_s = 2.0$ $Q_5 = 165 \text{ cfs}$ $C_{100} = 0.88$ $I_{100} = 4.5$ $Q_{100} = 314 \text{ cfs}$

60" @ 1.5%

Pond "D" Calculation

202 cfs is allowable at Leach/Picolan Boundary

$$\text{POND 9 - OUTFLOW} = 45 \text{ cfs (restricted release)} + 69 \text{ cfs (bypass release)} = 114 \text{ cfs}$$

$$\text{POND "D" allowable release} = 202 - 114 \text{ cfs} = 88 \text{ cfs}$$

Basin #	Area	C _s	C ₁₀₀	T _c
12+15	38.7 (20 ac was to be future unrestricted)	0.60	0.70	15 min
11	14.2	0.80	* * 0.85	16 min
16	5.8	0.90	0.95	18 min
Total	58.7	0.68	0.76 USE 0.75	18 min

* conservative numbers

Using MODIFIED Rational TR55

X: 880000.A11\889615\hydro\pondpack\
Basin D2.MOD

5.00 ac-ft required storage

$$Q_s = 61 \text{ cfs} - 45.7 \text{ cfs} = 15.3 \text{ cfs}$$

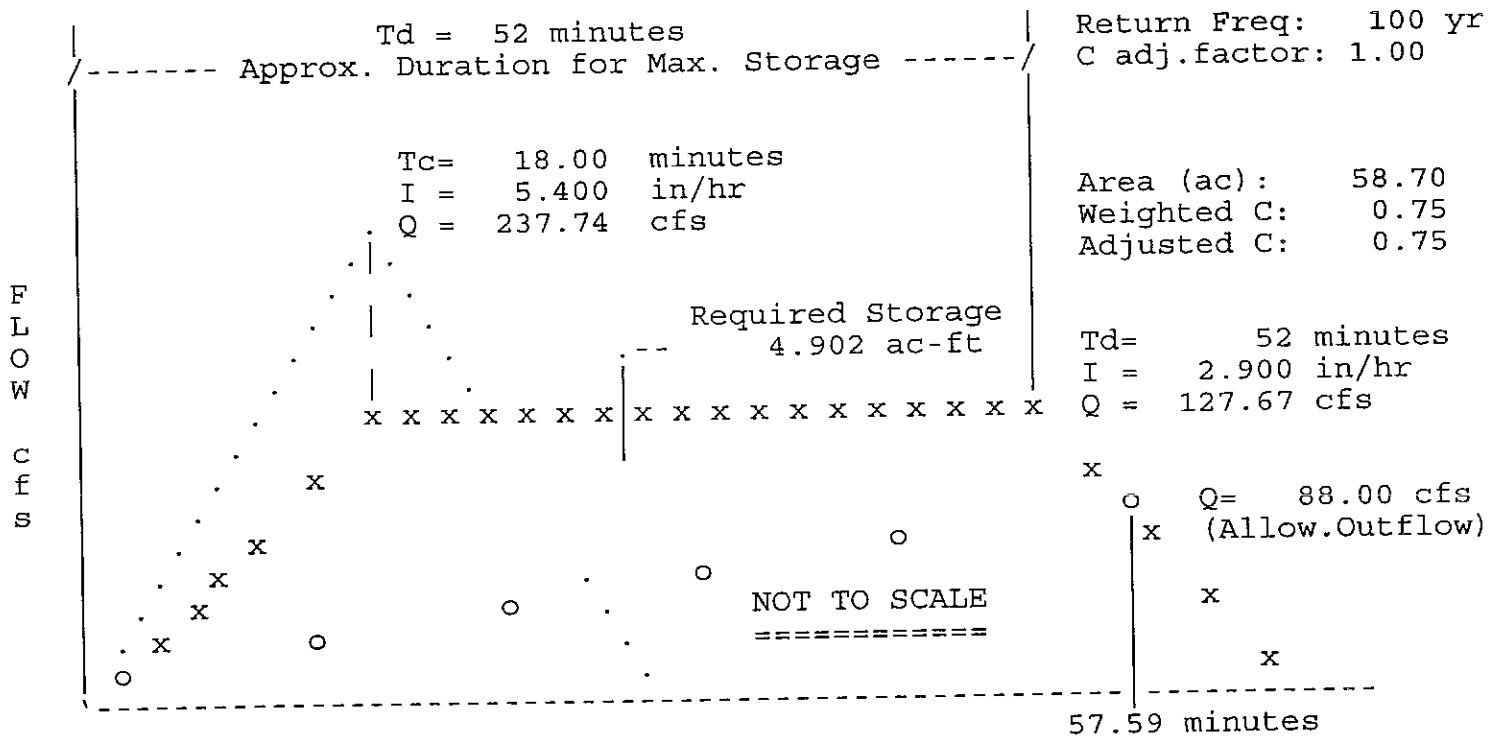
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DETENTION BASIN D REVISED

```

*****
* RETURN FREQUENCY: 100 yr | Allowable Outflow: 88.00 cfs *
* 'C' Adjustment: 1.000 | Required Storage: 4.902 ac-ft *
*-----*
* Peak Inflow: 127.67 cfs | Inflow .HYD stored: NONE STORED *
*****
  
```



Quick TR-55 Ver.5.46 S/N:
 Executed: 15:54:20 01-21-1999

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DETENTION BASIN D REVISED

**** Modified Rational Hydrograph ****

Weighted C = 0.750 Area= 58.700 acres Tc = 18.00 minutes
 Adjusted C = 0.750 Td= 52.00 min. I= 2.90 in/hr Qp= 127.67 cfs
 RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
 Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
 For the 100 Year Storm

Time increment = 0.017 Hours
 Time on left represents time for first Q in each row.

Time Hours	0.00	7.09	14.19	21.28	28.37	35.46	42.56
0.000	0.00	7.09	14.19	21.28	28.37	35.46	42.56
0.117	49.65	56.74	63.84	70.93	78.02	85.12	92.21
0.233	99.30	106.39	113.49	120.58	127.67	127.67	127.67
0.350	127.67	127.67	127.67	127.67	127.67	127.67	127.67
0.467	127.67	127.67	127.67	127.67	127.67	127.67	127.67
0.583	127.67	127.67	127.67	127.67	127.67	127.67	127.67
0.700	127.67	127.67	127.67	127.67	127.67	127.67	127.67
0.817	127.67	127.67	127.67	127.67	120.58	113.49	106.39
0.933	99.30	92.21	85.12	78.02	70.93	63.84	56.74
1.050	49.65	42.56	35.46	28.37	21.28	14.19	7.09
1.167	0.00						

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NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DETENTION BASIN D REVISED

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
 'C' adjustment, k = 1
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
D	0.750	58.70						
			18.00	0.750	0.750	5.400	58.70	237.74

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MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DETENTION BASIN D REVISED

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 88.00 cfs

Hydrograph file: NONE STORED Tc = 18.00 minutes
 ::

						VOLUMES	
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	Inflow (ac-ft)	Storage (ac-ft)
0.750	0.750	18	5.400	58.70	237.74	5.894	3.712
0.750	0.750	20	5.100	58.70	224.53	6.185	3.882
0.750	0.750	30	4.100	58.70	180.50	7.459	4.550
0.750	0.750	40	3.367	58.70	148.22	8.166	4.651
0.750	0.750	50	2.967	58.70	130.61	8.995	4.874
*****						Storage Maximum	
0.750	0.750	52	2.900	58.70	127.67	9.145	4.902

0.750	0.750	60	2.600	58.70	114.46	9.460	4.733

POND "E"

Calculate 100 yr allowable release from POND "E"

Drainage SITE₁₀₀ = 25 cfs restricted, 5 cfs unrestricted
 S = 11 cfs restricted, 2 cfs unrestricted

$$1+05-2 \quad 100 = 4.4 \text{ AC} \times \frac{0.80}{4.4} \times (1.1 \times .35) + (3.3 \times .95) \times 6.8 = 24 \text{ cfs}$$

$$S = 4.4 \text{ AC} \times \frac{.74}{4.4} \times (1.1 \times .25) + (3.3 \times .90) \times 4.0 = 130 \text{ cfs}$$

$T_c = 11 \text{ min}$ $I_5 = 4.0$ $I_{100} = 6.8$

Basin "B" 2 ac - Times mirrored $2 \times .20 \times 5.0 = 2 \text{ cfs}$
 $5 \times .15 \times 2.8 = 0.84$

$$Q_{100} = 123 \text{ cfs} - 25 - 5 - 24 - 2 \text{ cfs} = 67 \text{ cfs}$$

$$Q_5 = 50.1 \text{ cfs} - 11 - 2 - 13 - 0.84 = 23.3 \text{ cfs}$$

15.3 ac-ft Storage required

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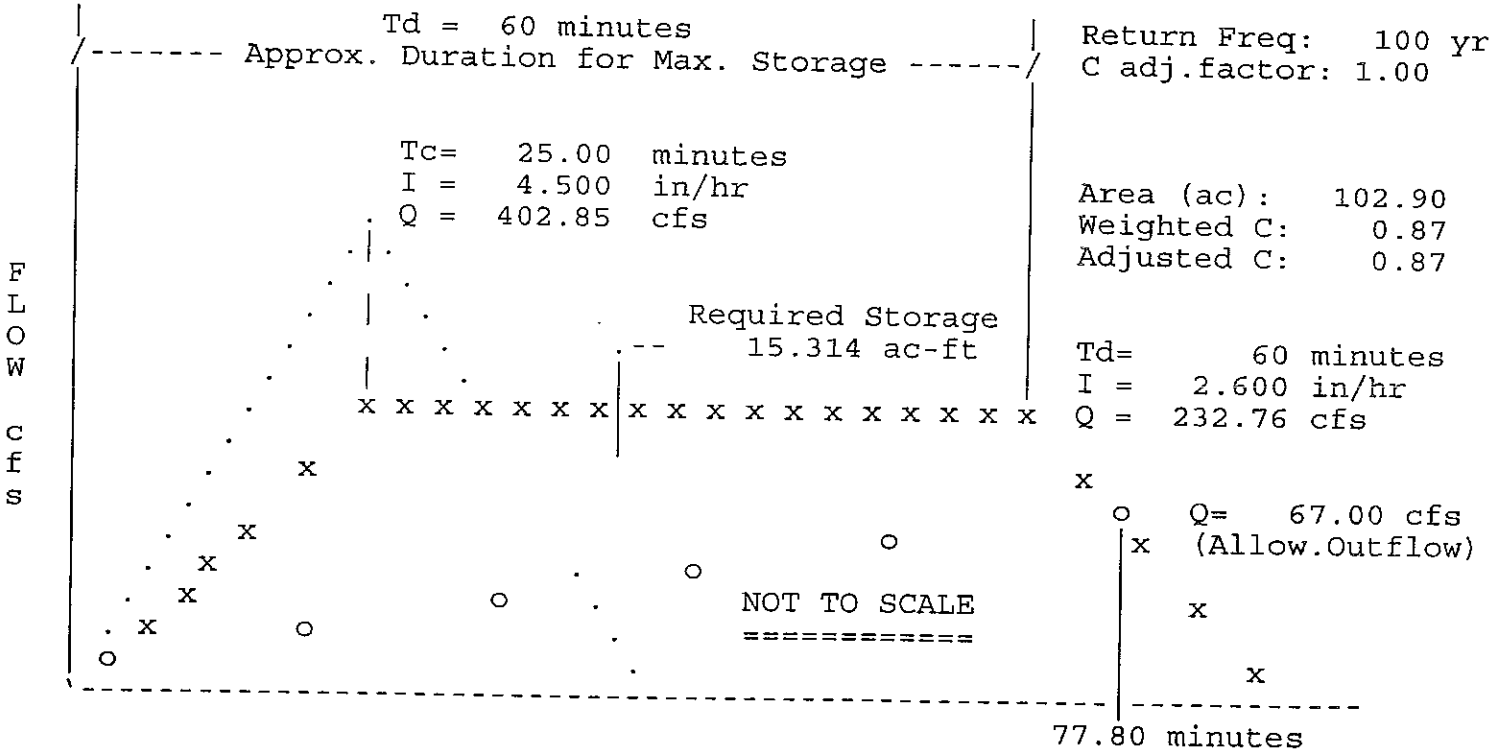
MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DET. BASIN E W/ LEACH ROAD UNRESTRICTED

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*****
* RETURN FREQUENCY: 100 yr | Allowable Outflow: 67.00 cfs *
* 'C' Adjustment: 1.000 | Required Storage: 15.314 ac-ft *
*-----*
* Peak Inflow: 232.76 cfs | Inflow .HYD stored: NONE STORED *
*****
  
```



Quick TR-55 Ver.5.46 S/N:
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NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DET. BASIN E W/ LEACH ROAD UNRESTRICTED

**** Modified Rational Hydrograph ****
 Weighted C = 0.870 Area= 102.900 acres Tc = 25.00 minutes
 Adjusted C = 0.870 Td= 60.00 min. I= 2.60 in/hr Qp= 232.76 cfs
 RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
 Output file: NONE STORED

HYDROGRAPH FOR MAXIMUM STORAGE
 For the 100 Year Storm

Time increment = 0.017 Hours
 Time on left represents time for first Q in each row.

Time Hours	0.00	9.31	18.62	27.93	37.24	46.55	55.86
0.000	0.00	9.31	18.62	27.93	37.24	46.55	55.86
0.117	65.17	74.48	83.79	93.10	102.41	111.72	121.04
0.233	130.35	139.66	148.97	158.28	167.59	176.90	186.21
0.350	195.52	204.83	214.14	223.45	232.76	232.76	232.76
0.467	232.76	232.76	232.76	232.76	232.76	232.76	232.76
0.583	232.76	232.76	232.76	232.76	232.76	232.76	232.76
0.700	232.76	232.76	232.76	232.76	232.76	232.76	232.76
0.817	232.76	232.76	232.76	232.76	232.76	232.76	232.76
0.933	232.76	232.76	232.76	232.76	232.76	223.45	214.14
1.050	204.83	195.52	186.21	176.90	167.59	158.28	148.97
1.167	139.66	130.35	121.04	111.72	102.41	93.10	83.79
1.283	74.48	65.17	55.86	46.55	37.24	27.93	18.62
1.400	9.31	0.00					

Quick TR-55 Ver.5.46 S/N:
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NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DET. BASIN E W/ LEACH ROAD UNRESTRICTED

* * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * *

$$Q = \text{adj} * C * I * A$$

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
 adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
 'C' adjustment, k = 1
 Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
E	0.870	102.90	25.00	0.870	0.870	4.500	102.90	402.85

Quick TR-55 Ver.5.46 S/N:
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*****
*****
*
*
*
*      MODIFIED RATIONAL METHOD
*    ---- Grand Summary For All Storm Frequencies ----
*
*
*****
*****
  
```

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DET. BASIN E W/ LEACH ROAD UNRESTRICTED

Area = 102.90 acres Tc = 25.00 minutes
 ::

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES	
						Inflow (ac-ft)	Storage (ac-ft)
100	0.870	60	2.600	232.76	67.00	19.236	15.314

Quick TR-55 Ver.5.46 S/N:
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MODIFIED RATIONAL METHOD
 ---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

NORTHGATE SOFTWARE CAMPUS MDDP
 1-99
 DET. BASIN E W/ LEACH ROAD UNRESTRICTED

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 67.00 cfs

Hydrograph file: NONE STORED

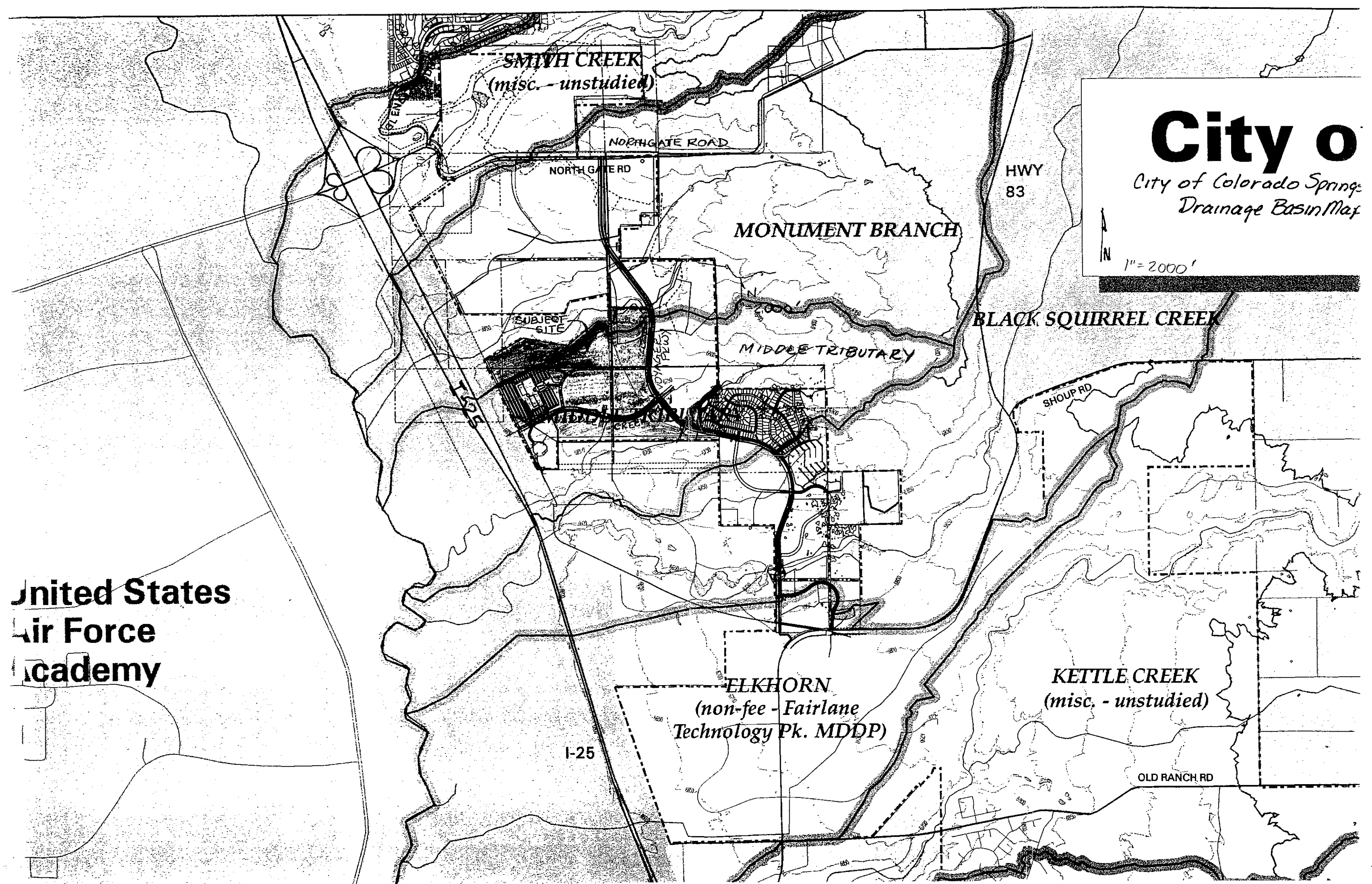
Tc = 25.00 minutes

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES	
						Inflow (ac-ft)	Storage (ac-ft)
0.870	0.870	25	4.500	102.90	402.85	13.872	11.565
0.870	0.870	30	4.100	102.90	367.04	15.167	12.629
0.870	0.870	40	3.367	102.90	301.39	16.606	13.606
0.870	0.870	50	2.967	102.90	265.58	18.291	14.830

***** Storage Maximum
 0.870 0.870 60 2.600 102.90 232.76 | 19.236 15.314

DRAINAGE MAPS

**United States
Air Force
Academy**



City of Colorado Springs

City of Colorado Springs
Drainage Basin Map

1" = 2000'