AMENDMENT NO. 2

To

PINE CREEK DRAINAGE BASIN PLANNING STUDY

And

MASTER DEVELOPMENT DRAINAGE PLAN

For

PINE CREEK SUBDIVISION

(Portion Contributing to Pine Creek)

JR Engineering, Ltd.

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

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October 1998

Prepared For:

LP47, LLC dba
LA PLATA INVESTMENTS
7150 Campus Drive, Suite 365
Colorado Springs, CO 80920
(719) 260-7477

Prepared By:

JR ENGINEERING, LTD.
4935 North 30th Street
Colorado Springs, CO 80919
(719) 593-2593

Job No. 8716.11

JR Engineering, Ltd.
4935 North 30th Street
Colorado Springs, Colorado 80919
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DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:
The attached amendment to the approved drainage basin planning study was prepared under my direction and supervision and is 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. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED VANCEL S. FOSSINGER 31972 PROFESSIONAL ENGINEER

Vancel S. Fossinger, Colorado P.E. #31972
For and On Behalf of JR Engineering, Ltd.

10/19/1998
Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this amendment to the approved Pine Creek Drainage Basin Planning Study.

Business Name: LP47, LLC
dba La Plata Investments

By: _____
Bob Ingels

Title: _____

Address: 7150 Campus Drive, Suite 365

Colorado Springs, CO 80920

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.

_____
City Engineer
Conditions

10/22/98
Date

EXECUTIVE SUMMARY

The "Pine Creek Drainage Basin Planning Study," by Obering, Wurth and Associates, approved June 20, 1989, implemented a stormwater management concept that included use of both private and public detention facilities to limit the fully developed condition peak 100-year flow rate in Pine Creek at Highway 83 to a maximum of 2536 cfs. The study identified the historic peak 100-year flow rate for this location as 1210 cfs and required the Developer of the Briargate area to make improvements to the reach of channel downstream of Highway 83 before the historic rate was exceeded. The study provided a phased approach for the construction of the required drainage improvements. In the initial phase, construction of Regional Detention Facility No. 1 was to occur and the Detention Facility was to be fitted with a restricted outlet to allow an estimated 1000 to 1500 acres of the watershed to develop before the historic flow rate was exceeded and downstream improvements were required. The study also recommended that a re-analysis of the basin be done when approximately 1000 acres of the basin had occurred.

Approximately 600 acres of the basin have been developed to date. Regional Detention Facility No. 1 has been constructed with the proposed restricted outlet. Several on-site detention facilities have also been constructed on commercial and office sites. It is estimated that development within the basin is approaching a level where the historic discharge from the watershed above Highway 83 will be exceeded and either the improvements required for the downstream channel must be constructed or additional detention facilities must be constructed within the basin above Highway 83 to limit the peak 100-year discharge to the historic 100-year peak rate. Heightened environmental concerns about construction of extensive improvements within historic watercourses as well as changes in drainage criteria and drainage management philosophy by government agencies and the current major land owner in the basin have driven a re-analysis and formulation of a revised Stormwater Management Plan for the portion of the basin located upstream of Highway 83.

The Stormwater Management Plan contained within this Amendment 2 to the Pine Creek Drainage Basin Planning Study requires additional regional detention facilities be constructed within the basin in order to limit the fully developed condition 100-year peak flow rate at Highway 83 to the previously defined historic 100-year peak flow rate of 1210 cfs. This is consistent with the goals of the effective DBPS as set forth in the section titled "Implementation." In addition, the plan contained within this Amendment eliminates the requirements of on-site detention within the basin except where downstream conveyance capacity is inadequate. This will be made possible by accomplishing more detention within the proposed regional detention facilities. This is consistent with current City policy.

As reported in the "Pine Creek Drainage Basin Planning Study," the Pine Creek Drainage Basin has been approved by jurisdictional agencies as a "No-Fee" basin as it relates to respective City ordinances and County resolutions. This Amendment is intended to serve as the stormwater management guideline for the portion of Pine Creek Drainage Basin located upstream of Highway 83.

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PINE CREEK DRAINAGE BASIN PLANNING STUDY AND
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I. INTRODUCTION

A. Contract Authorization

This document and associated analysis was prepared with private funds for LP47, LLC d.b.a. La Plata Investments by JR Engineering, Ltd. La Plata Investments is the major landowner and developer within the study area.

B. Purpose and Scope

This document is to serve as an update and second amendment to the Pine Creek Drainage Basin Planning Study (DBPS) prepared by Obering, Wurth and Associates as approved June 20, 1989, by the City of Colorado Springs. This document will also serve as the Master Development Drainage Plan for the portion of the Pine Creek Subdivision located within the Pine Creek drainage basin.

1. In regards to providing an update and amendment to the Pine Creek DBPS this document will provide:
    a. An updated hydrological analysis of the portion of the Pine Creek Basin located east of State Highway 83 (the study area)
    b. Identification of the drainage facilities that have been constructed within the portion of the basin located east of Highway 83
    c. Identification of the current proposed land uses within the portion of the Pine Creek Basin located east of Highway 83
    d. Revised proposed drainage treatment within the portion of the Pine Creek drainage basin located east of Highway 83. The treatment revisions consist primarily of:

- Eliminating the requirement for on-site detention except in areas where existing outfall lines do not have sufficient capacity to convey free discharge.
- Increasing the overall detention storage volume to be provided in the proposed regional detention ponds, thus reducing the design storm flow in several locations of Pine Creek including the point that it flows under Highway 83 and onto the grounds of the Air Force Academy.
- Replacing proposed lined open channel conveyances with underground storm drains in several locations.
- Relocation and reconfiguration of previously proposed regional detention facilities and adding additional regional detention facilities.

2. These revisions are proposed as a result of changes in land use planning in the basin, changes in drainage criteria by the governing agencies, and changes in overall drainage treatment philosophies by the governing agencies and by the major land owner in the basin.
3. In regards to the Pine Creek Subdivision this document will estimate the peak flow rates of storm water runoff and identify the overall concept for treatment of the runoff within the portion of the subdivision that will contribute runoff to Pine Creek when it is developed. The identified treatment will consist of:
   a. Indicating the general proposed direction of flow for developed condition drainage.
   b. The major components of proposed storm drain systems including outfall points, proposed detention basin locations and sizes.
   c. General guidelines for the proposed treatment of the portion of Pine Creek Channel that is contained within the subdivision.

More specific and detailed analysis and drainage treatment plans will be provided with the submittal of individual drainage reports for each subdivision filing within the Pine Creek Subdivision.

C. Past Studies

A number of previous studies and reports were reviewed during the preparation of the current study. The most relevant studies are listed below along with a brief synopsis. Additional, reports that were reviewed are noted in the reference section of this study.

"Pine Creek Drainage Basin Planning Study," June 1988 revised October 1988, by Obering, Wurth and Associates. This study included all of the Pine Creek drainage basin above Academy Boulevard. Key items of this study included the following:

- Major drainage conveyances were primarily to be open channels.
- Required onsite detention to achieve a 35 percent reduction in the peak flow rate resulting from development (the difference between the historic and developed peak rates) on all office, research and development, commercial, and school properties.
- Free discharge from all other properties was proposed.
- The 100-year historic peak flow rate in Pine creek as it crosses under Highway 83 was estimated at 1210 cfs.
- Improvements were to be made to the portion of Pine Creek between Highway 83 and Academy Boulevard to allow it to convey a proposed 100-year peak flow rate from above Highway 83 of 2536 cfs. These improvements were to be made to the channel before the historic flow rate from the area above Highway 83 was exceeded.
- Five regional detention ponds were to be constructed above Highway 83 to regulate the peak 100-year discharge rate to 2536 cfs.
- Detention Facility No. 1 was to be constructed on the Pine Creek Main Channel near the intersection of Briargate Parkway and Highway 83 and fitted with a restricter plate to temporarily reduce the planned outflow. The purpose of the reduced outflow was to regulate the down stream 100-year flow in Pine Creek to less than the historic 100-year peak rate. This was to be done to allow development to begin in the watershed before the portion of channel between Academy Boulevard and Highway 83 was improved.

"**Amendment No. 1 to the Pine Creek Drainage Basin Planning Study,**" July 17, 1992, revised July 29, 1992, by Obering, Wurth and Associates.

- This amendment proposed the addition of a sixth regional detention pond. The proposed 100-year peak flow rate from the area above Highway 83 was to remain at 2536 cfs.

D. Agency Jurisdictions

The drainage improvements proposed in the current study as well as the majority of the included watershed are located within the Colorado Springs City limits. The extreme upper portions of the watershed included in this study are unincorporated areas of El-Paso County. Runoff from the unincorporated areas of the watershed has been accounted for in the current study.

The portion of Pine Creek that is located immediately downstream of the area included in this proposed Amendment No. 2 to the Pine Creek Drainage Basin Planning Study is located on the grounds of the United States Air Force Academy (USAFA). The effective Pine Creek Drainage Basin Planning Study (DBPS) was reviewed by and contains a letter of approval from the (USAFA).

Section VIII of the effective Pine Creek (DBPS) is titled "Implementation." The second paragraph of this section states that "the primary basin management goal for this particular drainage basin is one of limiting a peak discharge from the study area at State Highway 83 to historic or below for as long a period as possible." Later in the text the "historic peak discharge" is mentioned as the 100-year historic rate of 1210 cfs.

The drainage plan contained in this current proposed Amendment No. 2 to the Pine Creek (DBPS) proposes to restrict the peak 100-year flow rate in Pine Creek at Highway 83 to a maximum of 1210 cfs with the upstream watershed in a fully developed condition. As this change in the plan is consistent with the stated goal of the effective (DBPS), and the

improvements required to accomplish this change will be constructed at the expense of and on land owned by La Plata Investments, the major land owner in the study area, it is anticipated that the City of Colorado Springs will be the sole agency for review and approval of this Amendment to the (DBPS).

It is understood that other agencies such as FEMA, the Corps of Engineers, and the Wildlife Service will have involvement in review and approval of more detailed plans for individual projects proposed in this study at the time that they are designed.

E. Drainage Criteria

Storm drainage design and management within the study area must conform to the current City Colorado Springs Criteria. In addition, the original D.B.P.S imposed a requirement for onsite detention to achieve a 35 percent reduction in the peak flow rate resulting from development (the difference between the historic and developed peak rates) on all office, research and development, commercial, and school properties. The current study proposes to eliminate this requirement for certain properties within the study area (refer to Section V).

II. PROJECT DESCRIPTION, LOCATION AND DRAINAGE

A. Basin Location and Size

The study area is a portion of the Briargate Community located in the northeast portion of Colorado Springs. As shown on the vicinity map the study area is bounded by the Kettle Creek Drainage Basin on the north and the Cottonwood Creek Drainage Basin on the south. The lower or western limit of the study area is defined by the crown of Highway 83. The upper limit of the study area is located approximately 22,000 feet to the east of Highway 83 and coincides with the upper limit of the Pine Creek Drainage Basin. The study area is approximately 2,930-acres or 4.58 square miles in size.

B. Major Drainageways and Facilities

An existing drainage facility map was prepared as a part of this study. A copy of this map is contained in the appendix of this report. As shown on the map a considerable amount of drainage improvement have been constructed to support the existing development. Three significant storm drain systems have been constructed in the study area to date. For the purpose of this study they will be referenced to as the Focus on the Family storm drain system, the South Chapel Hills Drive Storm Drain System and the North Chapel Hills Drive Storm Drain System.

The initial phase of the Focus on the Family Storm Drain System was constructed to serve as an outfall from the Focus on the Family Site. The system begins in Summer Field Subdivision Filings No. 5 and 6, is routed through the existing Summer Field Detention Pond, then south in Summerset Drive, west in Research Parkway, west across the Focus on the Family site, then north in Explorer Drive and finally west in Briargate Parkway to outfall into Detention Facility No. 1.

The South Chapel Hills Drive storm drain begins in Dynamic Drive east of Chapel Hills Drive. It is then routed north in Chapel Hills Drive to outfall into Pine Creek on the west side of Chapel Hills Drive.

The North Chapel Hills Drive storm drain begins in Lexington Drive just north of Chapel Hills Drive. It is the routed southwest in Chapel Hills Drive to outfall into Pine Creek on the west side of Chapel Hills Drive.

Pine Creek is an unimproved natural channel throughout most of the study area. At the downstream end of the study area a concrete box culvert with three (3) 14 foot span by 10-foot rise cells carries the creek under Highway 83. Upstream, a single cell 12-foot span by 10-foot rise concrete box culvert carries the outflow from Detention Facility No. 1 under Briargate Parkway and back to the Pine Creek Channel. On the upstream (north) side of Briargate Parkway, existing Detention Facility No. 1 accepts and detains all of the flow from the upstream Pine Creek Channel. A new bridge is expected to be constructed to carry Pine Creek under Chapel Hills Drive within the year.

The portion of Pine Creek that begins at Highway 83 and extends approximately 8,500 feet upstream to the historic confluence of the north and south fork of Pine Creek is for the most part heavily vegetated with willows and cattails and appears to be quite stable. This portion of channel is identified as Reaches 1, 2 and 3 on the drainage maps prepared for this study. This portion of channel has existed in a unique environment for several years in that it has been sheltered from significant frequent flows and has a minor base flow that provides the moisture required to support the vegetation. Aerial photography of the study area indicates that considerable water conservation treatment was constructed in the watershed prior to 1955. The treatment consists of small ditch/dikes constructed on the contour in many of the steeper portions of the watershed and several small on line retention ponds constructed at frequent intervals along both the north and south forks of Pine Creek upstream of the confluence. There are also several small retention basins spread throughout the watershed to intercept small concentrated flows upstream of the defined Pine Creek Channel. While a detailed analysis of this treatment has not been performed with the current study it is speculated that the treatment has sheltered the downstream channel from all but large infrequent flows. This environment has allowed the vegetation in the channel to become well established.

Upstream of the confluence of the north and south forks the character of the Pine Creek Channel changes as the presence of perennial water in the channel is greatly reduced. Several areas of the channel bottom are dry in all but large rainfall events. Other areas are kept moist by small springs and water impounded in the online retention basins. With the reduction of the available water in the channel the quantity and quality of the vegetation in the channel is also less in the reaches upstream of the confluence than found in the lower reaches of the channel.

C. Existing and Proposed Land Use

Approximately 600-acres of the 2,930-acre study area are currently developed. The remainder of the area is currently undeveloped rangeland. Much of the remaining undeveloped area is expected to develop at a relatively fast pace in the coming years.

Most of the study area has been master planned for land use. Where available, the master plan land uses were utilized for this study. The exhibit contained in the appendix entitled "Subdivision and Land Use Identification Map" indicates the current land use assumption. The following table is a summary of these land uses.

PROJECTED LAND USE
Fully Developed Condition

Land Use	Assumed Percent Impervious	Area (acres)	Percent of Study Area
Golf Course		204	7%
Park		128	4%
Open Space		151	5%
Residential			
1-2 DU/AC	20-25	150	5%
3 DU/AC	30	422	14%
4 DU/AC	37	115	4%
2-6 DU/AC	44	189	6%
5 DU/AC	44	78	3%
6-18 DU/AC	56-70	228	8%
Light Industrial/Office	83	498	17%
Commercial	95	239	8%
Church	80	20	1%
School	50	110	4%
Misc. Other	50-68	21	1%
Unknown	45	206	7%
Arterial Street	85	173	6%
TOTAL		**2932**	**100%**

D. Existing and Proposed Utilities

Several underground utility lines are in place within the study area. Many more will be constructed to support future development. Consideration was given to the fact that there will several locations where storm drain facilities and other utilities must cross. The major anticipated crossings were investigated and no problems that are insurmountable were found. All future storm drains as well as other underground utilities should be designed and constructed with consideration for existing and future adjacent facilities.

E. Soils / Erosion Potential

A Hydrologic Soils Group Map was provided in the original Pine Creek DBPS. This map shows the hydrologic soil group limits and the soil mapping units as identified in the "Soil Survey of El Paso County Area, Colorado," published by the U.S.D.A. Soil Conservation Service (SCS) in 1975. The map indicates that the majority of the soils in the study area belong to Hydrologic Soil Groups "A" and "B". A portion of the Briargate Business Campus contains soils in the Hydrologic Group "C". A small portion of Sub-basins PN7, PN10, and PN13 contain soils identified as belonging to Hydrologic Soil Group "D".

The erosion potential as reported in the SCS "Soils Survey for El Paso County Area," varies from slight too high in the study area.

III. FIELD INVESTIGATIONS

A. Topographic Mapping

Topographic data utilized in this study was obtained from the City of Colorado Springs FIMS program, where available. At the extreme upper end of the study area the FIMS topographic data was not available, so topography was obtained from the U.S.G.S. Quadrangle Map for the area.

B. Subsurface Investigation

No subsurface investigation was performed specifically for this project. Subsurface investigations will be required for individual projects as appropriate.

C. Environmental Considerations

LP47, LLC dba La Plata Investments, the majority landowner in the study area, has contracted with an environmental consultant to perform a survey to identify environmentally sensitive areas within the study area. Potential areas of concern are areas that meet the qualifications of wetlands and areas that may contain the habitat of the Prebles Meadow Jumping Mouse.

In general, one of the goals of the overall plan proposed by this study is to minimize the peak flow rates contributed to Pine Creek in order to minimize impacts to the channel.

IV. HYDROLOGIC AND HYDRAULIC DESIGN EVALUATION

A. Basin Hydrology

1. Analysis Purpose

The following items were the goals of the hydrologic analysis performed for this study:

a. Estimate peak runoff rates for sub-basins to be developed in the future

b. Provide peak flow rates to be used in the design of proposed major conveyances and the evaluation of the ability Pine Creek to convey developed condition flows.

c. Provide inflow and outflow hydrographic and required storage volumes to be used in the design of proposed regional detention facilities and the evaluation of existing regional detention facilities.

d. Demonstrate the adequacy of the proposed plan to control the 100-year peak flow rate in Pine Creek as it crosses under Highway 83 to a maximum of 1210 cfs (the historic 100-year peak flow rate established by the effective DBPS).

e. Estimate peak rates that are somewhat conservative so that some flexibility may be available for changes in land use planning. A conservative approach is prudent when working with a drainage system that relies on detention basins and closed conduit conveyance systems with finite capacities.

2. Methodology

The hydrologic analysis performed for this study was based on the Soil Conservation Service (SCS) Dimensionless Unit Hydrograph utilizing the U.S. Army Corps. Of Engineers HEC–1 computer program as modified by Haestad Methods Inc., May 1991 version. The original Pine Creek DBPS also utilized the HEC-1 program. Due to a multitude of changes that have occurred in the study area since the original study was performed the original model HEC-1 model was reviewed but not utilized in the

current study. A new basin map was created along with new sub-basin boundaries, lag times, and estimated curve numbers. A new HEC-1 Model was created to evaluate the basin in an anticipated fully developed condition with the new data. A second model was then created from the first with the upper part of the watershed evaluated in the "existing condition" in order to evaluate a partially developed or "interim" condition.

a. Times of Concentration

Times of Concentration (TC) were estimated based on actual flow paths in existing developed areas and undeveloped areas for the existing condition model only. Times of concentration for the fully developed condition model were based on estimated flow paths in areas where development has not occurred. Estimated flow paths were patterned after average flow paths for similar existing development located in the Briargate area. Summary sheets containing the data utilized in the TC calculations are included in the appendix of this study. Lag time as utilized in the methodology was calculated as 0.6 tc (in hours).

b. Curve Numbers

A problem that has been encountered in the past has been matching peak flow rates calculated in detailed analyses done for drainage reports to allowable flow rates calculated in non-detailed analyses based on general assumptions for drainage basin planning studies. A goal of the current analysis was to produce peak flow rates for individual sub-basins with the HEC-1 Model that are similar to peak flow rates that would be calculated by the rational method. In an effort to achieve this goal Curve Numbers (CN) utilized in the model were first estimated for individual sub-basins based on the anticipated land uses within the individual sub-basins assuming antecedent moisture condition II. These estimated CN's were then entered into the model and peak 100-year flow rates were generated by the HEC-1 program for individual sub-basins. The peak 100-year flow rates were then entered into a spreadsheet and compared to 100-year peak flow rates generated by a rational method calculation for corresponding sub-basins. The CNs were then adjusted and the process was repeated until a reasonable

agreement existed between the peak rates generated by the HEC-1 Model output and the peak rates generated by the rational method calculation. This adjustment caused an increase in the overall predicted peak rates and volumes generated in the study area. No effort was made to adjust Curve Numbers for the undeveloped basins in the Interim condition model, as future design calculations by rational method for the condition are unlikely. Copies of the spreadsheets utilized to calculate and adjust the curve numbers are contained in the appendix of this study.

c. Design Storm

The Type IIA 24 hour storm distribution was utilized in the HEC-I model. Rainfall depths of 4.4" for the 100-year storm and 2.6" for the 5-year storm were used in the simulations. A calculation time interval of 3 minutes was used in order to satisfy the program recommendation that the time interval be less than or equal to .29 lag. A limitation of the Version of HEC-1 program that was used is that it can only generate 300 hydrograph points. At three-minute intervals output is only generated for the first 15-hours of the 24-hour storm. The peak inflow and outflow rates associated with all of the facilities included in the model occur well before 15-hours of the storm has passed so this is considered insignificant for the purpose of this study.

d. Analysis Approach for Areas of Existing Development

The primary importance of including the existing developed areas in the current analysis was to generate hydrographs from these areas that were produced with the same methodology as used in the remainder of the study area. In the current analysis hydrographs from the areas of existing development were added to hydrographs from the areas of future development to produce hydrographs at points of interest to the current proposed plan.

The somewhat conservative methodology used for the current analysis has produced hydrographs in some of these areas of existing development that are larger than predicted by the existing approved MDDPs and final drainage reports for these areas. This is not necessarily indicative of problems with the previous

analyses but rather is the result of utilizing a different and potentially more conservative approach of analysis that was chosen to allow some tolerance for the unknowns that exist at the DBPS level of analysis.

One approach that was considered for modeling the existing areas was to revise the "curve numbers" and "lag times" used in the areas of existing development to produce peak flow rates similar to those produced by previous analyses. This approach was not used, as the resulting hydrographs would be skewed in volume and or in time in comparison with the remainder of the model. Both time and volume are very important when modeling detention facilities so it was determined that it was more appropriate to universally apply the chosen methods of calculating lag times and applying curve numbers than it was to match the output of several previous analyses performed by several individuals using varying methodologies and criteria.

The current analysis does not include a detailed analysis of the existing storm drain systems. At points in the watershed where runoff rates in excess of the existing downstream storm drain capacity would result in the excess flow being diverted out of the watershed or conveyed to a substantially different outfall into Pine Creek, a simplistic evaluation of the capacity of the existing storm drain was made. The downstream capacity was assumed to be equal to the full pipe conveyance capacity of the most restricted segment of the downstream storm drain of interest. Where storm drain capacity was found to be less than the 100 year peak flow rates predicted by the current analysis, the HEC I model was revised to divert excess flow from the storm drain system and route, it to Pine Creek via an approximate surface route or out of the watershed as appropriate for the location. This serves to provide a conservative estimate of the total flows that will be conveyed in Pine Creek through and out of the study area.

B. Major Drainageway Hydraulics

1. Floodplain Delineation Maps

The Federal Emergency Management Agency, Flood Insurance Study (FIS) for El-Paso County and Incorporated Areas was revised and reissued on March 17, 1997. Six Panels of the Flood Insurance Rate Maps (FIRMs) produced as a part of the FIS include potions of the Pine Creek study area. A Map entitled "Pine Creek FEMA 100-Year Flood Zone Limits" is included in the appendix of this report. The map contains the FEMA 100-year flood zone limits for all of the Pine Creek Study area as well as references to the individual FIRM panels that the information was obtained from. The floodzone limits were digitized into the map from the FIRM panels. It should be noted that some adjustments were made to the alignment of some segments of the boundaries in order to get them to generally line up with the Pine Creek Channel Topography because a direct overlay indicates that the overall accuracy of the FIRMS is not good. Due to this, the map should not be used to determine the specific location of the FEMA 100-year floodplain. Specific location of the FEMA floodplain should be determined from the FIRMs.

The 1997 FIRMs appear to contain the same base flood elevation data as the 1986 FIRMS contained for the Pine Creek Study area. It is assumed that no new study of the Pine Creek study area was performed for the 1997 revision.

2. Flood Profiles

A detailed hydraulic analysis for Pine Creek or major proposed storm drains was not included in the scope of this study. A detailed hydraulic analysis of Pine Creek between Chapel Hills Drive and Detention Facility No. 1 is presented in the "Final Drainage Report for Pine Creek Channel – Phase 1," dated April 1996, additions February 1997, by JR Engineering, Ltd. It is anticipated that similar reports will be prepared for the remainder of Pine Creek that is proposed to remain as an open channel. Hydraulic grade lines for proposed closed conduit conveyances will be prepared with and presented on the construction drawings for the same.

V. PROPOSED DRAINAGE PLAN

A. General Description

A proposed plan for the fully developed condition and an interim, partially developed condition has been prepared as a part of this study. Both plans are presented graphically on maps contained in the appendix of this study and are described in the following text. The fully developed condition plan proposes the construction of seven (7) additional regional detention facilities distributed throughout the study area. The plan also proposes to expand existing Regional Detention Facility No. 1 and modify its outlet. The proposed detention facilities will limit the 100-year peak outflow in Pine Creek from the study area to 1210 cfs. Proposed major conveyance facilities throughout the watershed consist of closed conduits and portions of the Pine Creek Natural Channel. The proposed detention facilities are distributed to mitigate high peak flow rates throughout the conveyance system in order to limit the size of the required storm drains and the erosion potential in the natural channels. The Interim Plan indicates the portion of the proposed facilities that are required to support a certain level of development in the study area.

B. Fully Developed Condition Plan

1. Pine Creek North Fork (Sub-basins PN1 through PN14)

The watershed begins east of future Powers Boulevard. Current land planing is very general for this area. It was assumed for the purpose of this plan that the runoff from Sub-basins PN1 through PN6 including a portion of Powers Boulevard will be collected in future streets and storm drains and conveyed to and routed through proposed Regional Detention Facility "G". Regional Detention Facility "G" is planned to have a 100-year peak inflow of 1747cfs, a 100-year peak outflow of 250 cfs, and a 100-year storage volume requirement of 60-acre feet. Outflow from Regional Detention Facility "G" will be passed under future Powers Boulevard and released into the Pine Creek North Fork Channel where it will be conveyed downstream to proposed Regional Detention Facility "F". In the future as more detailed planning in the watershed occurs consideration should

be given to an additional detention basin in located further up in the watershed to reduce the required size of Detention Facility "G" and the upstream conveyance facilities.

Regional Detention Facility "F" is planned to receive the routed outflow from Regional Detention Facility "G" as well as all of the runoff from Sub-basins PN7 and PN8. Regional Detention Facility "F" is planned to have a 100-year peak inflow of 578 cfs, a 100-year peak outflow of 239 cfs, and a 100-year storage volume requirement of 18-acre feet. Outflow from Regional Detention Facility "F" will be passed under a future collector street and released into Pine Creek North Fork Channel where it will be conveyed downstream to proposed Regional Facility "E". To the extent practical, the runoff from Sub-basins PN 7 and PN8 should be routed directly to Detention Facility "F" rather than into the upstream Pine Creek Channel in order to limit the potential for erosion in the channel.

Proposed Regional Detention Facility "E" is planned to receive the routed outflow from Regional Detention Facility "F" as well as all of the runoff from Sub-basins PN9 through PN13. Regional Detention Facility "E" is planned to have a 100-year peak inflow of 724 cfs, a 100-year peak outflow of 265 cfs, and a 100-year storage volume requirement of 19-acre feet. Outflow from Regional Detention Facility "E" will be conveyed in a storm drain to Analysis Point 5 located at the western limit of Sub-basin PN15. At Analysis Point 5, the runoff from Sub-basins PN14 and PN15 is planned to enter the storm drain. To the extent practical, the runoff from Sub-basins PN9 and PN10 should be collected and conveyed within the future development and released to the Pine Creek Channel near Analysis Point 4. Likewise, the runoff from Sub-basins PN11 should be collected and conveyed within the future development and released directly to Detention Facility "E". Sub-Basin PN12 is expected to remain mostly undeveloped with its runoff continuing to enter Pine Creek along historic flow paths.

2. **Pine Creek South Fork (Basins PS1 through PS13)**

The watershed begins east of future Powers Boulevard. Current land planning is very general for this area. It was assumed for the purpose of this plan that the runoff from Sub-basins PS1 through PS3 will be collected in future streets and storm drains and conveyed to and routed through proposed Regional Detention Facility "D". Regional Detention Facility "D" is planned to have a 100-year peak inflow of approximately 1,073 cfs, a 100-year peak outflow of 99 cfs, and a 100-year storage volume requirement of 41 acre feet. Outflow from Regional Detention Facility "D" will be routed down a proposed storm drain in the Briargate Parkway right-of-way to Analysis Point 6 at future Powers Boulevard. All of the runoff from Sub-basins PS4 and PS5 including a portion of Powers Boulevard is planned to enter the proposed storm drain at or above Powers Boulevard. In the future as more detailed planning in the watershed occurs consideration should be given to an additional detention basin located further up in the watershed to reduce the required size of Detention Facility "D" and the upstream conveyance facilities.

The storm drain planned for the Briargate Parkway right-of-way will extend downstream from Powers Boulevard to proposed Regional Detention Facility "C". For the purpose of this analysis, it was assumed that all of the runoff from Sub-basin PS6 would be included in the storm drain flow at or before Analysis Point 7 and the flow from Sub-basin PS7 would be included in the storm drain flow at or before Analysis Point 7A. The runoff from Sub-basin PS8 was assumed to enter the storm drain at or before Analysis Point 8 at the intersection of Briargate Parkway and Union Boulevard. Runoff from Sub-basins PS9 is expected to be piped directly to Detention Facility "C" but may share a common outlet with the proposed Briargate Parkway storm drain. Analysis Point 9 represents the combined flow from the Briargate Parkway storm drain and Sub-basin PS9. Sub-basin PS10 is planned to outfall directly to Detention Facility "C". Regional Detention Facility "C" is planned to have a 100-year peak inflow

rate of 1,840 cfs, a 100-year peak outflow rate of 227 cfs, and a 100-year peak storage volume requirement of 69-acre feet. Outflow from Regional Detention Facility "C" will be routed to proposed Regional Detention Facility "B" in a proposed storm drain to be located in or adjacent to the Briargate Parkway right-of-way.

It was assumed for the purpose of this analysis that the runoff from Sub-basin PS11 will combine with the outflow from Detention Facility "C" before the proposed Briargate Parkway storm drain outfalls into Regional Detention Facility "B". Analysis Point 10 represents this combined flow. The runoff from Sub-basin PS12 is planned to be routed through Detention Facility "B". Regional Detention Facility "B" is planned to have a 100-year peak inflow rate of 506 cfs, a 100-year peak outflow rate of 247 cfs, and a 100-year peak storage volume requirement of 14-acre feet. Outflow from Regional Detention Facility "B" will be routed in a storm drain to a storm drain junction to be located near Analysis Point 11.

At Analysis Point 11 runoff from Sub-basin PS13 is expected to be combined with the outflow from Regional Detention Facility "B". The flow at Analysis Point 11 will then be routed in a storm drain to a storm drain junction at Analysis Point 5A. At Analysis Point 5A this flow will be combined with the flow in the storm drain from the North Fork of Pine Creek (Analysis Point 5). The combined flow will be routed in a storm drain to an outfall in the existing Pine Creek Channel then down the natural channel to Analysis Point 12.

3. Pine Creek Main Channel (Basins PM1 through PM4)

As indicated in the approved "Master Development Drainage Plan for Village Center at Pine Creek and Preliminary/Final Drainage Report for Village Center at Pine Creek Filing No. 2 and Pine Creek Village Center Filing No. 1," by JR Engineering, Ltd., February 1998, the runoff from Sub-basins PM 1 and PM3 will

enter the Pine Creek Channel at or upstream of analysis point 12. The runoff from Sub-basin PM2 will also enter the Pine Creek channel at or just upstream of Analysis Point 12. The estimated peak flow rates at Analysis Point 12 are Q_5 = 408 cfs and Q_{100} = 985 cfs. The combined flow will be routed in the natural Pine Creek channel from Analysis Point 12 to Analysis Point 13 at the east side of Chapel Hills Drive

Runoff from Sub-basin PM4 is planned to outfall into Pine Creek at two locations between Analysis Points 12 and 13. Runoff from Sub-basin PM4 is included in the peak flow rates estimated at Analysis Point 13 of Q_5 = 437 cfs and Q_{100} = 1115 cfs. The combined flow will be routed under Chapel Hills Drive to Analysis Point 19.

4. **Chapel Hills Drive South (Sub-basins CS1 through CS4)**

Analysis Point 16 represents the flow collected in Chapel Hills Drive and the existing South Chapel Hills Drive Storm Drain System located south of the Pine Creek Channel. All or portions of the drainage area contributing to Analysis Point 16 has been included in the "MDDP for Briargate Business Campus," the "MDDP for Village Center at Pine Creek and Preliminary/Final Drainage Report for Village Center at Pine Creek Filing No. 2 and Pine Creek Village Center Filing No. 1," the "Final Drainage Report for Chapel Hills Drive," and or the "Final Drainage Report for Briargate Parkway." This flow will enter the Pine Creek Channel at Analysis Point 19 on the west side of Chapel Hills Drive.

5. **Chapel Hills Drive North (Sub-basins CN1 through CN3)**

Runoff from Sub-basin CN1 will be routed through proposed Regional Detention Facility "A". Regional Detention Facility "A" is planned to have a 100-year peak inflow rate of 275 cfs, a 100-year peak outflow rate of 9 cfs, and a 100-year peak storage volume requirement of 11-acre feet. Outflow from Regional Detention Facility "A" will be routed to Pine Creek Channel in the existing North Chapel Hills Drive Storm Drain System located in the Chapel Hills Drive right-of-way.

Regional Detention Facility "A" has been designed to facilitate park uses as well as serving as a drainage facility. Regional Detention Facility "A" represents a revision to the "MDDP for Charter Greens," dated January 1993, as well as the "Final Drainage Report for Chapel Hills Drive," dated January 1997. Detailed analysis of proposed Regional Detention Facility "A" is provided in the "Preliminary/Final Drainage Report for Park Site at Chapel Hills Drive and Amendment to Final Drainage Report for Chapel Hills Drive," dated December 1997.

Analysis Point 18 represents the flow collected in Chapel Hills Drive and the North Chapel Hills Drive Storm Drain System north of the Pine Creek Channel. This flow includes the outflow from Regional Detention Facility "A" as discussed above. All or portions of the drainage area contributing to Analysis Point 18 have been included in the "MDDP for Charter Greens," dated January 1993, the "Final Drainage Report for Chapel Hills Drive," dated January 1993 and/or the "Preliminary/Final Drainage Report for Park Site at Chapel Hills Drive and Amendment to Final Drainage Report for Chapel Hills Drive," dated December 1997. This flow will enter the Pine Creek Channel just upstream of Analysis Point 19 on the west side of Chapel Hills Drive.

6. **Pine Creek Main Channel (Basins PM5 through PM7)**

Analysis Point 19 represents the total estimated flow from the upstream Pine Creek Channel as well as the flow from Chapel Hills Drive and associated storm drain systems. The peak flow rates in the Pine Creek Channel at Analysis Point 19 are estimated at of Q_5 = 656 cfs and Q_{100} = 1753 cfs. This flow will be routed down the natural Pine Creek Channel to Regional Detention Facility No. 1. Runoff from Sub-basin PM5 will enter the Pine Creek Channel between Analysis Point 19 and Detention Facility No. 1. The flow from Sub-basin PM5 is included with the flow in the Pine Creek Channel at Analysis Point 20. The peak flow rates in the Pine Creek Channel at Analysis Point 20 are estimated at Q_5 = 712 cfs and Q_{100} = 1978 cfs.

Runoff from Sub-basin PM6 is planned to be collected in a future storm drain or storm drains and outfall to the Pine Creek Channel near Regional Detention Facility No. 1. The area included in Sub-basin PM6 was included in the approved "MDDP for Briargate Business Campus," dated October 1996. As discussed elsewhere in this study contrary to the approved MDDP the analysis done for the current study assumed free discharge from this sub-basin. Because some development in the sub-basin has proceeded this study at least some of the constructed outfall lines from the sub-basin may not be adequate to convey free discharge from developing properties. Discharge from future development in the sub-basin should be limited only by fitting within the land use assumptions made for this current study and the availability of an adequate outfall to Pine Creek. Runoff from Sub-basin PM6 is assumed to be included in the flow in Pine Creek Channel at Analysis Point 21. The peak flow rates at Analysis Point 21 are estimated at Q_5 = 797 cfs and Q_{100} = 2149 cfs. This is the total estimated flow to Regional Detention Facility No. 1 from Pine Creek Channel.

Runoff from Sub-basin PM7 is planned to be collected and conveyed to Regional Detention Facility No.1 in a proposed storm drain and open channel system that will originate at the intersection of Highway 83 and Springcrest Road. Free discharge was assumed from the sub-basin. Discharge from future development within the sub-basin should be limited only by fitting within the land use assumptions made for this current study and the availability of an adequate outfall to Regional Detention Facility No. 1.

For the purpose of this analysis it is assumed that all of the runoff from Sub-basin PM8, a portion of the Briargate Parkway right-of-way will be routed through Detention Facility No. 1.

7. **Focus on the Family Storm Drain System (Sub-basins F1 through F7)**

The current study does not propose changes to the drainage criteria implemented with previous plans for this area. Due to the capacity limitations of the outfall

line from this area onsite detention as called for in the "MDDP for Briargate Business Campus," dated October 1996, will remain a requirement for this area. As discussed in Section IV, Part A and this area was included in the current study so that hydrographs for this area could be produced with methodology consistent with the methodology applied to the remainder of the study area. These hydrographs were needed for addition to hydrographs from the remainder of the study area to evaluate the capacity of Regional Detention Facility No. 1 and the total outflow from the study area.

The more conservative hydrology methodology utilized for the current study generated 100-year storm hydrographs from portions of this area that were in excess of the existing downstream storm drain capacity. At Analysis Point 22 the excess flow was assumed to flow out of the Pine Creek Drainage Basin into Cottonwood Creek Drainage Basin. At Analysis Point 24 the excess flow was assumed to be routed on the surface to enter Pine Creek Channel near Analysis Point 27. At Analysis Point 25 the excess flow was assumed to be routed on the surface down Briargate Parkway to enter Pine Creek Channel near Analysis Point 26. Flow within the full pipe capacity of the storm drain system was routed within the HEC 1 model to Regional Detention Facility No. 1. The flow from the Focus on the Family storm drain combined with the flow from Pine Creek (Analysis Point 21) and flow from Sub-basins PM7 and PM8 represents the total planned inflow to Regional Detention Facility No. 1. The existing Regional Detention No. 1 is to be expanded in volume and fitted with a modified outlet structure. Regional Detention Facility No. 1 is planned to have a 100-year peak inflow rate of 2809 cfs, a 100-year peak outflow rate of 1147 cfs, and a 100-year peak storage volume requirement of 96-acre feet. Outflow from Regional Detention Facility No. 1 will be routed under existing Briargate Parkway to Analysis Point 26 in Pine Creek Channel via an existing 12' span by 10' rise concrete box culvert. At Analysis Point 26 the excess flow that was assumed to be routed in the street from Analysis Point 25 will enter Pine Creek Channel. This flow combined with the outflow from Regional Detention Facility No. 1 will

result in peak flow rates estimated at Q_5 = 488 cfs and Q_{100} = 1147 cfs. The combined flow will be routed down the Pine Creek natural channel to Analysis Point 27 on the east side of Highway 83.

8. Pine Creek Main Channel (Basins PM9, PM10, and PM11)

Sub-basins PM9 and PM11 will be allowed free discharge of the 100-year peak rate to Pine Creek through appropriate conveyance and outlet facilities. Free discharge of the 100-year peak rate from these areas is conducive to limiting the 100-year peak discharge in Pine Creek at Highway 83 to less than 1,210 cfs. Free discharge of the 100-year runoff will allow the bulk of the runoff from these areas to pass downstream ahead of significant discharge from upstream Detention Facility No. 1. Detention Facility No. 1 will be modified per this plan to facilitate greater lag of the discharge from the facility than is provided by the existing facility. Due to the proximity of Sub-basins PM9 and PM11 to the discharge point of the DBPS area, limited detention of storm water from these sub-basins may be required in order to mitigate local peak flows from frequent events and or improve storm water quality. The detention requirements will be determined at the time of Final Drainage Report as each sub-basin develops. If facilities to accomplish the above are required they should be designed to not significantly lag the discharge of the larger storms.

Runoff from Sub-basin PM10 is to be controlled to a maximum 100-year peak flow rate of 140 cfs as required by the Final Drainage Report for "Briargate Business Campus Filing No. 13," approved October 31, 1996.

Runoff from Sub-basin PM9 is planned to enter Pine Creek Channel upstream or at Analysis Point 27. The HEC-I Model for this study assumes that runoff from Sub-basin PM10 and PM11 will enter Pine Creek below Analysis Point 27. Analysis Point 28, at the east side of Highway 83 includes the flow from Analysis Point 27 and Sub-basins PM10 and PM11. The model predicts peak flow rates in the Pine Creek Channel at Analysis Point 28 will be Q_5 = 633 cfs, Q_{100} = 1207 cfs. This is the total planned discharge to Pine Creek from the study area.

C. Interim Condition Drainage Plan

Current development projections for the study area call for construction of Regional Detention Facilities "A" Regional Detention Facilities "B" and "E" and their storm drain outfalls to Pine Creek, and Regional Detention Facility "C" without an outfall, and expansion in volume and modifications to the outlet of existing Regional Detention Facility No. 1. in the near future. The interim condition plan demonstrates the need for these facilities and indicates the amount of development that these facilities will support. In the future as plans for development further upstream solidify, additional interim condition planning will be required.

The map titled "Interim Condition Basin Map and Master Plan," contained in the appendix indicates the upstream limits of the land assumed to be fully developed for the interim condition plan. Land located upstream of the indicated limits is considered to be mostly undeveloped in the interim condition plan. Interim condition sub-basins were delineated for the interim condition analysis. The labels for these sub-basins begin with the letter "I". Assumed development in the interim condition basins was limited to the following:

- 12.4-acres of the Powers Boulevard Corridor at 85% impervious area
- 30-acres north of Old Ranch Road at 1 DU/ AC
- 26.5-acres of Basin IPS9 at 4 DU/AC (portion of Sagewood)
- 10-acres of Basin IPS10 at 50% impervious area (YMCA)
- 16-acres of Basin IPS10 at 3 DU/AC (portion of existing Gatehouse Filing No. 5)

1. Pine Creek North Fork (Sub-basins IPN1 through IPN5 and PN9)

Runoff patterns in IPN1 through IPN5 are assumed to remain unchanged from the existing condition. The 100-peak flow rate from these sub-basins in addition to the fully developed condition runoff from Sub-basin PN9 will be concentrated at Analysis Point 4 in the Pine Creek Channel. The 100-year peak flow rates associated with Analysis Point 4 are estimated at Q_5 = 56 cfs and Q_{100} = 355 cfs.

The flow will be routed down the Pine Creek Channel to proposed Regional Detention Facility "E".

2. **Pine Creek North Fork (Sub-basins PN11 through PN13 and all downstream)**

Runoff from fully developed condition PN11 through PN13 will be routed through Regional Detention Facility "E" as described in the fully developed conditional plan. Regional Detention Facility "E" is planned to have a 100-year peak inflow rate of 643 cfs, a 100-year peak outflow rate of 267 cfs, and a 100-year peak storage volume requirement of 19-acre feet. The storage volume requirement for the interim condition is greater than the storage volume requirement in the fully developed condition. Region Detention Facility "E" should be designed to provide the required interim condition storage volume as well as meeting the required outflow criteria for both interim and fully developed conditions.

Downstream the plan is unchanged from the plan presented for the fully developed condition with the exception that peak flow rates in the major facilities are slightly less than for the fully developed condition. Estimated peak flow rates are shown on the "Interim Condition Basin Map and Master Plan."

3. **Pine Creek South Fork (Sub-basins IPS1 through IPS5)**

Runoff patterns in IPS1 through IPS5 are assumed to remain unchanged from the existing condition. Two temporary diversions are proposed to be constructed to direct the runoff generated in these basins to Regional Detention Facility "C". One of these diversions is proposed to be constructed at the lower end of Sub-basin IPS5 as an expansion of an existing small dam. The second diversion is proposed to be constructed at the lower end of Sub-basin IPS2 in or adjacent to the future Briargate Parkway right of way. Runoff from Sub-basins IPS1 and IPS2 will concentrate near Analysis Point I6 as it does in the existing condition. Runoff from Sub-basins IPS3 through IPS5 will concentrate at an existing stock pond near Analysis Point I5. The 100 peak flow rated associated with Analysis

Point I5 are estimated at Q_5 = 39 cfs and Q_{100} = 265 cfs. The proposed berm at this location will provide positive diversion of the flow from Analysis Point I5 through Sub-basin IPS2 to Analysis Point I6. At Analysis Point I6 the estimated peak flow rates are estimated at Q_5 = 55 cfs and Q_{100} = 399 cfs. This flow will enter Regional Detention Facility "C" via a temporary inlet structure and will be combined with developed condition runoff from Sub-basin PS10. Regional Detention Facility "C" is expected to be constructed to meet the fully developed condition storage volume requirements in the "interim condition" but not be fitted with an outlet in the "interim condition." The outfall line from Detention Facility "C" will be constructed prior to paving of the adjacent portion of Briargate Parkway or when predicted runoff exceeds its capacity as a retention pond. Regional Detention Facility "C" is planned to have an interim condition 100-year peak inflow rate of 409 cfs, a 100-year peak outflow rate of 0 cfs, and a 100-year peak storage volume requirement of 42-acre feet.

4. **Pine Creek South Fork (Sub-basins IPS6 through IPS10)**

Runoff patterns in Sub-basins IPS6 through IPS8 are assumed to remain unchanged from the existing condition. Runoff from these Sub-basins will be concentrated at Analysis Point I7 in the future Briargate Parkway right-of-way. Estimated peak flow rates associated with Analysis Point I7 are Q_5 = 8 cfs and Q_{100} = 186 cfs. This flow will follow the historic flow path to Analysis Point I8. At or above Analysis Point I8 it is assumed that the runoff from undeveloped Sub-basin IPS8 and partially developed Sub-basin IPS9 is added to the routed flow from Analysis Point I7. The combined flow at Analysis Point I8 will have estimated peak flow rates of Q_5 = 49 cfs and Q_{100} = 281 cfs. Runoff at Analysis Point I8 will be routed in the natural Pine Creek South Fork Channel to Analysis Point I9. At or near Analysis Point I9 runoff from partially developed Sub-basin IPS10 will enter the Pine Creek South Fork Channel. The combined flow at Analysis Point I9 will have estimated peak flow rates of Q_5 = 99 cfs and Q_{100} = 427 cfs. This compares well to the 100-year historic flow rate of 476 cfs presented for this portion of the watershed in "Amendment No. 1 to the Pine Creek Drainage Basin Planning Study," dated July 29, 1992. The flow at

Analysis Point I9 will be routed down the Pine Creek South Fork Channel to proposed Regional Detention Facility "B".

5. **Pine Creek South Fork (Sub-basins PS11 and PS12 and Downstream)**

Runoff from fully developed condition Sub-basins PS11 and PS12 will be collected and routed through Regional Detention Facility "B" as described in the fully developed condition plan. Regional Detention Facility "B" is planned to have an interim condition 100-year peak inflow rate of 663 cfs, a 100-year peak outflow rate of 266 cfs, and a 100-year peak storage volume requirement of 17-acre feet. The storage volume requirement for the interim condition is greater than the storage volume requirement in the fully developed condition. Region Detention Facility "B" should be designed to provide the required interim condition storage volume as well as meeting the required outflow criteria for both interim and fully developed conditions.

Downstream the plan is unchanged from the plan presented for the fully developed condition with the exception that peak flow rates in the major facilities are slightly less than for the fully developed condition. Estimated peak flow rates are shown on the "Interim Condition Basin Map and Master Plan."

D. Major Proposed Facilities

1. Storm Drains

Estimated required storm drain sizes are indicated on the Maps titled "Basin Map and Master Plan," contained in the appendix of this study. Design of these storm drains should include a detailed hydraulic analysis and sizes should be adjusted as required. Special attention should be given to the hydraulic grade line near the outlets of detention facilities to assure that backwater in the outfall lines will not interfere with the planned stage/discharge relationship.

2. Regional Detention Facilities

a. General Design Criteria

Design and construction of regional detention facilities proposed by this plan shall conform to the requirements of the City of Colorado Springs and the State Engineer. To the extent practical the detention facilities shall be recessed into the ground rather than created behind large unarmored embankments. To the extent practical the detention facilities shall be located on the upstream side of street crossings and shall utilize the roadway embankments as dams. The general design criteria for the detention facilities shall include the following:

The 100-year maximum water surface design elevation shall not exceed the height of the emergency spillway with the normal outlet operating normally.

- Each detention facility shall be fitted with an armored emergency spillway capable of passing the full 100-year peak inflow rate. In the case of Regional Detention Facilities "E" and "F" located downstream of Regional Detention Facility "G" the emergency spillways shall be capable of passing the highest inflow rate associated with the proposed detention facilities located upstream.

- The emergency spillways shall be oriented to direct flow in a manner that will minimize the potential for property damage and threat to human safety downstream if a spill occurs. In the case of Detention Facilities "E", "F and "G" the emergency spillways should be oriented to pass overflow to downstream Pine Creek Channel. Sufficient capacity should be maintained in the Pine Creek Channel to allow the design overflow to pass without damage to structures. In the case of Detention Facilities "B", "C" and "D" the emergency spillways should be oriented to pass overflow to the adjacent Briargate Parkway right-of-way. The potential for a large

flow to occur down Briargate Parkway should be considered in the design of the roadway and adjacent development.

- At least 2 feet of freeboard shall be provided above the water surface associated with the normal outlet clogged and the emergency spillway passing the full 100-year peak inflow rate.

b. Plan Assumptions for Individual Regional Detention Facilities

The following assumptions were utilized in the hydrologic modeling performed in the preparation of the plan. If the final design of these detention facilities deviates from these assumptions the changes should be modeled in the overall study done for this plan to verify that the changes do not negatively impact downstream facilities or planned peak flow rates downstream.

- **Regional Detention Facility No. 1**

The modeled volume was based on the contours shown on the FIMs Topographic Map with 0.65 acre of surface area added. The proposed expansion will result in a storage volume increase of approximately 11.5-acre feet below elevation 6578.0. Modeled outflow was based on a modified outlet structure instead of the existing outlet. The modeled outlet consists of a staged outlet. The lowest opening was assumed to consist of the bottom 2.5' of the existing box culvert. The remainder of the upstream end of the existing box culvert was assumed to be blocked. The upper opening of the assumed outlet was assumed to be a sharp crested weir with a crest elevation of 6567.2. The upper opening weir length was assumed to be equal to 12.77' (the skewed width of the CBC) adjusted for edge contractions. It is assumed that the upper opening will discharge into the existing box culvert. It is assumed that the upper opening will be created with construction of a three-sided structure on top of or a reconstructed portion of the existing CBC. The three-sides were assumed to terminate at elevation 6573.0 to allow flow over all walls of the structure above the terminal elevation.

The HEC-1 Model predicts a maximum 100-year water surface elevation of 6573.1 in the 100-year design storm. This maximum water surface is 1.9 lower than the existing emergency spillway crest for the facility.

MODIFIED DETENTION FACILITY NO.1

Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Outflow (cfs)
54	0	0
56	0.38	194
58	4.93	275
60	14.99	344
62	25.74	401
64	37.09	451
66	49.05	496
68	61.62	560
70	74.83	747
72	88.75	998
74	103.43	1,247
75	111.06	1,750

Normal Outlet Staged

Low Stage: 12.77' Wide X 2.50' High Vertical Orifice, Invert = 6553.00
High Stage: 12.77' Wide Weir, Invert = 6567.20

- **Regional Detention Facility "A"**
  The stage storage discharge curve is based on the design drawings for the proposed facility. The bottom of the pond is staged in order to maintain certain portions of the pond bottom dry in frequent rainfall events in order to facilitate park uses.

DETENTION FACILITY "A"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Outflow (cfs)
796.6	0	2.35
797.0	0.01	2.54
798.0	0.22	3.00
800.00	0.99	3.73
802.0	1.95	4.35
803.5	2.80	4.75
803.51	4.25	5.36
804.0	5.31	5.50
804.1	6.51	8.39
805.5	11.64	9.01
806.5	15.36	9.41

Normal Outlet: 12" dia storm drain
Normal Outlet Invert Elevation: 95.0

- **Regional Detention Facility "B"**
  The modeled volume was based on a preliminary grading plan prepared for the facility. In order to facilitate obtaining a flood plain development permit to construct the facility it is planned to have a maximum 100-year water surface that is below the FEMA base flood elevation and is mostly contained within the FEMA regulatory 100-year floodplain. The requirements associated with facilitating construction in the FEMA Regulatory Floodplain have resulted in a design that will produce peak 100-year water surface elevations well below the emergency spillway crest in the fully developed condition with upstream detention facilities in place.

DETENTION FACILITY "B"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
71.2	0	0
72.0	0.06	22
74	0.17	73
76	3.30	130
78	5.82	169
80	8.73	202
82	12.07	236
84	15.85	260
86	20.07	285
87.6	23.60	301
88	24.76	371
90	29.96	1222

Normal Outlet: 54" dia storm drain
Normal Outlet Invert Elevation: 70.2

- **Regional Detention Facility "C"**

DETENTION FACILITY "C"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
62	0	0
64	2.73	23
66	9.72	70
68	18.56	110
70	20.03	140
72	38.15	168
74	48.95	190
76	60.45	215
78	72.75	232
80	85.85	245
82	99.66	258

Normal Outlet: 48" dia storm drain
Normal Outlet Invert Elevation: 62.0

- **Regional Detention Facility "D"**

DETENTION FACILITY "D"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
100	0	0
102	6.8	18
104	14.3	54
106	22.4	72
108	31.1	87
110	40.6	99
112	50.8	110
114	61.8	120

Normal Outlet: 36" dia storm drain
Normal Outlet Invert Elevation: 100.0

- **Regional Detention Facility "E"**

DETENTION FACILITY "E"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
84	0	0
86	0	25
88	1.25	80
90	3.91	136
92	6.93	173
94	10.31	210
96	14.07	240
98	18.24	263
100	22.83	280
102	27.87	1431

Normal Outlet: 54" dia storm drain
Normal Outlet Invert Elevation: 84.0

- **Regional Detention Facility "F"**

DETENTION FACILITY "F"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
90	0	0
92	0	22
94	0.1	70
96	0.7	112
98	1.5	143
100	4.4	170
102	7.8	190
104	11.7	210
106	16.1	230
108	21.0	250
110	26.4	265

Normal Outlet: 48" dia storm drain
Normal Outlet Invert Elevation: 90.0

- **Regional Detention Facility "G"**
  The normal outlet was modeled based on a 48" diameter storm drain. A 10' by 10' box culvert to be constructed under future Powers Boulevard with a weir box on the upstream end has been evaluated as a means to carry the pond outflow from the 48" diameter normal outlet as well as providing an emergency spillway. Due to the large vertical distance between the likely grade of Powers Boulevard and the Pine Creek Channel on the downstream side of the crossing the cost of armoring the downstream embankment slope will likely offset the cost of constructing a box culvert.

DETENTION FACILITY "G"
Stage Storage Discharge Data

Water Surface Elevation (Feet)	Cumulative Storage Volume (AC/FT)	Normal Outlet Discharge (cfs)
59	0	0
60	0.1	10
62	2.8	47
64	8.0	93
66	14.1	130
68	20.9	160
70	28.4	180
72	36.6	203
74	45.5	222
76	55.11	240
78	65.3	262
80	76.3	280
82	88.2	295

Normal Outlet: 48" dia storm drain
Normal Outlet Invert Elevation: 59.0

c. Regional Detention Facility Maintenance

The eight Regional Detention Facilities proposed in this document are all proposed to be publicly owned and publicly maintained for functional purposes. Any aesthetic maintenance beyond the City's maintenance will be by and totally at the expense of others and will require an agreement with the City.

3. Pine Creek Channel

a. General

As discussed elsewhere in this report the character of the Pine Creek Channel varies considerably throughout the study area. Portions of the channel are well defined, well vegetated, and are aligned in a manner that allows reasonable development of adjacent land. Other portions are not well defined, lack significant vegetation, lack adequate conveyance capacity, and or are not aligned in a manner that allows reasonable development of adjacent properties. The plan for the majority of Pine Creek Channel between Powers Boulevard and Highway 83 is to preserve it at as a natural channel or a natural channel with some man made stabilization that will serve as the major drainage conveyance. In other portions of the study area storm drains will serve as the major drainage conveyances and the natural channel will be eliminated.

The following is a brief discussion of Pine Creek Channel reaches PC1 through PC7 as shown on the maps titled "Basin Map and Master Plan," contained in the appendix of this report.

- **Reach PC1**

Treatments proposed in past studies for this reach have included replacing the natural channel with a closed conduit. Due to current concerns about the Prebles Meadow Jumping Mouse, it is likely the channel will be required to be preserved in its natural condition with or without some man made stabilization. Further analysis to demonstrate the adequacy of the natural channel or proposed treatment and potentially an agreement between the developer of the property and the City will be required in the future when the desired treatment is known.

- **Reaches PC2 and PC3**

These two reaches are well vegetated and appear to be quite stable at the current time. It is expected that treatment in these reaches will be limited to energy dissipaters at the outfalls of storm drains contributing to the channel and potentially minor bank and channel stabilization. The current plan is for LP47,L.L.C. dba La Plata Investments to maintain ownership of the channel and to be responsible for

maintenance of the same, excepting the public street crossings. A detailed Hydraulic Analysis and Report has been prepared for Reach PC2 ("Pine Creek Channel-Phase 2," dated February 1997). La Plata is currently working to complete a maintenance agreement with the City for Reach PC2. A detailed Hydraulic Analysis of Reach PC3 will be required in the future as well as a maintenance agreement with the City of Colorado Springs.

- **Reach PC4**

  This reach is contained in a valley floor alluvial fan and is characterized by multiple, ill-defined flow paths lacking significant vegetation, natural stability, and adequate conveyance capacity. Due to this an underground storm drain is proposed to provide conveyance of runoff up to the 100-year planned discharge through this reach. It is also proposed that the corridor that the land above the proposed storm drain be graded into a broad swale recessed below the adjacent development. This swale will provide an emergency relief channel for the storm drain and the detention facilities that will be constructed upstream. In keeping with the proposed design criteria for the proposed detention facilities, the swale should be designed to allow passage of the largest peak 100-year inflow rate of the facilities to be located upstream. The proposed swale will also maintain continuity of the greenway or openspace that will occur along the upstream and downstream reaches of Pine Creek Channel. It is expected that the City of Colorado Springs will be responsible for the maintenance of the proposed storm drain.

- **Reaches PC5 through PC6**

  These reaches are generally well defined and contain some natural vegetation to aid in their stability. However, given the relatively steep natural slopes of these reaches and the lack of heavy vegetation it is anticipated that these reaches will require construction of grade control and potentially some spot armoring of banks in order to allow them to convey developed condition flows. The current plan proposes 100-year peak flow rates in these reaches that are similar or lower than historic 100-year flow rates. However, peak flow rates in smaller more frequent events will be increased and the frequency of flows in the channel will be much greater that in the existing condition when the contributing watershed is developed. Development of the

watershed will also reduce the sediment inflow into the channel. These factors will increase the potential for erosion of the channel. Detailed hydraulic analysis of the channel and the proposed treatment will be provided prior to significant development of areas contributing to these reaches. At the current time, with concerns about the Prebles Meadow Jumping Mouse, it is unknown what type of treatment will be allowed in the channel.

4. Proposed Drainage Discharge Constraints

The following discharge constraints are proposed for the study area:

a. The requirement for onsite detention to achieve a 35 percent reduction in the peak flow rate resulting from development (the difference between the historic and developed peak rates) on all office, research and development, commercial, and school properties as implemented with the original DB.P.S. will remain in effect for all existing developed properties and for future developing properties within Basins CS2, CS3, F1, F4, F5, F6, F7, PM6 and PM10 as shown on the Fully Developed Condition Drainage Map included in this study unless the following conditions are met.

- A separate detailed drainage analysis or the analysis done for this study demonstrates that the downstream existing or proposed drainage conveyance facilities are adequate to allow a greater discharge rate from the property.
- A detailed drainage analysis or the analysis performed for this study demonstrates that the greater discharge rate will not negatively impact downstream detention facilities or the overall discharge peak discharge goals of this study.

b. Runoff from Basin CS4 as shown on the Fully Developed Condition Drainage Map included in this study shall be routed through a common offsite private detention pond as proposed in the approved "Master Development Drainage Plan

for Village Center at Pine Creek and Preliminary /Final Drainage Report for Village Center at Pine Creek Filing No. 2 and Pine Creek Village Center Filing No. 1," by JR Engineering, Ltd., dated February 11,1998 unless the following conditions are met:

- A detailed drainage analysis demonstrates that the downstream existing or proposed drainage conveyance facilities are adequate to allow a greater discharge rate from the drainage basin.
- A separate detailed drainage analysis or the analysis performed for this study demonstrates that the greater discharge rate will not negatively impact downstream detention facilities or the overall discharge peak discharge goals of this study.

c. Free discharge of the 100-year runoff from Sub-basins PM9 and PM11 will be allowed provided that the following criteria is followed:

- Adequate downstream conveyance facilities exist or be provided in accordance with City of Colorado Springs policy and criteria.
- Land uses must be similar or less intensive than the land uses assumed for the purpose of this study unless a detailed drainage analysis indicates that free discharge from the more intensive land use will not have an adverse affect on the downstream drainage facilities.

Due to the proximity of Sub-basins PM9 and PM11 to the discharge point of the DBPS area, limited detention of storm water from these sub-basins may be required in order to mitigate local peak rates from frequent runoff events and or improve the storm water quality. The detention requirement will be determined at the time of Final Drainage Report as each sub-basin develops. If facilities to accomplish the above are required, they should be designed to not significantly lag the discharge of the larger storms.

d. Free discharge of drainage from the remainder of the study area will be allowed provided that the following criteria is followed:

- Adequate down stream conveyance facilities must exist or be provided in accordance with City of Colorado Springs policy and criteria.
- Runoff must be routed through the regional detention facilities as proposed in this study unless a detailed drainage study demonstrates the adequacy of alternative routing to achieve the discharge goals of this study.
- Land uses must be similar or less intensive than the land uses assumed for the purpose of this study unless a detailed drainage analysis indicates that free discharge from the more intensive land use will not have an adverse affect on the downstream drainage facilities.

5. Recommendations for Implementation

The portion of the Pine Creek drainage basin located east of Highway 83 is considered a closed basin thus, the developer of the properties within the basin is responsible for constructing the drainage improvements related to development within the basin. Construction of required drainage improvements should be timed to coincide with or precede construction of the development that the improvement will support. Several major proposed facilities have been identified in the interim drainage plan included in this study. A summary of these major proposed facilities and the development that the improvements will be required for follows:

- Regional Detention Facility "A" and the associated inflow collection system will be required to support future development in Sub-basin CN1
- Regional Detention Facilities "B" and "E", their proposed outfall storms drains to Pine Creek and collection systems in the developing area will be required to support development in Sub-basins PN9, PN11 through PN15 and PS10 through PS13.
- Regional Detention Facility "C" (constructed to serve, as a temporary retention facility) will be required to support development in Sub-basins PN9, PN11 through PN15 and PS10 through PS13.

    - It should be noted that the requirement for construction of Regional Detention Facilities "B" and "C" to support development in Sub-basins PN9 through PN15 and PS10 through PS13 is related in part to the need to eliminate the

FEMA 100-year flood zone that Briargate Parkway must cross to support development in this area.

- La Plata Investments plans to construct the proposed modifications to existing Regional Detention Facility No. 1 prior to May 1999. Construction of the modifications in this time frame is contingent upon timely receipt of the required permits and approvals.

- Pine Creek Channel Stabilization in Reach PC5 as determined by future analysis will be required to support development in Sub-basin PN9. Development in Sub-basin PN 11 will not contribute significant runoff to the channel and thus will not create an immediate need for improvements in Reach PC5.

- Additional storm drains shall be constructed as needed to provide collection systems and outfalls for individual development or prior to pavement construction in the roadways they are planned to be located in.

- Prior to development extending beyond the areas considered to be developed in the interim drainage plan, a revised interim plan should be prepared to identify the drainage facilities required to support additional development.

6. Requirements of Governmental Agencies

Outside of the City of Colorado Springs

Several governmental agencies external to the City of Colorado Springs will have involvement in the review and approval process for individual construction projects proposed for the study area.

- The Federal Emergency Management Agency has jurisdiction over development within the regulatory 100-year floodplain. The developer will be required to obtain Letter of Map Revisions for modifications that the proposed development will make to the floodplain within the study area.

- The U.S. Army Corps of Engineers has jurisdiction over development within or modifications to features defined as "waters of the United States." Some or potentially all of the modifications proposed to the Pine Creek Channel may require permitting by the U.S. Army Corps of Engineers.

- The Prebles Meadow Jumping Mouse is currently listed as a threatened species by the U.S. Fish and Wildlife Service. Portions of the study area may contain habitat for the mouse. Due to this, some or all of the proposed projects may be subject to review by local, state, and/or Federal agencies in regards to potential impacts on the mouse.

- The office of the State Engineer has jurisdiction over many of the dams in the State. Depending upon final design, configurations of the proposed Regional Detention Facilities some may be "Jurisdictional Dams," and may be "exempt" or "nonexempt" from the rules of the State Engineer. Facilities should be evaluated on an individual basis at the time of design.

REFERENCES

1. "City of Colorado Springs/County of El Paso Drainage Criteria Manual," dated November 1991.

2. Soils Survey of El Paso County Area, Colorado Soil Conservation Service.

3. "Pine Creek Drainage Basin Planning Study," by Obering, Wurth & Associated, dated June 1988, revised October 1988.

4. "Amendment No. 1 to Pine Creek Drainage Basin Planning Study," by Obering, Wurth & Associated, dated July 29,1992.

5. "Master Development Drainage Plan for Briargate Business Campus in Pine Creek Basin," by JR Engineering, Ltd., dated October 1996.

6. "Master Development Drainage Plan for Summerfield at Briargate," by JR Engineering, Ltd., dated March 1993.

7. "Master Development Drainage Plan for Charter Greens," by JR Engineering, Ltd., dated November 1992, revised January 1993.

8. "Master Development Drainage Plan for Village Center at Pine Creek and Preliminary/Final Drainage Report for Village Center at Pine Creek Filing No.2 and Pine Creek Village Center Filing No.1," by JR Engineering, Ltd., dated February 1998

9. "Preliminary/Final Drainage Report for Park Site at Chapel Hills Drive and Amendment to Final Drainage Report for Chapel Hills Drive," by JR Engineering, Ltd., dated December 1997 (not yet approved).

10. "Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas," Federal Emergency Management Agency, revised March 17, 1997.

11. "Master Plan, Pine Creek at Briargate," by Downing Thorpe James, drafts dated August 1, 1997.

12. "Gatehouse Neighborhood Plan," by N.E.S. Inc., dated April 1997.

13. "Summerfield Neighborhood Plan," by N.E.S. Inc., dated April 1997.

14. "Johnson Ranch Neighborhood Plan," by N.E.S. Inc., dated April 1997.

15. "Briargate Business Campus," a Land Use Plan, by N.E.S. Inc., dated April 1997.

16. "Final Drainage Report for Pine Creek Channel-Phase I, (from Pond No. 1 to Chapel Hills Drive)," by JR Engineering, Ltd., dated February 1997 (not yet approved).

17. "HEC-1 Flood Hydrographic Package Users Manual," U.S. Army Corps of Engineers, dated September 1990.

APPENDIX

VICINITY MAP

HYDROLOGIC MODEL INPUT CALCULATIONS

- Curve Numbers
- Curve Number Adjustment
- Lag Time

HYDROLOGIC MODEL (HEC-1) OUTPUT

FULLY DEVELOPED CONDITION

- 5-Year Storm
- 100-Year Storm

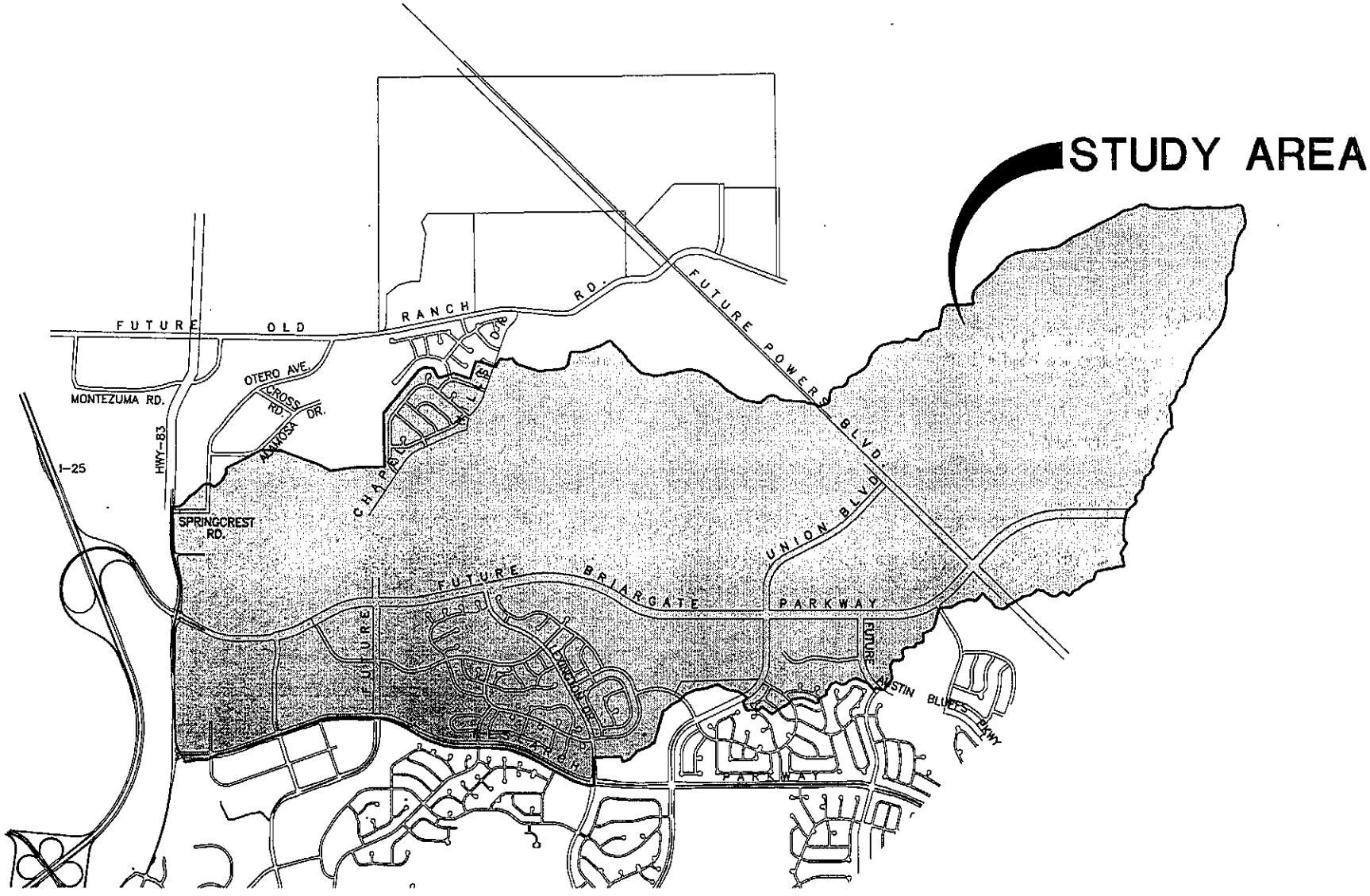
INTERIM CONDITION

- 5-Year Storm
- 100-Year Storm

MAPS (FOLDED IN POCKETS)

- FULLY DEVELOPED CONDITION BASIN MAP AND MASTER PLAN
- INTERIM CONDITION BASIN MAP AND MASTER PLAN
- F.E.M.A. 100-YEAR FLOOD FACILITY MAP
- SUBDIVISION AND LAND USE IDENTIFICATION MAP
  EXISTING DRAINAGE FACILITIES MAP

VICINITY MAP



VICINITY MAP
1" = 3000'

HYDROLOGIC MODEL INPUT CALCULATIONS

- CURVE NUMBERS
- CURVE NUMBER ADJUSTMENT
- LAG TIME

AMMENDMENT No. 2 TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

FULLY DEVELOPED CONDITION CURVE NUMBERS

5/5/98

	SUB AREA ONE				SUB AREA TWO				SUB AREA THREE				SUB AREA FOUR				SUB AREA FIVE							
SUB-BASIN LABEL	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	TOTAL AREA AC.	TOTAL AREA S.M.	WEIGHTED CN	WEIGHTED PERCENT INPERVIOUS
CN1	SCHOOL	50.0	84.0	27.0	3 DU/AC	30.0	72.0	23.0	4 DU/AC	40.0	76.0	22.0	M.A. STREET	85.0	93.0	6.0	GOLF/ PARK		64.0	15.0	93.0	0.145	76.5	36.9
CN2	3 DU/AC	30.0	72.0	47.0	M.A. STREET	85.0	93.0	3.0													50.0	0.078	73.3	33.3
CN3	3 DU/AC	30.0	72.0	13.0	5 DU/AC	44.0	77.0	9.5	M.A. STREET	85.0	93.0	5.0									27.5	0.043	77.5	44.8
CS1	SCHL/LNDSCP	20.0	68.0	11.0	3 DU/AC	30.0	72.0	19.6	PARK	10.0	65.0	3.3									33.9	0.053	70.0	24.8
CS2	OPEN SPC.		69.0	1.5	3-4 DU/AC	33.0	73.0	2.0	LI/O	83.0	92.0	39.0	M.A. STREET	85.0	93.0	2.5					45.0	0.070	90.4	78.1
CS3	OPEN SPC.		69.0	2.9	3 DU/AC	30.0	72.0	8.2	LI/O	83.0	92.0	9.0	M.A. STREET	85.0	93.0	12.7	COM	95.0	96.0	1.2	34.0	0.053	85.7	64.3
CS4	COM.	95.0	96.0	12.3	6 DU/AC	56.0	82.0	8.2	OPEN SPC		69.0	1.6	10-16 DU/AC	70.0	87.0	12.1					34.2	0.053	88.2	72.4
F1	COM	62.0	84.0	16.0	SCHOOL	40.0	76.0	4.5	4 DU/AC	37.0	76.0	50.5	WATER TNK	68.0	86.0	5.0					76.0	0.119	78.3	44.5
F2	3 DU/AC	30.0	72.0	20.0	OPEN SPC		69.0	5.0													25.0	0.039	71.4	24.0
F3	3 DU/AC	30.0	72.0	60.0	M.A. STREET	85.0	93.0	8.5	CHURCH	80.0	91.0	4.5									73.0	0.114	75.6	39.5
F4	LI/O	65.0	85.0	11.5	OPEN SPC		69.0	3.5	M.A. STREET	85.0	93.0	7.5	3 DU/AC	30.0	72.0	2.0					24.5	0.038	84.1	59.0
F5	LI/O	83.0	92.0	35.0	M.A. STREET	85.0	93.0	6.0													41.0	0.064	92.1	83.3
F6	LI/O	83.0	92.0	21.5	M.A. STREET	85.0	93.0	3.0													24.5	0.038	92.1	83.2
F7	LI/O	83.0	92.0	29.0	M.A. STREET	85.0	93.0	4.5													33.5	0.052	92.1	83.3
PM1	SCHOOL	50.0	84.0	25.0	3 DU/AC	30.0	72.0	9.5													34.5	0.054	80.7	44.5
PM2	GOLF CRS		61.0	92.8	3DU/AC	30.0	72.0	5.8													98.6	0.154	61.6	1.8
PM3	MULTI FAM.	70.0	87.0	15.6	3 DU/AC	30.0	72.0	1.1	OPEN SPC		69.0	26.3									43.0	0.067	75.6	26.2
PM4	GOLF CRS		61.0	26.4	3 DU/AC	30.0	72.0	44.5													70.9	0.111	67.9	18.8
PM5	GOLF CRS		61.0	49.0	2 DU/AC	25.0	70.0	59.0	OPEN SPC		69.0	9.0									117.0	0.183	66.2	12.6
PM6	COM	95.0	96.0	14.5	LI/OF	83.0	92.0	42.0													56.5	0.088	93.0	86.1
PM7	CHURCH	80.0	91.0	15.9	SCHOOL	50.0	84.0	9.9	1 DU/AC	20.0	68.0	53.7	LI/O	83.0	92.0	8.5					88.0	0.138	76.3	40.3
PM8	M.A. STREET	85.0	93.0	8.7																	8.7	0.014	93.0	85.0
PM9	OPEN SPC.		69.0	8.5	COM	95.0	96.0	35.0													43.5	0.068	90.7	76.4
PM10	LI/O	83.0	92.0	31.0																	31.0	0.048	92.0	83.0
PM11	LI/O	83.0	92.0	17.0	M.A. STREET	85.0	93.0	10.0													27.0	0.042	92.4	83.7
PN1	UNKNOWN	45.0	77.0	95.5	COM.	95.0	96.0	6.0	M.A. STREET	85.0	93.0	3.5									105.0	0.164	78.6	49.2
PN2	UNKNOWN	45.0	77.0	95.4																	95.4	0.149	77.0	45.0
PN3	2-6 DU/AC	44.0	77.0	12.2	6-12 DU/AC	70.0	87.0	12.2	LI / O	83.0	92.0	19.5	M.A. STREET	85.0	93.0	9.0					52.9	0.083	87.6	71.3
PN4	UNKNOWN	45.0	77.0	15.0	0-2 DU/AC	25.0	68.0	11.0	2-6 DU/AC	44.0	77.0	41.0	SCHOOL	50.0	84.0	6.0					73.0	0.114	76.2	41.8
PN5	LI / O	83.0	92.0	33.0	2-6 DU/AC	44.0	77.0	14.3													47.3	0.074	87.5	71.2
PN6	COM.	95.0	96.0	58.0	M.A. STREET	85.0	93.0	19.0	LI /O	83.0	92.0	8.6	OPEN SPC.		69.0	7.5					93.1	0.146	92.8	84.2
PN7	3 DU/AC	30.0	72.0	41.0	5 DU/AC	44.0	77.0	3.5	PARK		65.0	2.7	OPEN SPC.		69.0	2.5					49.7	0.078	71.8	27.8
PN8	5 DU/AC	44.0	77.0	31.9	6 DU/AC	56.0	82.0	21.0	OPEN SPC.		69.0	8.3	COMMERCIAL	95.0	96.0	11.3					72.5	0.113	80.5	50.4
PN9	3 DU/AC	30.0	72.0	15.8	PARK		65.0	4.0	OPEN SPC.		69.0	3.3									23.1	0.036	70.4	20.5
PN10	3DU/AC	30.0	72.0	1.3	5 DU/AC	44.0	77.0	11.5	OPEN SPC.		69.0	14.5									27.3	0.043	72.5	20.0
PN11	SCHOOL	50.0	84.0	16.1	3 DU/AC	30.0	72.0	34.3													50.4	0.079	75.8	36.4
PN12	3DU/AC	30.0	72.0	2.5	5 DU/AC	44.0	77.0	1.1	OPEN SPC.		69.0	21.1									24.7	0.039	69.7	5.0
PN13	GOLF CRS		61.0	20.9	5 DU/AC	44.0	77.0	20.0	2 DU/AC	25.0	70.0	8.2	3DU/AC	30.0	72.0	32.0					81.1	0.127	70.2	25.2
PN14	2 DU/AC	25.0	68.0	17.5																	17.5	0.027	68.0	25.0
PN15	3 DU/AC	30.0	72.0	35.4	OPEN SPC.		69.0	11.7													47.1	0.074	71.3	22.5
PS1	2-6 DU/AC	44.0	77.0	81.2	SCHOOL	50.0	84.0	15.0													96.2	0.150	78.1	44.9
PS2	6-12 DU/AC	70.0	87.0	33.0	12-18 DU/AC	70.0	87.0	7.5	LI /O	83.0	92.0	46.8	OPEN SPC.		69.0	11.0					98.3	0.154	87.4	68.4
PS3	2-6 DU/AC	44.0	72.0	10.0	6-18 DU/AC	70.0	87.0	68.5	GOV	50.0	84.0	6.0	M.A. STREET	85.0	93.0	7.4	LI / O	83.0	88.0	11.7	103.6	0.162	85.9	68.9
PS4	LI /O	83.0	92.0	25.0	M.A. STREET	85.0	93.0	9.8													34.8	0.054	92.3	83.6
PS5	COM.	95.0	96.0	36.5	M.A. STREET	85.0	93.0	5.5													42.0	0.066	95.6	93.7
PS6	LI / O	83.0	92.0	8.0	M.A. STREET	85.0	93.0	10.0	2-6 DU/AC	44.0	77.0	30.0									48.0	0.075	82.8	59.0
PS7	LI / O	83.0	92.0	39.0	COM.	95	96	18													57.0	0.089	93.3	86.8
PS8	COM.	95.0	96.0	6.0	YMCA	50.0	84.0	10.0	2-12 DU/AC	61.0	80.0	50.0	OPEN SPC.		69.0	7.0	M.A. STREET	85.0	93.0	5.3	78.3	0.122	81.6	58.4
PS9	LI / O	83.0	92.0	55.2	M.A. STREET	85.0	93.0	9.6	COM.	95.0	96.0	17.0									81.8	0.128	92.9	85.7
PS10	4 DU/AC	37.0	76.0	13.5	OPEN SPC.		69.0	10.9													24.4	0.038	72.9	20.5
PS11	4DU/AC	30.0	72.0	23.6	M.A. STREET	85.0	93.0	12.1													35.7	0.056	79.1	48.6
PS12	PARK/O.S.		67.0	82.2	4 DU / AC	37.0	76.0	3.0	SCHOOL	50.0	84.0	6.0	LI/O	83.0	92.0	6.8					98.0	0.153	70.0	9.9
PS13	3 DU/ AC	30.0	72.0	7.1	PARK/ OS		67.0	25.0	M.A. STREET	85.0	93.0	9.8									41.9	0.065	73.9	25.0
																			TOTAL		2934.0	4.584		

AMMENDMENT No. 2 TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

FULLY DEVELOPED CONDITION OUTPUT SUMMARY AND CURVE NUMBER ADJUSTMENT

5/5/98

TYPE IIa 24HR STRM @3 MIN. TIME STEP

									HEC1 MODEL					RATIONAL METHOD	COMPUTED HEC1 VS. RATIONAL	ADJUSTED HEC1 VS. RATIONAL
									W/ COMPUTED CN		W/ ADJUSTED CN					
SUB BASIN I.D.	AREA (sq miles)	AREA (acres)	IMPERVIOUS PERCENT	COMPUTED CN	ADJUSTED CN	COMPUTED C100	TC (min)	LAG (hours)	Q100 (cfs)	Q100/ACRE (cfs)	Q100 (cfs)	Q100/ACRE (cfs)	I100 (in/hr)	Q100 (cfs/AC)	PERCENT	PERCENT
CN1	0.145	93.0	36.9	76.5	76.8	0.57	19.00	0.19	272	2.92	275	2.96	5.23	2.99	-2	-1
CN2	0.078	50.0	33.3	73.3	75.5	0.55	21.40	0.21	124	2.48	136	2.72	4.91	2.70	-9	1
CN3	0.043	27.5	44.8	77.5	80.0	0.62	15.70	0.16	90	3.27	98	3.56	5.76	3.57	-9	0
CS1	0.053	33.9	24.8	70.0	73.6	0.50	18.10	0.18	77	2.27	90	2.65	5.36	2.67	-18	-1
CS2	0.070	45.0	78.1	90.4	98.0	0.82	10.10	0.10	229	5.09	254	5.64	7.04	5.77	-13	-2
CS3	0.053	34.0	64.3	85.7	84.8	0.74	17.70	0.18	140	4.12	137	4.03	5.42	3.99	3	1
CS4	0.053	34.2	72.4	88.2	95.5	0.78	10.10	0.10	165	4.82	188	5.50	7.04	5.52	-14	0
F1	0.119	76.0	44.5	78.3	78.3	0.62	20.80	0.21	233	3.07	233	3.07	4.98	3.07	0	0
F2	0.039	25.0	24.0	71.4	74.0	0.49	17.10	0.17	62	2.48	69	2.76	5.52	2.73	-10	1
F3	0.114	73.0	39.5	75.6	77.0	0.59	21.50	0.22	199	2.73	210	2.88	4.89	2.87	-5	0
F4	0.038	24.5	59.0	84.1	83.0	0.70	19.70	0.20	92	3.76	89	3.63	5.13	3.61	4	1
F5	0.064	41.0	83.3	92.1	95.5	0.85	12.10	0.12	212	5.17	225	5.49	6.51	5.54	-7	-1
F6	0.038	24.5	83.2	92.1	98.0	0.85	10.60	0.11	128	5.22	138	5.63	6.90	5.86	-12	-4
F7	0.052	33.5	83.3	92.1	93.0	0.85	13.70	0.14	170	5.07	173	5.16	6.15	5.23	-3	-1
PM1	0.054	34.5	44.5	80.7	78.5	0.62	20.30	0.20	109	3.16	107	3.10	5.05	3.11	1	0
PM2	0.154	98.6	1.8	61.6	66.0	0.36	31.01	0.31	102	1.03	139	1.41	3.97	1.43	-38	-2
PM3	0.067	43.0	26.2	75.6	73.5	0.51	24.80	0.25	108	2.51	99	2.30	4.52	2.29	9	0
PM4	0.111	70.9	18.8	67.9	71.9	0.46	17.00	0.17	149	2.10	180	2.54	5.54	2.56	-22	-1
PM5	0.183	117.0	12.6	66.2	70.0	0.43	18.50	0.19	221	1.89	265	2.26	5.30	2.26	-19	0
PM6	0.088	56.5	86.1	93.0	98.0	0.87	11.00	0.11	300	5.31	319	5.65	6.79	5.89	-11	-4
PM7	0.138	88.0	40.3	76.3	76.3	0.59	35.31	0.35	191	2.17	191	2.17	3.67	2.17	0	0
PM8	0.014	8.7	85.0	93.0	98.0	0.86	10.00	0.10	48	5.52	51	5.86	7.07	6.08	-10	-4
PM9	0.068	43.5	76.4	90.7	93.0	0.81	12.00	0.12	220	5.06	230	5.29	6.54	5.29	-5	0
PM10	0.048	31.0	83.0	92.0	98.0	0.85	10.00	0.10	163	5.26	175	5.65	7.07	6.00	-14	-6
PM11	0.042	27.0	83.7	92.4	98.0	0.85	10.00	0.10	139	5.15	149	5.52	7.07	6.03	-17	-9
PN1	0.164	105.0	49.2	78.6	80.2	0.65	18.80	0.19	335	3.19	355	3.38	5.26	3.39	-6	0
PN2	0.149	95.4	45.0	77.0	79.0	0.62	19.20	0.19	284	2.98	306	3.21	5.20	3.22	-8	-1
PN3	0.083	52.9	71.3	87.6	85.8	0.78	19.60	0.20	225	4.25	213	4.03	5.14	4.00	6	1
PN4	0.114	73.0	41.8	76.2	78.5	0.60	18.50	0.19	213	2.92	234	3.21	5.30	3.19	-9	1
PN5	0.074	47.3	71.2	87.5	86.2	0.78	17.50	0.18	207	4.38	199	4.21	5.46	4.24	3	-1
PN6	0.146	93.1	84.2	92.8	95.0	0.85	12.70	0.13	432	4.64	507	5.44	6.37	5.45	-17	0
PN7	0.078	49.7	27.8	71.8	74.6	0.52	16.50	0.17	128	2.58	144	2.90	5.62	2.91	-13	0
PN8	0.113	72.5	50.4	80.5	80.9	0.65	17.60	0.18	254	3.50	257	3.54	5.44	3.55	-1	0
PN9	0.036	23.1	20.5	70.4	72.8	0.47	17.00	0.17	55	2.38	61	2.64	5.54	2.62	-10	1
PN10	0.043	27.3	20.0	72.5	72.7	0.47	14.10	0.14	77	2.82	78	2.86	6.07	2.85	-1	0
PN11	0.079	50.4	36.4	75.8	76.7	0.57	18.90	0.19	145	2.88	150	2.98	5.24	2.98	-4	0
PN12	0.039	24.7	5.0	69.7	68.2	0.38	12.90	0.13	64	2.59	60	2.43	6.33	2.40	7	1
PN13	0.127	81.1	25.2	70.2	74.0	0.50	19.50	0.20	183	2.26	215	2.65	5.16	2.59	-15	2
PN14	0.027	17.5	25.0	68.0	74.3	0.50	15.70	0.16	38	2.17	50	2.86	5.76	2.88	-33	-1
PN15	0.074	47.1	22.5	71.3	72.7	0.49	18.60	0.19	113	2.40	120	2.55	5.29	2.57	-7	-1
PS1	0.150	96.2	44.9	78.1	78.4	0.62	20.50	0.21	293	3.05	296	3.08	5.02	3.11	-2	-1
PS2	0.154	98.3	68.4	87.4	85.2	0.76	18.80	0.19	421	4.28	394	4.01	5.26	4.00	7	0
PS3	0.162	103.6	68.9	85.9	84.8	0.76	20.50	0.21	411	3.97	397	3.83	5.02	3.83	3	0
PS4	0.054	34.8	83.6	92.3	93.2	0.85	13.40	0.13	178	5.11	181	5.20	6.22	5.29	-3	-2
PS5	0.066	42.0	93.7	95.6	98.0	0.91	13.50	0.14	230	5.48	237	5.64	6.19	5.65	-3	0
PS6	0.075	48.0	59.0	82.8	86.5	0.70	12.30	0.12	196	4.08	218	4.54	6.47	4.55	-12	0
PS7	0.089	57.0	86.8	93.3	96.3	0.87	11.90	0.12	302	5.30	321	5.63	6.56	5.71	-8	-1
PS8	0.122	78.3	58.4	81.6	86.0	0.70	12.70	0.13	305	3.89	348	4.44	6.37	4.46	-15	0
PS9	0.128	81.8	85.7	92.9	94.5	0.86	13.00	0.13	428	5.23	446	5.45	6.30	5.45	-4	0
PS10	0.038	24.4	20.5	72.9	72.9	0.47	16.00	0.16	66	2.70	66	2.70	5.71	2.70	0	0
PS11	0.056	35.7	48.6	79.1	80.3	0.64	17.20	0.17	121	3.39	126	3.53	5.50	3.53	-4	0
PS12	0.153	98.0	9.9	70.0	68.5	0.41	23.30	0.23	199	2.03	189	1.93	4.68	1.92	6	1
PS13	0.065	41.9	25.0	73.9	76.1	0.50	14.90	0.15	121	2.89	122	2.91	5.91	2.95	-2	-1
TOTAL	4.584	2934.0														

AMMENDMENT No. 2
TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

INTERIM CONDITION CURVE NUMBERS

4/14/98

	SUB AREA ONE				SUB AREA TWO				SUB AREA THREE						
SUB-BASIN LABEL	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	ASSUMED LAND USE	ESTIMATED PERCENT IMPERVIOUS	ESTIMATED CN	AREA AC.	TOTAL AREA AC.	TOTAL AREA S.M.	WEIGHTED CN
IPN1	1DU/AC	20.0	68.0	30.0	PASTURE	0.0	62.0	74.7					104.7	0.164	63.7
IPN2	PASTURE	0.0	62.0	146.5									146.5	0.229	62.0
IPN3	PASTURE	0.0	62.0	75.1	M.A. STREET	85.0	93.0	3.2					78.3	0.122	63.3
IPN4	PASTURE	0.0	62.0	90.7	M.A. STREET	85.0	93.0	0.2					90.9	0.142	62.1
IPN5	PASTURE	0.0	62.0	27.3									27.3	0.043	62.0
IPS1	PASTURE	0.0	62.0	90.5	M.A. STREET	85.0	93.0	3.3					93.8	0.147	63.1
IPS2	PASTURE	0.0	62.0	66.2	M.A. STREET	85.0	93.0	0.5					66.7	0.104	62.2
IPS3	PASTURE	0.0	62.0	69.8									69.8	0.109	62.0
IPS4	PASTURE	0.0	62.0	106.5									106.5	0.166	62.0
IPS5	PASTURE	0.0	62.0	84.7	M.A. STREET	85.0	93.0	1.3					86.0	0.134	62.5
IPS6	PASTURE	0.0	62.0	84.4									84.4	0.132	62.0
IPS7	PASTURE	0.0	62.0	130.9	M.A. STREET	85.0	93.0	2.6					133.5	0.209	62.6
IPS8	PASTURE	0.0	62.0	55.0	M.A. STREET	85.0	93.0	1.3					56.3	0.088	62.7
IPS9	4 DU/AC	37.0	76.0	26.5	OPEN SPC.		69.0	11.3					37.8	0.059	73.9
IPS10	YMCA	50.0	84.0	10.0			69.0	52.3	3 DU/AC	17.0	72.0	16.0	78.3	0.122	71.5
												TOTAL	1260.8	1.970	

AMMENDMENT No. 2 TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

FULLY DEVELOPED CONDITION LAG TIME ESTIMATE
5/5/98

BASIN	OVERLAND FLOW				SWALE OR STREET FLOW					CHANNEL OR S.D. FLOW					TOTAL	TOTAL	TOTAL
ID.	L (ft)	C(10YR)	S (%)	TC(min)	TYPE	L (ft)	S (%)	V (fps)	TC(min)	TYPE	L (ft)	S(%)	V (fps)	TC(min)	TC(min)	LAG(min.)	LAG(hrs)
CN1	100	0.25	2	12.65	ST	2000	4	5.5	6.06	SD	300	3	19	0.26	18.97	11.38	0.190
CN2	100	0.25	2	12.65	ST	2000	2.5	4.5	7.41	SD	900	1	11	1.36	21.42	12.85	0.214
CN3	100	0.25	2	12.65	ST	1100	5	6	3.06					0.00	15.70	9.42	0.157
CS1	100	0.25	2	12.65	ST	1650	2.5	5	5.50					0.00	18.15	10.89	0.181
CS2	200	0.75	3	6.44	SW	600	6	5	2.00	SD	1400	1.7	14	1.67	10.11	6.06	0.101
CS3	100	0.25	2	12.65	ST	1400	3.2	5.5	4.24	SD	800	4	17	0.78	17.67	10.60	0.177
CS4	200	0.75	3	6.44	ST	800	3	5	2.67	SD	1050	4	18	0.97	10.08	6.05	0.101
F1	100	0.25	2	12.65	ST	2200	2.3	4.5	8.15					0.00	20.79	12.48	0.208
F2	100	0.25	2	12.65	ST	1000	3	5	3.33	SD	800	4.5	12	1.11	17.09	10.25	0.171
F3	100	0.25	2	12.65	ST	2650	3	5	8.83					0.00	21.48	12.89	0.215
F4	100	0.25	2	12.65	ST	1700	2	4	7.08					0.00	19.73	11.84	0.197
F5	200	0.75	2.8	6.59	SW	1000	3.3	3	5.56					0.00	12.15	7.29	0.121
F6	200	0.75	3	6.44	SW	1000	3.9	4	4.17					0.00	10.61	6.36	0.106
F7	200	0.75	3	6.44	SW	1300	3	3	7.22					0.00	13.66	8.20	0.137
PM1	100	0.25	2	12.65	ST	1700	1.5	4	7.08	SD	650	3.5	19	0.57	20.30	12.18	0.203
PM2	300	0.25	6	15.24	SW	3300	5	3.5	15.71						30.96	18.57	0.310
PM3	300	0.25	3.0	19.16	SW	650	6.0	3.5	3.10	CH	900	2	6.00	2.50	24.75	14.85	0.248
PM4	100	0.25	2	12.65	ST	800	6	6.5	2.05	SD	2600	5	19	2.28	16.98	10.19	0.170
PM5	100	0.25	2	12.65	ST	1800	5	6	5.00	SD	600	3.5	12	0.83	18.48	11.09	0.185
PM6	200	0.75	3	6.44	SW	400	3	3.5	1.90	SD	2500	3	16	2.60	10.95	6.57	0.110
PM7	300	0.25	9	13.33	SW	4600	2.5	3.5	21.90	SD	200	14	30	0.11	35.35	21.21	0.353
PM8	300	0.75	5	6.67	ST	1200	5	6	3.33					0.00	10.00	6.00	0.100
PM9	200	0.75	3	6.44	ST	2000	4	6	5.56					0.00	12.00	7.20	0.120
PM10	200	0.75	3	6.44	SW	500	4	4.5	1.85	SD	800	2.5	15	0.89	9.18	5.51	0.092
PM11	200	0.75	3	6.44	ST	450	4	6	1.25	SD	1350	2.5	12	1.88	9.57	5.74	0.096
PN1	100	0.25	2.0	12.65	ST	1600	7.0	7.5	3.56	SD	3400	5	22.0	2.58	18.78	11.27	0.188
PN2	100	0.25	2.0	12.65	ST	1600	6.0	7.0	3.81	SD	3300	4	20.0	2.75	19.20	11.52	0.192
PN3	100	0.25	2.0	12.65	ST	1500	3.0	5.0	5.00	SD	2500	3	21.0	1.98	19.63	11.78	0.196
PN4	100	0.25	2.0	12.65	ST	1500	7.0	7.5	3.33	SD	2600	3	17.0	2.55	18.53	11.12	0.185
PN5	100	0.25	2.0	12.65	ST	1600	3.0	6.0	4.44	SD	400	1	17.0	0.39	17.48	10.49	0.175
PN6	200	0.75	3.0	6.44	ST	1300	3.0	5.0	4.33	SD	1700	3	15.0	1.89	12.66	7.60	0.127
PN7	100	0.25	2	12.65	ST	1500	5.5	6.5	3.85					0.00	16.49	9.89	0.165
PN8	100	0.25	2	12.65	ST	1600	5	6	4.44	SD	400	3	13	0.51	17.60	10.56	0.176

AMMENDMENT No. 2 TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

FULLY DEVELOPED CONDITION LAG TIME ESTIMATE
5/5/98

BASIN	OVERLAND FLOW				SWALE OR STREET FLOW					CHANNEL OR S.D. FLOW					TOTAL	TOTAL	TOTAL
ID.	L (ft)	C(10YR)	S (%)	TC(min)	TYPE	L (ft)	S (%)	V (fps)	TC(min)	TYPE	L (ft)	S(%)	V (fps)	TC(min)	TC(min)	LAG(min.)	LAG(hrs)
PN9	100	0.25	2	12.65	ST	1400	5	6	3.89	SD	500	4	20	0.42	16.95	10.17	0.170
PN10	100	0.25	3	11.06	ST	1000	4	5.5	3.03					0.00	14.09	8.46	0.141
PN11	100	0.25	2	12.65	ST	1750	3.5	5	5.83	SD	500	4	20	0.42	18.90	11.34	0.189
PN12	300	0.25	25	9.52	SW	450	11	6	1.25	CH	900	3	7	2.14	12.91	7.75	0.129
PN13	100	0.25	2	12.65	ST	1500	3	5	5.00	SD	2500	4	22	1.89	19.54	11.72	0.195
PN14	100	0.25	2	12.65	ST	1100	5	6	3.06					0.00	15.70	9.42	0.157
PN15	100	0.25	2	12.65	ST	1800	3	5	6.00						18.65	11.19	0.186
PS1	100	0.25	2.0	12.65	ST	1700	3.0	5.0	5.67	SD	2100	2	16.0	2.19	20.50	12.30	0.205
PS2	100	0.25	2.0	12.65	ST	1500	2.5	5.0	5.00	SD	1400	3	20.0	1.17	18.81	11.29	0.188
PS3	100	0.25	2.0	12.65	ST	1700	2.5	5.0	5.67	SD	2100	2	16.0	2.19	20.50	12.30	0.205
PS4	200	0.75	3.0	6.44	ST	1500	2.0	4.0	6.25	SD	400	1	9.0	0.74	13.43	8.06	0.134
PS5	200	0.75	3.0	6.44	SW	1400	4.0	4.0	5.83	SD	1200	1	16.0	1.25	13.52	8.11	0.135
PS6	200	0.75	3.0	6.44	ST	1500	3.0	5.0	5.00	SD	1000	2	20.0	0.83	12.27	7.36	0.123
PS7	200	0.75	3.0	6.44	ST	1500	2.5	5.0	5.00	SD	600	3	20.0	0.50	11.94	7.16	0.119
PS8	200	0.75	3.0	6.44	ST	1500	3.0	5.0	5.00	SD	1000	2	13.0	1.28	12.72	7.63	0.127
PS9	200	0.75	3.0	6.44	ST	1500	2.5	5.0	5.00	SD	1800	3	19.0	1.58	13.02	7.81	0.130
PS10	100	0.25	2.0	12.65	ST	1200	5.0	6.0	3.33						15.98	9.59	0.160
PS11	100	0.25	2.0	12.65	ST	1400	5.0	6.0	3.89	SD	900	4	21.0	0.71	17.25	10.35	0.172
PS12	300	0.25	9.0	13.33	SW	300	3.0	3.0	1.67	CH	3000	2.5	6.0	8.33	23.33	14.00	0.233
PS13	300	0.25	12.0	12.13	SW	200	6.0	5.0	0.67	ST	500	2	4.00	2.08	14.88	8.93	0.149

OVERLAND FLOW (TC=1.87*(1.1-C10)(*L^.5)*S^-.33)

STREET AND SWALE VELOCITY PER MANNINGS BASED ON A ESTIMATED AVERAGE FLOW RATE

CHANNEL VELOCITY PER MANNINGS BASED ON APPROXMATE SECTION AND FLOW RATE
STORM DRAIN VELOCITY PER MANNINGS BASED ON AN ESTIMATED STORM DRAIN SIZE

AMMENDMENT No. 2
TO
PINE CREEK DRAINAGE BASIN PLANNING STUDY

INTERIM CONDITION LAG TIME ESTIMATE

4/10/98

BASIN	OVERLAND FLOW				SHALLOW CONCENTRATED FLOW					CHANNEL FLOW					TOTAL	TOTAL	TOTAL
ID.	L (ft)	C(10YR)	S (%)	TC(min)	TYPE	L (ft)	S (%)	V (fps)	TC(min)	TYPE	L (ft)	S(%)	V (fps)	TC(min)	TC(min)	LAG(min.)	LAG(hrs)
IPN1	300	0.25	10.0	12.88	GRASS CHAN.	5000	5.0	3.6	23.15					0.00	36.03	21.62	0.360
IPN2	300	0.25	4.7	16.52	GRASS CHAN.	4200	4.2	3.3	21.21					0.00	37.73	22.64	0.377
IPN3	300	0.25	4.7	16.52	GRASS CHAN.	1600	4.5	3.4	7.84	NAT. CHANNEL	1300	3.4	9.0	2.41	26.77	16.06	0.268
IPN4	300	0.25	6.0	15.24	GRASS CHAN.	1100	6.2	4.0	4.58					0.00	19.82	11.89	0.198
IPN5	300	0.25	14.0	11.52	GRASS CHAN.	700	9.0	5.0	2.33	NAT. CHANNEL	1100	2.5	6.0	3.06	16.91	10.15	0.169
IPS1	300	0.25	7.0	14.49	GRASS CHAN.	4200	3.0	2.8	25.00					0.00	39.49	23.69	0.395
IPS2	300	0.25	2.7	19.84	GRASS CHAN.	2750	2.8	2.7	16.98					0.00	36.81	22.09	0.368
IPS3	300	0.25	13.6	11.63	GRASS CHAN.	3050	5.7	3.8	13.38					0.00	25.01	15.01	0.250
IPS4	300	0.25	4.7	16.52	GRASS CHAN.	1650	4.2	3.3	8.33	NAT. CHANNEL	1700	3.1	5.0	5.67	30.52	18.31	0.305
IPS5	300	0.25	3.3	18.57	GRASS CHAN.	3300	3.0	2.8	19.64					0.00	38.21	22.93	0.382
IPS6	300	0.25	5.3	15.88	GRASS CHAN.	3600	3.7	3.1	19.35					0.00	35.23	21.14	0.352
IPS7	300	0.25	3.5	18.21	GRASS CHAN.	1050	3.6	3.1	5.65	NAT. CHANNEL	1800	2.9	6.0	5.00	28.85	17.31	0.289
IPS8	300	0.25	3.7	17.88	GRASS CHAN.	1500	3.1	2.9	8.62					0.00	26.50	15.90	0.265
IPS9	100	0.25	2.0	12.65	STREET	800	3.5	6.0	2.22	NAT. CHANNEL	800	3.5	8.0	1.67	16.53	9.92	0.165
IPS10	100	0.25	2.0	12.65	STREET	1150	3.3	5.5	3.48	NAT. CHANNEL	600	5.0	7.0	1.43	17.56	10.54	0.176

NOTE: LAG TIMES IN SUB-BASINS NOT INCLUDED IN THE TABLE ABOVE ARE NOT CHANGED FROM THE FULLY DEVELOPED CONDITION.

HYDROLOGIC MODEL (HEC-1) OUTPUT

FULLY DEVELOPED CONDITION

- 5-YEAR STORM
- 100-YEAR STORM

INTERIM CONDITION

- 5-YEAR STORM
- 100-YEAR STORM

HEC-1 MODEL OUTPUT

FULLY DEVELOPED CONDITION

• 5-YEAR STORM

HEC1 S/N: 1343000062 HMVersion: 6.33 Data File: X:\870000.ALL\871611\898DBPS\PCDBPSD5.DAT

```
*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                MAY  1991              *
*             VERSION 4.0.1E            *
*                                       *
*    RUN DATE  08/05/1998  TIME  17:41:14 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

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::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM