

**MASTER DEVELOPMENT DRAINAGE PLAN FOR
STONEWATER AT NORTHGATE
AND
FINAL DRAINAGE REPORT FOR
STONEWATER AT NORTHGATE FILING NO. 1, 2 & 3**

September 2007

Prepared for:

**NORTHGATE PROPERTIES, LLC
1295 Kelly Johnson Blvd. Suite 230
Colorado Springs, CO 80920**

Prepared by:



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JOB NO. 1010


**MDDP FOR STONEWATER AT NORTHGATE &
FINAL DRAINAGE REPORT FOR STONEWATER
AT NORTHGATE FIL. NO. 1, 2 & 3**



DRAINAGE REPORT STATEMENT

I. ENGINEER'S STATEMENT:

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



Bob H. Yoo, Colorado P.E. #36793
For and On Behalf of Executive Consulting Engineers, Inc.


9-11-07

Date

II. DEVELOPER'S STATEMENT:

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

Business Name: Northgate Properties, LLC

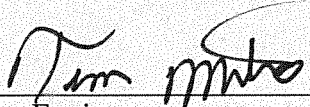
By: 

Gary Erickson

Title: Manager
Address: 1295 Kelly Johnson Blvd. Suite 230
Colorado Springs, CO 80920

III. CITY OF COLORADO SPRINGS ONLY:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.



For City Engineer

Sept 17, 2007

Date

Conditions:

MDDP FOR STONWATER AT NORTHGATE & FINAL DRAINAGE REPORT FOR STONWATER AT NORTHGATE FIL. NO. 1, 2 & 3

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PURPOSE

This master development drainage plan for Stonewater at Northgate and final drainage report for Stonewater at Northgate filing no. 1, 2 & 3 drainage report has been prepared to conform to “The City of Colorado Springs Drainage Criteria Manual, 1994” requirements for new developments. The specific scope of this study includes the following:

1. A description of the property and surrounding platted/unplatted developments.
2. A discussion of the drainage design criteria that govern analysis and design.
3. A discussion on the major basins and sub-basins and the changes to drainage patterns due to development.
4. A preliminary discussion on the drainage facilities required to accommodate the developed runoff.

GENERAL LOCATION AND DESCRIPTION

The proposed Stonewater at Northgate development is a 32.788 acre tract of Town homes development, and a portion of the tract is located in the northeast quarter of Section 18, northwest quarter of Section 17 and southeast quarter of Section 8, Township 12 South, Range 66 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bordered by Sybilla Lane to the north, Voyager Parkway to the east, Middle Creek Parkway to the south and Nicky Cruz Outreach Office complex to the west. On-site soils are comprised of “92” and “93” Tomah-Crowfoot loamy sands. All soils are classified as Hydrologic Soil Group “B”.

CRITERIA

The “City of Colorado Springs/El Paso County Drainage Criteria Manual” dated October 1987, Revised November 1991 and the amendment to the manual dated October 15, 1994 are the primary basis of this study. Forthwith, these documents shall be referred to as the “Manual”. The following Drainage Report was also considered in this study:

1. "Middle Tributary Drainage Basin Planning Study (D.B.P.S.)" by URS Consultants, Inc., dated 1987.
2. "Northgate Master Development Drainage Plan" by URS Consultants, Inc., dated June 27, 1988.
3. "Preliminary/Final Drainage Report for Northgate Filing No. 6 (Voyager Parkway Phase 1)" by JR Engineering, last October 1998.
4. "Master Development Drainage Plan for Northgate Software Campus (Monument Branch and Middle Tributary Basins)" by JR Engineering, last revision dated January 28, 1999.
5. "Preliminary/Final Drainage Report for Compassion International's Northgate Campus Filing No. 1" by JR Engineering, Revised date August 13, 1999.
6. "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)", dated May 2002.
7. "Preliminary/Final Drainage Report for Compassion International's Northgate Campus Filing No. 2", by JR Engineering, PE signature dated May 5, 2004.
8. "Addendum to Preliminary/Final Drainage Report for Compassion International's Northgate Campus Filing No. 1", by JR Engineering, last revision dated January 2000.
9. "Preliminary Drainage Report for Lot 2 Progressive at Northgate Filing No. 1 and Final Drainage Report for Lot 1 Progressive at Northgate Filing No. 1", by Classic Consulting Engineers & Surveyors, dated November 2002.
10. "Final Drainage Report for N.C. Subdivision Filing No. 1" by JR Engineering, Date July 2001, Revised October 2001.

Storm runoff rates for all onsite basins are calculated based on the following criteria found in the manual. The initial storm (5-year event) and the major storm (100-year event) are considered to size drainage facilities and verify conformance with drainage criteria. Additionally, per El Paso County and City's policy for flows upstream of the Air Force Academy, developed peak flows for 2-, 5-, 10-, 50- and 100- year storm frequencies are released at below the historical "undeveloped" flows. Runoff rates are calculated using the Rational Method Equation $Q=CIA$. The values for the runoff coefficient "C" acres based on the "Residential 1/8 Acre" surface characteristic found in Table 5-1 of the Manual. Rainfall intensities "I" are taken from the Intensity-Duration-Frequency table. Time of concentration is

calculated as the sum of overland flow time and travel time. Overland flow time is calculated over a maximum 300 foot distance using the FAA equation $T_i = 1.87(1.1 - C_5)L^{0.5} S^{-0.33}$ where:

C_5	=	basin composite runoff coefficient for the five-year storm event
L	=	length of overland flow in feet
S	=	slope of flow path in percent
T_i	=	travel time in minutes

Travel time is calculated as the flow time thru a length of street gutter or channel by multiplying the average flow velocity by the travel length. Flow velocity is obtained thru Manning's equation based on the allowed flow depth for the initial and major storms.

DISCUSSION

The results of this Drainage Study show that the proposed development complies with City criteria and the expected developed drainage patterns as discussed in the MDDP for Northgate Software Campus, Preliminary/Final Drainage Report for Compassion International's Northgate Campus Filing No. 1 and Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9).

Per "MDDP for Northgate Software Campus", an approximate 4.9 ac-ft publicly owned and maintained detention pond "D" (referred in MDDP) is proposed to intake developed flows from this development and future development of Compassion International's Northgate Campus (a 31.3 acres site; see Master Development Drainage Plan for Northgate Software Campus). But, when Compassion International's Northgate Campus Filing No. 1 was proposed for their development (Preliminary/Final Drainage Report for Compassion International's Northgate Campus Filing No. 1), one privately owned and maintained detention pond and a temporary detention pond were proposed to restrict their outflows for developed condition. Per this study, these two ponds were designed to provide the necessary storage volume for only Compassion International's site, and off-sites including this development's developed flows are to be routed through future 54" R.C.P. pipe and routed to the Public Regional Detention Pond "E" (located south to the Oracle site across Middle Creek Parkway; see Developed Drainage map for the Master Development Drainage Plan for Northgate Software Campus). Since this study, JR

Engineering issued "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9). From this study, developed flows from the Stonewater at Northgate development with routed flows from the Regional Detention Facility No 9 are released onto the Compassion site as did historically without adversely affect downstream facilities. With development of future Compassion site, future design will determine the proper routing of these flows.

EXISTING DRAINAGE CONDITIONS

The site is situated within the Middle Tributary Drainage Basin area. The site is currently vacant and undeveloped. The topography of the site shows that a portion of the site drains to the southwest toward Middle Creek Parkway, and flows are being collected by existing 54" and discharges into the Middle Tributary Drainage way. Another portion of the site drains to the northwest direction toward Sybilla Lane. One temporary detention pond exists on-site at the southeast corner of this site.

As stated in the "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)", currently, the existing regional facility site is occupied by a temporary detention pond that was outlined in the "Preliminary/Final Drainage Report for Voyager Parkway Filing No. 6 – Phase I (2,200 feet north of Middle Creek Parkway). This temporary facility accepts flows from portions of Voyager Parkway, Filing No. 1 & 2 of Middle Creek Manor and vastly developed Northgate Village Filing No. 1 site. Flows enter this temporary detention facility and released from the pond by the existing 15" C.M.P. outlet pipe. With development of Stonewater at Northgate Filing No. 1, this temporary detention pond (Regional Detention Pond 9) will be permanently build out and will be dedicate to the City of Colorado Springs as a Public Detention Pond as stated in the MDDP for Northgate Software Campus. Also stated in the "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)", total flows out of the pond were $Q_2=12.60$ cfs, $Q_5=14.94$ cfs, $Q_{10}=37.17$ cfs, $Q_{50}=79.19$ cfs and $Q_{100}= 95.74$ c.f.s. These flows will be used as restricted flows from this detention pond for all five (5)

storms to conform to the MDDP report. See page 8 under **DEVELOPED DRAINAGE CONDITION** for the final total flows out of Regional Detention Pond No. 9.

DEVELOPED DRAINAGE CONDITION

The existing land use for this site is PUD. The proposed Town Homes development is allowed in the current zoning.

The general developed drainage patterns are similar to the existing drainage patterns and according to the Master Development Drainage Plan for Northgate Software Campus.

As required by City of Colorado Springs Drainage Manual and per El Paso County and City's policy for flows upstream of the Air Force Academy, outfall from the Regional Detention pond 9 is released at below historical flows as outlined in the MDDP for the Northgate Software Campus and Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9).

In the developed condition, largely, drainage patterns can be divided into three basins. One basin contains sub-basin I, J and K, located at the east and southeast corner of the site. Flows from this basin into the Regional Detention Pond No. 9 are in conformance with the "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)". This basin also contains the previously mentioned Regional Detention Pond 9. Flows from these on-site sub-basins and flows from east to Voyager Parkway flow into this Regional Detention Pond 9. These flows will be routed through an outlet structure and routed by a 42" HDPE storm system and will be connected to the existing storm sewer manhole in Middle Creek Parkway. Total flows out of the pond are $Q_2=12.42$ cfs, $Q_5=14.69$ cfs, $Q_{10}=33.50$ cfs, $Q_{50}=80.68$ cfs and $Q_{100}=85.66$ c.f.s. As stated in the "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9), these flows agree with the M.D.D.P. for Northgate Software Campus. Routed flows are then carried in the existing 42" R.C.P. westerly direction along Middle Creek Parkway to a low point. At this point, the 42" R.C.P. outfalls into a 54" R.C.P. that conveys flows south of Middle Creek Parkway. Flows are then carried via existing 54" R.C.P. southerly direction along the southern outfalls overland into Compassion International's Campus site.

Flows are then travel overland through the Compassion International's site, and flow into the Allison Ranch property as did historically and at historical flow rates.

Second drainage basin contains sub-basin A, B, C, D, E, F, G, H and O. Developed flows ($Q_2=17.14$ cfs, $Q_5=23.55$ cfs, $Q_{10}=27.58$ cfs, $Q_{50}=40.10$ cfs and $Q_{100}=41.89$ c.f.s) from these sub-basins will flow toward southerly direction and enter into a proposed Porous Landscape Detention (water quality pond; Design Point 9) near the main entrance off Middle Creek Parkway. Flows then will be carried by 36" H.D.P.E. pipe to a proposed storm junction box. Flows then merge with flows from Regional Detention Pond 9 and are carried in an existing 54" R.C.P. south of Middle Creek Parkway (Design Point 17). Combined total developed flows are $Q_2=29.15$ cfs, $Q_5=37.42$ cfs, $Q_{10}=54.15$ cfs, $Q_{50}=120.14$ cfs and $Q_{100}=127.16$ c.f.s. These flows are less than the flows shown in the approved "Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9); $Q_2=48.01$ cfs, $Q_5=64.13$ cfs, $Q_{10}=74.85$ cfs, $Q_{50}=117.20$ cfs and $Q_{100}=154.57$ c.f.s. As stated in the earlier paragraph, the existing 54" storm sewer is adequately designed to convey the developed flows to the Compassion site. These flows agree with the approved MDDP for Northgate Software Campus, and these flows will not adversely affect the Compassion site.

Lastly, flows from the drainage basin located in the northern portion of the site (Sub-basin L & M) will flow northwesterly direction toward the northwest corner of the site. According to the Final Drainage Report for N.C. Foundation, 36" RCP with a grated manhole is stubbed out at the western property line of the site for flows from this basin. Because of the actual drainage pattern of this basin is differ from the assumption made in the N.C. Foundation's drainage report, basin L's flow will be collected by a proposed inlet at the end of the cul-de-sac and routed through a proposed 24" HDPE storm system to an existing storm sewer manhole type I in Sybilla Lane. Although this new connection does not conform to the N.C. Foundation's drainage report, but flows from the site will be collected and detained in the Regional Detention Pond "E" as stated in the N.C. Foundation's drainage report. The developed flows ($Q_5=7.9$ c.f.s and $Q_{100}=18.0$ c.f.s.) are in accordance with the approved MDDP for Northgate Software Campus, and flows do not impact the adjacent properties. Per approved "Preliminary Drainage Report for Lot 2 Progressive at Northgate Filing No. 1 and Final Drainage Report for Lot 1 Progressive at Northgate Filing No. 1" anticipated developed flows from Progressive site ($Q_5=53$ cfs, $Q_{100}=92$ cfs) is less than the originally anticipated $Q_5=60$ cfs, $Q_{100}=114$ cfs (Design Point 16A) Additionally, per "Final Drainage Report for Lot 2 Progressive at Northgate Filing

No. 1” anticipated developed flows from Progressive site ($Q_2=2$ cfs, $Q_5=5$ cfs) is less than the originally anticipated $Q_2=9.5$ cfs, $Q_5=18.8$ cfs (Design Point 16B). Therefore, additional anticipated flows from the site ($Q_2=7.9$ cfs, $Q_5=18.0$ cfs) will be adequately conveyed by the existing 48” RCP in Sybilla Lane.

All three large basins’ flows comply with Master Development Drainage Plan for Northgate Software Campus, Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9) and Preliminary/Final Drainage Report for Compassion International’s Northgate Campus Filing No. 1, 2 and Addendum to Preliminary/Final Drainage Report for Compassion International’s Northgate Campus Filing No. 1.

Outfalls from the Design Point 15 are released at below historical “undeveloped” flows for 2-, 5-, 10-, 50- and 100-year storm frequencies City’s policy for flows upstream of the Air Force Academy. And, outfalls from Regional Detention Pond 9 and outfalls from Design Point 10 (water quality pond) are released at below restricted flows as described in the “Addendum No. 1 to the Final Drainage Report for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)” for 2-, 5-, 10-, 50- and 100-year storm frequencies City’s policy for flows upstream of the Air Force Academy.

FLOODPLAIN STATEMENT

No portion of the site is located within a FEMA delineated floodplain as determined by Flood Insurance Rate Map Number 08041C 0295F, effective date, March 17, 1997.

DETENTION/WATER QUALITY CAPTURE VOLUME

As mentioned earlier in this report, one public regional detention facility 9 will be provided and built with this development. This pond provides required detention storage for the upstream development. Detailed construction plans for the detention pond and outlet structure design will be submitted to City of Colorado Springs, Subdivision Review Team for an approval. Detailed calculation of the pond is included in the Appendix.

For this Stonewater at Northgate development, Porous Landscape Detention (PLD) with the base course with 6”(min.) Sandy Loam Turf Layer, 18” (min.) Layer of 25% Peat and 75%

Sand Mix and 9" (min.) Layer of ASSHTO #8 Coarse Aggregate is proposed near main entrance off Middle Creek Parkway. Minimum required design volume is 7,118.8 cubic feet, and provided volume is 7,594 cubic feet. See Developed Drainage Plan for location of water quality pond. The Porous landscape Detention Pond will be maintained by the Home Owners' Association of Stonewater at Northgate.

The detailed construction plans for the design of Porous Landscape Detention will be included in the Detailed Grading and Erosion Control Plan.

EROSION CONTROL PLAN

The City of Colorado Springs Drainage Criteria Manual specifies that an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request the Erosion Control Plan and Cost Estimate be submitted in conjunction with the Grading Plan and construction assurances posted prior to obtaining a grading permit.

REIMBURSABLES**Stonewater at Northgate****Public Detention Facility (Reimbursable)-Detention Pond No. 9**

<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>COST</u>
Regional Detention Facility, outlet Structure, outlet pipes & landscaping	1 L.S.	\$115,000	\$115,000
TOTAL			\$115,000

Stonewater at Northgate Pond Land Cost (Reimbursable)

<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>COST</u>
*Regional Detention Facility	1.825 A.C.	\$76,602/A.C.	\$139,799
TOTAL			<u>\$139,799</u>

As stated in the DBPS for Middle Tributary, in the year of 1987, land costs for detention ponds are to be reimbursed at \$15,600 per acre in the City and in the County. This land fee is corresponds to the City's park land fee (in the year of 1987). DBPS also stated that these land costs will be adjusted in subsequent years to reflect the park land value that year. The current 2007 year's park fee is \$76,602 per acre.

REIMBURSEMENT AVAILABLE PER MIDDLE TRIBUTARY D.B.P.S.

A Regional Detention Facility to be built with this development is shown on Figure 13 of the D.B.P.S. as design point 9. Middle Tributary Drainage Basin's unit costs are shown in Table 9 of the D.B.P.S.

1987 Middle Tributary Drainage Fees set by Middle Tributary D.B.P.S. (1987 dollars)

Drainage Fee: \$2,766/A.C.
Bridge Fee: N/A
Pond Fee: \$228/A.C.

2007 Middle Tributary Drainage Fees (2007 dollars)

Drainage Fee: \$5,169/A.C.
Bridge Fee: N/A
Pond Fee: \$1,121/A.C.

Conversion Factor for Middle Tributary Drainage Fees:

Drainage Fee: \$2,766/A.C. vs. \$5,169/A.C. **1.87 CF (Conversion Factor)**
Bridge Fee: N/A N/A
Pond Fee: \$228/A.C. vs. \$1,121/A.C. **4.92 CF (Conversion Factor)**

2007 D.B.P.S. COST CALCULATIONS**Public Detention Facility (Design Point 9)**

DESCRIPTION	QUANTITY	UNIT COST	COST
1987 DBPS cost			
Regional Detention Facility (Construction including landscaping)	1 L.S.	\$68,000	\$68,000
15% Engineering/Contingency			\$10,200
		TOTAL	<u>\$78,200</u>
2007 DBPS cost			
		1.87 CF x \$78,200	<u>\$146,234</u>
		TOTAL	<u>\$146,234</u>

DESCRIPTION	QUANTITY	UNIT COST	COST
1987 DBPS cost			
Regional Detention Facility (Land)	1 L.S.	\$16,848/L.S.	\$16,848
15% Engineering/Contingency			\$2,527
		TOTAL	<u>\$19,375</u>
2007 DBPS cost (Land)			
		4.92 CF x \$19,375	<u>\$95,325</u>
		TOTAL	<u>\$95,325</u>

REIMBURSABLE DRAINAGE CREDIT (2007 DOLLARS) FOR REGIONAL DETENTION FACILITY

DESCRIPTION	QUANTITY	COST
2007 D.B.P.S. Detention Construction Cost	1 L.S.	\$146,234
Public Regional Detention Facility (Construction)	1 L.S.	\$115,000
		Amount Available for Reimbursement
		\$146,234
		Available Drainage Credits
		\$146,234
2007 D.B.P.S. Land Cost	1 L.S.	\$95,325
Pond (Land) Cost	1 L.S.	\$139,799
		Amount Available for Reimbursement
		\$95,325
		Available Pond Credits
		\$95,325

ote: Above available Drainage Fee (\$146,234) and Pond Fee (\$95,325) will be credit toward Northgate Properties, LLC's future development projects within the Northgate Master Plan. Fees are calculated based on the year of 2007 drainage fees.

DRAINAGE FEE SUMMARY:

This area lies within the Middle Tributary Drainage Basin boundaries. Drainage and pond fees are as follows: Total site = 32.788 acres.

Filing No. 1= 15.786 acres; Filing No. 2=7.720 acres; Filing No. 3=9.282 acres

STONEWATER AT NORTHGATE FILING NO. 1**Drainage Fees :**

15.786 acres x \$5,169/ac. **\$81,598**

Pond Fees:

Stonewater at Northgate Filing No. 1

15.786 acres x \$1,121/ac. **\$17,696**

STONEWATER AT NORTHGATE FILING NO. 2**Drainage Fees :**

7.720 acres x \$5,169/ac. **\$39,905**

Pond Fees:

7.720 acres x \$1,121/ac. **\$8,654**

STONEWATER AT NORTHGATE FILING NO. 3**Drainage Fees :**

9.282 acres x \$5,169/ac. **\$47,979**

Pond Fees:

9.282 acres x \$1,121/ac. **\$10,405**

Notes:

1. Fees are due prior to final plat recordation. Prior to issuance of building permits a plat shall be submitted and appropriate drainage facility and erosion control assurance will need to be posted.
2. See reimbursable fees calculation under **REIMBURSEMENT AVAILABLE PER MIDDLE TRIBUTARY D.B.P.S.** for details.

CONSTRUCTION COST ESTIMATE**Public Drainage Facilities (Non-reimbursable) –Stonewater at Northgate Filing No. 1**

DESCRIPTION	QUANTITY	UNIT COST	COST
15" HDPE pipe	11 L.F.	\$22	\$264
42" HDPE pipe	275 L.F.	\$35	\$9,625
Storm Sewer MH-Type 1	1 EA	\$4,000	\$4,000
Headwall Section	1 EA	\$500	\$500
	Sub-Total		\$14,389
	15% Engineer/contingency		\$2,158
	Total		\$16,547

Note: Public drainage facilities construction cost estimate for future Stonewater at Northgate Filing 2 & 3 will be submitted at the time of final platting.

EROSION CONTROL CONSTRUCTION ESTIMATE

We respectfully request the Cost Estimate be submitted in conjunction with the Grading Plan and construction assurances posted prior to obtaining a grading permit.

SUMMARY

Development of the proposed town homes with an existing temporary pond (Regional Detention Pond No 9) will not adversely affect surrounding developments. With this development the temporarily constructed Regional Detention Pond No. 9 will be constructed, and this regional detention facility will be publicly owned and maintained by the City of Colorado Springs with light surface maintenance by the Stonewater at Northgate HOA. Developed flows will be detained/released at or below historical per El Paso County/City's policy for upstream development of the Air Force Academy. General outfall locations are in accordance with the M.D.D.P. and the latest final drainage report.

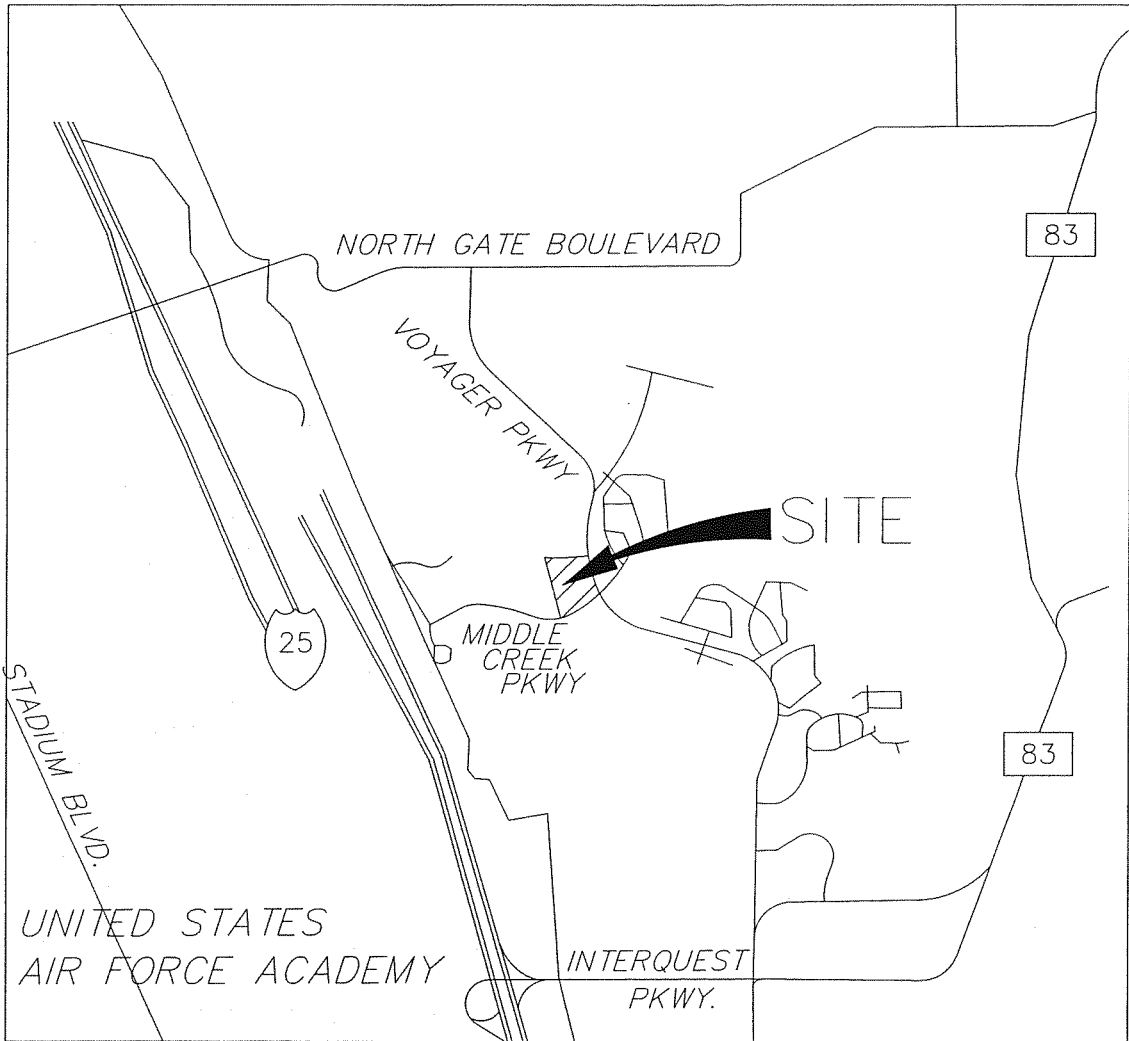
Respectfully submitted,

Executive Consulting Engineers, Inc.

Bob H. Yoo, P.E.
Project Manager

APPENDIX

VICINITY MAP

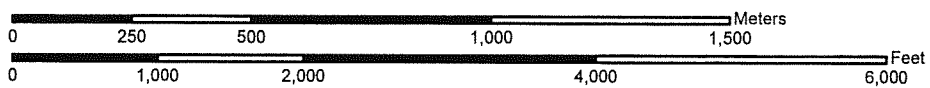
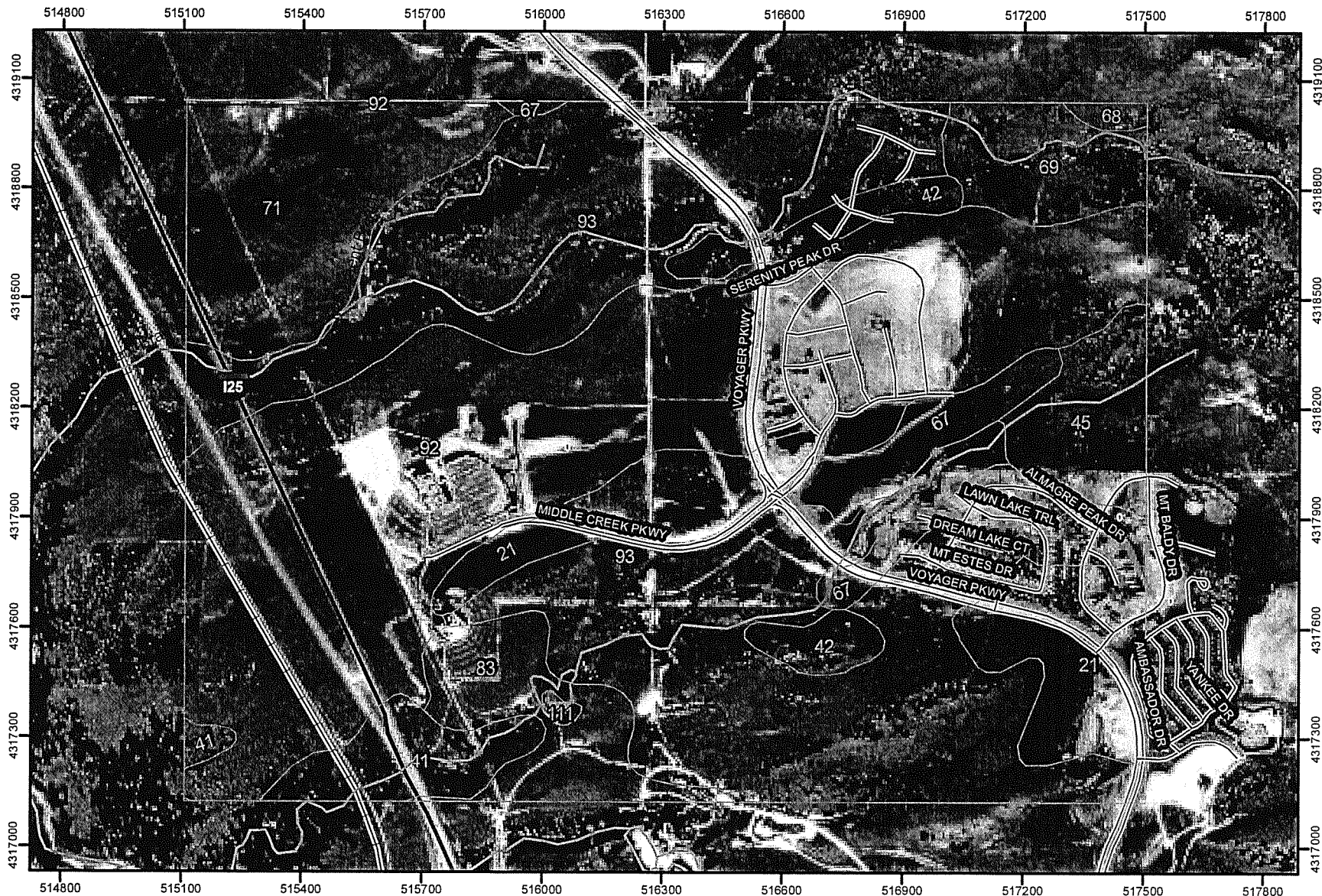


VICINITY MAP

NOT TO SCALE

SCS MAP

Soil Map—El Paso County Area, Colorado



MAP LEGEND

- | | | |
|-------------------------------|------------------------------|---------------------|
| Area of Interest (AOI) | | Very Stony Spot |
| | | Wet Spot |
| Soils | | Other |
| | Special Line Features | |
| Special Point Features | | Gully |
| | | Short Steep Slope |
| | | Other |
| | Political Features | |
| | Municipalities | |
| | | Cities |
| | | Urban Areas |
| | Water Features | |
| | | Oceans |
| | | Streams and Canals |
| | Transportation | |
| | | Rails |
| | Roads | |
| | | Interstate Highways |
| | | US Routes |
| | | State Highways |
| | | Local Roads |
| | | Other Roads |
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MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 13N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 4, Dec 20, 2006

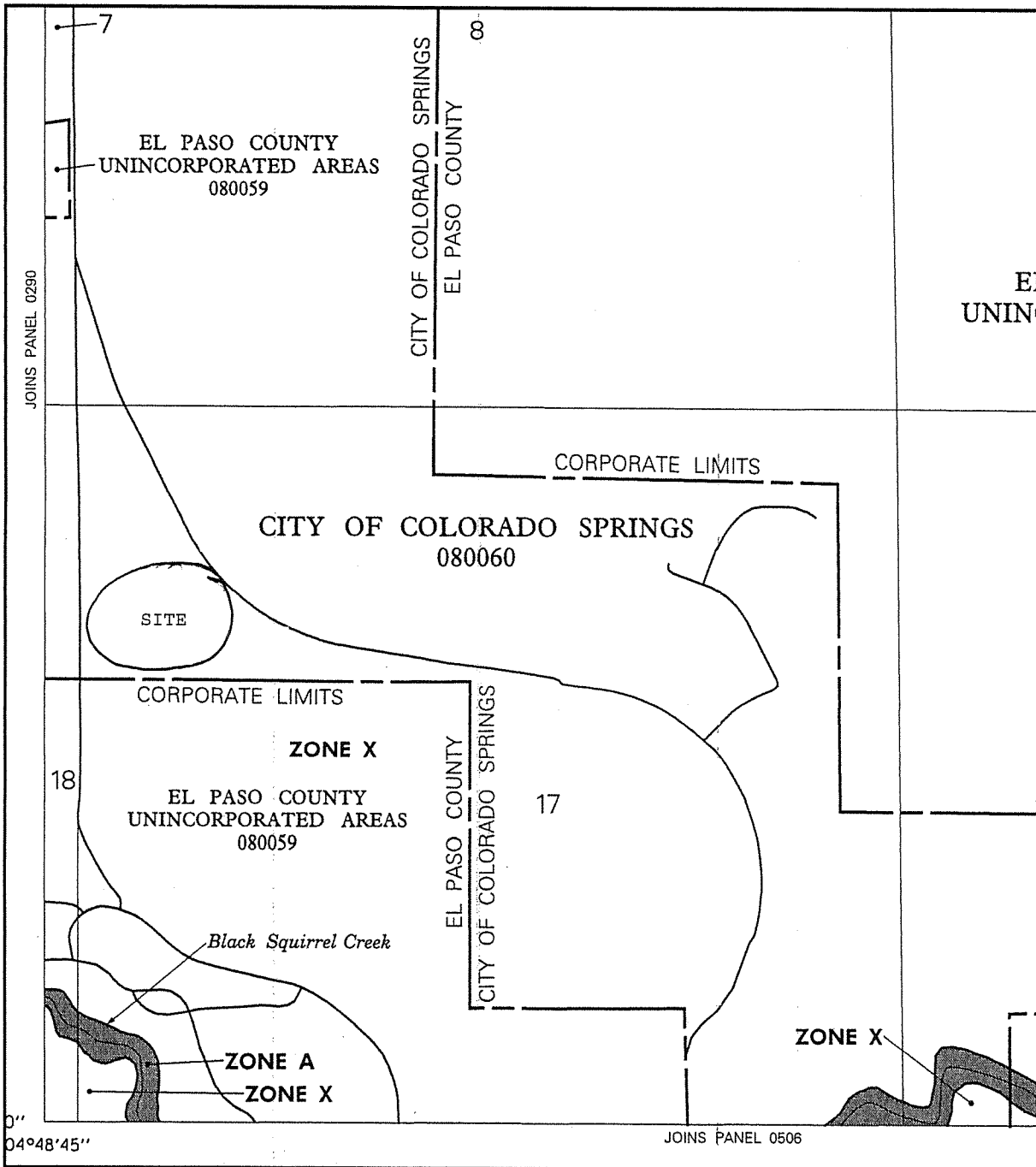
Date(s) aerial images were photographed: 1999

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
21	Cruckton sandy loam, 1 to 9 percent slopes	64.8	5.2%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	34.6	2.8%
42	Kettle-Rock outcrop complex	28.4	2.3%
45	Kutch clay loam, 5 to 20 percent slopes	39.7	3.2%
67	Peyton sandy loam, 5 to 9 percent slopes	49.1	3.9%
68	Peyton-Pring complex, 3 to 8 percent slopes	3.4	0.3%
69	Peyton-Pring complex, 8 to 15 percent slopes	37.2	3.0%
71	Pring coarse sandy loam, 3 to 8 percent slopes	99.6	8.0%
83	Stapleton sandy loam, 3 to 8 percent slopes	48.5	3.9%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	299.8	24.1%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	538.2	43.2%
111	Water	1.5	0.1%
Totals for Area of Interest (AOI)		1,244.8	100.0%

FEMA MAP



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP


EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 295 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0295	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0295	F

MAP NUMBER
08041C0295 F

EFFECTIVE DATE:
MARCH 17, 1997



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

HYDROLOGIC AND HYDRAULIC CALCULATIONS

**Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Area Runoff Coefficient Summary)**

BASIN	TOTAL AREA (Acres)	STREETS / DEVELOPED					OVERLAND / UNDEVELOPED					WEIGHTED						
		AREA (Acres)	C ₂	C ₅	C ₁₀	C ₅₀	C ₁₀₀	AREA (Acres)	C ₂	C ₅	C ₁₀	C ₅₀	C ₁₀₀	C ₂	C ₅	C ₁₀	C ₅₀	C ₁₀₀
A	3.84													0.50	0.55	0.60	0.65	0.70
B	4.04													0.50	0.55	0.60	0.65	0.70
C	4.73													0.50	0.55	0.60	0.65	0.70
D	0.62													0.50	0.55	0.60	0.65	0.70
E	2.70													0.50	0.55	0.60	0.65	0.70
F	0.47			PER TABLE 5-1, "RECOMMENDED AVERAGE RUNOFF										0.50	0.55	0.60	0.65	0.70
G	2.58			COEFFICIENTS AND PERCENT IMPERVIOUS CHART										0.50	0.55	0.60	0.65	0.70
H	1.64			(Residential 1/8 acre or less)										0.50	0.55	0.60	0.65	0.70
I	0.60													0.50	0.55	0.60	0.65	0.70
J	0.93													0.50	0.55	0.60	0.65	0.70
K	2.74													0.50	0.55	0.60	0.65	0.70
L	4.07													0.50	0.55	0.60	0.65	0.70
M	1.95													0.50	0.55	0.60	0.65	0.70
N	1.04													0.50	0.55	0.60	0.65	0.70
O	0.84													0.50	0.55	0.60	0.65	0.70
OFFSITE	44.78																	
<p><i>Note: offsite basin represents all contributing basins except on-site drainage. Per MDDP for Northgate Software Campus, six(6) areas identified as contributing areas. See MDDP for Northgate Software Campus for details.</i></p>																		

Calculated by: BHY
 Date: _____
 Checked by: BHY

**Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Area Drainage Summary)**

From Area Runoff Coefficient Summary							OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T _t)	INTENSITY *					TOTAL FLOWS					
BASIN	AREA TOTAL (Acres)	C ₂	C ₅	C ₁₀	C ₅₀	C ₁₀₀	C _s	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _t (min)	TOTAL (min)	I ₂ (in/hr)	I ₅ (in/hr)	I ₁₀ (in/hr)	I ₅₀ (in/hr)	I ₁₀₀ (in/hr)	Q ₂ (c.f.s.)	Q ₅ (c.f.s.)	Q ₁₀ (c.f.s.)	Q ₅₀ (c.f.s.)	Q ₁₀₀ (c.f.s.)	
From DCM Table 5-1																										
A	3.84	0.50	0.55	0.60	0.65	0.70	0.25	86	2.5	10.4	827	3.9%	6.9	2.0	12.4	2.7	3.8	4.4	6.4	6.7	5.26	7.96	10.13	15.99	18.03	
B	4.04	0.50	0.55	0.60	0.65	0.70	0.25	312	16	16.4	504	4.6%	7.5	1.1	17.5	2.3	3.2	3.8	5.5	5.7	4.73	7.16	9.11	14.38	16.21	
C	4.73	0.50	0.55	0.60	0.65	0.70	0.25	245	19	12.7	773	3.4%	6.4	2.0	14.7	2.5	3.5	4.1	5.9	6.2	6.01	9.10	11.58	18.28	20.62	
D	0.62	0.50	0.55	0.60	0.65	0.70	0.25	261	8	17.7	177	2.8%	5.9	0.5	18.2	2.3	3.2	3.7	5.4	5.6	0.71	1.08	1.37	2.16	2.44	
E	2.70	0.50	0.55	0.60	0.65	0.70	0.25	121	2.5	13.8	754	2.7%	5.7	2.2	16.0	2.4	3.4	3.9	5.7	6.0	3.30	5.00	6.36	10.04	11.32	
F	0.47	0.50	0.55	0.60	0.65	0.70	0.25	354	13	19.5	0	0.0%	0.0	0.0	19.5	2.2	3.1	3.6	5.2	5.4	0.52	0.79	1.01	1.59	1.79	
G	2.58	0.50	0.55	0.60	0.65	0.70	0.25	107	5	9.9	535	4.4%	7.4	1.2	11.1	2.9	3.9	4.6	6.7	7.0	3.69	5.59	7.11	11.23	12.66	
H	1.64	0.50	0.55	0.60	0.65	0.70	0.25	183	10	12.3	536	3.2%	6.2	1.4	13.7	2.6	3.6	4.2	6.1	6.4	2.15	3.25	4.14	6.53	7.37	
I	0.60	0.50	0.55	0.60	0.65	0.70	0.25	0	0	0.0	658	4.3%	7.3	1.5	5.0	3.7	5.1	6.0	8.7	9.1	1.11	1.68	2.14	3.38	3.82	
J	0.93	0.50	0.55	0.60	0.65	0.70	0.25	121	2	14.8	608	4.4%	7.4	1.4	16.2	2.4	3.3	3.9	5.7	5.9	1.13	1.71	2.18	3.43	3.87	
K	2.74	0.50	0.55	0.60	0.65	0.70	0.25	472	22	20.8	0	0.0%	0.0	0.0	20.8	2.1	3.0	3.4	5.0	5.3	2.94	4.45	5.67	8.95	10.09	
L	4.07	0.50	0.55	0.60	0.65	0.70	0.25	0	0	0.0	1139	2.8%	5.9	3.2	5.0	3.7	5.1	6.0	8.7	9.1	7.55	11.43	14.54	22.96	25.89	
M	1.95	0.50	0.55	0.60	0.65	0.70	0.25	112	6.2	9.6	860	2.8%	5.8	2.5	12.0	2.8	3.8	4.4	6.5	6.8	2.70	4.09	5.21	8.22	9.27	
N	1.04	0.50	0.55	0.60	0.65	0.70	0.25	65	7	5.8	0	0.0%	0.0	0.0	5.8	3.6	4.9	5.7	8.3	8.7	1.85	2.80	3.56	5.63	6.34	
O	0.84	0.50	0.55	0.60	0.65	0.70	0.25	0	0	0.0	686	4.7%	7.6	1.5	5.0	3.7	5.1	6.0	8.7	9.1	1.56	2.36	3.00	4.74	5.34	
OFFSITE	44.78	0.51	0.57	0.62	0.67	0.72									16.0	2.4	3.4	3.9	5.7	6.0	56.24	85.13	108.35	171.04	192.86	

Note: Off-site's time of concentration of 16 minutes is taken from Addendum no. 1 to the FDR for Northgate Village Filing No. 1 (Regional Detention Facility No. 9)

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: BHY
Date: _____
Checked by: BHY

**Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Off-Site Area Drainage Summary)**

From Area Runoff Coefficient Summary							OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T _t)	INTENSITY *					TOTAL FLOWS						
BASIN	AREA TOTAL (Acres)	C ₂	C ₅	C ₁₀	C ₅₀	C ₁₀₀	C _s	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _t (min)	TOTAL (min)	I ₂	I ₅	I ₁₀	I ₅₀	I ₁₀₀	Q ₂	Q ₅	Q ₁₀	Q ₅₀	Q ₁₀₀		
		From DCM Table 5-1														(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)	(c.f.s.)		
12A	3.84	0.13	0.15	0.16	0.18	0.20	0.15								25.0	1.9	2.7	3.1	4.6	4.8	0.97	1.54	1.92	3.15	3.67		
12B	4.04	0.13	0.15	0.16	0.18	0.20	0.15								16.0	2.4	3.4	3.9	5.7	6.0	1.28	2.04	2.53	4.15	4.83		
16	4.73	0.13	0.15	0.16	0.18	0.20	0.15								16.0	2.4	3.4	3.9	5.7	6.0	1.50	2.38	2.97	4.86	5.66		

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: BHY
Date: _____
Checked by: BHY

**Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Pipe Routing Summary)**

Pipe Run	Contributing Basins/Design Points	Equivalent CA ₅	Equivalent CA ₁₀₀	Maximum T _c	Intensity *		Flow		Pipe Size (RCP)
					I ₅	I ₁₀₀	Q ₅	Q ₁₀₀	
1	A	2.11	2.69	12.4	3.8	6.7	8.0	18.0	18"
2	A, B	4.33	5.52	17.5	3.2	5.7	14.0	31.6	24"
2A	E	1.49	1.89	17.5	3.2	5.7	4.8	10.8	18"
2B	A, B, E	5.82	7.41	17.5	3.2	5.7	18.7	42.5	36"
3	D	0.34	0.43	18.2	3.2	5.6	1.1	2.4	18"
4	D	0.34	0.43	18.2	3.2	5.6	1.1	2.4	18"
5	D, F	0.60	0.76	19.5	3.1	5.4	1.8	4.1	18"
6	DP 1-4, 7, 8	9.02	11.48	19.5	3.1	5.4	27.6	62.4	36"
7	G	1.42	1.81	11.1	3.9	7.0	5.6	12.7	18"
8	G, H	2.32	2.95	16.0	3.4	6.0	7.8	17.7	18"
9	DP 1-9	11.80	15.02	19.5	3.1	5.4	36.1	81.7	42"
11	I	0.33	0.42	5.0	5.1	9.1	1.7	3.8	18"
12	I, J	0.84	1.07	16.2	3.3	5.9	2.8	6.4	18"
13	OUTLET	FROM DETENTION POND OUTLET (SEE HYDROLOGIC STUDY)					14.7	85.7	42"
14	L	2.24	2.85	5.0	5.1	9.1	11.4	25.9	24"

* Intensity equations assume a minimum travel time of 5 minutes.
 DP - Design Point FB- Flow By from Design Point
 EX - Existing Design Point INT- Intercepted Flow from Design Point

Calculated by: BHY
 Date: _____
 Checked by: BHY

*Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Inlet Calculations - Sump Condition)*

Design Point 3

Total Flow: Q_5 = 1.1 cfs
 Q_{100} = 2.4 cfs

Maximum allowable ponding depth at sump:

D_{max_5} = 0.50'
 $D_{max_{100}}$ = 0.67'

$$Q_i = 1.7(L_i + 1.8(W))(D_{max} + w/12)^{1.85}$$

where: W = 3 feet
 w = 4 inches

Clogging Factor = 1.25
 $L_i(1.25)$ = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

*(Install a 4' D-10-R inlet to accept both 5 yr. & 100 yr.
developed flows at this design point.)*

Calculated by: BHY
Date: _____
Checked by: BHY

***Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Inlet Calculations - Sump Condition)***

Design Point 8

Total Flow: Q_5 = 9.1 cfs
 Q_{100} = 20.6 cfs

Maximum allowable ponding depth at sump:

D_{max_5} = 0.50'
 $D_{max_{100}}$ = 0.67'

$$Q_i = 1.7(L_i + 1.8(W))(D_{max} + w/12)^{1.85}$$

where: W = 3 feet
 w = 4 inches

Clogging Factor = 1.25
 $L_i(1.25)$ = Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 10 foot inlet required

***(Install a 10' D-10-R inlet to accept both 5 yr. & 100 yr.
developed flows at this design point.)***

Calculated by: BHY
Date:
Checked by: BHY

Stonewater at Northgate Filing No. 1
(Inlet Calculations - Sump Condition)

Design Point 9

Total Flow:

$$Q_5 = 2.4 \text{ cfs}$$
$$Q_{100} = 5.3 \text{ cfs}$$

Maximum allowable ponding depth at sump:

$$D_{\max_5} = 0.50'$$
$$D_{\max_{100}} = 0.67'$$

$$Q_i = 1.7(L_i + 1.8(W))(D_{\max} + w/12)^{1.85}$$

where: $W = 3$ feet
 $w = 4$ inches

Clogging Factor = 1.25
 $L_i(1.25) =$ Length of inlet opening

5-Year Event: 4 foot inlet required

100-Year Event: 4 foot inlet required

*(Install a 4' D-10-R inlet to accept both 5 yr. & 100 yr.
developed flows at this design point.)*

Calculated by: BHY
Date: _____
Checked by: BHY

Final Drainage Report for Stonewater at Northgate Filing No. 1 (Inlet Calculations - At-Grade)

Proposed 14' Inlet at DP-1

5-YR FLOW					
	Q(5)	8.0 cfs	I(5)	3.8	Inlet size (Li) = 14 feet
	Q overtop	26.1 cfs			
	Depth	0.29'	Fw	2.79	Li >= L(2) then Qi = 4.9 cfs Qi- CA(eqv.) = 1.30
	Spread	10.3'	L(1)	22.0	Flow-by = 3.1 cfs FB- CA(eqv.) = 0.81
	CROSS SLOPE	2.0%	L(2)	13.2	
	STREET SLOPE	5.3%	L(3)	47.2	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	18.0 cfs	I(100)	6.7 cfs	Inlet size (Li) = 14 feet
	Q overtop	26.1 cfs			
	Depth	0.38'	Fw	2.99	Li < L(2) then Qi = 7.6 cfs Qi- CA(eqv.) = 1.13
	Spread	14.5'	L(1)	33.3	Flow-by = 10.5 cfs FB- CA(eqv.) = 1.56
	CROSS SLOPE	2.0%	L(2)	20.1	
	STREET SLOPE	5.3%	L(3)	71.6	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

***Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Inlet Calculations - At-Grade)***

Proposed 14' Inlet at DP-2

5-YR FLOW					
	Q(5)	7.2 cfs	I(5)	3.2	Inlet size (Li) = 14 feet
	Q overtop	20.6 cfs			
	Depth	0.30'	Fw	2.23	Li >= L(2) then Qi = 4.7 cfs Qi- CA(eqv.) = 1.46
	Spread	10.9'	L(1)	18.6	Flow-by = 2.5 cfs FB- CA(eqv.) = 0.76
	CROSS SLOPE	2.0%	L(2)	11.2	
	STREET SLOPE	3.3%	L(3)	40.0	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	16.2 cfs	I(100)	5.7	Inlet size (Li) = 14 feet
	Q overtop	20.6 cfs			
	Depth	0.39'	Fw	2.39	Li < L(2) then Qi = 8.0 cfs Qi- CA(eqv.) = 1.40
	Spread	15.4'	L(1)	28.2	Flow-by = 8.2 cfs FB- CA(eqv.) = 1.42
	CROSS SLOPE	2.0%	L(2)	17.0	
	STREET SLOPE	3.3%	L(3)	60.6	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

Final Drainage Report for Stonewater at Northgate Filing No. 1 (Inlet Calculations - At-Grade)

Proposed 4' Inlet at DP-4

5-YR FLOW					
	Q(5)	0.8 cfs	I(5)	3.1	Inlet size (Li) = 4 feet
	Q overtop	18.2 cfs			
	Depth	0.16'	Fw	1.47	Li >= L(2) then Qi = 0.6 cfs Qi- CA(eqv.) = 0.19
	Spread	3.5'	L(1)	4.0	Flow-by = 0.2 cfs FB- CA(eqv.) = 0.07
	CROSS SLOPE	2.0%	L(2)	2.4	
	STREET SLOPE	2.6%	L(3)	8.5	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	1.8 cfs	I(100)	5.4	Inlet size (Li) = 4 feet
	Q overtop	18.2 cfs			
	Depth	0.20'	Fw	1.72	Li < L(2) then Qi = 0.9 cfs Qi- CA(eqv.) = 0.17
	Spread	5.9'	L(1)	7.8	Flow-by = 0.9 cfs FB- CA(eqv.) = 0.16
	CROSS SLOPE	2.0%	L(2)	4.7	
	STREET SLOPE	2.6%	L(3)	16.7	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

***Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Inlet Calculations - At-Grade)***

Proposed 12' Inlet at DP-5

<i>5-YR FLOW</i>					
	Q(5)	5.6 cfs	I(5)	3.9	Inlet size (Li) = 12 feet
	Q overtop	46.9 cfs			Li < L(2) then Qi = 3.0 cfs
	Depth	0.22'	Fw	4.55	Qi- CA(eqv.) = 0.75
	Spread	6.5'	L(1)	22.7	Flow-by = 2.6 cfs
	CROSS SLOPE	2.0%	L(2)	13.7	FB- CA(eqv.) = 0.67
	STREET SLOPE	17.2%	L(3)	48.8	Overtop Flow-By = 0
					Overtop FB- CA(eqv.) = 0.00

<i>100-YR FLOW</i>					
	Q(100)	12.7 cfs	I(100)	7.0	Inlet size (Li) = 12 feet
	Q overtop	46.9 cfs			Li < L(2) then Qi = 4.1 cfs
	Depth	0.28'	Fw	4.98	Qi- CA(eqv.) = 0.58
	Spread	9.8'	L(1)	37.3	Flow-by = 8.6 cfs
	CROSS SLOPE	2.0%	L(2)	22.4	FB- CA(eqv.) = 1.23
	STREET SLOPE	17.2%	L(3)	80.1	Overtop Flow-By = 0
					Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

Final Drainage Report for Stonewater at Northgate Filing No. 1 (Inlet Calculations - At-Grade)

Proposed 12' Inlet at DP-6

5-YR FLOW			
Q(5)	3.3 cfs	I(5)	3.6
			Inlet size (Li) = 12 feet
Q overtop	14.8 cfs		
Depth	0.26'	Fw	1.54
			Li >= L(2) then Qi = 2.5 cfs
Spread	8.8'	L(1)	10.3
			Qi- CA(eqv.) = 0.71
CROSS SLOPE	2.0%	L(2)	6.2
			Flow-by = 0.7 cfs
STREET SLOPE	1.7%	L(3)	22.2
			FB- CA(eqv.) = 0.20
			Overtop Flow-By = 0
			Overtop FB- CA(eqv.) = 0.00

100-YR FLOW			
Q(100)	7.4 cfs	I(100)	6.4
			Inlet size (Li) = 12 feet
Q overtop	14.8 cfs		
Depth	0.34'	Fw	1.66
			Li >= L(2) then Qi = 4.8 cfs
Spread	12.6'	L(1)	16.1
			Qi- CA(eqv.) = 0.75
CROSS SLOPE	2.0%	L(2)	9.7
			Flow-by = 2.5 cfs
STREET SLOPE	1.7%	L(3)	34.6
			FB- CA(eqv.) = 0.40
			Overtop Flow-By = 0
			Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

Final Drainage Report for Stonewater at Northgate Filing No. 1 (Inlet Calculations - At-Grade)

Proposed 14' Inlet at DP-7

5-YR FLOW					
	Q(5)	5.0 cfs	I(5)	3.4	Inlet size (Li) = 14 feet
	Q overtop	13.9 cfs			
	Depth	0.31'	Fw	1.51	Li >= L(2) then Qi = 3.8 cfs Qi- CA(eqv.) = 1.14
	Spread	11.0'	L(1)	12.7	Flow-by = 1.2 cfs FB- CA(eqv.) = 0.35
	CROSS SLOPE	2.0%	L(2)	7.7	
	STREET SLOPE	1.5%	L(3)	27.4	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	11.3 cfs	I(100)	11.3	Inlet size (Li) = 14 feet
	Q overtop	13.9 cfs			
	Depth	0.40'	Fw	1.61	Li >= L(2) then Qi = 7.3 cfs Qi- CA(eqv.) = 0.65
	Spread	15.6'	L(1)	19.4	Flow-by = 4.0 cfs FB- CA(eqv.) = 0.35
	CROSS SLOPE	2.0%	L(2)	11.7	
	STREET SLOPE	1.5%	L(3)	41.6	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

***Final Drainage Report for
Stonewater at Northgate Filing No. 1
(Inlet Calculations - At-Grade)***

Proposed 12' Inlet at DP-11

5-YR FLOW					
	Q(5)	1.7 cfs	I(5)	5.1	Inlet size (Li) = 12 feet
	Q overtop	22.6 cfs			
	Depth	0.19'	Fw	2.05	Li >= L(2) then Qi = 1.5 cfs Qi- CA(eqv.) = 0.29
	Spread	5.0'	L(1)	7.9	Flow-by = 0.2 cfs FB- CA(eqv.) = 0.04
	CROSS SLOPE	2.0%	L(2)	4.7	
	STREET SLOPE	4.0%	L(3)	16.9	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	3.8 cfs	I(100)	9.1	Inlet size (Li) = 12 feet
	Q overtop	22.6 cfs			
	Depth	0.24'	Fw	2.28	Li >= L(2) then Qi = 2.7 cfs Qi- CA(eqv.) = 0.29
	Spread	7.8'	L(1)	13.6	Flow-by = 1.1 cfs FB- CA(eqv.) = 0.13
	CROSS SLOPE	2.0%	L(2)	8.2	
	STREET SLOPE	4.0%	L(3)	29.2	Overtop Flow-By = 0 Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
Date: _____
Checked by: _____

Final Drainage Report for Stonewater at Northgate Filing No. 1 (Inlet Calculations - At-Grade)

Proposed 12' Inlet at DP-12

5-YR FLOW					
	Q(5)	1.7 cfs	I(5)	3.3	Inlet size (Li) = 12 feet
	Q overtop	22.6 cfs			Li >= L(2) then Qi = 1.5 cfs
	Depth	0.19'	Fw	2.05	Qi- CA(eqv.) = 0.45
	Spread	5.0'	L(1)	7.9	Flow-by = 0.2 cfs
	CROSS SLOPE	2.0%	L(2)	4.7	FB- CA(eqv.) = 0.07
	STREET SLOPE	4.0%	L(3)	16.9	Overtop Flow-By = 0
					Overtop FB- CA(eqv.) = 0.00

100-YR FLOW					
	Q(100)	3.9 cfs	I(100)	5.9	Inlet size (Li) = 12 feet
	Q overtop	22.6 cfs			Li >= L(2) then Qi = 2.7 cfs
	Depth	0.24'	Fw	2.29	Qi- CA(eqv.) = 0.45
	Spread	7.9'	L(1)	13.9	Flow-by = 1.2 cfs
	CROSS SLOPE	2.0%	L(2)	8.3	FB- CA(eqv.) = 0.20
	STREET SLOPE	4.0%	L(3)	29.8	Overtop Flow-By = 0
					Overtop FB- CA(eqv.) = 0.00

Calculated by: _____
 Date: _____
 Checked by: _____

Emergency Spillway for Detention Pond A

Given: 100-year inflow into pond = 91.4 cfs
100-year surface elevation = 6715.92 feet

Calculate:

Using Broad Crested Weir formula,

$$Q = C \times L \times H^{1.5}$$

Where, Q = 91.4 c.f.s.
C = 3.71
L = ? Feet
H = 1 foot

total runoff into the pond
coefficient of discharge
Length of broad crest weir
head of water
(top of bank=6788.0)

$$91.4 = 3.71 \times L \times 1^{1.5}$$

$$L = 24.7 \text{ feet}$$

$$L = 25 \text{ feet required}$$

Therefore, the dimensions for the broad crested weir is 25' long by 1' depth.
See Rip Rap calculations for rip rap design

STONEWATER AT NORTHGATE FILING NO. 1

15-Aug-07

ECE

PROJECT NO.: 1010

CALCULATED BY: BHY

CHECKED BY: BHY

OBJECTIVE: SIZE RIP RAP AT ALL DESIGN POINTS AND OUTLET LOCATIONS. USE THE METHOD FOUND IN THE UDFCD MANUAL VOL. 2, SECTION 3.4.3.2

AT #X-3

GIVEN $Q_{design}=Q_{100}=62.4$ CFS
 $A=PI \times r^2 = 7.07$ s.f. (36" DIA. PIPE)
 $Pd=(v^2+gd)/2$ (eq. HS-16, UDFCD Vol. 2)
 $g = 32.2$ ft/sec²
 $d = 1.0'$
 $T = 1.75$ D50 (eq.HS-17, UDFCD Vol. 2)
 $L = 4D$ or $L = D/2 (v/2)$ (EQ HS-19, UDFCD Vol.2)
 $W = 4D$ (Eq HS-20, UDFCD Vol. 2)

THEN: $V = Q/A = 62.4/7.07 = 8.83$ fps
 $Pd = (8.83 + 32.2 \times 1.0)/2 = 10.5'$ So use Type "M" (D50 = 12") as a minimum
 $T = 1.75(1) = 1.75'$ thick rip rap layer
 $L = 4(3) = 12'$ or $L = 3.0/2(8.83/2) = 7.65'$
So use $L = 12'$
 $W = 4(3.0) = 12'$
So use Type M rip rap in a pad measuring 12ft wide X 12ft long X 2ft thick

AT #T-1

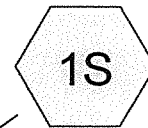
GIVEN $Q_{design}=Q_{100}=6.4$ CFS
 $A=PI \times r^2 = 1.77$ s.f. (18" DIA. PIPE)
 $Pd=(v^2+gd)/2$ (eq. HS-16, UDFCD Vol. 2)
 $g = 32.2$ ft/sec²
 $d = 1.0'$
 $T = 1.75$ D50 (eq.HS-17, UDFCD Vol. 2)
 $L = 4D$ or $L = D/2 (v/2)$ (EQ HS-19, UDFCD Vol.2)
 $W = 4D$ (Eq HS-20, UDFCD Vol. 2)

THEN: $V = Q/A = 6.4/1.77 = 3.62$ fps
 $Pd = (3.62 + 32.2 \times 1.0)/2 = 6.0'$ So use Type M (D50 = 12") as a minimum
 $T = 1.75(1) = 1.75'$ thick rip rap layer
 $L = 4(1.5) = 6.0'$ or $L = 1.5/2(3.62/2) = 1.35'$
So use $L = 6'$
 $W = 4(1.5) = 6.0'$ Use $W=6'$

So use Type M rip rap in a pad measuring 6ft wide X 6ft long X 2ft thick



On-site



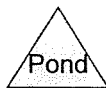
Tributary Areas



Regional Pond No. 9



(new Reach)



1010-hydro-1

colorado springs 2-Year Duration=60 min, Inten=1.15 in/hr

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Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Tributary Areas

Runoff Area=44.780 ac Runoff Depth=0.83"
Tc=16.0 min C=0.72 Runoff=37.39 cfs 3.090 af

Subcatchment 3S: On-site

Runoff Area=21.120 ac Runoff Depth=0.81"
Tc=0.0 min C=0.70 Runoff=17.14 cfs 1.431 af

Reach 4R: (new Reach)

Peak Depth=0.68' Max Vel=24.3 fps Inflow=29.15 cfs 3.791 af
D=36.0" n=0.010 L=33.0' S=0.0900 '/' Capacity=260.12 cfs Outflow=29.15 cfs 3.757 af

Pond 2P: Regional Pond No. 9

Peak Elev=6,713.05' Storage=97,727 cf Inflow=37.39 cfs 3.090 af
Outflow=12.42 cfs 2.360 af

Total Runoff Area = 65.900 ac Runoff Volume = 4.521 af Average Runoff Depth = 0.82"

1010-hydro-1

colorado springs 2-Year Duration=60 min, Inten=1.15 in/hr

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Subcatchment 1S: Tributary Areas

Tributary areas taken from MDDP for Northgate Software Campus, Last dated January 28, 1999.

Runoff = 37.39 cfs @ 0.27 hrs, Volume= 3.090 af, Depth= 0.83"

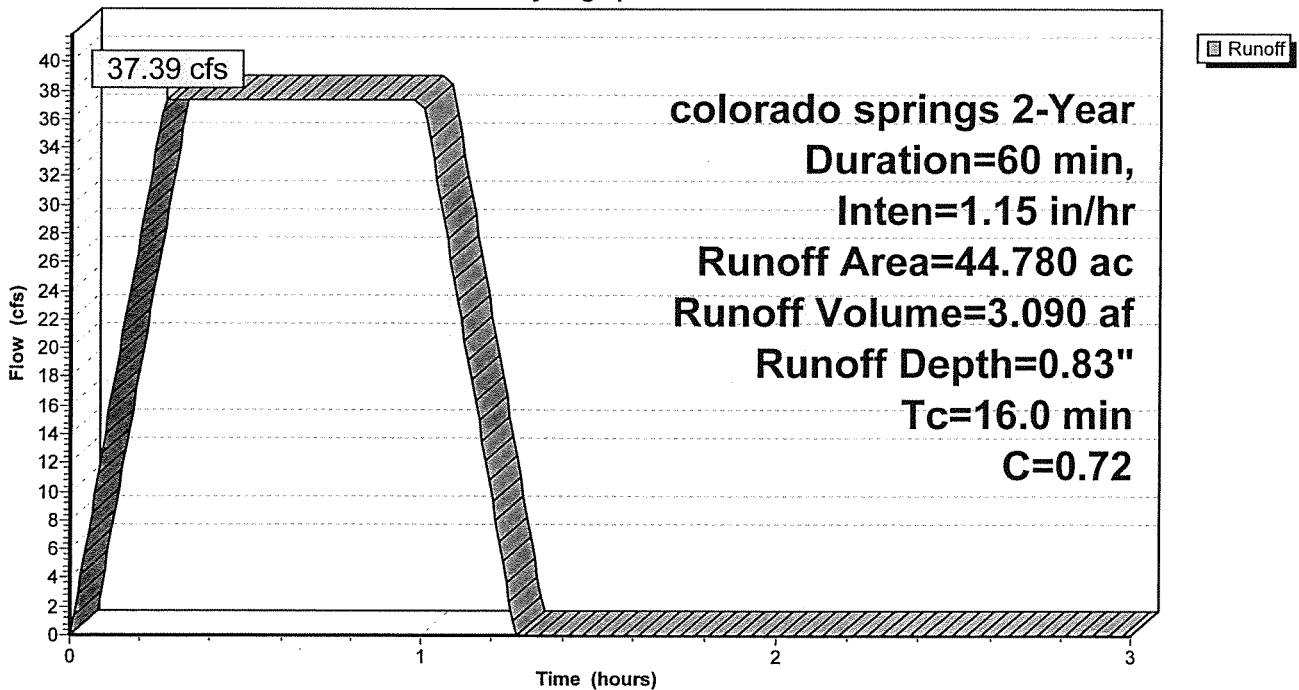
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 2-Year Duration=60 min, Inten=1.15 in/hr

Area (ac)	C	Description
4.270	0.70	Onsite into Pond
4.110	0.90	OS-4
4.300	0.71	2
4.000	0.74	2
24.000	0.70	OS-3
1.820	0.70	H
2.280	0.70	N
44.780	0.72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					Direct Entry,

Subcatchment 1S: Tributary Areas

Hydrograph



Subcatchment 3S: On-site

Runoff = 17.14 cfs @ 0.00 hrs, Volume= 1.431 af, Depth= 0.81"

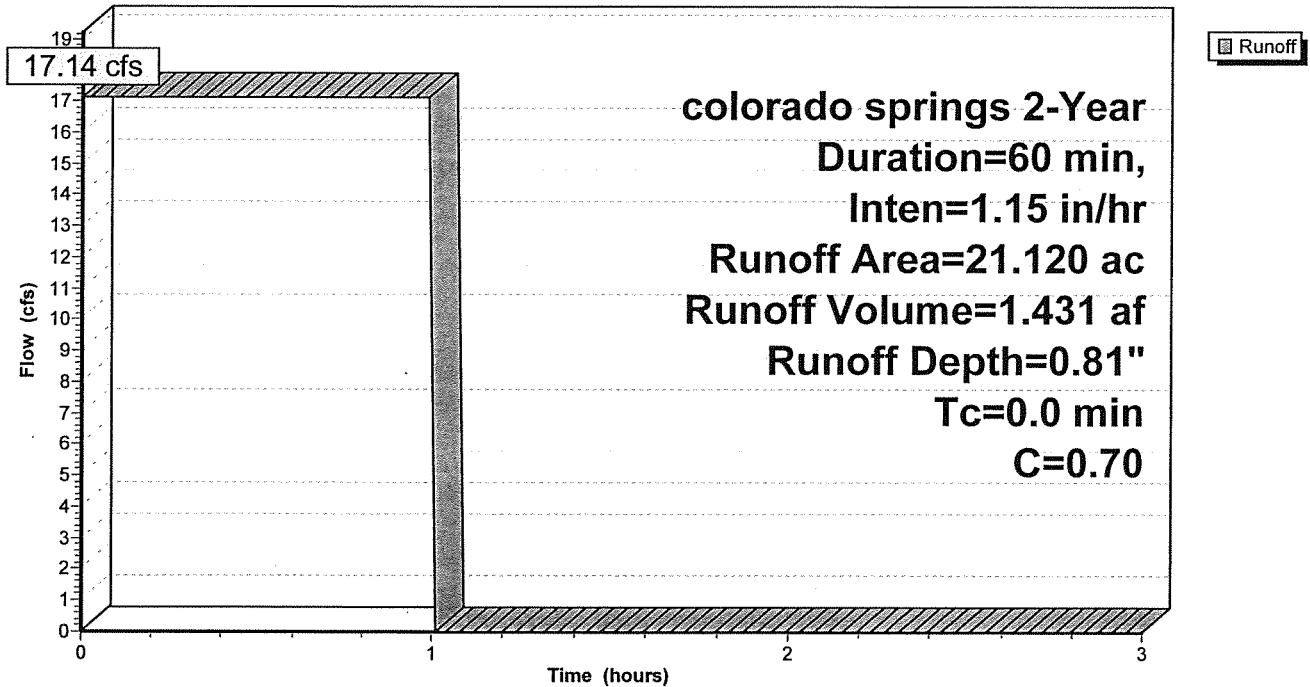
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 colorado springs 2-Year Duration=60 min, Inten=1.15 in/hr

Area (ac)	C	Description
21.120	0.70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					Direct Entry, 19.5

Subcatchment 3S: On-site

Hydrograph



Reach 4R: (new Reach)

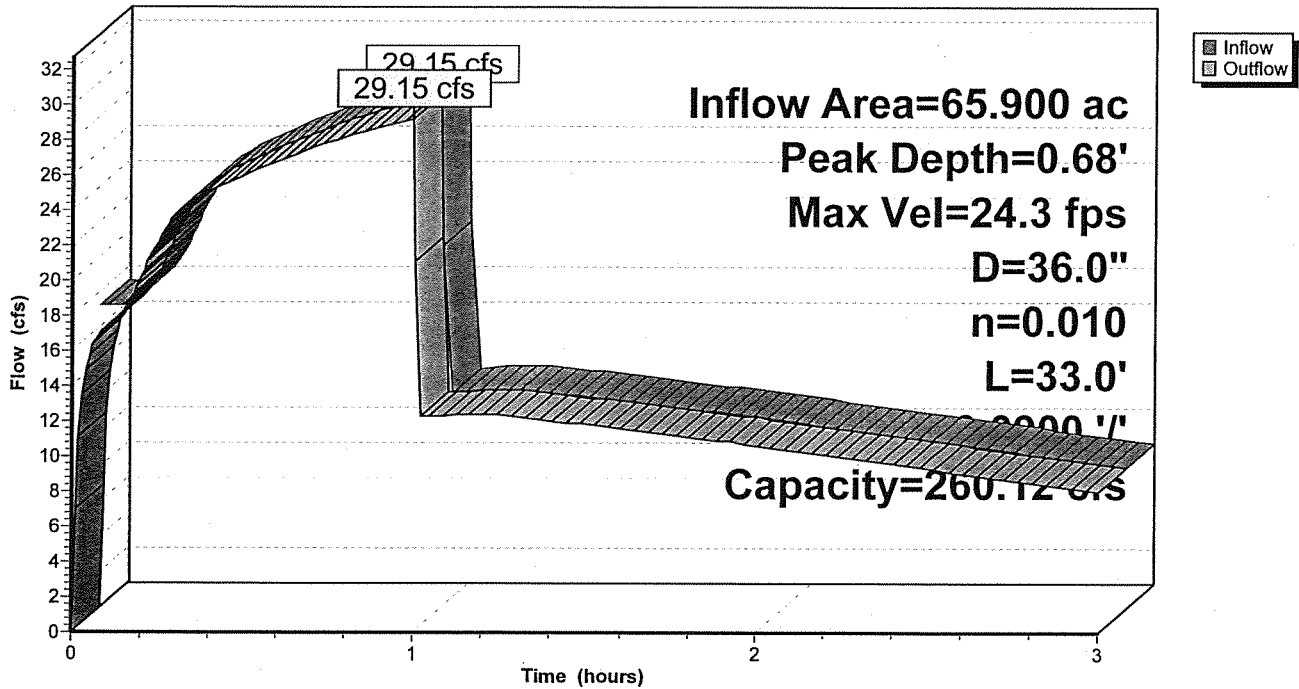
Inflow Area = 65.900 ac, Inflow Depth = 0.69" for 2-Year event
 Inflow = 29.15 cfs @ 1.00 hrs, Volume= 3.791 af
 Outflow = 29.15 cfs @ 1.00 hrs, Volume= 3.757 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 2
 Max. Velocity= 24.3 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 19.6 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.68' @ 1.00 hrs
 Capacity at bank full= 260.12 cfs
 Inlet Invert= 6,688.00', Outlet Invert= 6,685.03'
 36.0" Diameter Pipe n= 0.010 Length= 33.0' Slope= 0.0900 '/'

Reach 4R: (new Reach)

Hydrograph



Pond 2P: Regional Pond No. 9

Inflow Area = 44.780 ac, Inflow Depth = 0.83" for 2-Year event
 Inflow = 37.39 cfs @ 0.27 hrs, Volume= 3.090 af
 Outflow = 12.42 cfs @ 1.18 hrs, Volume= 2.360 af, Atten= 67%, Lag= 54.5 min
 Primary = 12.42 cfs @ 1.18 hrs, Volume= 2.360 af

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 Peak Elev= 6,713.05' @ 1.18 hrs Surf.Area= 27,996 sf Storage= 97,727 cf
 Plug-Flow detention time= 64.7 min calculated for 2.360 af (76% of inflow)
 Center-of-Mass det. time= 57.4 min (95.4 - 38.0)

#	Invert	Avail.Storage	Storage Description
1	6,708.00'	189,296 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,708.00	0	0	0
6,710.00	21,445	21,445	21,445
6,712.00	25,662	47,107	68,552
6,714.00	30,125	55,787	124,339
6,716.00	34,832	64,957	189,296

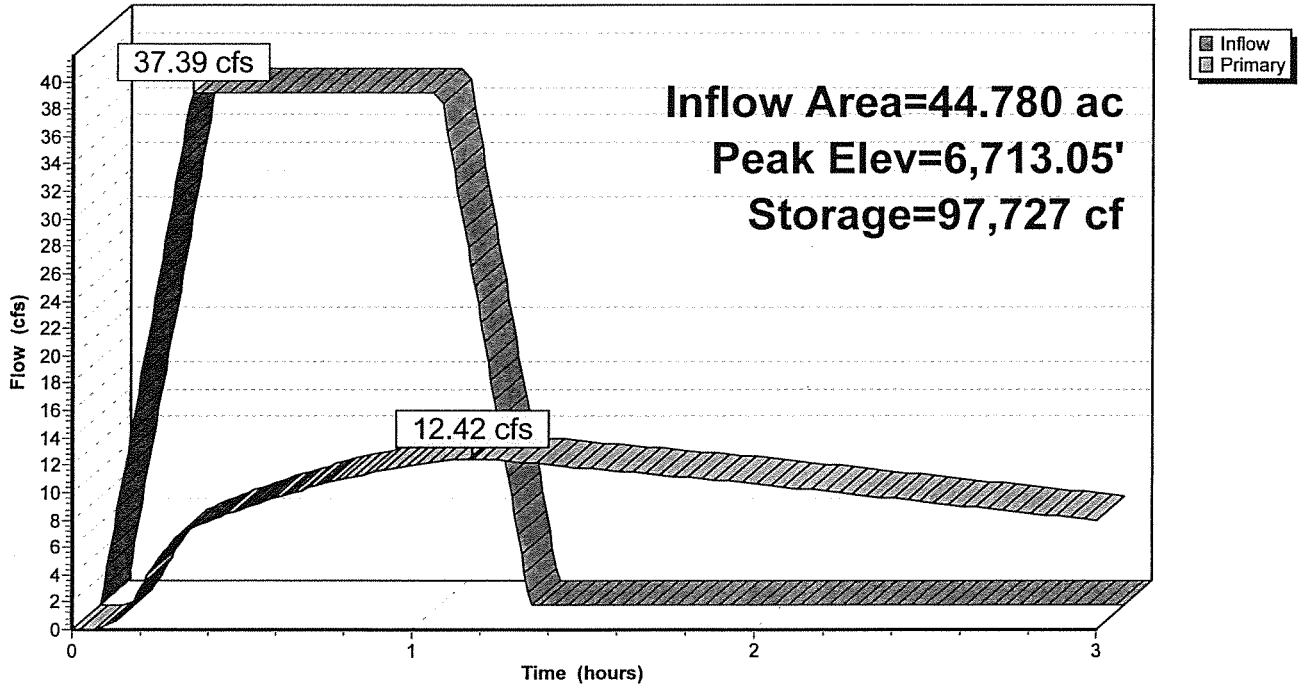
#	Routing	Invert	Outlet Devices
1	Primary	6,708.00'	15.0" Vert. Orifice/Grate C= 0.600
2	Primary	6,714.50'	48.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600

Primary OutFlow Max=12.42 cfs @ 1.18 hrs HW=6,713.05' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 12.42 cfs @ 10.1 fps)
- 2=Orifice/Grate (Controls 0.00 cfs)

Pond 2P: Regional Pond No. 9

Hydrograph



1010-hydro-1

colorado springs 5-Year Duration=60 min, Inten=1.58 in/hr

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Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Tributary Areas

Runoff Area=44.780 ac Runoff Depth=1.14"
Tc=16.0 min C=0.72 Runoff=51.37 cfs 4.245 af

Subcatchment 3S: On-site

Runoff Area=21.120 ac Runoff Depth=1.12"
Tc=0.0 min C=0.70 Runoff=23.55 cfs 1.966 af

Reach 4R: (new Reach)

Peak Depth=0.77' Max Vel=26.2 fps Inflow=37.43 cfs 4.788 af
D=36.0" n=0.010 L=33.0' S=0.0900 '/' Capacity=260.12 cfs Outflow=37.42 cfs 4.737 af

Pond 2P: Regional Pond No. 9

Peak Elev=6,714.53' Storage=141,638 cf Inflow=51.37 cfs 4.245 af
Outflow=14.69 cfs 2.822 af

Total Runoff Area = 65.900 ac Runoff Volume = 6.211 af Average Runoff Depth = 1.13"

Subcatchment 1S: Tributary Areas

Tributary areas taken from MDDP for Northgate Software Campus, Last dated January 28, 1999.

Runoff = 51.37 cfs @ 0.27 hrs, Volume= 4.245 af, Depth= 1.14"

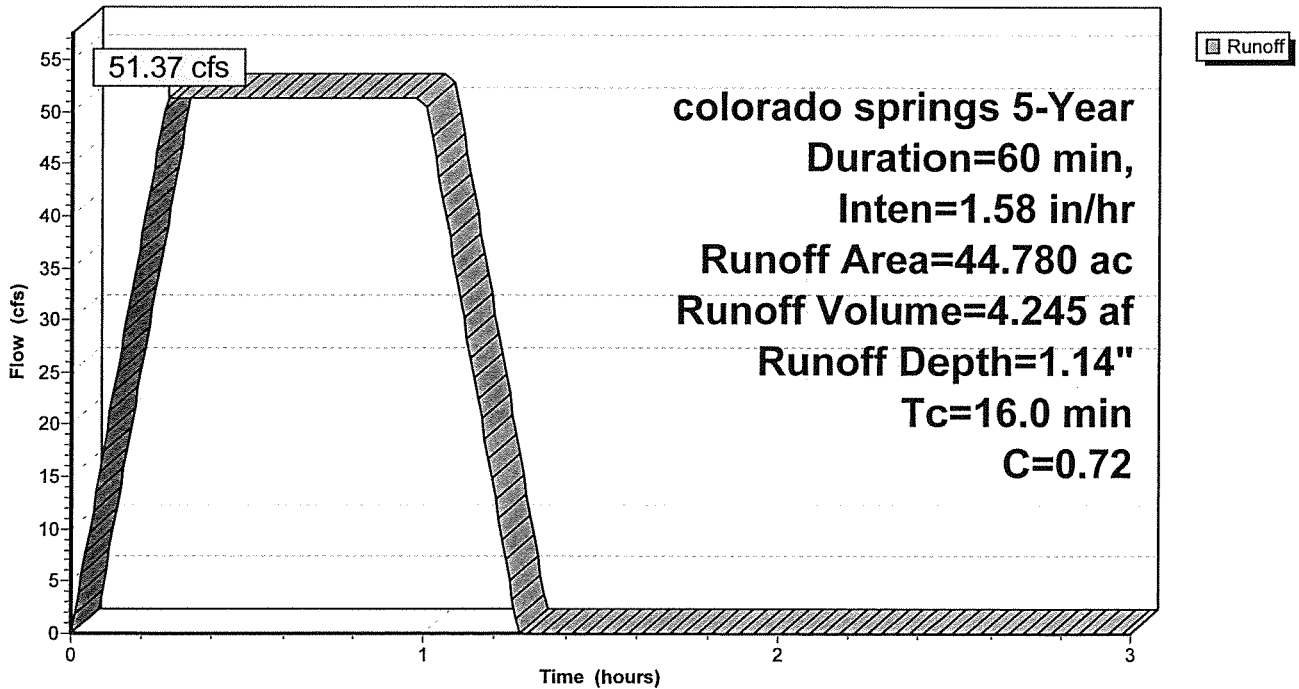
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 colorado springs 5-Year Duration=60 min, Inten=1.58 in/hr

Area (ac)	C	Description
4.270	0.70	Onsite into Pond
4.110	0.90	OS-4
4.300	0.71	2
4.000	0.74	2
24.000	0.70	OS-3
1.820	0.70	H
2.280	0.70	N
44.780	0.72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					Direct Entry,

Subcatchment 1S: Tributary Areas

Hydrograph



1010-hydro-1

colorado springs 5-Year Duration=60 min, Inten=1.58 in/hr

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Subcatchment 3S: On-site

Runoff = 23.55 cfs @ 0.00 hrs, Volume= 1.966 af, Depth= 1.12"

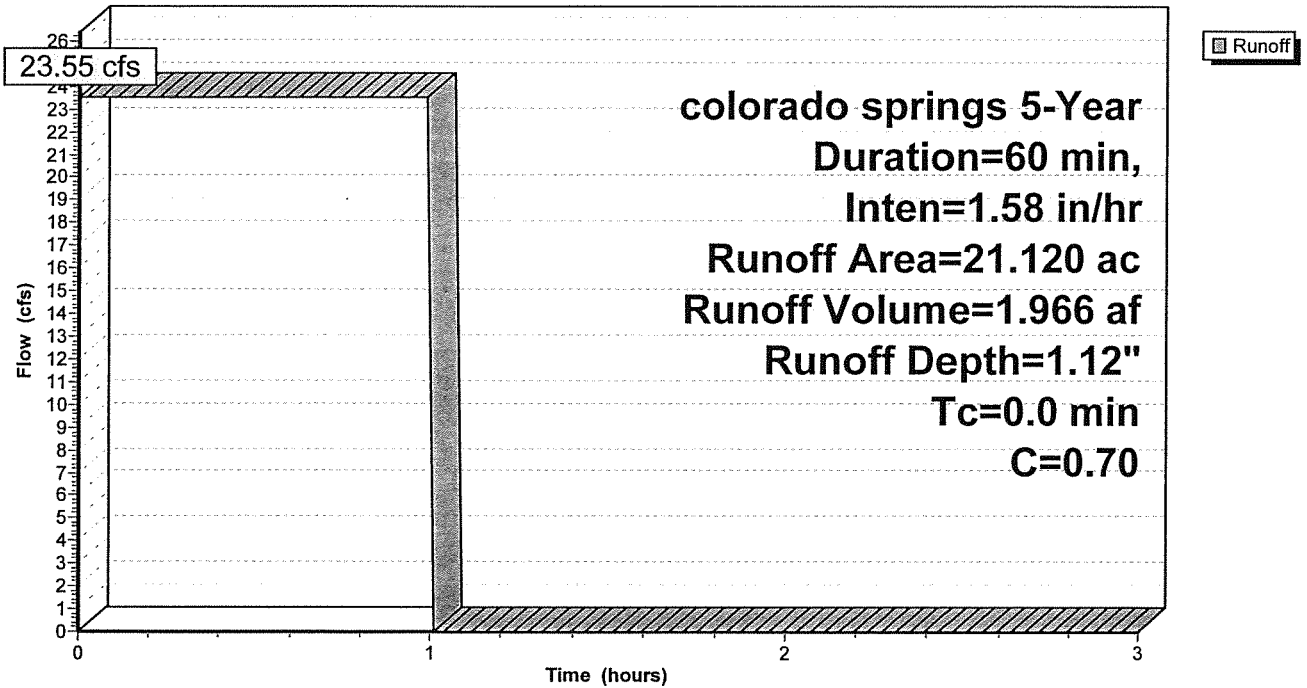
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 5-Year Duration=60 min, Inten=1.58 in/hr

Area (ac)	C	Description
21.120	0.70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					Direct Entry, 19.5

Subcatchment 3S: On-site

Hydrograph



Reach 4R: (new Reach)

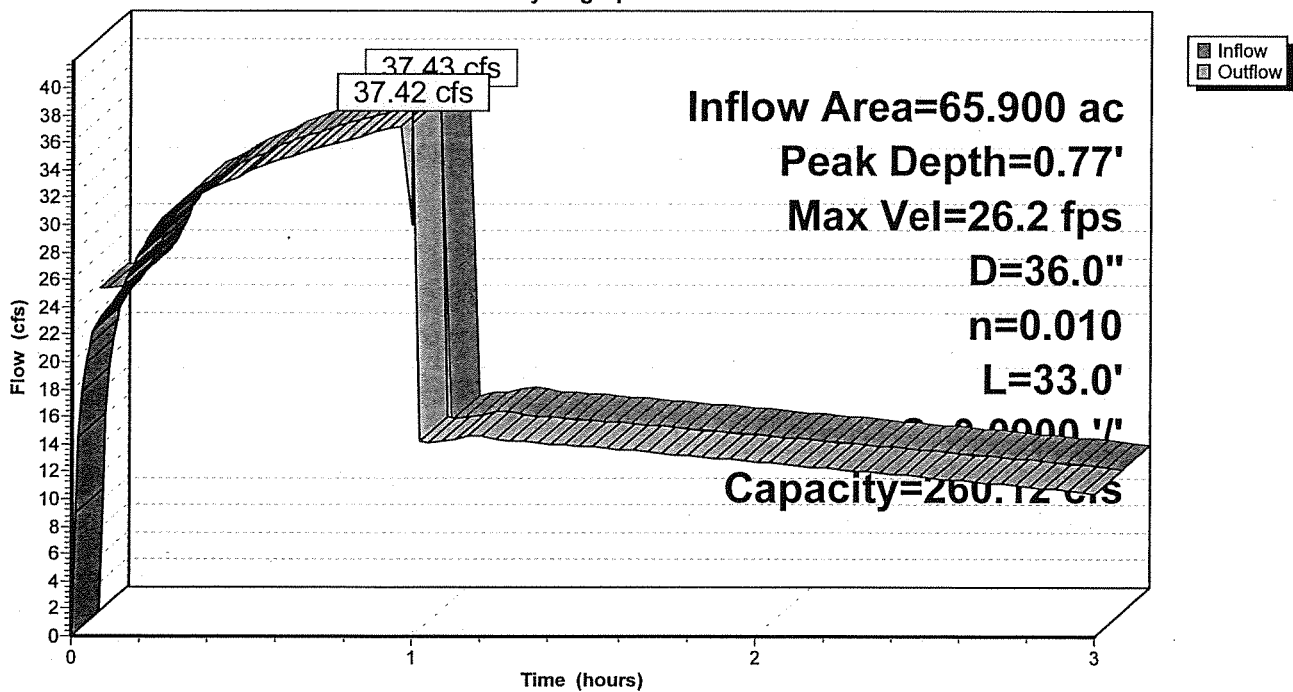
Inflow Area = 65.900 ac, Inflow Depth = 0.87" for 5-Year event
 Inflow = 37.43 cfs @ 1.00 hrs, Volume= 4.788 af
 Outflow = 37.42 cfs @ 1.00 hrs, Volume= 4.737 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 2
 Max. Velocity= 26.2 fps, Min. Travel Time= 0.0 min
 Avg. Velocity= 21.0 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.77' @ 1.00 hrs
 Capacity at bank full= 260.12 cfs
 Inlet Invert= 6,688.00', Outlet Invert= 6,685.03'
 36.0" Diameter Pipe n= 0.010 Length= 33.0' Slope= 0.0900 1'

Reach 4R: (new Reach)

Hydrograph



Pond 2P: Regional Pond No. 9

Inflow Area = 44.780 ac, Inflow Depth = 1.14" for 5-Year event
 Inflow = 51.37 cfs @ 0.27 hrs, Volume= 4.245 af
 Outflow = 14.69 cfs @ 1.19 hrs, Volume= 2.822 af, Atten= 71%, Lag= 55.2 min
 Primary = 14.69 cfs @ 1.19 hrs, Volume= 2.822 af

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 Peak Elev= 6,714.53' @ 1.19 hrs Surf.Area= 31,379 sf Storage= 141,638 cf
 Plug-Flow detention time= 69.0 min calculated for 2.822 af (66% of inflow)
 Center-of-Mass det. time= 58.7 min (96.7 - 38.0)

#	Invert	Avail.Storage	Storage Description
1	6,708.00'	189,296 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,708.00	0	0	0
6,710.00	21,445	21,445	21,445
6,712.00	25,662	47,107	68,552
6,714.00	30,125	55,787	124,339
6,716.00	34,832	64,957	189,296

#	Routing	Invert	Outlet Devices
1	Primary	6,708.00'	15.0" Vert. Orifice/Grate C= 0.600
2	Primary	6,714.50'	48.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600

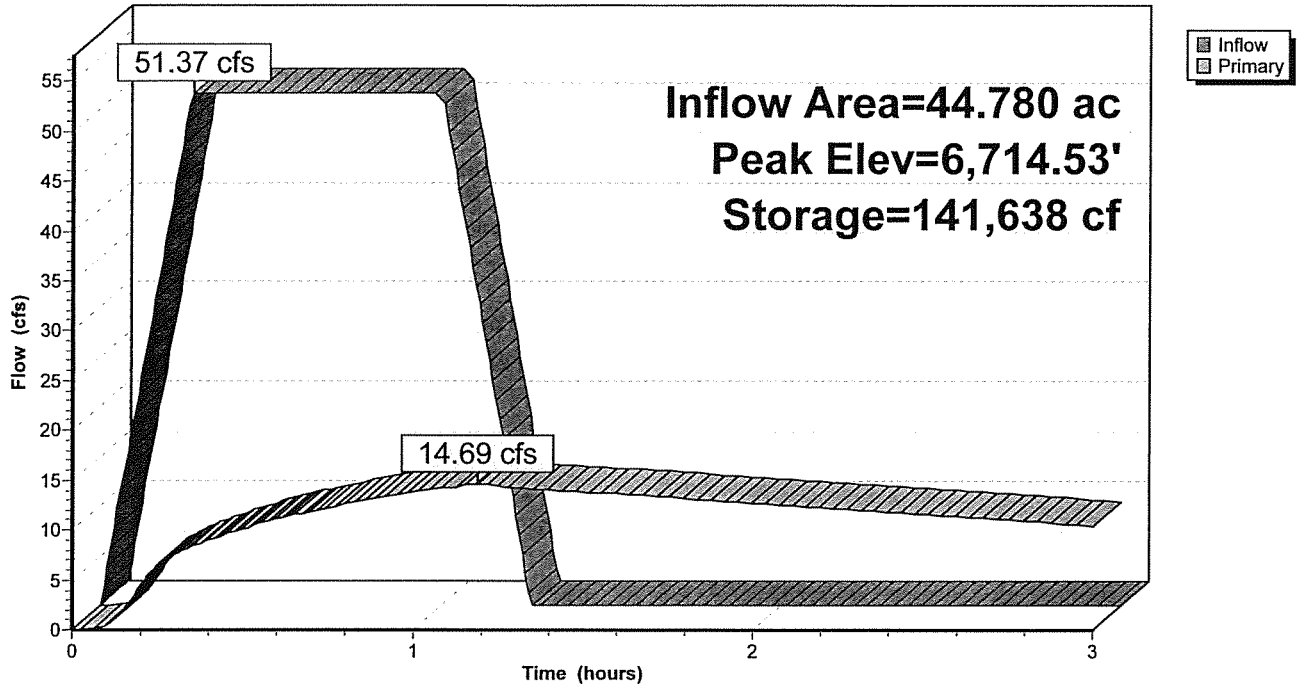
Primary OutFlow Max=14.60 cfs @ 1.19 hrs HW=6,714.53' (Free Discharge)

1=Orifice/Grate (Orifice Controls 14.36 cfs @ 11.7 fps)

2=Orifice/Grate (Weir Controls 0.24 cfs @ 0.6 fps)

Pond 2P: Regional Pond No. 9

Hydrograph



1010-hydro-1

colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

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Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Tributary Areas

Runoff Area=44.780 ac Runoff Depth=1.33"
Tc=16.0 min C=0.72 Runoff=60.14 cfs 4.971 af

Subcatchment 3S: On-site

Runoff Area=21.120 ac Runoff Depth=1.31"
Tc=0.0 min C=0.70 Runoff=27.58 cfs 2.302 af

Reach 4R: (new Reach)

Peak Depth=0.93' Max Vel=28.7 fps Inflow=54.37 cfs 5.670 af
D=36.0" n=0.010 L=33.0' S=0.0900 '/' Capacity=260.12 cfs Outflow=54.15 cfs 5.608 af

Pond 2P: Regional Pond No. 9

Peak Elev=6,715.09' Storage=159,621 cf Inflow=60.14 cfs 4.971 af
Outflow=33.50 cfs 3.368 af

Total Runoff Area = 65.900 ac Runoff Volume = 7.273 af Average Runoff Depth = 1.32"

1010-hydro-1

colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

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Subcatchment 1S: Tributary Areas

Tributary areas taken from MDDP for Northgate Software Campus, Last dated January 28, 1999.

Runoff = 60.14 cfs @ 0.27 hrs, Volume= 4.971 af, Depth= 1.33"

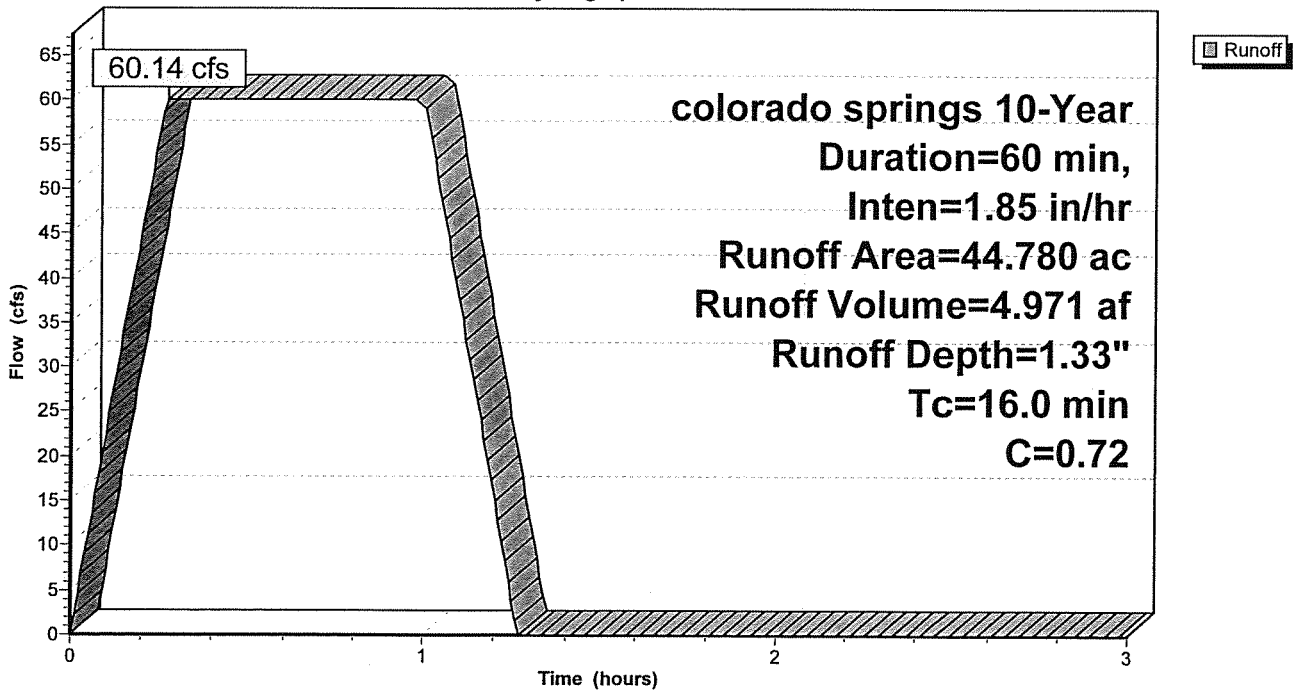
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

Area (ac)	C	Description
4.270	0.70	Onsite into Pond
4.110	0.90	OS-4
4.300	0.71	2
4.000	0.74	2
24.000	0.70	OS-3
1.820	0.70	H
2.280	0.70	N
44.780	0.72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					Direct Entry,

Subcatchment 1S: Tributary Areas

Hydrograph



1010-hydro-1

colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

Prepared by Executive Consulting Engineers, Inc.

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Subcatchment 3S: On-site

Runoff = 27.58 cfs @ 0.00 hrs, Volume= 2.302 af, Depth= 1.31"

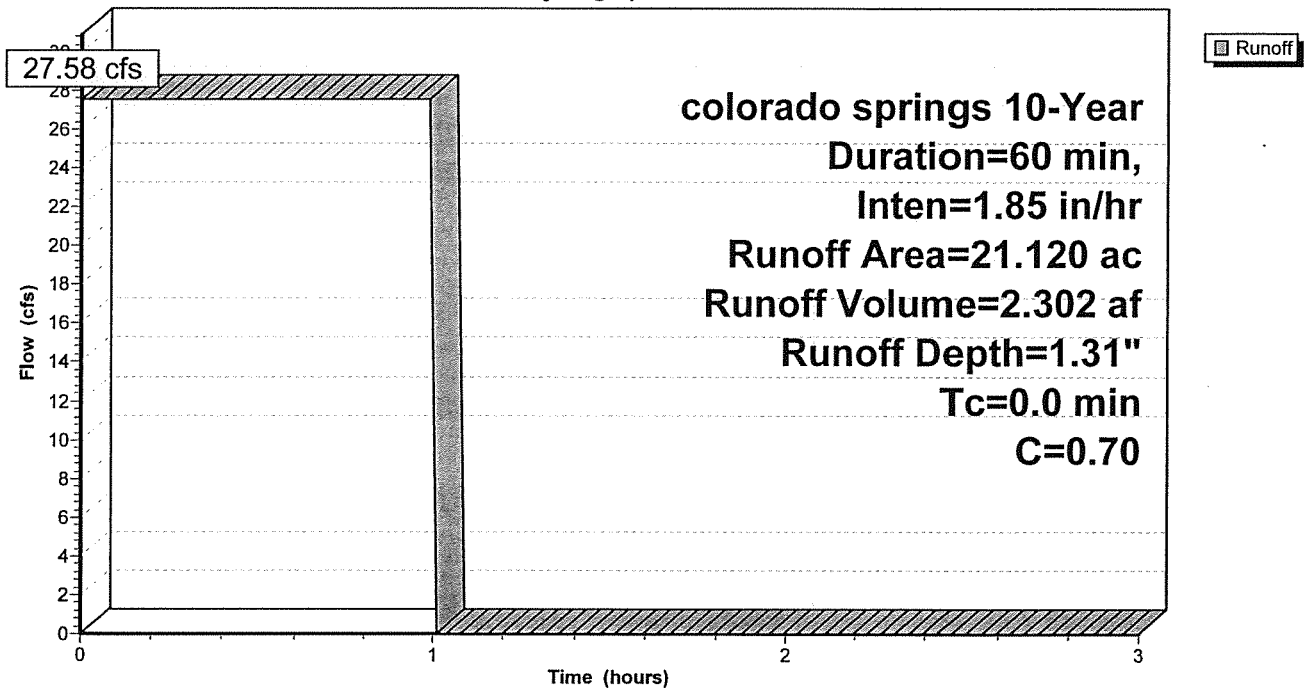
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

Area (ac)	C	Description
21.120	0.70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					Direct Entry, 19.5

Subcatchment 3S: On-site

Hydrograph



Reach 4R: (new Reach)

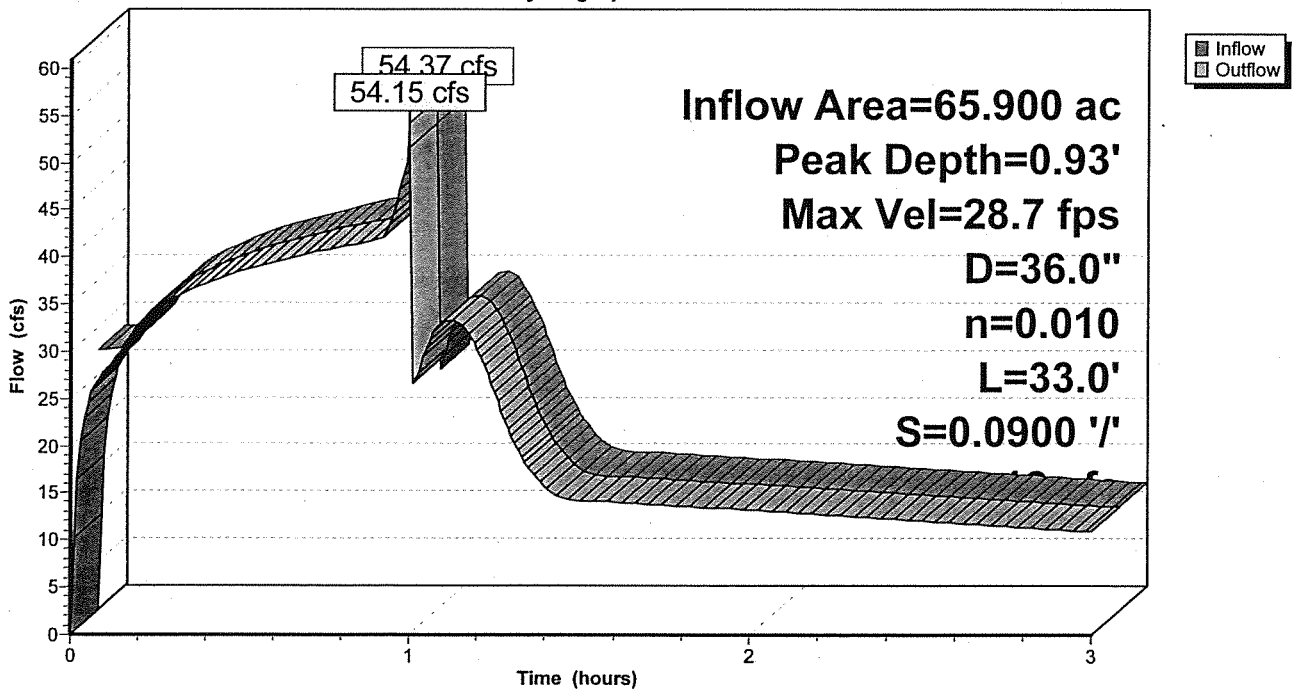
Inflow Area = 65.900 ac, Inflow Depth = 1.03" for 10-Year event
 Inflow = 54.37 cfs @ 1.00 hrs, Volume= 5.670 af
 Outflow = 54.15 cfs @ 1.00 hrs, Volume= 5.608 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 2
 Max. Velocity= 28.7 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 21.9 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.93' @ 1.00 hrs
 Capacity at bank full= 260.12 cfs
 Inlet Invert= 6,688.00', Outlet Invert= 6,685.03'
 36.0" Diameter Pipe n= 0.010 Length= 33.0' Slope= 0.0900 '/'

Reach 4R: (new Reach)

Hydrograph



1010-hydro-1

colorado springs 10-Year Duration=60 min, Inten=1.85 in/hr

Prepared by Executive Consulting Engineers, Inc.

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Pond 2P: Regional Pond No. 9

Inflow Area = 44.780 ac, Inflow Depth = 1.33" for 10-Year event
 Inflow = 60.14 cfs @ 0.27 hrs, Volume= 4.971 af
 Outflow = 33.50 cfs @ 1.12 hrs, Volume= 3.368 af, Atten= 44%, Lag= 50.9 min
 Primary = 33.50 cfs @ 1.12 hrs, Volume= 3.368 af

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 Peak Elev= 6,715.09' @ 1.12 hrs Surf.Area= 32,682 sf Storage= 159,621 cf
 Plug-Flow detention time= 64.7 min calculated for 3.368 af (68% of inflow)
 Center-of-Mass det. time= 54.8 min (92.8 - 38.0)

#	Invert	Avail.Storage	Storage Description
1	6,708.00'	189,296 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,708.00	0	0	0
6,710.00	21,445	21,445	21,445
6,712.00	25,662	47,107	68,552
6,714.00	30,125	55,787	124,339
6,716.00	34,832	64,957	189,296

#	Routing	Invert	Outlet Devices
1	Primary	6,708.00'	15.0" Vert. Orifice/Grate C= 0.600
2	Primary	6,714.50'	48.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600

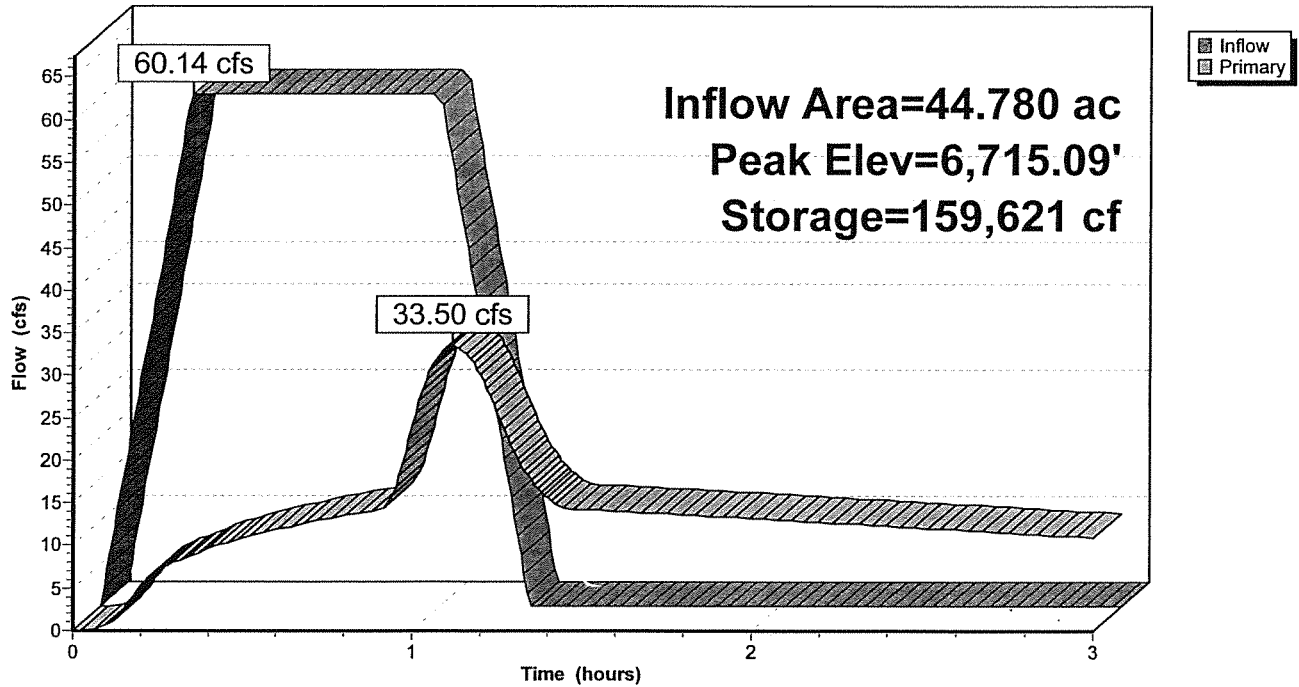
Primary OutFlow Max=33.46 cfs @ 1.12 hrs HW=6,715.09' (Free Discharge)

1=Orifice/Grate (Orifice Controls 15.02 cfs @ 12.2 fps)

2=Orifice/Grate (Weir Controls 18.44 cfs @ 2.5 fps)

Pond 2P: Regional Pond No. 9

Hydrograph



1010-hydro-1

colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

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Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Tributary Areas

Runoff Area=44.780 ac Runoff Depth=1.94"
Tc=16.0 min C=0.72 Runoff=87.45 cfs 7.227 af

Subcatchment 3S: On-site

Runoff Area=21.120 ac Runoff Depth=1.90"
Tc=0.0 min C=0.70 Runoff=40.10 cfs 3.347 af

Reach 4R: (new Reach)

Peak Depth=1.43' Max Vel=36.1 fps Inflow=120.17 cfs 8.883 af
D=36.0" n=0.010 L=33.0' S=0.0900 '/' Capacity=260.12 cfs Outflow=120.14 cfs 8.785 af

Pond 2P: Regional Pond No. 9

Peak Elev=6,715.85' Storage=184,571 cf Inflow=87.45 cfs 7.227 af
Outflow=80.68 cfs 5.535 af

Total Runoff Area = 65.900 ac Runoff Volume = 10.575 af Average Runoff Depth = 1.93"

1010-hydro-1

colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

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Subcatchment 1S: Tributary Areas

Tributary areas taken from MDDP for Northgate Software Campus, Last dated January 28, 1999.

Runoff = 87.45 cfs @ 0.27 hrs, Volume= 7.227 af, Depth= 1.94"

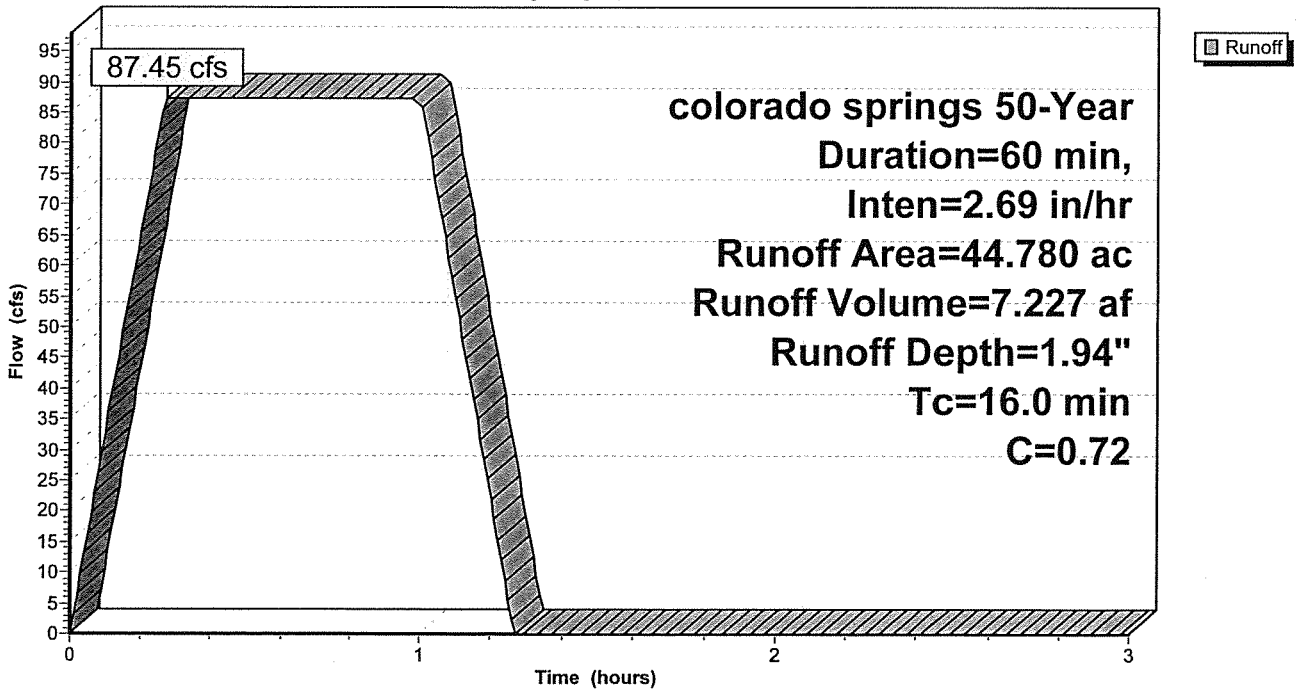
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

Area (ac)	C	Description
4.270	0.70	Onsite into Pond
4.110	0.90	OS-4
4.300	0.71	2
4.000	0.74	2
24.000	0.70	OS-3
1.820	0.70	H
2.280	0.70	N
44.780	0.72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					Direct Entry,

Subcatchment 1S: Tributary Areas

Hydrograph



1010-hydro-1

colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

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Subcatchment 3S: On-site

Runoff = 40.10 cfs @ 0.00 hrs, Volume= 3.347 af, Depth= 1.90"

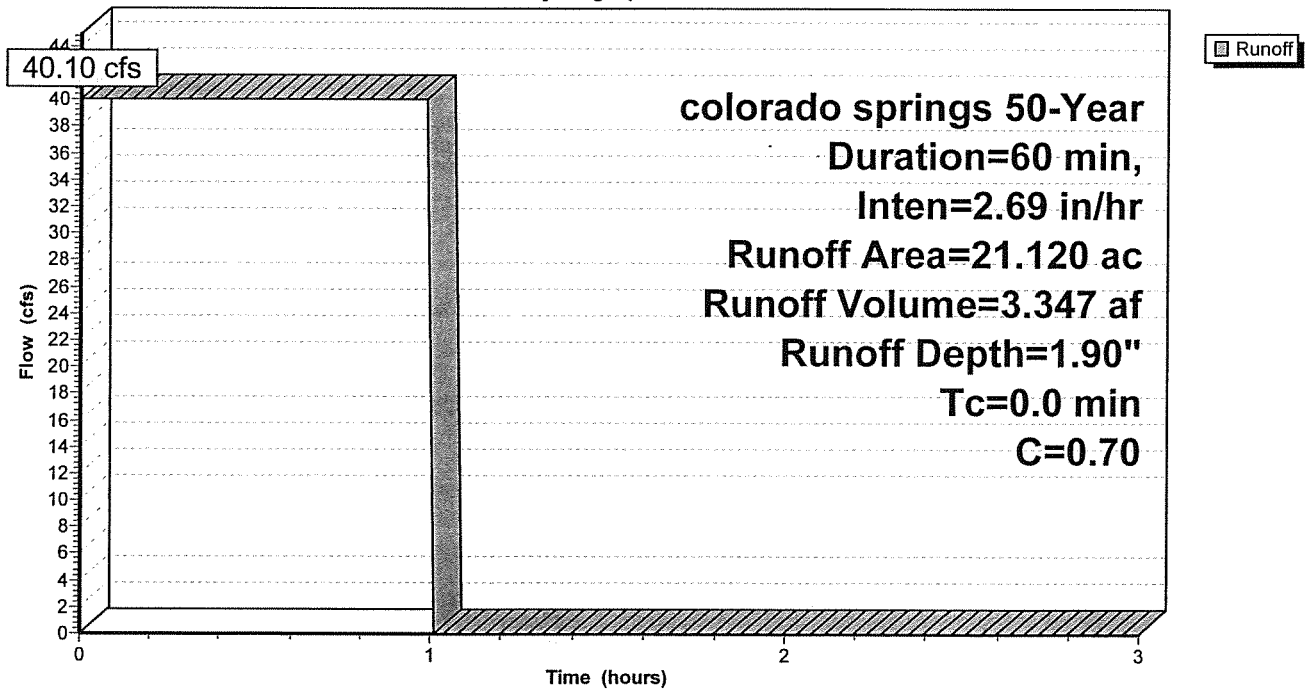
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

Area (ac)	C	Description
21.120	0.70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					Direct Entry, 19.5

Subcatchment 3S: On-site

Hydrograph



1010-hydro-1

colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

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Reach 4R: (new Reach)

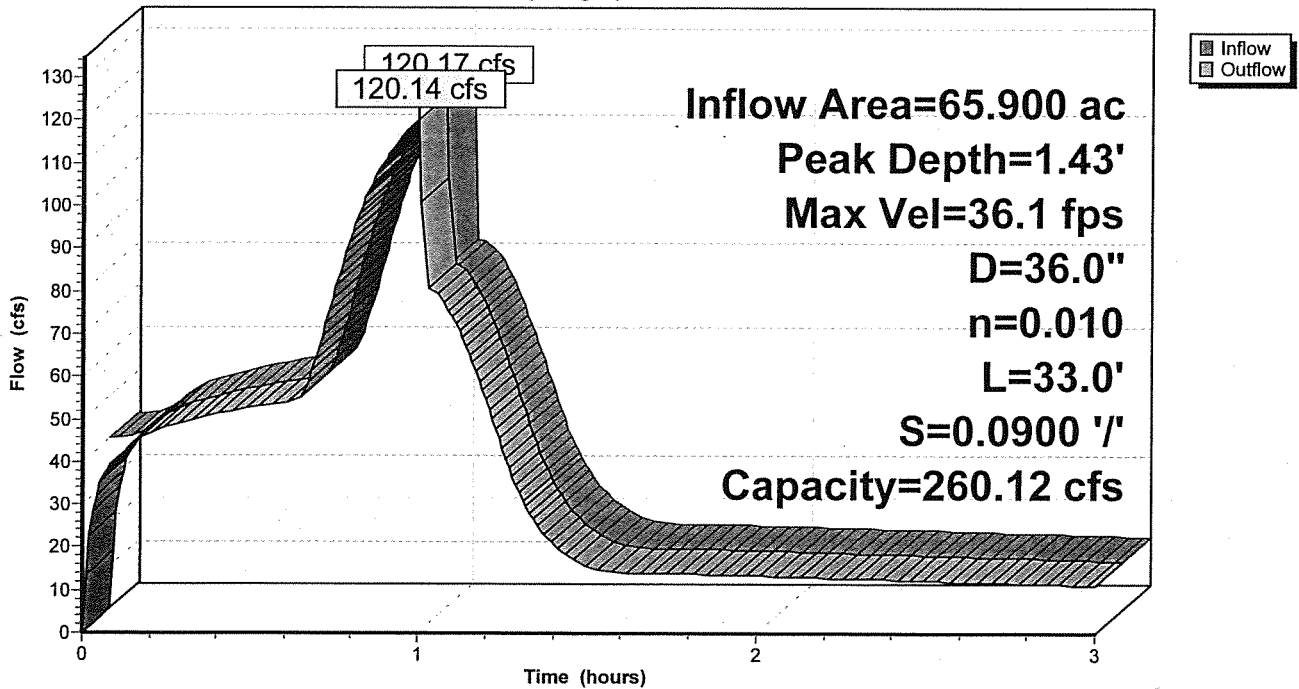
Inflow Area = 65.900 ac, Inflow Depth = 1.62" for 50-Year event
Inflow = 120.17 cfs @ 1.00 hrs, Volume= 8.883 af
Outflow = 120.14 cfs @ 1.00 hrs, Volume= 8.785 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 36.1 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 24.0 fps, Avg. Travel Time= 0.0 min

Peak Depth= 1.43' @ 1.00 hrs
Capacity at bank full= 260.12 cfs
Inlet Invert= 6,688.00', Outlet Invert= 6,685.03'
36.0" Diameter Pipe n= 0.010 Length= 33.0' Slope= 0.0900 1'

Reach 4R: (new Reach)

Hydrograph



1010-hydro-1

colorado springs 50-Year Duration=60 min, Inten=2.69 in/hr

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Pond 2P: Regional Pond No. 9

Inflow Area = 44.780 ac, Inflow Depth = 1.94" for 50-Year event
 Inflow = 87.45 cfs @ 0.27 hrs, Volume= 7.227 af
 Outflow = 80.68 cfs @ 1.02 hrs, Volume= 5.535 af, Atten= 8%, Lag= 45.1 min
 Primary = 80.68 cfs @ 1.02 hrs, Volume= 5.535 af

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 Peak Elev= 6,715.85' @ 1.02 hrs Surf.Area= 34,490 sf Storage= 184,571 cf
 Plug-Flow detention time= 48.6 min calculated for 5.517 af (76% of inflow)
 Center-of-Mass det. time= 41.6 min (79.6 - 38.0)

#	Invert	Avail.Storage	Storage Description
1	6,708.00'	189,296 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,708.00	0	0	0
6,710.00	21,445	21,445	21,445
6,712.00	25,662	47,107	68,552
6,714.00	30,125	55,787	124,339
6,716.00	34,832	64,957	189,296

#	Routing	Invert	Outlet Devices
1	Primary	6,708.00'	15.0" Vert. Orifice/Grate C= 0.600
2	Primary	6,714.50'	48.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600

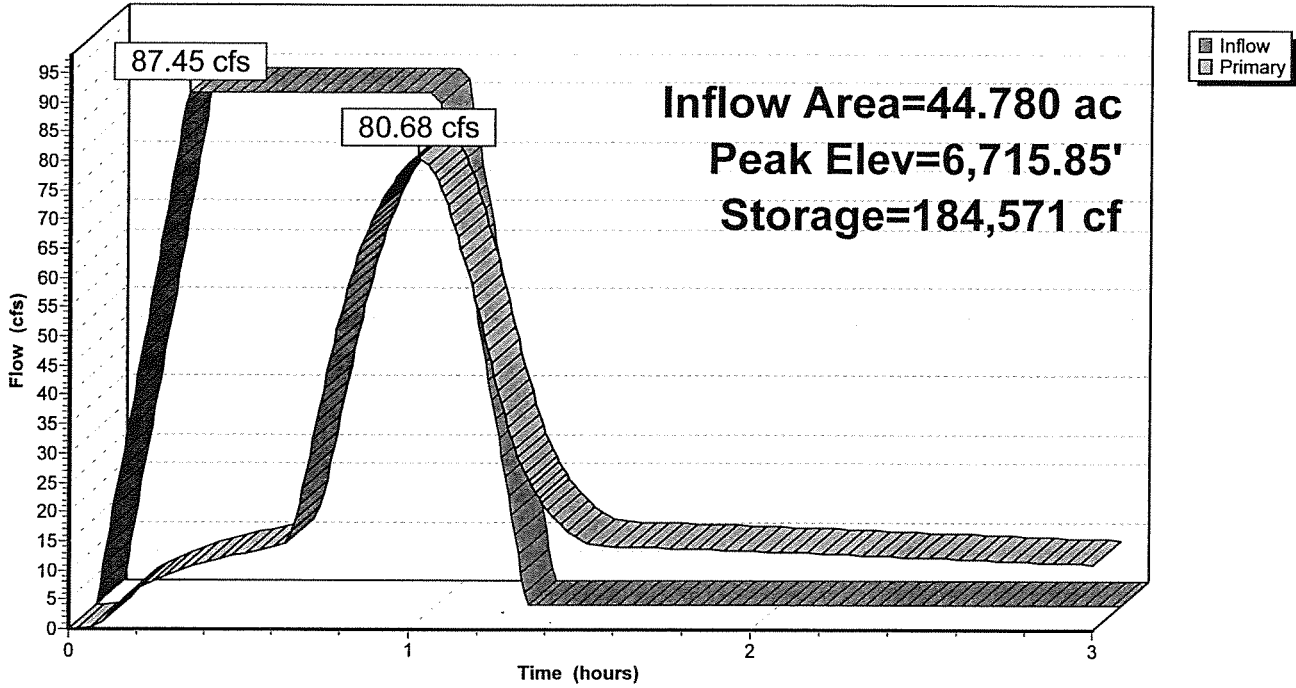
Primary OutFlow Max=80.66 cfs @ 1.02 hrs HW=6,715.85' (Free Discharge)

1=Orifice/Grate (Orifice Controls 15.89 cfs @ 12.9 fps)

2=Orifice/Grate (Weir Controls 64.77 cfs @ 3.8 fps)

Pond 2P: Regional Pond No. 9

Hydrograph



1010-hydro-1

colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

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Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Tributary Areas

Runoff Area=44.780 ac Runoff Depth=2.02"
Tc=16.0 min C=0.72 Runoff=91.35 cfs 7.550 af

Subcatchment 3S: On-site

Runoff Area=21.120 ac Runoff Depth=1.99"
Tc=0.0 min C=0.70 Runoff=41.89 cfs 3.497 af

Reach 4R: (new Reach)

Peak Depth=1.48' Max Vel=36.6 fps Inflow=127.18 cfs 9.349 af
D=36.0" n=0.010 L=33.0' S=0.0900 '/ Capacity=260.12 cfs Outflow=127.16 cfs 9.245 af

Pond 2P: Regional Pond No. 9

Peak Elev=6,715.92' Storage=186,788 cf Inflow=91.35 cfs 7.550 af
Outflow=85.66 cfs 5.852 af

Total Runoff Area = 65.900 ac Runoff Volume = 11.046 af Average Runoff Depth = 2.01"

1010-hydro-1

colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

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Subcatchment 1S: Tributary Areas

Tributary areas taken from MDDP for Northgate Software Campus, Last dated January 28, 1999.

Runoff = 91.35 cfs @ 0.27 hrs, Volume= 7.550 af, Depth= 2.02"

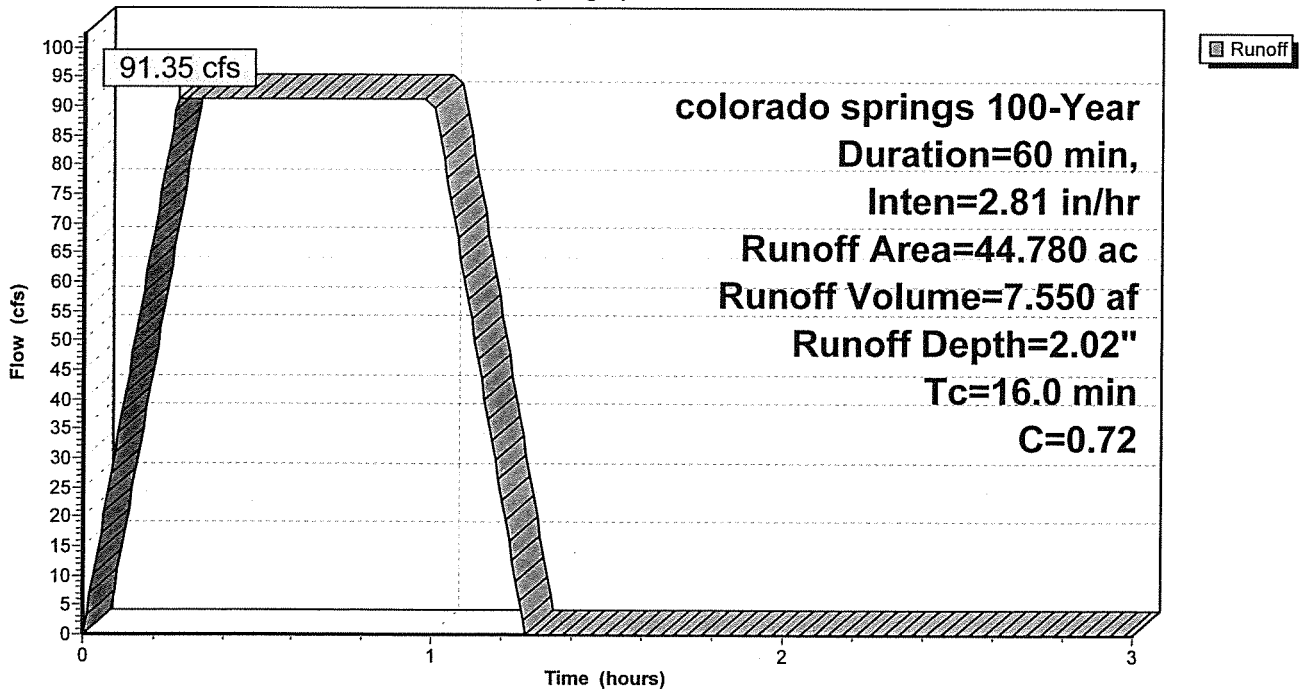
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

Area (ac)	C	Description
4.270	0.70	Onsite into Pond
4.110	0.90	OS-4
4.300	0.71	2
4.000	0.74	2
24.000	0.70	OS-3
1.820	0.70	H
2.280	0.70	N
44.780	0.72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0					Direct Entry,

Subcatchment 1S: Tributary Areas

Hydrograph



1010-hydro-1

colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

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Subcatchment 3S: On-site

Runoff = 41.89 cfs @ 0.00 hrs, Volume= 3.497 af, Depth= 1.99"

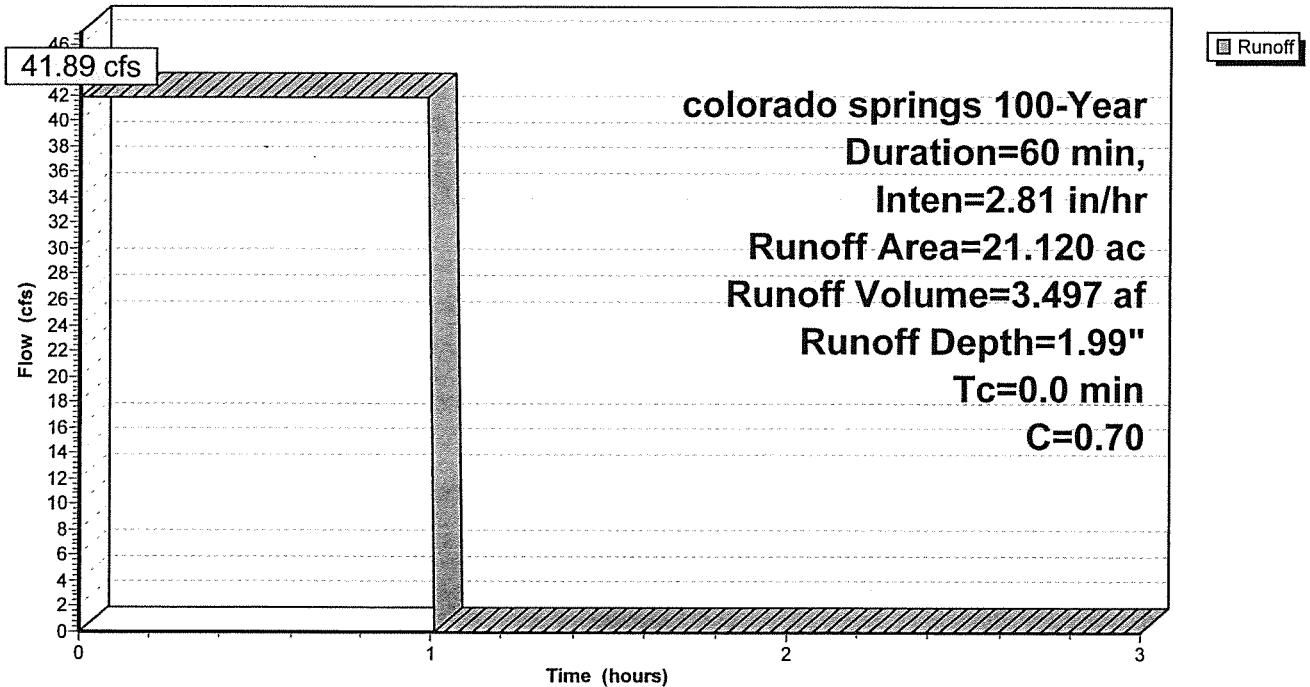
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

Area (ac)	C	Description
21.120	0.70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					Direct Entry, 19.5

Subcatchment 3S: On-site

Hydrograph



Reach 4R: (new Reach)

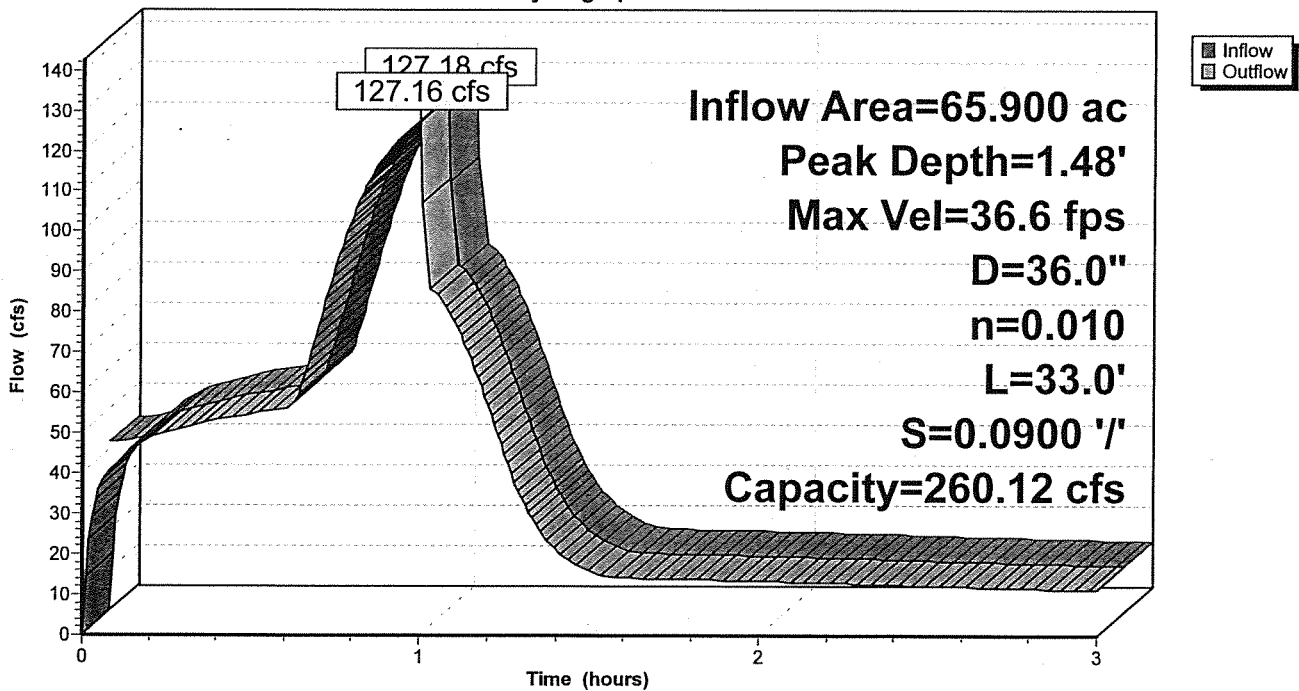
Inflow Area = 65.900 ac, Inflow Depth = 1.70" for 100-Year event
Inflow = 127.18 cfs @ 1.00 hrs, Volume= 9.349 af
Outflow = 127.16 cfs @ 1.00 hrs, Volume= 9.245 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 36.6 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 24.2 fps, Avg. Travel Time= 0.0 min

Peak Depth= 1.48' @ 1.00 hrs
Capacity at bank full= 260.12 cfs
Inlet Invert= 6,688.00', Outlet Invert= 6,685.03'
36.0" Diameter Pipe n= 0.010 Length= 33.0' Slope= 0.0900 '/'

Reach 4R: (new Reach)

Hydrograph



1010-hydro-1

colorado springs 100-Year Duration=60 min, Inten=2.81 in/hr

Prepared by Executive Consulting Engineers, Inc.

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Pond 2P: Regional Pond No. 9

Inflow Area = 44.780 ac, Inflow Depth = 2.02" for 100-Year event
 Inflow = 91.35 cfs @ 0.27 hrs, Volume= 7.550 af
 Outflow = 85.66 cfs @ 1.02 hrs, Volume= 5.852 af, Atten= 6%, Lag= 44.8 min
 Primary = 85.66 cfs @ 1.02 hrs, Volume= 5.852 af

Routing by Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
 Peak Elev= 6,715.92' @ 1.02 hrs Surf.Area= 34,650 sf Storage= 186,788 cf
 Plug-Flow detention time= 47.1 min calculated for 5.852 af (78% of inflow)
 Center-of-Mass det. time= 40.2 min (78.2 - 38.0)

#	Invert	Avail.Storage	Storage Description
1	6,708.00'	189,296 cf	Custom Stage Data (Prismatic) Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,708.00	0	0	0
6,710.00	21,445	21,445	21,445
6,712.00	25,662	47,107	68,552
6,714.00	30,125	55,787	124,339
6,716.00	34,832	64,957	189,296

#	Routing	Invert	Outlet Devices
1	Primary	6,708.00'	15.0" Vert. Orifice/Grate C= 0.600
2	Primary	6,714.50'	48.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600

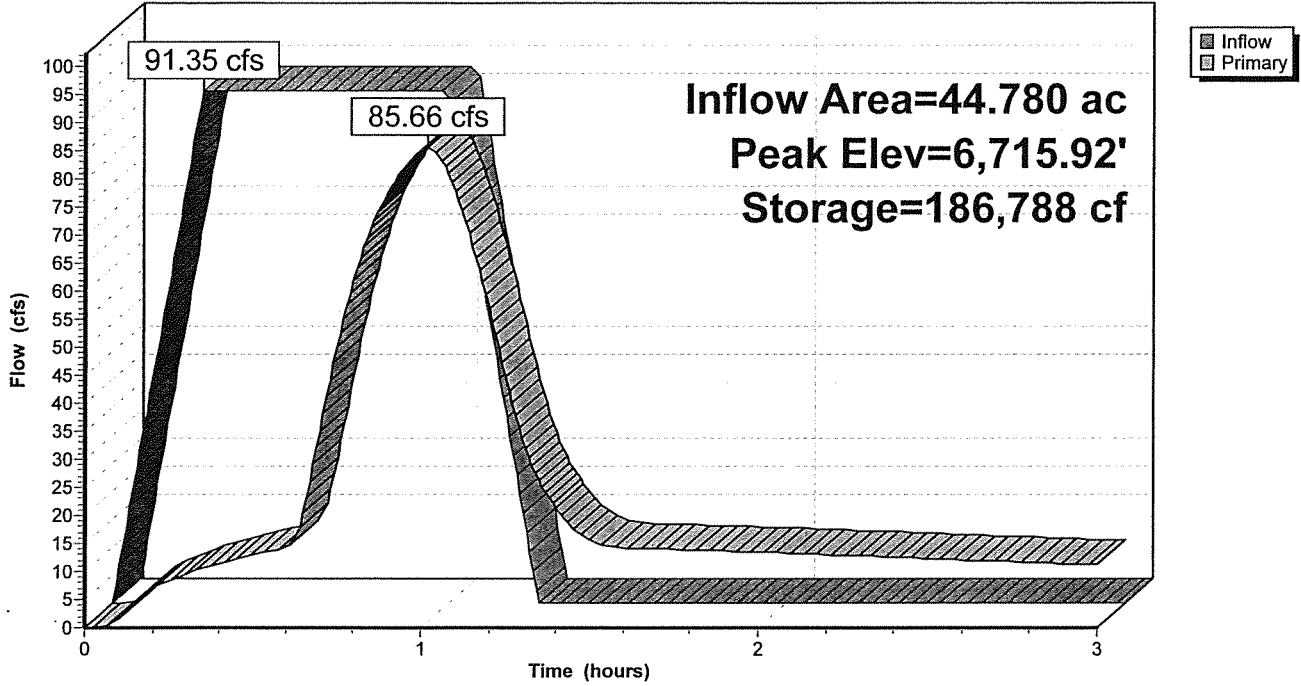
Primary OutFlow Max=85.67 cfs @ 1.02 hrs HW=6,715.92' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 15.96 cfs @ 13.0 fps)

└ **2=Orifice/Grate** (Weir Controls 69.71 cfs @ 3.9 fps)

Pond 2P: Regional Pond No. 9

Hydrograph



MISCELLANEOUS DOCUMENTS

Design Procedure Form: Porous Landscape Detention (PLD)

Designer: Bob Yoo
 Company: ECE
 Date: June 11, 2007
 Project: Stonewater at Northgate Filing No. 1
 Location: NE-Middle Creek PKWY/Voyager PKWY

<p>1. Basin Storage Volume ($I_a = 100\%$ if all paved and roofed areas u/s of PLD)</p> <p>A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>B) Contributing Watershed Area Including the PLD (Area)</p> <p>C) Water Quality Capture Volume (WQCV) ($WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)$)</p> <p>D) Design Volume: $Vol_{PLD} = (WQCV / 12) * Area$</p>	<p>$I_a =$ <u>19.60</u> %</p> <p>$i =$ <u>0.20</u></p> <p>Area = <u>936,540</u> square feet</p> <p>WQCV = <u>0.09</u> watershed inches</p> <p>Vol = <u>7,118.8</u> cubic feet</p>				
<p>2. PLD Surface Area (A_{PLD}) and Average Depth (d_{av})</p> <p>($d_{av} = (Vol / A_{PLD})$, Min=0.5', Max=1.0')</p>	<p>$A_{PLD} =$ <u>7,594</u> square feet</p> <p>$d_{av} =$ <u>0.94</u> feet</p>				
<p>3. Base Course (See Figure PLD-1)</p>	<p><input checked="" type="checkbox"/> 6" (Min.) Sandy Loam Turf Layer, Plus 18" (Min.) Layer of 25% Peat and 75% Sand Mix, Plus 9" (Min.) Layer of ASSHTO #8 Coarse Aggregate (CDOT Section 703 Specification).</p> <p>Other: _____</p>				
<p>5. Draining of porous pavement (Check a, or b, or c, answer d) Based on answers to 5a through 5d, check the appropriate method</p> <p>a) Check box if subgrade is heavy or expansive clay <input type="checkbox"/></p> <p>b) Check box if subgrade is silty or clayey sands <input type="checkbox"/></p> <p>c) Check box if subgrade is well-draining soils <input checked="" type="checkbox"/></p> <p>d) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.?</p> <table style="margin-left: 200px; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px 10px;">yes</td> <td style="border: 1px solid black; padding: 2px 10px;">no</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px 10px;"></td> <td style="border: 1px solid black; padding: 2px 10px; text-align: center;">x</td> </tr> </table>	yes	no		x	<p><input checked="" type="checkbox"/> Infiltration to Subgrade with Permeable Membrane: 5(c) checked and 5(d) = no</p> <p><input type="checkbox"/> Underdrain with Impermeable Membrane: 5(a) checked or 5(d) = yes</p> <p><input type="checkbox"/> Underdrain with Permeable Membrane: 5(b) checked and 5(d) = no</p> <p>Other: _____</p>
yes	no				
	x				

Notes:


DRAINAGE MAPS


STONEWATER AT NORTHGATE FILING NO. 1, 2 & 3


CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO


HISTORICAL DRAINAGE MAP


LEGEND

BASIN BOUNDARY 

FLOW DIRECTION 

BASIN IDENTIFIER 

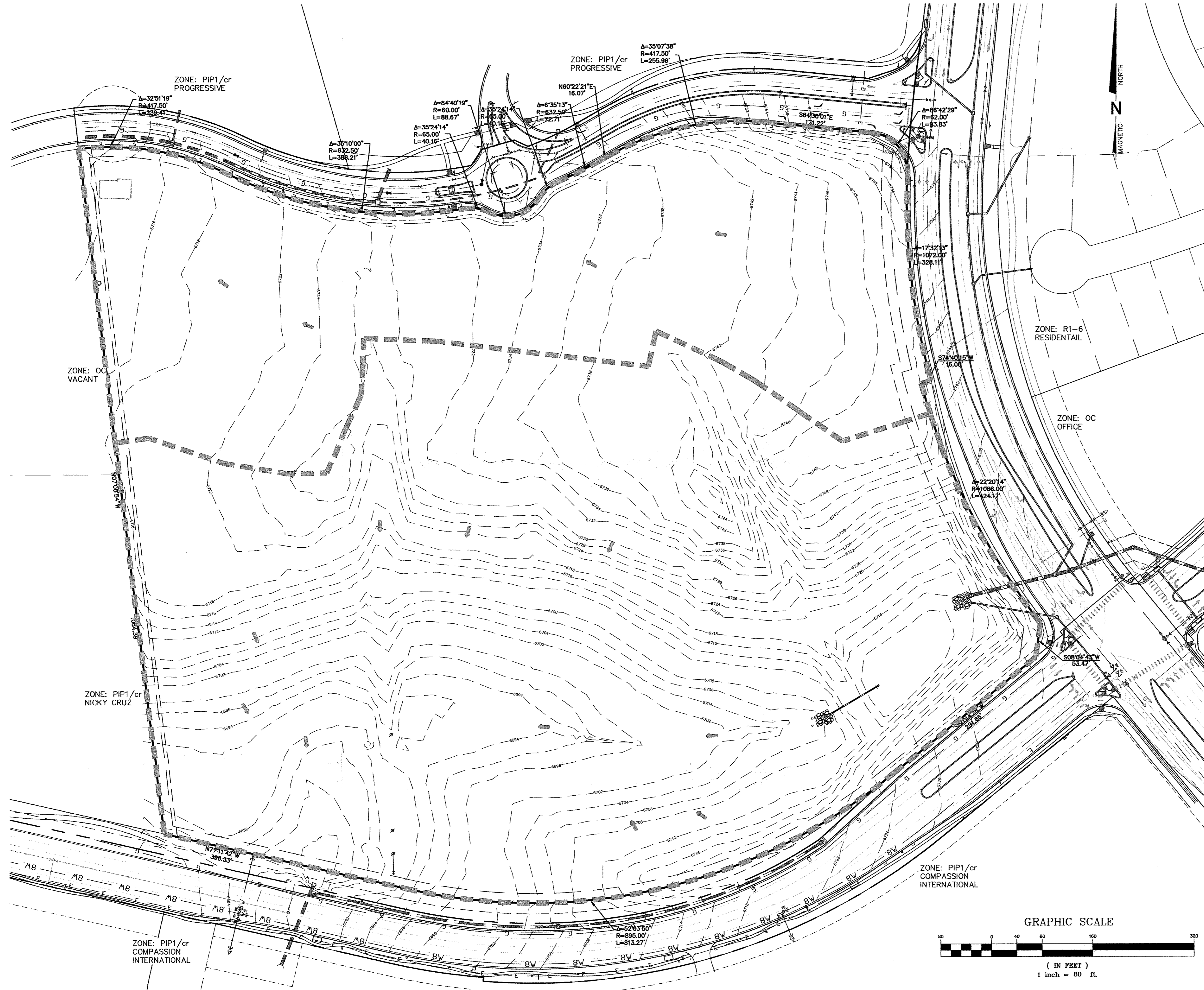
AREA IN ACRES 

DESIGN POINT 



ECE
EXECUTIVE CONSULTING ENGINEERS
1295 Kelly Johnson BLVD.
Suite 200
Colorado Springs, Colorado
80920
(719)481-9707

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NO.	REVISION DESCRIPTION	BY	DATE

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF
EXECUTIVE CONSULTING ENGINEERS, INC.

BOB H. YOO, COLORADO P.E. #48793

DATE _____

PROJECT NAME
STONEWATER AT NORTHGATE FIL. NO. 1, 2 & 3
COLORADO SPRINGS, COLORADO
FINAL DRAINAGE STUDY

DRAWING TITLE
HISTORICAL DRAINAGE MAP

H-Scale	1" = 80'
V-Scale	N/A
Date	31 MAY 2007
Project No.	1010
Drawn by	BHY
Designed by	BHY
Checked by	BHY
SHEET:	1 OF 2

COMPASSION INTERNATIONAL'S
NORTHGATE CAMPUS FILING NO. 1
REC NO. 99162816

STONEWATER AT NORTHGATE FILING NO. 1, 2 & 3

CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

DEVELOPED DRAINAGE MAP

LEGEND

BASIN BOUNDARY

FLOW DIRECTION

BASIN IDENTIFIER

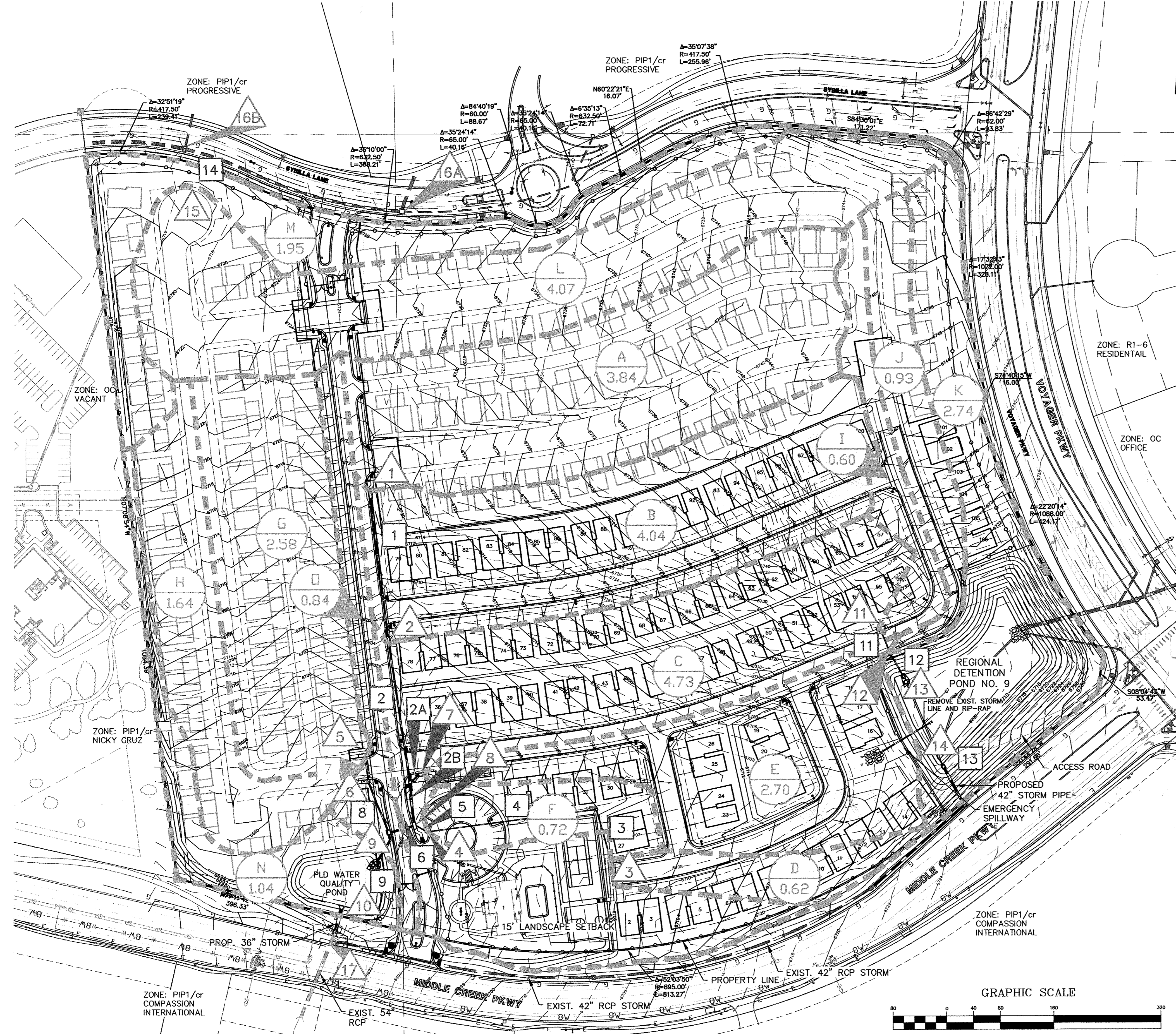
AREA IN ACRES

DESIGN POINT

PIPE RUN

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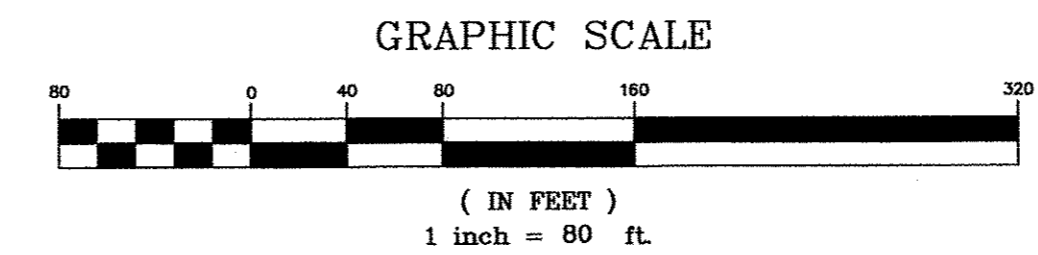


Final Drainage Report for Stonewater at Northgate (SURFACE ROUTING SUMMARY)

Design Point(s)	Contributing Basins/Design Points	Equivalent CA ₅	Equivalent CA ₁₀₀	Maximum T _c	Intensity *		Flow	
					I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
1	A	2.11	2.69	12.4	3.8	6.7	8.0	18.0
2	B	2.22	2.83	17.5	3.2	5.7	7.2	16.2
3	D	0.34	0.43	18.2	3.2	5.6	1.1	2.4
4	F	0.26	0.33	19.5	3.1	5.4	0.8	1.8
5	G	1.42	1.81	11.1	3.9	7.0	5.6	12.7
6	H	0.90	1.15	13.7	3.6	6.4	3.3	7.4
7	E	1.49	1.89	16.0	3.4	6.0	5.0	11.3
8	C	2.60	3.31	14.7	3.5	6.2	9.1	20.6
9	O	0.46	0.59	1.5	5.1	9.1	2.4	5.3
10	DP-1 THRU 9	11.80	15.02	19.5	3.1	5.4	36.1	81.7
11	I	0.33	0.42	5.0	5.1	9.1	1.7	3.8
12	J	0.51	0.65	16.2	3.3	5.9	1.7	3.9
13	-	0.00	0.00	5.0	5.1	9.1	0.0	0.0
14	I, J, K & OFFSITE	27.68	35.23	20.8	3.0	5.3	81.8	185.4
15	L	2.24	2.85	5.0	5.1	9.1	11.4	25.9
Offsite Info								
17	12A, 12B, 16 & DP 1-9	13.69	17.54	25.0	2.7	4.8	36.7	83.7

Final Drainage Report for Stonewater at Northgate (Pipe Routing Summary)

Pipe Run	Contributing Basins/Design Points	Equivalent CA ₅	Equivalent CA ₁₀₀	Maximum T _c	Intensity *		Flow		Pipe Size (HDPE)
					I ₅	I ₁₀₀	Q ₅	Q ₁₀₀	
1	A	2.11	2.69	12.4	3.8	6.7	8.0	18.0	18"
2	A, B	4.33	5.52	17.5	3.2	5.7	14.0	31.6	24"
2A	E	1.49	1.89	17.5	3.2	5.7	4.8	10.8	18"
2B	A, B, E	5.82	7.41	17.5	3.2	5.7	18.7	42.5	36"
3	D	0.34	0.43	18.2	3.2	5.6	1.1	2.4	18"
4	D	0.34	0.43	18.2	3.2	5.6	1.1	2.4	18"
5	D, F	0.60	0.76	19.5	3.1	5.4	1.8	4.1	18"
6	DP 1-4, 7, 8	9.02	11.48	19.5	3.1	5.4	27.6	62.4	36"
7	G	1.42	1.81	11.1	3.9	7.0	5.6	12.7	18"
8	G, H	2.32	2.95	16.0	3.4	6.0	7.8	17.7	18"
9	DP 1-9	11.80	15.02	19.5	3.1	5.4	36.1	81.7	36"
11	I	0.33	0.42	5.0	5.1	9.1	1.7	3.8	18"
12	I, J	0.84	1.07	16.2	3.3	5.9	2.8	6.4	18"
13	OUTLET	FROM DETENTION POND OUTLET (SEE HYDROLOGIC STUDY)					14.7	85.7	42"
14	L	2.24	2.85	5.0	5.1	9.1	11.4	25.9	24"



COMPASSION INTERNATIONAL'S NORTHGATE CAMPUS FILING NO. 1 REC NO. 99162816

BY DATE

NO. REVISION DESCRIPTION

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF EXECUTIVE CONSULTING ENGINEERS, INC.

BOB H. YOQ, COLORADO P.E. #46793

DATE

PROJECT NAME: STONEWATER AT NORTHGATE FIL. NO. 1, 2 & 3

COLORADO SPRINGS, COLORADO

FINAL DRAINAGE STUDY

DRAWING TITLE: DEVELOPED DRAINAGE MAP

H-Scale: 1"= 80'

V-Scale: N/A

Date: 08 JUNE 2007

Project No. 1010

Drawn by: BHY

Designed by: BHY

Checked by: BHY

SHEET: 2 OF 2