INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT

HANNAH RIDGE AT FEATHERGRASS FILINGS 5, 6 & 7

January 2019

Prepared for:
ELITE PROPERTIES OF AMERICA, INC.
6385 CORPORATE DRIVE
COLORADO SPRINGS, CO 80919

Prepared by:
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SF-18-038
SF-18-039
SF-18-040

Job no. 1116.05

FINAL DRAINAGE REPORT FOR HANNAH RIDGE AT FEATHERGRASS FILINGS NO. 5, 6 & 7

DRAINAGE REPORT STATEMENT

DESIGN 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 report and said report is in conformity with the applicable master plan and drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Marc A. Whorton, Colorado P.E. #37155 ______ Date: 2/6/19

OWNERS/DEVELOPER'S STATEMENT:

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

Business Name: Feathergrass Investments LLC

Kenneth P. Driscoll ______ Date: 2/5/19

Title: MANAGER

Address: 6385 Corporate Dr., Suite 200

Colorado Springs, CO 80919

EL PASO COUNTY:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code, as amended.

______________________ ______________

Jennifer Irvine, P.E. Date

County Engineer / ECM Administrator

Conditions:

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FINAL DRAINAGE REPORT FOR HANNAH RIDGE AT FEATHERGRASS FILINGS NO. 5, 6 & 7

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FINAL DRAINAGE REPORT FOR HANNAH RIDGE AT FEATHERGRASS FILINGS NO. 5, 6 & 7

PURPOSE

This document is the Final Drainage Report for Hannah Ridge at Feathergrass Filings No. 5, 6 & 7. The purpose of this report is to identify onsite and offsite drainage patterns, storm sewer, inlet locations, and areas tributary to the site, and to safely route developed storm water runoff to adequate detention and water quality facilities while releasing storm water at or below historic rates and in accordance with all applicable master drainage plans. This report will discuss the proposed storm system to be built with Filing 5, 6 and 7 and discuss the final construction details, and more specifically, the final design details of the proposed sub-regional public detention/water quality facility located at the southerly end of Filing 6 that will handle the treatment for Filings 5, 6 and 7. Final design information for the Filing No. 5, 6 and 7 detention/water quality facility included in this report.

GENERAL DESCRIPTION

The Hannah Ridge at Feathergrass development is a 121.2 acre residential and commercial district within the south half of Section 32, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located on the west side of Akers Drive just north of Constitution Avenue. The existing abandoned Chicago Rock Island and Pacific Railroad sits directly north and west of the site, with Akers Drive bordering the east side and Constitution adjoining the south side of the site. The entire proposed development includes a total of 345 single-family residences and will be developed in seven filings. The Filing No. 5, 6 and 7 are the only remaining areas that are currently undeveloped within the community and was previously re-platted under Hannah Ridge at Feathergrass Filing No. 1. Filing No. 5 includes 55 residential lots on approximately 12.92 acres. Filing No. 6 will include 33 lots on approximately 7.94 acres, and Filing No. 7 is 81 lots on approximately 15.40 acres.

The average soil condition of the entire site and tributary area to the proposed ponds reflects Hydrologic Group "A" (Blakeland, loamy sand) as determined by the "Soil Survey of El Paso County Area," prepared by the National Cooperative Soil Survey (see map in Appendix).

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EXISTING DRAINAGE CONDITIONS

The site is located within the Sand Creek Drainage Basin. More specifically, it is situated in the north half of the overall Hannah Ridge at Feathergrass residential portion of the development. These last three residential filings makeup nearly all of the Basin A4, as shown on the existing drainage map provided by MVE, Inc. (See Appendix) The abandoned railroad bed along the north edge of the development serves as the northerly basin boundary and Winslow Park Dr. to the south as the southerly basin boundary. The recent construction of Filing 3 improvements included a 6'x10' CBC under Winslow Park Dr. out-falling into a 90" RCP storm. Adjacent to the 6'x10' CBC, a stormwater quality facility (Sand Filter Basin) was also constructed within Tract E, Hannah Ridge at Feathergrass Filing 1. The on-site pre-development drainage patterns sheet flow towards the natural channel through the middle of the property and ultimately into the 6'x10' CBC. This facility was constructed to allow the significant off-site flows from the north, passing under the railroad bed (Q_{10} = 360 cfs and Q_{100} = 640 cfs per Sand Creek DBPS) historically, traversing the site within an unimproved natural channel within a drainage easement. These off-site flows will continue to flow through the site as planned with the Hannah Ridge at Feathergrass Filing 3 construction drawings, designed by MVE, Inc., approved October 2017. This concept will be finalized in the Filing 5 construction drawings.

DEVELOPED DRAINAGE CONDITIONS

Given some recent changes in City/County Drainage Criteria, the calculations for these last phases of development now reflect current criteria for stormwater quality requirements. Proposed Pond 1 will be designed as a full spectrum facility to accommodate the developed flows from Filings 5, 6 and 7. This will include the design of concrete forebays, concrete trickle channels, concrete micropool and an outlet structure designed to release flows based on full spectrum criteria. The attached developed conditions drainage map contains many design points related to proposed at-grade and sump conditions. All public Type R inlets have been designed at these various locations to accept both the 5-yr. and 100-yr. developed flows. As stated in the Final Drainage Reports for both Hannah Ridge at Feathergrass Filing No. 1 and Filing No. 3, it is intended that the major drainage corridor within Tracts D and E, Hannah Ridge at Feathergrass Filing No. 1, including all channel improvements and box culvert to be owned and maintained by El Paso County in concert with the public transportation infrastructure through the mechanism of Public Right-of-Way and Public Drainage Easements through the site. Upon construction and acceptance of the all proposed channel improvements, Tracts D and E will be deeded to El Paso County.

All proposed storm facilities within the public Right-of-way will be public with ownership and maintenance by El Paso County. All other proposed storm facilities within easements or tracts and the proposed Pond 1 will be owned and maintained by the Hannah Ridge HOA.

Design Point 1 (Q_5 = 7 cfs and Q_{100} = 15 cfs) and **Design Point 2** (Q_5 = 0.7 cfs and Q_{100} = 1.4 cfs) collect developed flows from Basins OS-2, A and F. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 24" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 2 (Q_5 = 7 cfs and Q_{100} = 16 cfs).** The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards Pond 1.

Design Point 3 (Q_5 = 9 cfs and Q_{100} = 21 cfs) and **Design Point 4** (Q_5 = 2 cfs and Q_{100} = 4 cfs) collect developed flows from Basins OS-3, D and E. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 30" RCP storm sewer towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 4 (Q_5 = 11 cfs and Q_{100} = 24 cfs).** The emergency overflow route at this location is via a natural swale between two lots within a drainage easement and then directly into the natural channel. **Pipe Run 5 (Q_5 = 17 cfs and Q_{100} = 38 cfs)** represents the combined pipe flows from Design Points 1-4. This 36" RCP storm sewer will route these combined developed flows directly into Pond 1. This pond inflow is designated later in this report as the easterly pond inflow.

Design Point 5 (Q_5 = 9 cfs and Q_{100} = 25 cfs) collects developed flows from Basins OS-4 and J. At this sump condition, a 15' Type R sump inlet will be installed to collect a portion of both the 5-year and 100-year developed flows. These flows being collected have a maximum ponding depth up to the crown of the street. The collected flows at this location equal (Q_5 = 8 cfs and Q_{100} = 8 cfs) with flow-by of (Q_5 = 1 cfs and Q_{100} = 17 cfs) that will overtop the crown and travel into basins K and L. Given the location of the inlet with respect to this "T" intersection, it is assumed that approximately 75% of the flow-by will enter Basin K and 25% of the flow-by will enter Basin L. The downstream design points account for this flow-by assumption.

Design Point 6 (Q_5 = 6 cfs and Q_{100} = 24 cfs) and **Design Point 7** (Q_5 = 4 cfs and Q_{100} = 12 cfs) collect developed flows from Basins K, L and the flow-by described above from DP-5. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth up to the crown in Electronic Drive and be conveyed via a 36" RCP storm sewer in a southerly direction towards Design Point 8. The total flow within the pipe at this location is given by **Pipe Run 9 (Q_5 = 17 cfs and Q_{100} = 44 cfs).** The emergency overflow route at this location is in the southerly direction over the crown of Electronic Drive towards Design Point 8.

Design Point 8 (Q_5 = 3 cfs and Q_{100} = 7 cfs) collects developed flows from Basin M. At this sump condition, a 10' Type R sump inlet will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and be conveyed via a 36" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 10 (Q_5 = 20 cfs and Q_{100} = 49 cfs).** The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the Grand Prix cul-de-sac.

Design Point 9 (Q_5 = 9 cfs and Q_{100} = 19 cfs) and **Design Point 10** (Q_5 = 2 cfs and Q_{100} = 5 cfs) collect developed flows from Basins OS-5, N and O. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 36" RCP storm sewer in an easterly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 12 (Q_5 = 10 cfs and Q_{100} = 23 cfs).** The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the natural channel. **Pipe Run 13 (Q_5 = 30 cfs and Q_{100} = 71 cfs)** represents the combined pipe flows from Pipe Runs 10 and 12. This 42" RCP storm sewer will route these developed flows directly into Pond 1. This pond inflow is designated later in this report as the westerly pond inflow.

Basin OS-1 (Q_5 = 0.6 cfs and Q_{100} = 1.3 cfs) develops flows from the existing Akers Dr. roadway, north of the highpoint, that will continue to drain in a northerly direction as curb and gutter flow. **Basin C** (Q_5 = 0.5 cfs and Q_{100} = 1 cfs) develops flows from the existing Akers Dr. parkway landscape area adjacent to the roadway that will sheet flow into the road and continue to travel in a southerly direction. **Basin G** (Q_5 = 0.7 cfs and Q_{100} = 1.4 cfs) develops flows from a small portion of the proposed lots and roadway that cannot be collected on-site. These minor flow will continue to drain in a southerly direction directly into Winslow Park Dr. **Basin B1** (Q_5 = 0.1 cfs and Q_{100} = 0.9 cfs) develops flow from the northerly portion of Tract A and does not include any impervious improvements. Thus, this basin will continue to sheet flow off-site. **Basin B** (Q_5 = 1 cfs and Q_{100} = 3 cfs), **Basin** H (Q_5 = 1 cfs and Q_{100} = 2 cfs) and **Basin P** (Q_5 = 2 cfs and Q_{100} = 4 cfs) develop flows from the rear yards of the proposed lots that cannot be reasonably collected by Pond 1. As noted on the drainage map, all impervious roof area within these basins will require roof drains to be routed to the front of the lots and directly into the public roadway. As such, these flows are then treated by Pond 1. Any remaining minor impervious areas not able to be routed to the front of the lot must travel across a grass buffer (sodded rear yard) prior to exiting the lot. **Basin Q** (Q_5 = 2 cfs and Q_{100} = 6 cfs) develops flows from rear yards of the proposed lots adjacent to Pond 1 and the facility itself. These flows are all tributary to Pond 1.

The total inflow into Pond 1 equals Q_5 = 44 cfs and Q_{100} = 103 cfs per the UD-Detention spreadsheet. (See Appendix) This facility will be constructed with the proposed Filing 7 development and the downstream flows will remain consistent with the previous filings. This facility will have two separate inflow points (westerly and easterly). The westerly inflow (Q_5 = 30 cfs and Q_{100} = 71 cfs) will be from a 42" RCP into a concrete forebay with a required size of 566 CF based on 3% of the WQCV from this inflow. The forebay is designed with 18" high walls, 6" notch and a 24" wide concrete trickle channel routing the flows towards the pond outlet. The easterly inflow (Q_5 = 17 cfs and Q_{100} = 38 cfs) will outlet from a 36" RCP, down a rip-rap chute into a concrete forebay with a required size of 305 CF based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 5" notch and an 28" wide concrete trickle channel routing the flows towards the pond outlet. These two forebays trickle channels will combine into a 30" wide concrete trickle channel conveying the flows to the outlet structure. The outlet structure consists of a 6'x4' concrete box with an integral 190 SF micropool allowing for 6" initial surcharge depth. The micropool total depth of 3.0' provides the required 0.3% of the WQCV. The outlet box height required to meet the EURV design volume equals 5.75'. (See UD-BMP Spreadsheets in Appendix) The orifice plate on the front of the outlet box consists of a series of 5 holes, 13.8" apart. (See UD-Detention Spreadsheets in Appendix) This facility will be owned and maintained by the Hannah Ridge HOA.

Pond 1 has the following design parameters as a full-spectrum facility:

0.74 Ac.-ft. WQCV required

2.44 Ac.-ft. EURV required

2.6 Ac.-ft. EURV design with 4:1 max. slopes

4.4 Ac.-ft. 100-yr. storage

Total In-flow:	**Q_5 = 44 cfs, Q_{100} = 103 cfs**
Pond Design Release:	**Q_5 = 0.8 cfs, Q_{100} = 38 cfs**
Pre-development Release:	**Q_5 = 0.8 cfs, Q_{100} = 46 cfs**

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Individual on-site developed basin design used for inlet sizing and storm system routing was calculated using the Rational Method. Full-Spectrum detention pond modeling developed using UD-Detention spreadsheet ver. 3.07, Urban Drainage and Flood Control District.

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.

This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed impervious areas (roof tops, patios) will sheet flow across landscaped yards and through open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.

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2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the front yards, these flows will travel via curb and gutter within the public streets and eventually public storm systems. These collected flows are then routed directly to the full-spectrum detention facility on-site (Pond 1). Where developed flows are not able to be routed to public streets (rear yards), sheet flows will travel towards the natural drainage channel within the open space corridor. This corridor will be protected with rip-rap and erosion control matting as required to reduce velocities to non-erosive levels.

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in the proposed full-spectrum permanent Extended Detention Basin (Pond 1) designed per current El Paso County drainage criteria.

4. **Consider need for Industrial and Commercial BMPs**: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative has been submitted along with the grading and erosion control plan. Details such as site specific source control construction BMP's as well as permanent BMP's were detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

ROCK ISLAND TRAIL (BOX CULVERT)

Kiowa Engineering Corporation prepared a report titled "Hydrology Analysis, East Fork Sand Creek, Tributary 6", having revision date of January 18, 2007. The report served to amend the Sand Creek DBPS and was reviewed and accepted by El Paso County during the same time frame as the Preliminary Plan approval for Hannah Ridge at Feathergrass. The amendment specified that the existing 7'x7' railroad culvert crossing, located just north of the proposed Filing 5, is to remain in place. Said DBPS amendment indicates that the existing ponding area on the upstream side of the railroad embankment is to remain in the current and future drainage conditions, thereby reducing the resultant developed flows trough the properties downstream of the embankment, including flows through the tributary in Hannah Ridge. Flows at this structure are as follows: Inflow Q_{10} = 374 cfs and Q_{100} = 915 cfs, Outflow Q_{10} = 360 cfs and Q_{100} = 640 cfs with a 100 yr. upstream storage elevation of 6495.3. The 2007 DBPS Amendment Map is included in the Appendix for easy reference. In accordance with BOCC conditions of approval of the Preliminary Plan, maintenance on this existing structure was to take place in conjunction with the Hannah Ridge at Feathergrass Filing 3 improvements. As such, specified improvements were included in the approved construction drawings for Filing 3 (Sheet 31). These improvements included concrete surface repairs within the box culvert, wingwall reconditioning and addition of rip-rap aprons. To date, these improvements have been completed by Classic Homes with the development of Filing 3 and inspected by El Paso County. The City of Colorado Springs is aware of the recent improvements and is scheduled to inspect them for completion, as they will maintain ownership and maintenance responsibility for this structure and associated improvements. A letter from City acknowledging these improvements will be provided to County Staff.

Still unresolved, the comment that the owner of the Box Culvert, The City of Colorado Springs has in writing accepted the improvements is still outstanding.

FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C0752G and 08041C0539G, with effective dates of December 7, 2018 (See Appendix).

Still need acceptance of repairs letter from The City of Colorado Springs.

EROSION CONTROL PLAN

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

DRAINAGE FACILITY COST OPINION

The concrete box culvert, as proposed with these filings for the Sand Creek Tributary 6 drainageway, was not specifically planned in the DBPS. However, these improvements are a functional substitute for the check structures and rip-rap channel lining as presented in the DBPS. Therefore, the cost of such improvements are creditable towards fees or reimbursable up to the cost as presented in the DBPS. The costs of the improvements as shown in the DBPS are as follows and as presented in the previous report (Hannah Ridge at Feathergrass Filing No. 3):

Include the cost presented in the DBPS for this specific reach of channel improvements.

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Hannah Ridge at Feathergrass DSPS Improvements Costs (Reimbursable)				
Item	Quantity	Unit	Unit Cost	Cost
Rip Rap Channel (20' BW, 4' H) L = 1350' (DBPS Sht EF-23, EF-25)	6599	CY	$98	$646, 702
Concrete Check for 20' BW channel Number=2 (DBPS Sht EF-23, EF-25)	6	CY	$312	$1,872
Rip Rap Channel (15' BW, 2' H) L = 840' (DBPS Sht EF-23J EF-24)	2520	CY	$98	$246,960
Concrete Check for 15' BW channel Number = 1 (DBPS Sht EF-24)	3	CY	$312	$936
Rip Rap Channel (30' BW, 4' H) L = 2430 (DBPS Sht. EF-21, EF-23)	14460	CY	$98	$1,417,080
Concrete Check for 30' BW channel Number = 3 (DBPS Sht 21 23)	12	CY	$312	$3, 744
Rip Rap Channel (10' BW, 2' H) L = 660' (DBPS Sht EF-22)	1613	CY	$98	$158,074
Concrete Check for 10' BW channel Number = 2 (DBPS Sht EF-22)	4	CY	$312	$1 , 248
GRAND TOTAL				**$2,476,616**

The proposed Sand Creek Tributary 6 channel improvements as shown in the Hannah Ridge at Feathergrass Filing No. 5 construction plans and associated reimbursable costs are as follows:

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<u>Hannah Ridge at Feathergrass Filing No. 5 Drainage Improvement Costs (Reimbursable)</u>

ITEM	DESCRIPTION	QUANTITY	UNIT COST	COST
1.	50' BW, 4' H Grass Channel (Incl. grading, seeding, E.C)	420 LF	$165/LF	$ 69,300.00
2.	62' BW Rip-Rap Channel (Type L Rip-Rap D=18")	415 CY	$93/CY	$ 38,595.00
3.	74' BW Grouted Rip-Rap (Type L Grouted D=18")	165 CY	$227/CY	$ 37,455.00
~~4.~~	~~Concrete Box Culvert (6x12)~~	~~463 LF~~	~~$520/LF~~	~~$ 240,760.00~~
~~5.~~	~~End Treatment - Headwall~~	~~1 EA~~	~~$3,500 EA~~	~~$ 3,500.00~~
~~6.~~	~~End Treatment - Wingwalls~~	~~2 EA~~	~~$5,000 EA~~	~~$ 10,000.00~~
~~7.~~	~~End Treatment – Cutoff wall~~	~~1 EA~~	~~$500 EA~~	~~$ 500.00~~
TOTAL				**~~$ 400,110.00~~**

Classic Consulting Engineers & Surveyors cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular.

DRAINAGE & BRIDGE FEES

This site lies within the Sand Creek Drainage Basin. The fees are calculated using the following impervious acreage method approved by El Paso County. All three Filings are re-plats of previously platted tracts within Filing 1. However, these tracts were designated as future development and no fees were paid at time of original platting. Thus, the percent imperviousness for each Filing is calculated below based on the following acreages:

Only the amount of channel improvements that were proposed in the 1996 DBPS for the specific length carried forward to today through approved fee increases would be allowed to be Deferred. If you wish to do this, call these numbers out in the report and show your calculations. It must also be stated that these improvement costs were not previously deferred in previous filings.
if you wish to get the box culvert reimbursed (along with an associated drainage fee increase) through the drainage board that would be a separate item.

Filing 5: 12.92 ac.

Filing 6: 7.94 ac.

Filing 7: 15.40 ac. However, 1.69 ac. is a re-plat of Tract A, Filing 6 with fees paid at that time

Filing 7 net acreage for drainage/bridge fees = 13.71 ac.

The total development area for each Filing is broken into different residential uses:

PUD zone (5000-6000 SF lots – 60% Impervious)

PUD zone (6000 SF avg. lots – 53% Impervious)

PUD zone Open space/drainage tracts (Greenbelts – 2% Impervious).

The following calculations are based on the 2018 drainage/bridge fees for the Sand Creek Basin:

FILING 5:

6000 SF avg. lots

(Per El Paso County Percent Impervious Chart for 6000 SF lots: 53%)

11.93 Ac. x 53% = **6.32 Impervious Ac.**

Open Space Tracts

(Per El Paso County Percent Impervious Chart for greenbelts: 2%)

0.99 Ac. x 2% = **0.02 Impervious Ac.**

Total Impervious Acreage: **6.34 Imp. Ac.**

FILING 5 FEE TOTALS:

Bridge Fees

$ 5,210.00 x 6.34 Impervious Ac. = $ 33,031.40

Drainage Fees

$ 17,751.00 x 6.34 Impervious Ac. = $ 112,541.34
(These Drainage Fees will be paid by developer in the form of cash and/or credits based on the aforementioned reimbursable drainage costs)

FILING 6:

5000 - 6000 SF avg. lots

(Per El Paso County Percent Impervious Chart for 5000 - 6000 SF lots: 60%)

6.25 Ac. x 60% = **3.75 Impervious Ac.**

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<u>Open Space Tracts</u>

(Per El Paso County Percent Impervious Chart for greenbelts: 2%)

1.69 Ac. x 2% = **0.03 Impervious Ac.**

Total Impervious Acreage: 3.78 Imp. Ac.

FILING 6 FEE TOTALS:

Bridge Fees

$ 5,210.00 x 3.78 Impervious Ac. = <u>$ 19,693.80</u>

Drainage Fees

$ 17,751.00 x 3.78 Impervious Ac. = <u>$ 67,098.78</u>
(These Drainage Fees will be paid by developer in the form of cash and/or credits based on the aforementioned reimbursable drainage costs)

<u>FILING 7:</u>

<u>5000 - 6000 SF avg. lots</u>

(Per El Paso County Percent Impervious Chart for 5000 - 6000 SF lots: 60%)

13.71 Ac. x 60% = **8.23 Impervious Ac.**

Total Impervious Acreage: 8.23 Imp. Ac.

FILING 7 FEE TOTALS:

Bridge Fees

$ 5,210.00 x 8.23 Impervious Ac. = <u>$ 42,878.30</u>

Drainage Fees

$ 17,751.00 x 8.23 Impervious Ac. = <u>$ 146,090.73</u>
(These Drainage Fees will be paid by developer in the form of cash and/or credits based on the aforementioned reimbursable drainage costs)

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Per the ECM 3.10.4a, this development requests a reduction of drainage fees based on the on-site full spectrum detention/SWQ facility proposed within the Sand Creek Drainage Basin to be constructed with the first Filing developed. The following facility seems to meet the required six criteria as follows:

There is not a planned regional system downstream, therefore, the reduction of fees is not allowed. per ECM 3.10.4a.

1. No downstream regional facility in place yet.
2. Proposed facility is less than 15 ac-ft. in volume
3. The proposed on-site facility is not part of a regional plan.
4. The proposed outlet is designed to release to full-spectrum criteria.
5. Proposed facility is per County criteria and will gain County approval.
6. Proposed facility will be private with ownership and maintenance by HOA.

Total Reduction

Detention Pond 1	4.4 ac-ft. full spectrum	$ 83,270 x 50% =	~~**$ 41,635.00**~~

SUMMARY

This proposed development remains consistent with the previously approved MDDP and Final Drainage Reports for Hannah Ridge at Feathergrass Filings 2, 3 and 4. The existing storm facilities continue to adequately handle both the 5-yr. and 100-yr. developed flows. All proposed detention facilities meet current criteria and provide full spectrum design. The proposed development will not adversely impact surrounding developments.

PREPARED BY:
Classic Consulting

Marc A. Whorton, P.E.
Project Manager

maw/1116.05/REPORTS/PDR-Fil. 5-6-7.doc

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated October 1991.

2. "Sand Creek Drainage Basin Planning Study," Kiowa Engineering Corp, dated March 1996.

3. "Master Development Drainage Plan for Hannah Ridge", prepared by MVE, Inc. November 2007

4. "Hydrology Analysis, East Fork Sand Creek, Tributary 6", prepared by Kiowa Engineering Corp, dated January 2007

5. "Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 3", by MVE, Inc. October 2017.

6. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.

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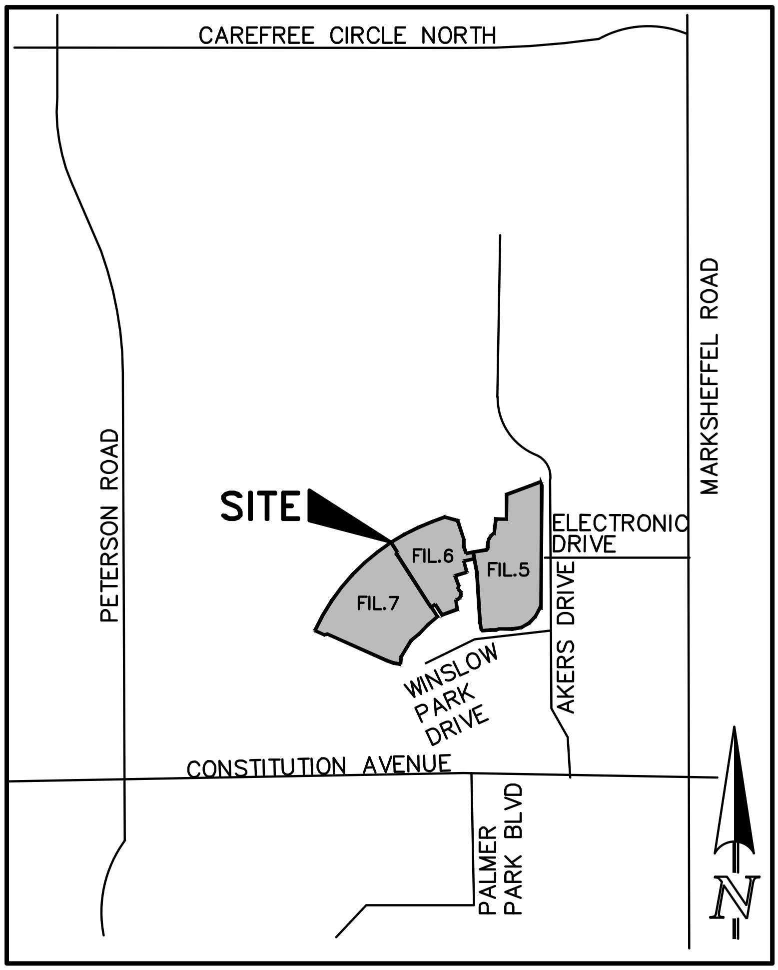
APPENDIX

VICINITY MAP



VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

Map Scale: 1:5,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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 16, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	119.8	88.4%
97	Truckton sandy loam, 3 to 9 percent slopes	15.7	11.6%
Totals for Area of Interest		**135.4**	**100.0%**

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

F.E.M.A. MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. **The community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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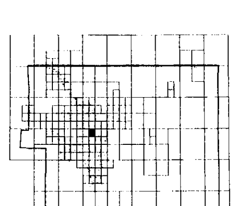
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

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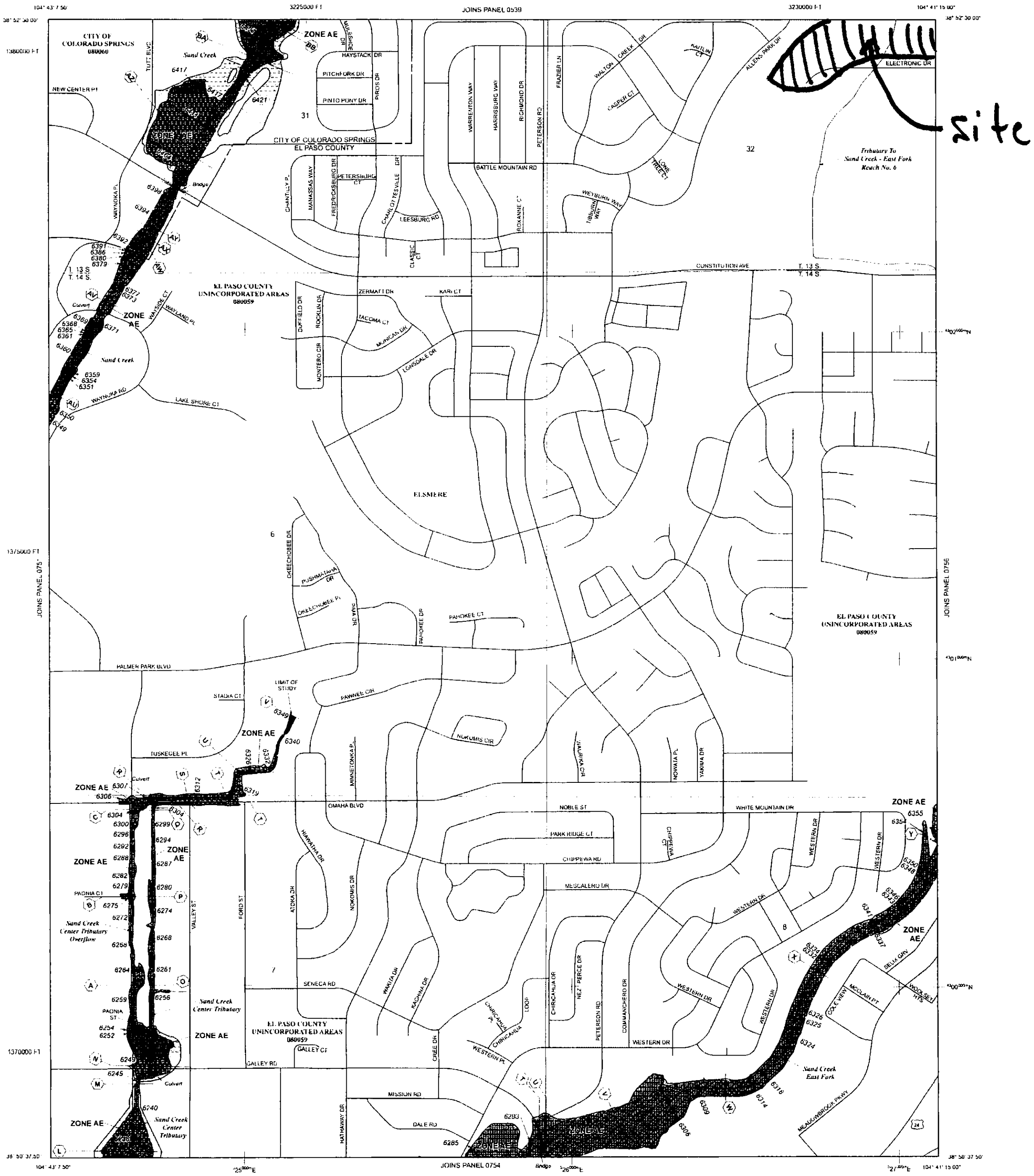

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A) ---- (A)	Cross section line
(23) ---- (23)	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4276000 N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0752G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 752 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	G
EL PASO COUNTY	080059	0752	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0752G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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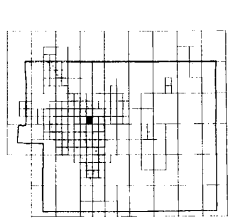

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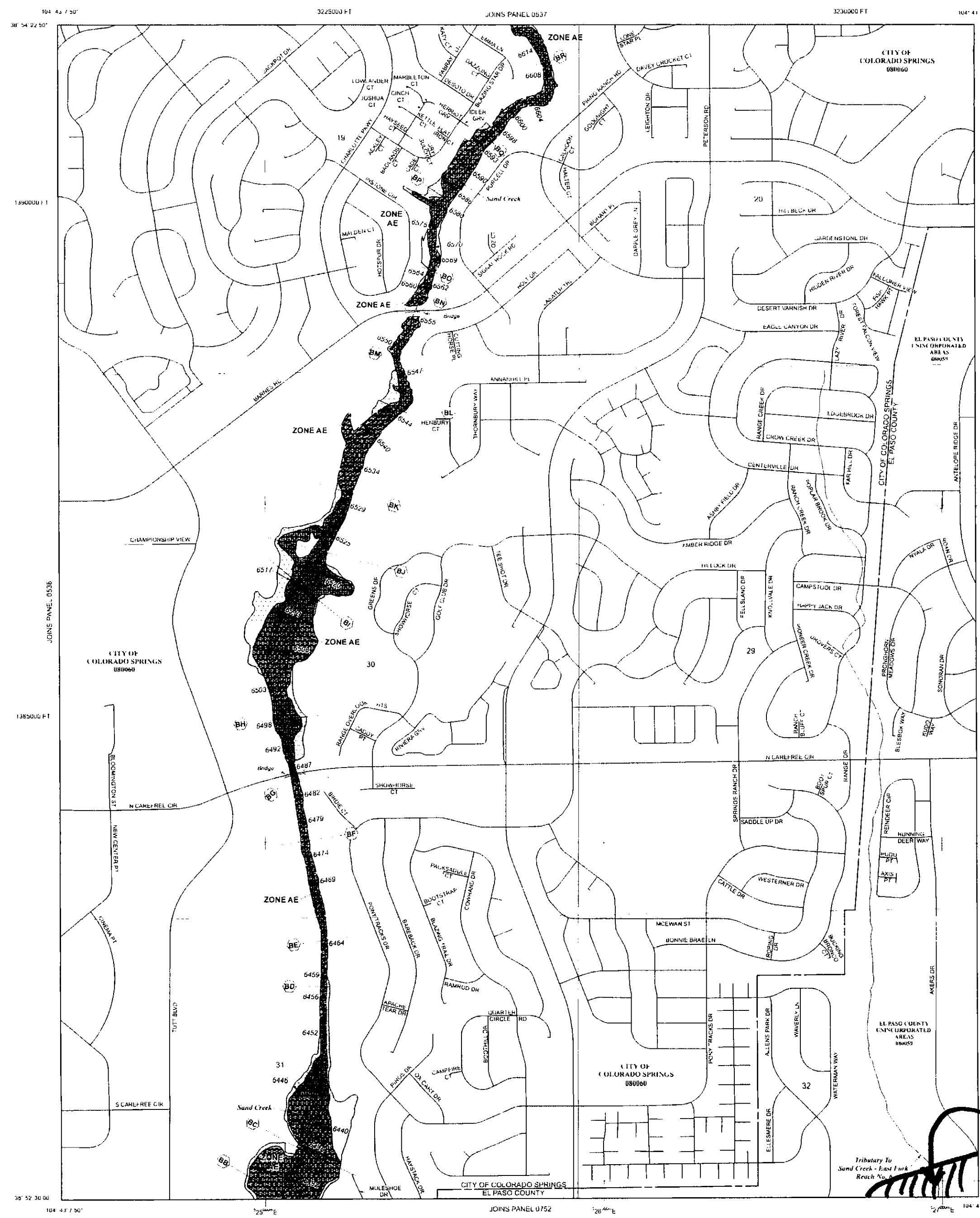

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EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

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150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 0539G

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 539 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0539	G
EL PASO COUNTY	080059	0539	G

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MAP NUMBER
08041C0539G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

HYDROLOGIC / HYDRAULIC CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7*
JOB NUMBER: *1116.05*
DATE: *10/01/18*
CALCULATED BY: *K. CERJAN*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS							LANDSCAPE/UNDEVELOPED AREAS							WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
OS-1	0.23	0.16	0.89	0.90	0.92	0.94	0.95	0.96	0.07	0.02	0.08	0.15	0.25	0.30	0.35	0.63	0.65	0.77	0.14	0.15	0.18
OS-2	0.35	0.25	0.89	0.90	0.92	0.94	0.95	0.96	0.10	0.02	0.08	0.15	0.25	0.30	0.35	0.64	0.67	0.79	0.22	0.23	0.28
OS-3	0.27	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.27	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.01	0.02	0.09
OS-4	3.40	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.40	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.07	0.27	1.19
OS-5	0.36	0.33	0.89	0.90	0.92	0.94	0.95	0.96	0.03	0.02	0.08	0.15	0.25	0.30	0.35	0.82	0.83	0.91	0.29	0.30	0.33
A	3.90	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.90	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.52	1.68	2.22
B	0.52	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.52	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.20	0.22	0.30
B1	0.28	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.28	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.01	0.02	0.10
C	0.21	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.21	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.08	0.09	0.12
D	5.60	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.60	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	2.18	2.41	3.19
E	0.96	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.96	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.37	0.41	0.55
F	0.26	0.08	0.89	0.90	0.92	0.94	0.95	0.96	0.18	0.39	0.43	0.47	0.52	0.55	0.57	0.54	0.57	0.69	0.14	0.15	0.18
G	0.25	0.10	0.89	0.90	0.92	0.94	0.95	0.96	0.15	0.39	0.43	0.47	0.52	0.55	0.57	0.59	0.62	0.73	0.15	0.15	0.18
H	0.40	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.40	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.16	0.17	0.23
I	Not Used																				
J	5.30	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.30	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	2.07	2.28	3.02
K	3.60	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.60	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.40	1.55	2.05
L	2.30	0.00	0.89	0.90	0.92	0.94	0.95	0.96	2.30	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.90	0.99	1.31
M	1.70	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.70	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.66	0.73	0.97
N	5.10	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.10	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.99	2.19	2.91
O	1.20	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.20	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.47	0.52	0.68
P	0.77	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.77	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.30	0.33	0.44
Q	3.20	0.90	0.39	0.43	0.47	0.52	0.55	0.57	2.30	0.02	0.08	0.15	0.25	0.30	0.35	0.12	0.18	0.41	0.40	0.57	1.32

JOB NAME:	*HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7*
JOB NUMBER:	*1116.05*
DATE:	*10/01/18*
CALC'D BY:	*K. CERJAN*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$

Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$$t_c = \frac{L}{180} + 10$$

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS		
BASIN	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.14	0.15	0.16	0.17	0.17	0.18	0.08	25	0.5	7.3	230	1.0%	2.0	1.9	9.2	3.39	4.25	4.96	5.66	6.37	7.13	0.5	0.6	1.3
OS-2	0.22	0.23	0.25	0.26	0.27	0.28	0.08	25	0.5	7.3	320	1.0%	2.0	2.7	10.0	3.30	4.13	4.82	5.51	6.20	6.93	0.7	1	2
OS-3	0.01	0.02	0.04	0.07	0.08	0.09	0.08	100	10	8.6					8.6	3.47	4.35	5.08	5.80	6.53	7.31	0.02	0.1	0.7
OS-4	0.07	0.27	0.51	0.85	1.02	1.19	0.08	180	10	14.0					14.0	2.89	3.62	4.22	4.83	5.43	6.08	0.2	1	7
OS-5	0.29	0.30	0.31	0.32	0.32	0.33	0.08	10	0.2	4.6	470	2.8%	3.3	2.3	7.0	3.72	4.67	5.45	6.23	7.01	7.84	1.1	1	3
A	1.52	1.68	1.83	2.03	2.15	2.22	0.43	100	2	9.6	750	1.5%	2.4	5.1	14.7	2.83	3.55	4.14	4.73	5.32	5.96	4	6	13
B	0.20	0.22	0.24	0.27	0.29	0.30	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	1	3
B1	0.01	0.02	0.04	0.07	0.08	0.10	0.08	55	13	4.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.0	0.1	0.9
C	0.08	0.09	0.10	0.11	0.12	0.12	0.43	20	0.4	4.3					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.3	0.5	1
D	2.18	2.41	2.63	2.91	3.08	3.19	0.43	100	2	9.6	575	4.0%	4.0	2.4	12.0	3.08	3.85	4.50	5.14	5.78	6.47	7	9	21
E	0.37	0.41	0.45	0.50	0.53	0.55	0.43	50	1	6.8	375	2.7%	3.3	1.9	8.7	3.46	4.34	5.06	5.78	6.51	7.28	1	2	4
F	0.14	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8					6.8	3.75	4.71	5.49	6.28	7.06	7.90	0.5	0.7	1.4
G	0.15	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8	60	1.5%	2.4	0.4	7.2	3.68	4.62	5.39	6.16	6.93	7.76	0.5	0.7	1.4
H	0.16	0.17	0.19	0.21	0.22	0.23	0.43	30	0.6	5.3					5.3	4.06	5.09	5.94	6.79	7.64	8.55	1	1	2
I	Not Used																							
J	2.07	2.28	2.49	2.76	2.92	3.02	0.43	100	2	9.6	850	1.5%	2.4	5.8	15.4	2.78	3.48	4.06	4.64	5.22	5.84	6	8	18
K	1.40	1.55	1.69	1.87	1.98	2.05	0.43	100	2	9.6	425	1.5%	2.4	2.9	12.5	3.03	3.79	4.42	5.06	5.69	6.37	4	6	13
L	0.90	0.99	1.08	1.20	1.27	1.31	0.43	100	2	9.6	510	2.5%	3.2	2.7	12.3	3.05	3.82	4.45	5.09	5.73	6.41	3	4	8
M	0.66	0.73	0.80	0.88	0.94	0.97	0.43	50	1	6.8	475	1.5%	2.4	3.2	10.0	3.29	4.12	4.81	5.50	6.19	6.92	2	3	7
N	1.99	2.19	2.40	2.65	2.81	2.91	0.43	100	2	9.6	975	2.0%	2.8	5.7	15.4	2.78	3.48	4.07	4.65	5.23	5.85	6	8	17
O	0.47	0.52	0.56	0.62	0.66	0.68	0.43	50	1	6.8	575	2.0%	2.8	3.4	10.2	3.27	4.10	4.78	5.47	6.15	6.88	1.5	2	5
P	0.30	0.33	0.36	0.40	0.42	0.44	0.43	50	6	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.2	2	4
Q	0.40	0.57	0.77	1.04	1.19	1.32	0.08	260	5	23.9					23.9	2.26	2.82	3.29	3.76	4.23	4.73	1	2	6

JOB NAME: *HANNAH RIDGEAT FEATHERGRASS FILING NO. 5, 6 & 7*
JOB NUMBER: *1116.05*
DATE: *10/01/18*
CALCULATED BY: *K. CERJAN*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Inlet Size
1	A, OS-2	1.91	2.50	14.7	3.55	5.96	7	15	10' Type R Sump
2	F	0.15	0.18	6.8	4.71	7.90	0.7	1.4	5' Type R Sump
3	D, OS-3	2.43	3.29	12.0	3.85	6.47	9	21	15' Type R Sump
4	E	0.41	0.55	8.7	4.34	7.28	2	4	5' Type R Sump
5	OS-4, J	2.55	4.21	15.4	3.48	5.84	9	25	15' Type R Sump
6	K, DP-5 Flowby (75%)	1.76	4.20	15.8	3.44	5.78	6	24	10' Type R Sump
7	L, DP-5 Flowby (25%)	1.06	2.03	15.8	3.44	5.78	4	12	5' Type R Sump
8	M	0.73	0.97	10.0	4.12	6.92	3	7	10' Type R Sump
9	N, OS-5	2.49	3.23	15.4	3.48	5.85	9	19	10' Type R Sump
10	O	0.52	0.68	10.2	4.10	6.88	2	5	5' Type R Sump
E'LY INFLOW TO POND	DP1 - DP4	4.90	6.51	15.5	3.47	5.82	17	38	
W'LY INFLOW TO POND	DP-5 - DP-10	8.83	12.46	16.2	3.40	5.72	30	71	
TOTAL INFLOW TO POND	**OS-2, OS-3, OS-4, OS-5, A, D, E, F, J, K, L, M, N, O, Q**	**See UD-Detention Spreadsheet**					**44**	**103**	

JOB NAME: *HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7*
JOB NUMBER: *1116.05*
DATE: *10/01/18*
CALCULATED BY: *K. CERJAN*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Pipe Size*	Velocity (ft/sec.)
1	DP-1	1.91	2.50	14.7	3.55	5.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	14.8	3.54	5.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	12.0	3.85	6.47	9	21	30" RCP	8.4
4	DP-4, PR-3	2.84	3.83	12.6	3.78	6.35	11	24	30" RCP	16.3
5	PR-2, PR-4	4.90	6.51	15.5	3.47	5.82	17	38	36" RCP	23.6 (Use Class 5 RCP w/ Rstrnts)
6	DP-5 Collected	2.27	1.35	15.4	3.48	5.84	8	8	18" RCP	10.4
7	DP-6, Flow-by from DP-5 (75%)	1.76	4.20	15.8	3.44	5.78	6	24	30" RCP	16.8
8	DP-7, Flow-by from DP-5 (25%)	1.06	2.03	15.8	3.44	5.78	4	12	24" RCP	9.5
9	RP-6, PR-7, PR-8	5.09	7.57	15.9	3.43	5.76	17	44	36" RCP	10.1
10	DP-8, PR-9	5.82	8.54	16.1	3.41	5.73	20	49	36" RCP	10.3
11	DP-10	0.52	0.68	10.3	4.09	6.86	2	5	18" RCP	4.5
12	DP-9, PR-11	3.01	3.92	15.5	3.47	5.83	10	23	36" RCP	6.6
13	PR-10, PR-12	8.83	12.46	16.2	3.40	5.72	30	71	42" RCP	9.5

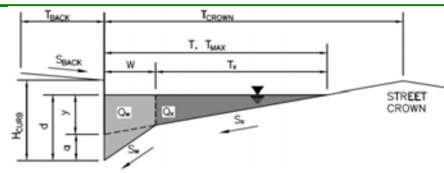
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-1

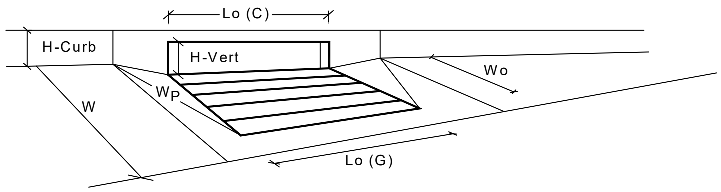


Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**25.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.0	15.0	cfs

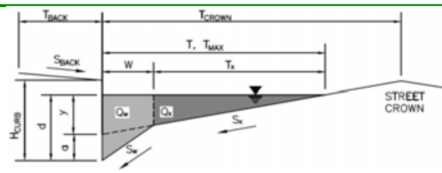
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-2



Gutter Geometry (Enter data in the blue cells)

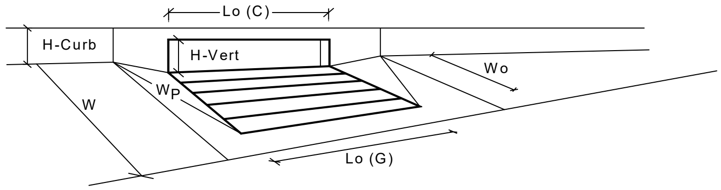
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.4	cfs

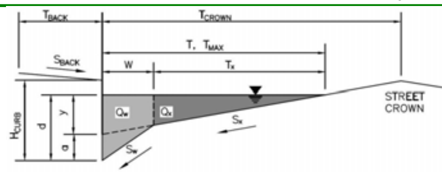
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-3



Gutter Geometry (Enter data in the blue cells)

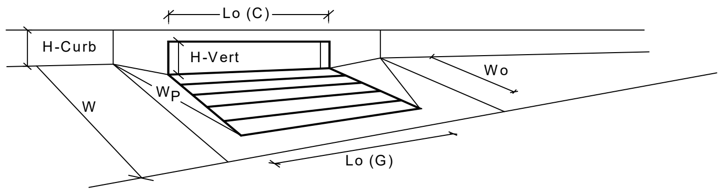
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**9.7**	**39.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.0	21.0	cfs

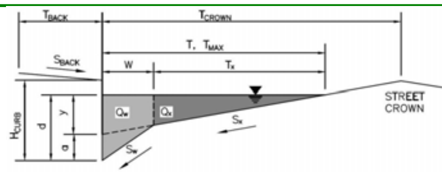
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-4



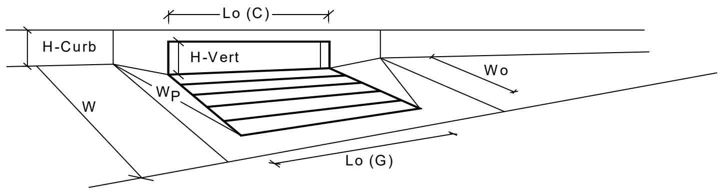
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	4.0	cfs

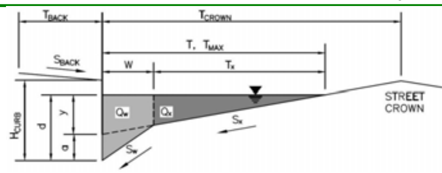
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-5



Gutter Geometry (Enter data in the blue cells)

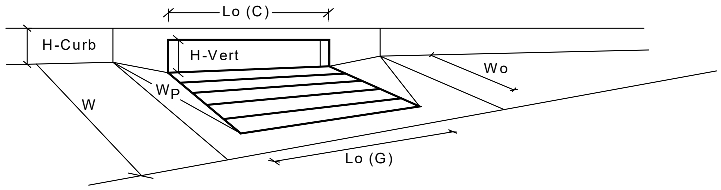
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	0.76	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

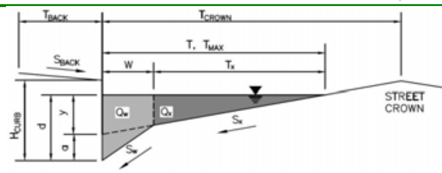
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.0**	**8.0**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	9.0	25.0	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-6



Gutter Geometry (Enter data in the blue cells)

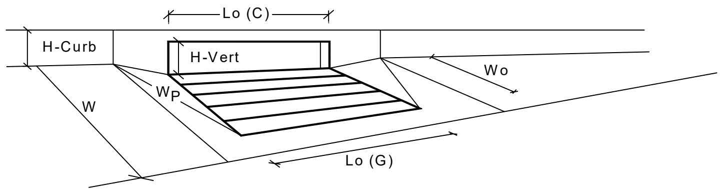
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**25.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.0	24.0	cfs

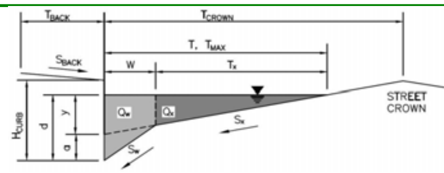
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-7



Gutter Geometry (Enter data in the blue cells)

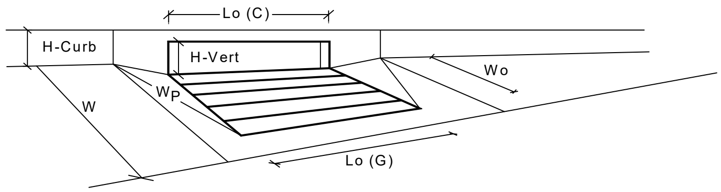
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.0	12.0	cfs

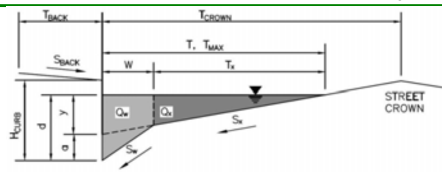
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-8



Gutter Geometry (Enter data in the blue cells)

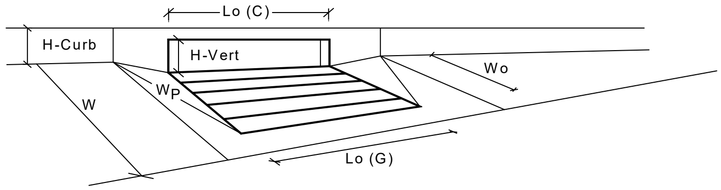
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**8.3**	**8.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.0	7.0	cfs

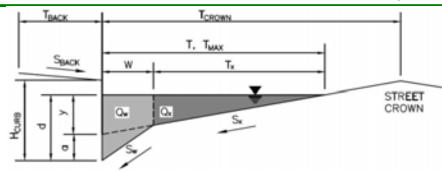
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-9



Gutter Geometry (Enter data in the blue cells)

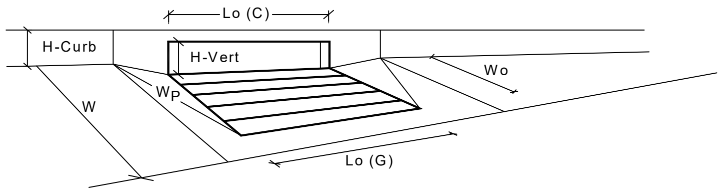
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**25.5**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	9.0	19.0	cfs

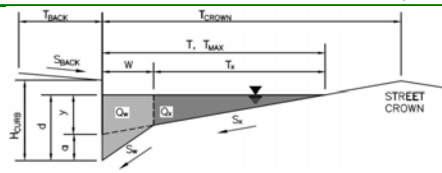
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: DP-10



Gutter Geometry (Enter data in the blue cells)

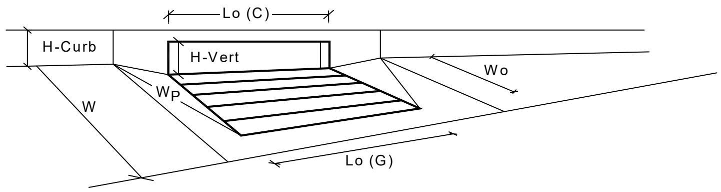
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLEET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	5.0	cfs

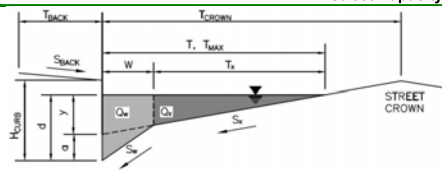
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID: Street Capacity



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.6	8.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.7	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.3**	**13.3**	**cfs**
Flow Velocity within the Gutter Section	V =	6.1	6.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	11.5	132.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	11.5	91.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	5.4	19.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	25.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	16.8	137.2	cfs
Average Flow Velocity Within the Gutter Section	V =	6.4	10.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.2	10.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**16.8**	**137.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.41	6.41	inches

MINOR STORM Allowable Capacity is based on Spread Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.3**	**137.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	15.00	ft³/s

Results

Normal Depth	1.19	ft
Flow Area	1.95	ft²
Wetted Perimeter	3.52	ft
Hydraulic Radius	0.55	ft
Top Width	1.96	ft
Critical Depth	1.40	ft
Percent Full	59.5	%
Critical Slope	0.00632	ft/ft
Velocity	7.70	ft/s
Velocity Head	0.92	ft
Specific Energy	2.11	ft
Froude Number	1.36	
Maximum Discharge	24.33	ft³/s
Discharge Full	22.62	ft³/s
Slope Full	0.00440	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	59.50	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02800	ft/ft
Diameter	2.00	ft
Discharge	16.00	ft³/s

Results

Normal Depth	0.91	ft
Flow Area	1.39	ft²
Wetted Perimeter	2.96	ft
Hydraulic Radius	0.47	ft
Top Width	1.99	ft
Critical Depth	1.44	ft
Percent Full	45.4	%
Critical Slope	0.00661	ft/ft
Velocity	11.54	ft/s
Velocity Head	2.07	ft
Specific Energy	2.98	ft
Froude Number	2.44	
Maximum Discharge	40.72	ft³/s
Discharge Full	37.85	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	45.38	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	21.00	ft³/s

Results

Normal Depth	1.27	ft
Flow Area	2.50	ft²
Wetted Perimeter	3.96	ft
Hydraulic Radius	0.63	ft
Top Width	2.50	ft
Critical Depth	1.56	ft
Percent Full	50.7	%
Critical Slope	0.00519	ft/ft
Velocity	8.41	ft/s
Velocity Head	1.10	ft
Specific Energy	2.37	ft
Froude Number	1.48	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00262	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.70	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05500	ft/ft
Diameter	2.50	ft
Discharge	24.00	ft³/s

Results

Normal Depth	0.85	ft
Flow Area	1.47	ft²
Wetted Perimeter	3.11	ft
Hydraulic Radius	0.47	ft
Top Width	2.37	ft
Critical Depth	1.67	ft
Percent Full	34.0	%
Critical Slope	0.00556	ft/ft
Velocity	16.28	ft/s
Velocity Head	4.12	ft
Specific Energy	4.97	ft
Froude Number	3.64	
Maximum Discharge	103.47	ft³/s
Discharge Full	96.19	ft³/s
Slope Full	0.00342	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.04	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	3.00	ft
Discharge	38.00	ft³/s

Results

Normal Depth	1.62	ft
Flow Area	3.90	ft²
Wetted Perimeter	4.96	ft
Hydraulic Radius	0.79	ft
Top Width	2.99	ft
Critical Depth	2.01	ft
Percent Full	54.1	%
Critical Slope	0.00524	ft/ft
Velocity	9.74	ft/s
Velocity Head	1.48	ft
Specific Energy	3.10	ft
Froude Number	1.50	
Maximum Discharge	71.74	ft³/s
Discharge Full	66.69	ft³/s
Slope Full	0.00325	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.07	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03400	ft/ft
Diameter	1.50	ft
Discharge	8.00	ft³/s

Results

Normal Depth	0.67	ft
Flow Area	0.77	ft²
Wetted Perimeter	2.20	ft
Hydraulic Radius	0.35	ft
Top Width	1.49	ft
Critical Depth	1.10	ft
Percent Full	44.8	%
Critical Slope	0.00742	ft/ft
Velocity	10.44	ft/s
Velocity Head	1.69	ft
Specific Energy	2.36	ft
Froude Number	2.57	
Maximum Discharge	20.83	ft³/s
Discharge Full	19.37	ft³/s
Slope Full	0.00580	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.79	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient		0.013	
Channel Slope		0.06000	ft/ft
Diameter		2.50	ft
Discharge		24.00	ft³/s

Results

Normal Depth		0.83	ft
Flow Area		1.43	ft²
Wetted Perimeter		3.07	ft
Hydraulic Radius		0.46	ft
Top Width		2.36	ft
Critical Depth		1.67	ft
Percent Full		33.3	%
Critical Slope		0.00555	ft/ft
Velocity		16.80	ft/s
Velocity Head		4.38	ft
Specific Energy		5.22	ft
Froude Number		3.80	
Maximum Discharge		108.07	ft³/s
Discharge Full		100.47	ft³/s
Slope Full		0.00342	ft/ft
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Average End Depth Over Rise		0.00	%
Normal Depth Over Rise		33.27	%
Downstream Velocity		Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula		
Solve For	Normal Depth		

Input Data

Roughness Coefficient		0.013	
Channel Slope		0.02000	ft/ft
Diameter		2.00	ft
Discharge		12.00	ft³/s

Results

Normal Depth		0.85	ft
Flow Area		1.27	ft²
Wetted Perimeter		2.84	ft
Hydraulic Radius		0.45	ft
Top Width		1.98	ft
Critical Depth		1.24	ft
Percent Full		42.4	%
Critical Slope		0.00558	ft/ft
Velocity		9.46	ft/s
Velocity Head		1.39	ft
Specific Energy		2.24	ft
Froude Number		2.08	
Maximum Discharge		34.41	ft³/s
Discharge Full		31.99	ft³/s
Slope Full		0.00281	ft/ft
Flow Type	SuperCritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Average End Depth Over Rise		0.00	%
Normal Depth Over Rise		42.43	%
Downstream Velocity		Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03400	ft/ft
Diameter	2.50	ft
Discharge	24.00	ft³/s

Results

Normal Depth	0.97	ft
Flow Area	1.75	ft²
Wetted Perimeter	3.36	ft
Hydraulic Radius	0.52	ft
Top Width	2.44	ft
Critical Depth	1.67	ft
Percent Full	38.7	%
Critical Slope	0.00556	ft/ft
Velocity	13.68	ft/s
Velocity Head	2.91	ft
Specific Energy	3.87	ft
Froude Number	2.84	
Maximum Discharge	81.35	ft³/s
Discharge Full	75.63	ft³/s
Slope Full	0.00342	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	38.71	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	3.00	ft
Discharge	44.00	ft³/s

Results

Normal Depth	1.78	ft
Flow Area	4.37	ft²
Wetted Perimeter	5.27	ft
Hydraulic Radius	0.83	ft
Top Width	2.95	ft
Critical Depth	2.16	ft
Percent Full	59.3	%
Critical Slope	0.00577	ft/ft
Velocity	10.08	ft/s
Velocity Head	1.58	ft
Specific Energy	3.36	ft
Froude Number	1.46	
Maximum Discharge	71.74	ft³/s
Discharge Full	66.69	ft³/s
Slope Full	0.00435	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	59.30	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	3.00	ft
Discharge	49.00	ft³/s

Results

Normal Depth	1.91	ft
Flow Area	4.75	ft²
Wetted Perimeter	5.55	ft
Hydraulic Radius	0.86	ft
Top Width	2.89	ft
Critical Depth	2.28	ft
Percent Full	63.7	%
Critical Slope	0.00630	ft/ft
Velocity	10.31	ft/s
Velocity Head	1.65	ft
Specific Energy	3.56	ft
Froude Number	1.42	
Maximum Discharge	71.74	ft³/s
Discharge Full	66.69	ft³/s
Slope Full	0.00540	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.70	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	1.50	ft
Discharge	5.00	ft³/s

Results

Normal Depth		0.90	ft
Flow Area		1.11	ft²
Wetted Perimeter		2.66	ft
Hydraulic Radius		0.42	ft
Top Width		1.47	ft
Critical Depth		0.86	ft
Percent Full		60.1	%
Critical Slope		0.00578	ft/ft
Velocity		4.51	ft/s
Velocity Head		0.32	ft
Specific Energy		1.22	ft
Froude Number		0.91	
Maximum Discharge		7.99	ft³/s
Discharge Full		7.43	ft³/s
Slope Full		0.00227	ft/ft
Flow Type	SubCritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	60.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	3.00	ft
Discharge	23.00	ft³/s

Results

Normal Depth	1.48	ft
Flow Area	3.47	ft²
Wetted Perimeter	4.67	ft
Hydraulic Radius	0.74	ft
Top Width	3.00	ft
Critical Depth	1.54	ft
Percent Full	49.3	%
Critical Slope	0.00431	ft/ft
Velocity	6.63	ft/s
Velocity Head	0.68	ft
Specific Energy	2.16	ft
Froude Number	1.09	
Maximum Discharge	50.73	ft³/s
Discharge Full	47.16	ft³/s
Slope Full	0.00119	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.27	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00650	ft/ft
Diameter	3.50	ft
Discharge	71.00	ft³/s

Results

Normal Depth	2.54	ft
Flow Area	7.47	ft²
Wetted Perimeter	7.13	ft
Hydraulic Radius	1.05	ft
Top Width	3.13	ft
Critical Depth	2.64	ft
Percent Full	72.5	%
Critical Slope	0.00591	ft/ft
Velocity	9.50	ft/s
Velocity Head	1.40	ft
Specific Energy	3.94	ft
Froude Number	1.08	
Maximum Discharge	87.25	ft³/s
Discharge Full	81.11	ft³/s
Slope Full	0.00498	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	72.49	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.11290	ft/ft
Diameter	3.00	ft
Discharge	38.00	ft³/s

Results

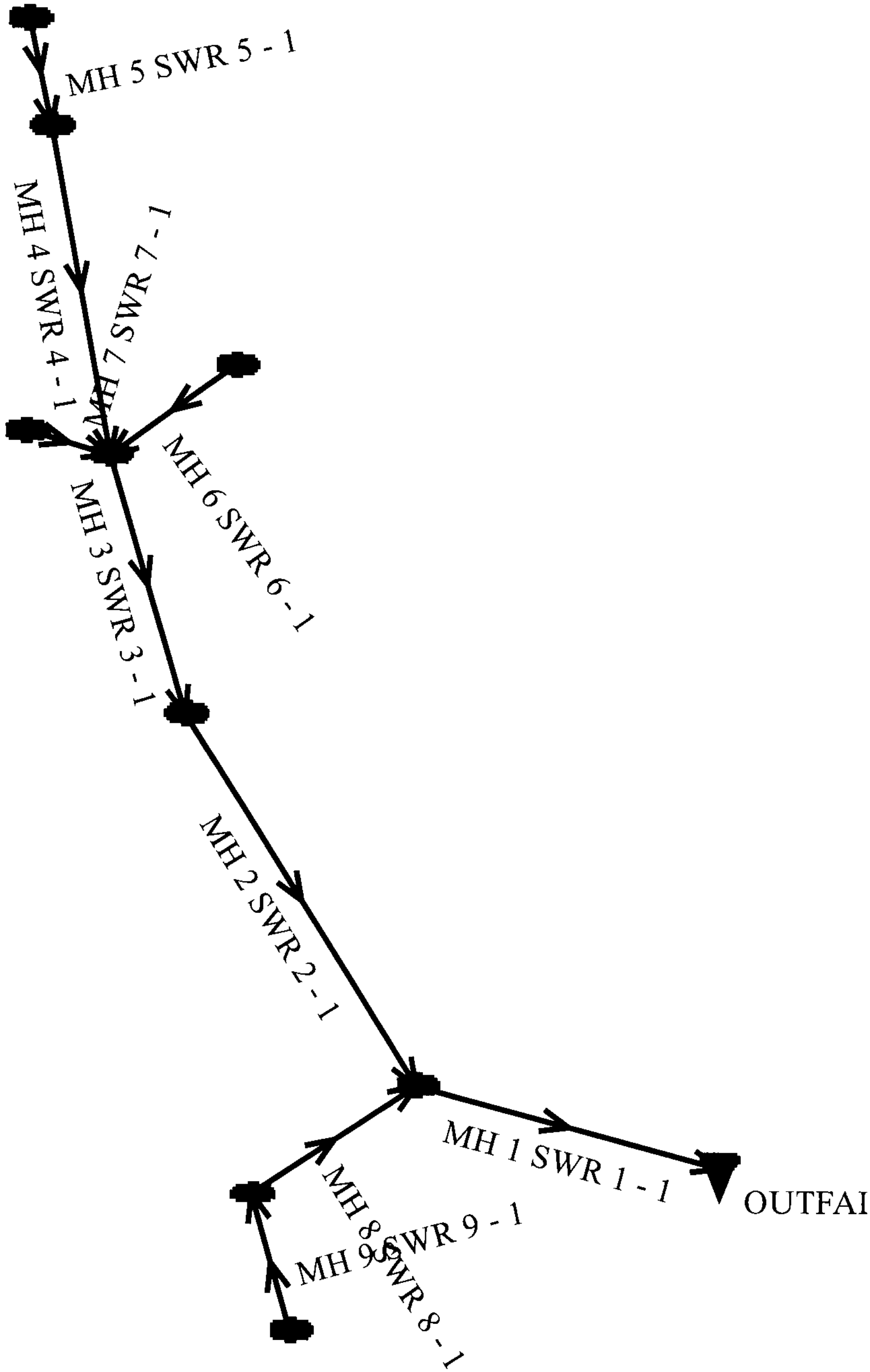
Normal Depth	0.84	ft
Flow Area	1.61	ft²
Wetted Perimeter	3.34	ft
Hydraulic Radius	0.48	ft
Top Width	2.69	ft
Critical Depth	2.01	ft
Percent Full	27.9	%
Critical Slope	0.00524	ft/ft
Velocity	23.62	ft/s
Velocity Head	8.67	ft
Specific Energy	9.50	ft
Froude Number	5.38	
Maximum Discharge	241.06	ft³/s
Discharge Full	224.10	ft³/s
Slope Full	0.00325	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	27.86	%
Downstream Velocity	Infinity	ft/s


MH 5 SWR 5 - 1
MH 4 SWR 4 - 1
MH 7 SWR 7 - 1
MH 6 SWR 6 - 1
MH 3 SWR 3 - 1
MH 2 SWR 2 - 1
MH 1 SWR 1 - 1
OUTFAl
MH 8 SWR 8 - 1
MH 9 SWR 9 - 1

Westerly Storm Outfall

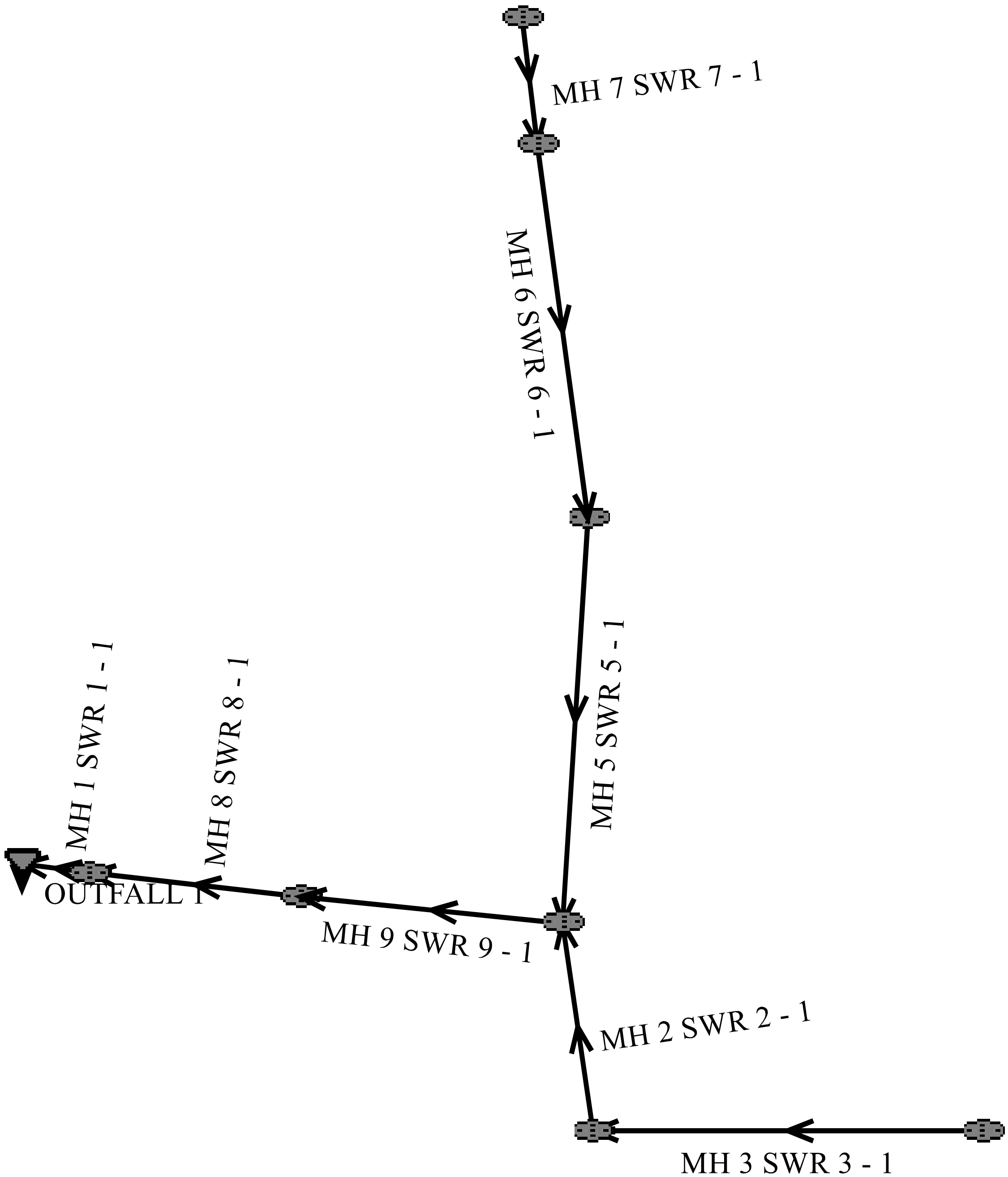
Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	87.66	6464.04	0.6	6464.57	0.013	0.05	1.00	CIRCULAR	42.00 in	42.00 in
MH 8 SWR 8 - 1	73.59	6465.60	1.2	6466.48	0.013	1.06	0.00	CIRCULAR	36.00 in	36.00 in
MH 9 SWR 9 - 1	42.21	6467.48	1.5	6468.11	0.013	1.06	0.00	CIRCULAR	18.00 in	18.00 in
MH 2 SWR 2 - 1	172.08	6465.10	1.0	6466.82	0.013	0.20	1.00	CIRCULAR	36.00 in	36.00 in
MH 3 SWR 3 - 1	71.52	6467.11	1.0	6467.83	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
MH 7 SWR 7 - 1	5.00	6468.33	6.0	6468.63	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
MH 4 SWR 4 - 1	190.00	6468.89	3.4	6475.35	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in
MH 5 SWR 5 - 1	25.08	6475.35	1.0	6475.60	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in
MH 6 SWR 6 - 1	28.62	6468.83	2.0	6469.40	0.013	0.83	0.00	CIRCULAR	24.00 in	24.00 i

Grade Line Summary:

Tailwater Elevation (ft): 6468.85

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
MH 1 SWR 1 - 1	6464.04	6464.57	0.00	0.00	6468.85	6469.28	6469.70	0.43	6470.13
MH 8 SWR 8 - 1	6465.60	6466.48	0.17	0.00	6470.14	6470.23	6470.30	0.09	6470.39
MH 9 SWR 9 - 1	6467.48	6468.11	0.13	0.00	6470.40	6470.49	6470.52	0.10	6470.62
MH 2 SWR 2 - 1	6465.10	6466.82	0.15	0.10	6469.63	6470.56	6470.38	0.92	6471.30
MH 3 SWR 3 - 1	6467.11	6467.83	0.03	0.14	6470.88	6471.18	6471.48	0.31	6471.79
MH 7 SWR 7 - 1	6468.33	6468.63	0.49	0.00	6471.91	6471.92	6472.28	0.02	6472.29
MH 4 SWR 4 - 1	6468.89	6475.35	0.02	0.28	6471.77	6476.45	6472.09	4.88	6476.97
MH 5 SWR 5 - 1	6475.35	6475.60	0.02	0.00	6476.46	6476.70	6476.99	0.22	6477.22
MH 6 SWR 6 - 1	6468.83	6469.40	0.19	0.00	6471.75	6471.83	6471.97	0.08	6472.05


MH 7 SWR 7 - 1
MH 6 SWR 6 - 1
MH 5 SWR 5 - 1
MH 1 SWR 1 - 1
MH 8 SWR 8 - 1
OUTFALL 1
MH 9 SWR 9 - 1
MH 2 SWR 2 - 1
MH 3 SWR 3 - 1

Easterly Storm Outfall

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	14.07	6466.64	1.0	6466.78	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in
MH 8 SWR 8 - 1	28.60	6466.77	11.3	6470.00	0.013	0.06	0.00	CIRCULAR	36.00 in	36.00 in
MH 9 SWR 9 - 1	56.15	6475.00	1.0	6475.56	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
MH 2 SWR 2 - 1	116.19	6476.00	1.9	6478.21	0.013	0.83	1.00	CIRCULAR	30.00 in	30.00 in
MH 3 SWR 3 - 1	121.85	6478.52	5.5	6485.22	0.013	1.32	1.00	CIRCULAR	30.00 in	30.00 in
MH 4 SWR 4 - 1	35.33	6485.53	1.0	6485.88	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
MH 5 SWR 5 - 1	161.78	6476.62	5.5	6485.52	0.013	1.32	1.00	CIRCULAR	24.00 in	24.00 in
MH 6 SWR 6 - 1	168.18	6485.75	2.8	6490.46	0.013	0.05	1.00	CIRCULAR	24.00 in	24.00 in
MH 7 SWR 7 - 1	35.33	6490.76	1.0	6491.11	0.013	0.05	1.00	CIRCULAR	24.00 in	24.00 in

Grade Line Summary:

Tailwater Elevation (ft): 6468.85

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	6466.64	6466.78	0.00	0.00	6468.85	6469.07	6469.74	0.00	6469.74
MH 8 SWR 8 - 1	6466.77	6470.00	0.03	0.00	6469.10	6475.86	6476.30	0.00	6476.30
MH 9 SWR 9 - 1	6475.00	6475.56	0.02	0.00	6476.62	6477.57	6478.10	0.36	6478.45
MH 2 SWR 2 - 1	6476.00	6478.21	0.31	0.08	6477.95	6479.88	6479.04	1.58	6480.62
MH 3 SWR 3 - 1	6478.52	6485.22	0.49	0.00	6480.37	6486.89	6483.50	4.13	6487.63
MH 4 SWR 4 - 1	6485.53	6485.88	0.01	0.09	6486.99	6487.44	6487.89	0.21	6488.10
MH 5 SWR 5 - 1	6476.62	6485.52	0.53	0.05	6478.14	6486.96	6480.78	6.86	6487.64
MH 6 SWR 6 - 1	6485.75	6490.46	0.02	0.00	6486.98	6491.90	6488.73	3.84	6492.58
MH 7 SWR 7 - 1	6490.76	6491.11	0.02	0.05	6491.97	6492.51	6492.87	0.27	6493.14

SWQ / DETENTION CALCULATIONS

CLASSIC CONSULTING ENGINEERS & SURVEYORS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**October 3, 2018**
Project:	**HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7**
Location:	**EL PASO COUNTY**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 60.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.600
C) Contributing Watershed Area	Area = 37.500 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$	V_{DESIGN}= 0.738 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.721 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 2.448 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**October 3, 2018**
Project:	**HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7**
Location:	**EL PASO COUNTY**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.022 ac-ft

B) Actual Forebay Volume — V_F = 0.022 ac-ft

C) Forebay Depth (D_F = 30 inch maximum) — D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 103.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 2.06 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ____ in

G) Rectangular Notch Width — Calculated W_N = 9.8 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ◉ Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 190 sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.62 inches

E) Total Outlet Area — A_{ot} = 15.81 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**October 3, 2018**
Project:	**HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7**
Location:	**EL PASO COUNTY**

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} =	6	in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} =	94.2	cu ft
C) Initial Surcharge Provided Above Micropool	V_s=	95.0	cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t =	522	square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N		*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =		
D) Total Water Quality Screen Area (based on screen type)	A_{total} =	735	sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H=	5.75	feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}=	97	inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ =	12.0	inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: EL PASO COUNTY

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Weir with rip-rap
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**October 2, 2018**
Project:	**HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7**
Location:	**Westerly Pond Inflow**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 60.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.600
C) Contributing Watershed Area	Area = 22.960 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.452 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.441 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 1.499 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	Concrete Forebays
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 2, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Westerly Pond Inflow

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.013 ac-ft

B) Actual Forebay Volume — V_F = 0.013 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 71.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.42 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ____ in

G) Rectangular Notch Width — Calculated W_N = 6.4 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ◉ Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = ____ ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = ____ sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = ____ inches

E) Total Outlet Area — A_{ot} = ____ square inches

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Easterly Pond Inflow

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 60.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.600

C) Contributing Watershed Area — Area = 11.340 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$) — V_{DESIGN}= 0.223 ac-ft

G) For Watersheds Outside of the Denver Region,
Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$= 0.218 ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= ______ ac-ft

I) Predominant Watershed NRCS Soil Group

Choose One
- ○ A
- ◉ B
- ○ C / D

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— EURV = 0.740 ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: — Concrete Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Easterly Pond Inflow

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.007 ac-ft

B) Actual Forebay Volume — V_F = 0.007 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 38.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.76 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ______ in

G) Rectangular Notch Width — Calculated W_N = 5.1 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ◉ Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = ______ ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = ______ sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = ______ inches

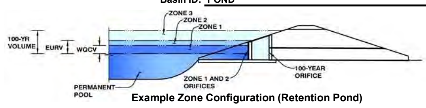
E) Total Outlet Area — A_{ot} = ______ square inches

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7

Basin ID: POND



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	37.50	acres
Watershed Length =	1,700	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	60.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

			Optional User Override 1-hr Precipitation	
Water Quality Capture Volume (WQCV) =	0.738	acre-feet		
Excess Urban Runoff Volume (EURV) =	2.441	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	2.004	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.697	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.518	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.635	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.434	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.483	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	10.626	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	1.877	acre-feet		
Approximate 5-yr Detention Volume =	2.533	acre-feet		
Approximate 10-yr Detention Volume =	3.265	acre-feet		
Approximate 25-yr Detention Volume =	3.531	acre-feet		
Approximate 50-yr Detention Volume =	3.681	acre-feet		
Approximate 100-yr Detention Volume =	4.019	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.738	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.703	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.578	acre-feet
Total Detention Basin Volume =	4.019	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
6462	--	0.50	--	--	--	100	0.002	49	0.001
6464	--	2.50	--	--	--	12,825	0.294	12,975	0.298
6466	--	4.50	--	--	--	37,534	0.862	63,334	1.454
6468	--	6.50	--	--	--	46,042	1.057	146,910	3.373
6470	--	8.50	--	--	--	53,898	1.237	246,850	5.667
6471	--	9.50	--	--	--	58,000	1.331	302,799	6.951
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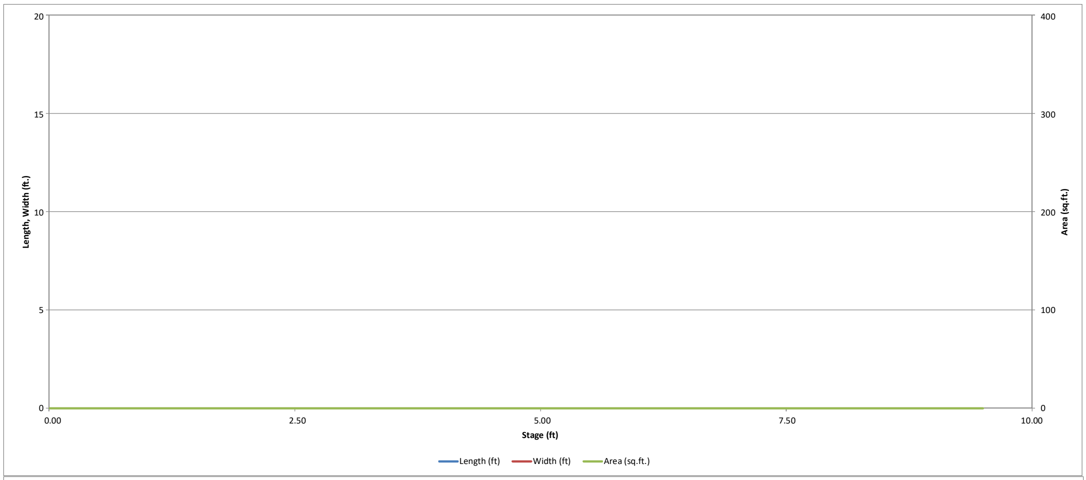
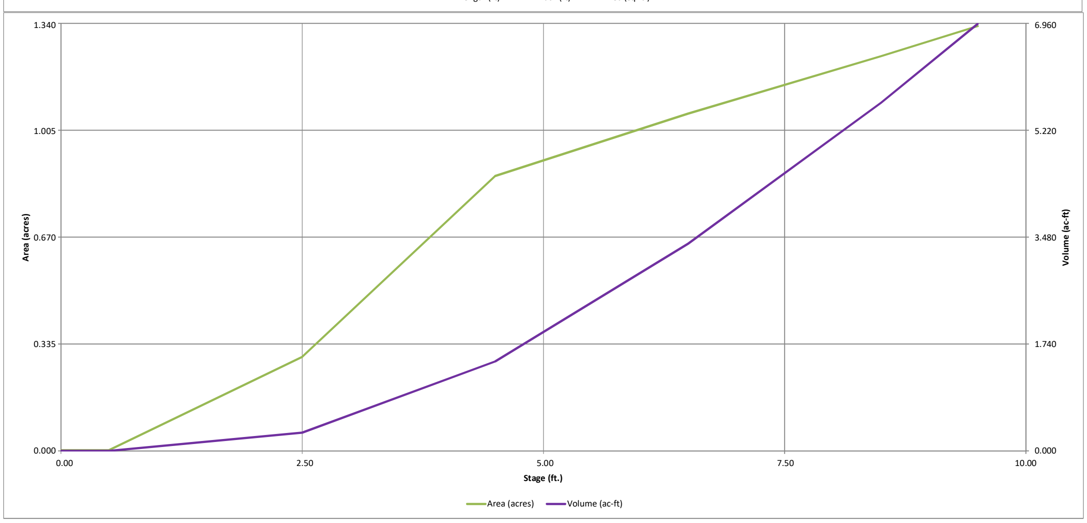
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



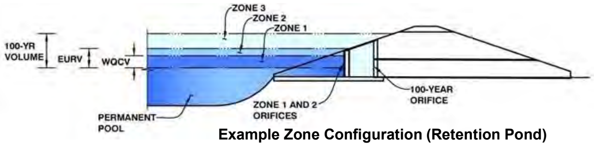


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7

Basin ID: POND



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.51	0.738	Orifice Plate
Zone 2 (EURV)	5.58	1.703	Orifice Plate
Zone 3 (100-year)	7.10	1.578	Weir&Pipe (Restrict)
		4.019	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.75	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.80	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40	3.60	4.80			
Orifice Area (sq. inches)	2.43	2.43	2.05	4.45	4.45			

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.75	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.91	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	18.55	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.28	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

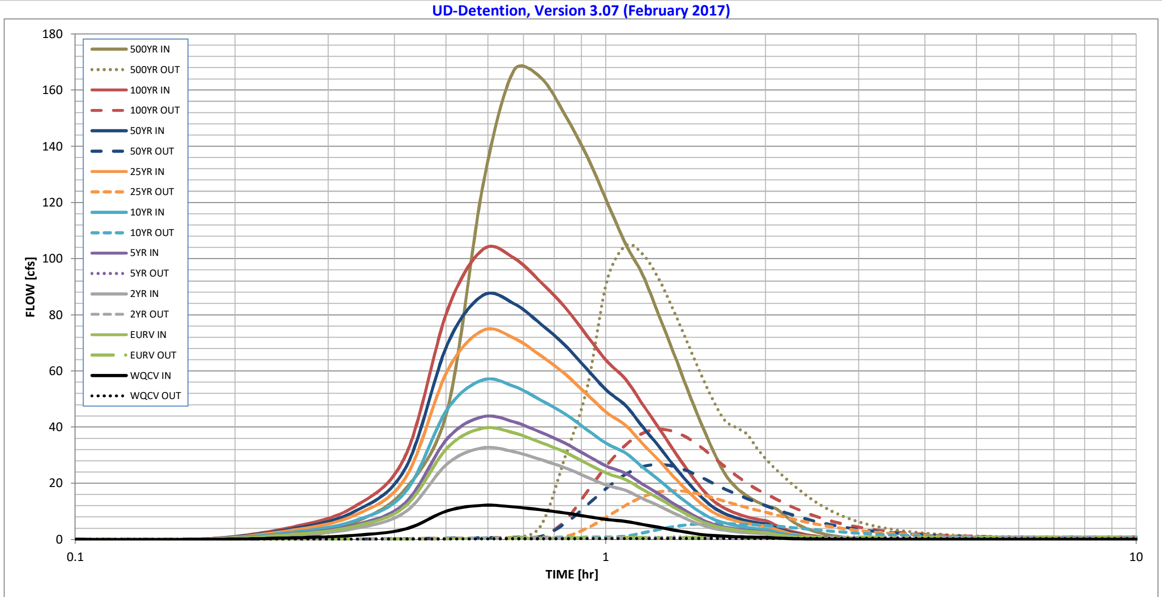
Spillway Design Flow Depth=	0.87	feet
Stage at Top of Freeboard =	9.37	feet
Basin Area at Top of Freeboard =	1.32	acres

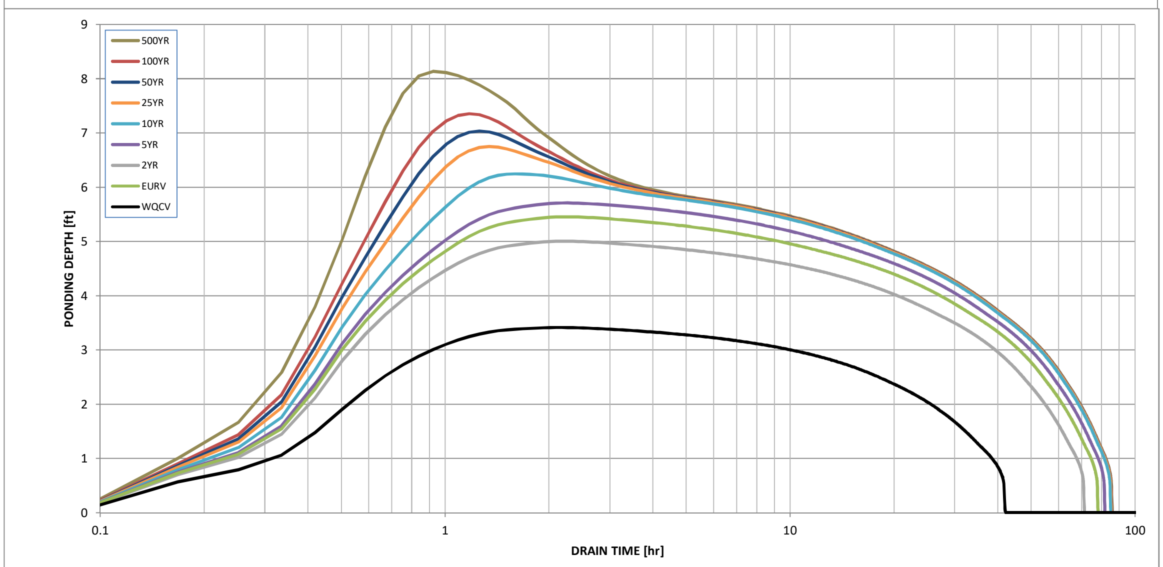
Routed Hydrograph Results

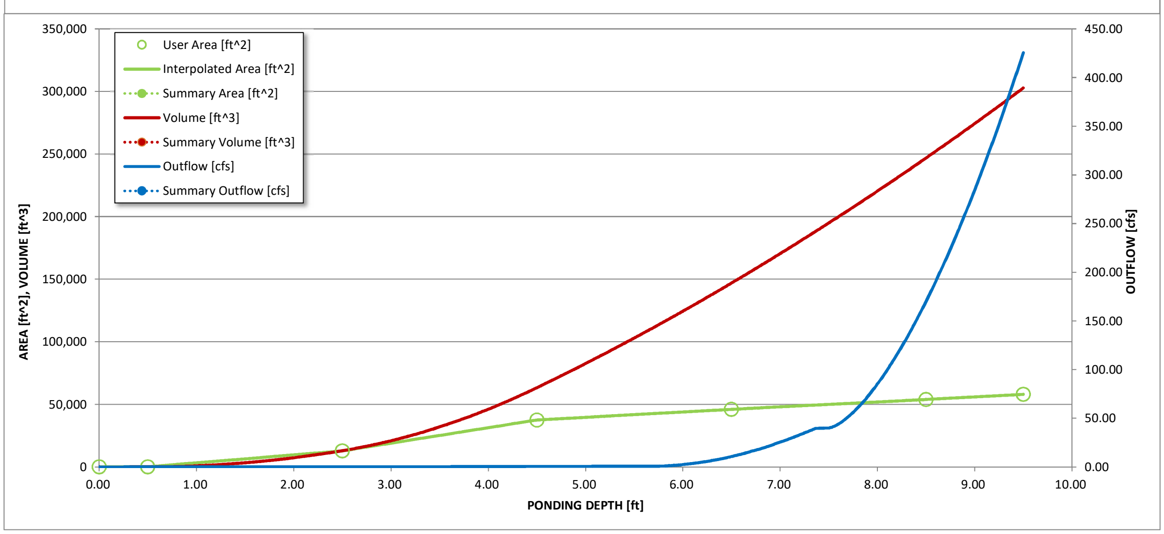
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.738	2.441	2.004	2.697	3.518	4.635	5.434	6.483	10.626
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.737	2.438	2.002	2.694	3.515	4.631	5.428	6.478	10.618
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.91	1.23	2.23
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.777	7.5	24.8	34.3	46.1	83.6
Peak Inflow Q (cfs) =	12.1	39.6	32.6	43.7	56.8	74.4	86.9	103.3	166.9
Peak Outflow Q (cfs) =	0.3	0.8	0.7	0.849	5.6	17.4	26.7	39.2	104.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.8	0.7	0.8	0.8	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	0.9	1.4	2.0	2.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	63	72	73	71	70	68	61
Time to Drain 99% of Inflow Volume (hours) =	41	74	68	77	79	79	78	77	74
Maximum Ponding Depth (ft) =	3.41	5.45	5.00	5.71	6.25	6.75	7.04	7.35	8.13
Area at Maximum Ponding Depth (acres) =	0.55	0.95	0.91	0.98	1.03	1.08	1.10	1.13	1.20
Maximum Volume Stored (acre-ft) =	0.683	2.317	1.897	2.558	3.101	3.640	3.945	4.304	5.215

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
5.03 min	0.993

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:15:05	0.54	1.69	1.40	1.86	2.39	3.06	3.51	4.08	6.06
0:20:07	1.45	4.63	3.83	5.10	6.59	8.54	9.88	11.61	17.96
0:25:09	3.72	11.90	9.83	13.10	16.92	21.92	25.38	29.81	46.16
0:30:11	10.21	32.66	26.99	35.96	46.41	60.09	69.54	81.63	126.09
0:35:13	12.15	39.60	32.60	43.69	56.78	74.42	86.91	103.28	166.89
0:40:14	11.60	37.95	31.22	41.89	54.53	71.73	84.02	100.24	164.42
0:45:16	10.56	34.54	28.42	38.12	49.62	65.38	76.69	91.64	151.12
0:50:18	9.44	31.04	25.52	34.28	44.68	58.91	69.12	82.62	136.40
0:55:20	8.15	27.04	22.19	29.88	39.04	51.57	60.58	72.51	120.17
1:00:22	7.10	23.53	19.28	26.02	34.05	45.05	52.95	63.42	105.25
1:05:23	6.43	21.31	17.48	23.55	30.77	40.63	47.70	57.05	94.24
1:10:25	5.32	17.79	14.57	19.67	25.75	34.09	40.10	48.08	80.07
1:15:27	4.35	14.69	12.02	16.26	21.32	28.27	33.28	39.93	66.64
1:20:29	3.36	11.55	9.42	12.80	16.85	22.44	26.48	31.86	53.58
1:25:31	2.50	8.84	7.18	9.81	12.98	17.36	20.53	24.76	41.87
1:30:32	1.81	6.53	5.28	7.27	9.66	12.99	15.41	18.63	31.74
1:35:34	1.40	4.94	4.01	5.49	7.27	9.72	11.50	13.87	23.44
1:40:36	1.15	4.01	3.26	4.44	5.86	7.81	9.21	11.08	18.57
1:45:38	0.98	3.38	2.75	3.75	4.93	6.57	7.74	9.30	15.54
1:50:40	0.86	2.95	2.41	3.27	4.30	5.71	6.72	8.07	13.44
1:55:41	0.77	2.64	2.16	2.93	3.85	5.10	6.01	7.20	11.96
2:00:43	0.71	2.42	1.98	2.68	3.52	4.67	5.49	6.58	10.91
2:05:45	0.52	1.79	1.46	1.99	2.62	3.49	4.13	4.97	8.41
2:10:47	0.38	1.30	1.06	1.44	1.90	2.53	2.98	3.59	6.06
2:15:49	0.28	0.96	0.78	1.07	1.40	1.87	2.21	2.66	4.50
2:20:50	0.21	0.71	0.58	0.79	1.04	1.39	1.64	1.98	3.34
2:25:52	0.15	0.52	0.42	0.58	0.76	1.02	1.21	1.46	2.47
2:30:54	0.10	0.37	0.30	0.41	0.55	0.73	0.87	1.05	1.79
2:35:56	0.07	0.27	0.22	0.30	0.40	0.53	0.63	0.76	1.29
2:40:58	0.05	0.19	0.15	0.21	0.28	0.37	0.44	0.54	0.92
2:45:59	0.03	0.12	0.09	0.13	0.18	0.24	0.29	0.35	0.61
2:51:01	0.01	0.06	0.05	0.07	0.10	0.14	0.17	0.21	0.37
2:56:03	0.00	0.03	0.02	0.03	0.04	0.06	0.08	0.10	0.18
3:01:05	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.06
3:06:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:11:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:16:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:21:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:31:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:36:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:41:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:46:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:51:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:56:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:01:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:06:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:11:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:16:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:21:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:26:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:31:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:36:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:41:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:46:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:51:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:56:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:01:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:06:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:11:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:16:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:21:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:26:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:31:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:37:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:42:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:47:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:52:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:57:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:02:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DRAINAGE MAPS

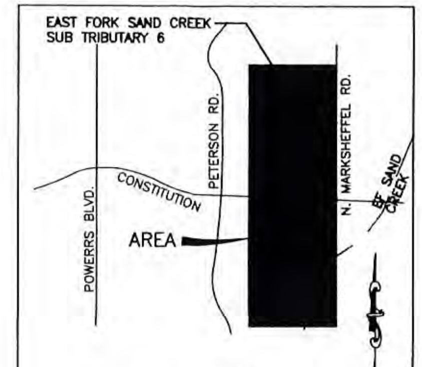
CLASSIC CONSULTING ENGINEERS & SURVEYORS

SUMMARY OF DISCHARGES

DESIGN POINT LOCATION	DRAINAGE AREA (SM)	Q_{100}/Q_{10} (cfs)
1 AT N, CAREFREE CIR.	0.34	551/255
14 AT RAILROAD GRADE (INFLOW)	0.66	915/374
14 AT RAILROAD GRADE (OUTFLOW)	0.66	640/360
8 AT CONSTITUTION	1.07	1076/457
8A AT CONFLUENCE WITH EF SAND CREEK	1.91	2088/925

SUMMARY OF ROUTING ELEMENTS

ROUTING ELEMENT	LOCATION	DESCRIPTION
RT-8	DP 7 TO DP 8A	45' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-7	DP 6 TO DP 7	45' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-6/6A	DP 8 TO D 6	30' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-2A	DP 4A TO DP 8	30' BW, 3:1 SS, S = 1.0% RIPRAP CHANNEL
RT-2B	DP 14 TO DP 4A	16' BW, 3:1 SS, S = 0.5% RIPRAP CHANNEL
RT 3 - RT 3A	SB 3 TO DP4A	60" RCP TO 42" RCP
RT-1	DP 1 TO DP14	NATURAL CHANNEL, S = 3.0%
RT-5	SB 5 TO DP1	NATURAL CHANNEL, S = 3.0%

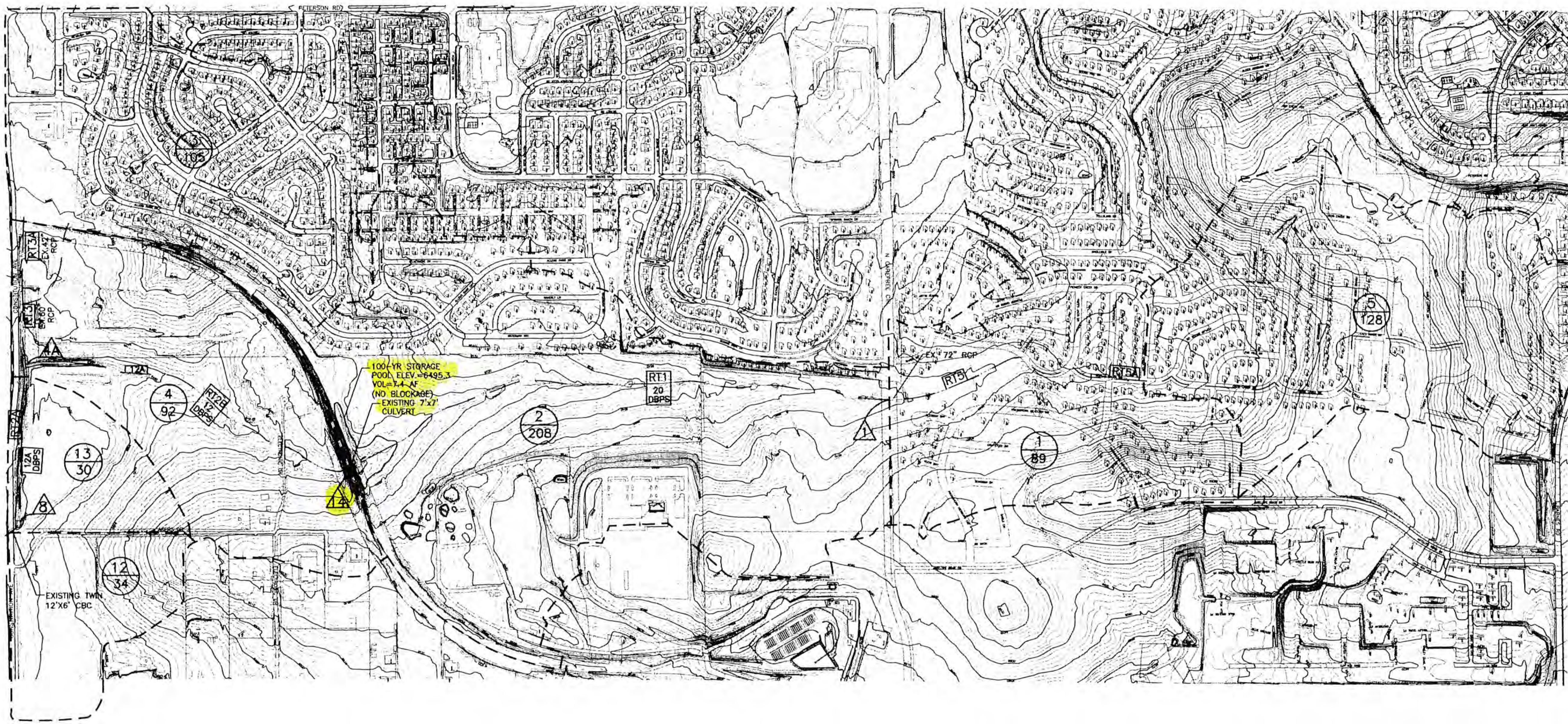


VICINITY MAP
NO SCALE

0' 400' 800'

LEGEND

1	DRAINAGE BASIN DESIGNATION
89	DRAINAGE BASIN AREA (ACRES)
RT1	HEC1 ROUTING ELEMENT
20 DBPS	DBPS ROUTING ELEMENT
— — —	DRAINAGE BASIN BOUNDARY
△	DESIGN POINT



Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904-4208
(719) 630-7342

EAST FORK SAND CREEK
SUBTRIBUTARY HYDROLOGIC ANALYSIS
HYDROLOGIC BASIN MAP
EL PASO COUNTY, COLORADO

Project No.:	06040
Date:	AUG 2006
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

Fig. 4.2

06040 Fig4.2.dwg/Aug 02, 2011

60970

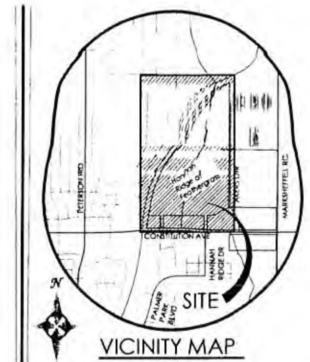
EXISTING SUMMARY RUNOFF TABLE

BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)
OSA1 (IN)		425	360 *	886 (IN)
1 (OUT)	OSA1	425	351 *	627 (OUT)
OSA2		1.9	2	5
OSA3		0.3	1	2
OSC1		3.4	5	11
A4		38.1	31	71
2	OSA1, OSA2, OSA3, OSC1, A4	468.7	351 *	627
3	OSF1	105	130 *	283
OSF2		4.9	4	9
OSF3		0.5	1	2
A7		30.2	19	45
4	OSA1, OSA2, OSA3, OSC1, A4, OSF1, OSF2, OSF3, F7	137.1	393 *	831
OSB1		0.6	3	5
A9		33.6	19	46
OSA8		16.2	40	78
A16		18.0	12	26
5	OSA8, A16	34.2	50	103
OSA11		3.7	12	21
OSA12		1.7	5	9
6	OSA1, OSA2, OSA3, OSC1, A4, OSF1, OSF2, OSF3, A7, A9, OSB1, OSA8, A16, OSA11, OSA12	650.5	392 *	856

* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY

LEGEND

- EXISTING INDEX CONTOUR
- EXISTING STORM DRAIN CURB INLET
- 24" RCP — EXISTING STORM DRAIN LINE
- EXISTING PROPERTY LINE
- EXISTING ROAD
- DRAINAGE BASIN BOUNDARY
- OSA2 14.9 / A5 2.6 — DRAINAGE BASIN DESIGNATION, DRAINAGE BASIN AREA
- Q_5 = 3.3 cfs, Q_{100} = 7.4 cfs — FLOW DIRECTION AND QUANTITIES
- FLOW DIRECTION
- 2 — DESIGN POINT



VICINITY MAP

NTS

BENCHMARK

THE BENCHMARK FOR THESE PLANS IS THE TOP OF #4 REBAR, PANEL POINT NO. 1, LOCATED ON THE SOUTH EDGE OF CONSTITUTION AVE AND THE WEST EDGE OF THE ROCK ISLAND TRAIL, 535 FEET WEST OF THE CENTERLINE OF SHAWNEE DR. ELEVATION = 6486.63. (EPC DATUM ELEVATION = 6485.29).

N

50 0 100 200 400

1" = 200' 1:2,400

MVE, INC.
ENGINEERS, SURVEYORS

1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

DESIGNED BY DRG August 21, 2013
DRAWN BY TJW August 21, 2013
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge at Feathergrass

EXISTING DRAINAGE MAP

MVE PROJECT **60970**

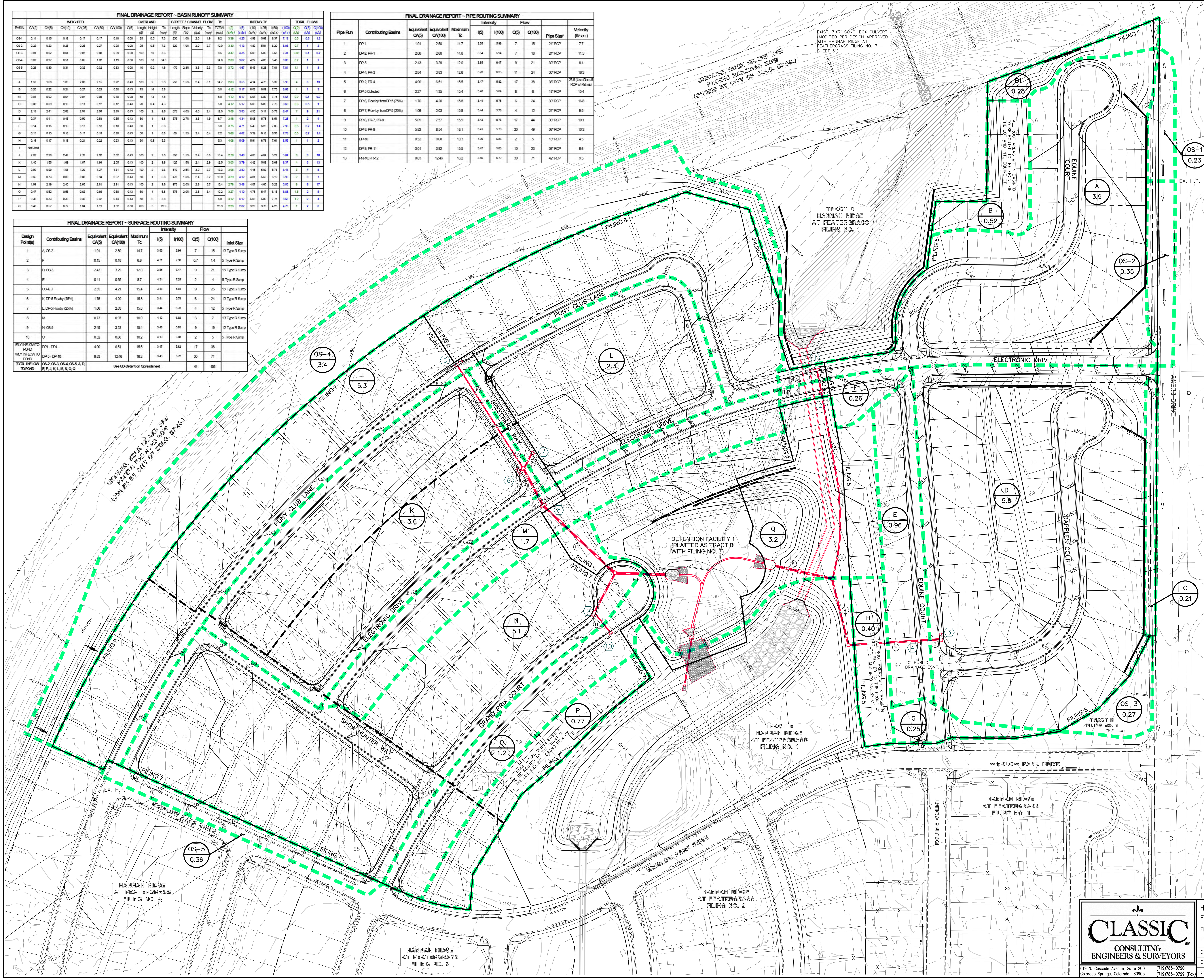
MVE DRAWING **60970109**

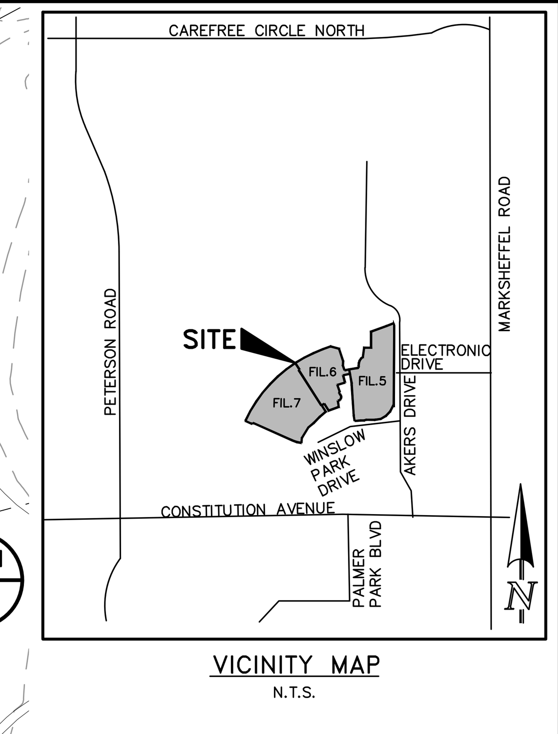
December 12, 2013

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY																								
	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS		
BASIN	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.14	0.15	0.16	0.17	0.17	0.18	0.08	25	0.5	7.3	230	1.0%	2.0	1.9	9.2	3.39	4.25	4.96	5.66	6.37	7.13	0.5	0.6	1.3
OS-2	0.22	0.23	0.25	0.26	0.27	0.28	0.08	25	0.5	7.3	320	1.0%	2.0	2.7	10.0	3.30	4.13	4.82	5.51	6.20	6.93	0.7	1	2
OS-3	0.01	0.02	0.04	0.07	0.08	0.09	0.08	100	10	8.6					8.6	3.47	4.35	5.08	5.80	6.53	7.31	0.02	0.1	0.7
OS-4	0.07	0.27	0.51	0.85	1.02	1.19	0.08	180	10	14.0					14.0	2.89	3.62	4.22	4.83	5.43	6.08	0.2	1	7
OS-5	0.29	0.30	0.31	0.32	0.32	0.33	0.08	10	0.2	4.6	470	2.8%	3.3	2.3	7.0	3.72	4.67	5.45	6.23	7.01	7.84	1.1	1	3
A	1.52	1.68	1.83	2.03	2.15	2.22	0.43	100	2	9.6	750	1.5%	2.4	5.1	14.7	2.83	3.55	4.14	4.73	5.32	5.96	4	6	13
B	0.20	0.22	0.24	0.27	0.29	0.30	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	1	3
B1	0.01	0.02	0.04	0.07	0.08	0.10	0.08	55	13	4.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.0	0.1	0.9
C	0.08	0.09	0.10	0.11	0.12	0.12	0.43	20	0.4	4.3					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.3	0.5	1
D	2.18	2.41	2.63	2.91	3.08	3.19	0.43	100	2	9.6	575	4.0%	4.0	2.4	12.0	3.08	3.85	4.50	5.14	5.78	6.47	7	9	21
E	0.37	0.41	0.45	0.50	0.53	0.55	0.43	50	1	6.8	375	2.7%	3.3	1.9	8.7	3.46	4.34	5.06	5.78	6.51	7.28	1	2	4
F	0.14	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8					6.8	3.75	4.71	5.49	6.28	7.06	7.90	0.5	0.7	1.4
G	0.15	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8	60	1.5%	2.4	0.4	7.2	3.68	4.62	5.39	6.16	6.93	7.76	0.5	0.7	1.4
H	0.16	0.17	0.19	0.21	0.22	0.23	0.43	30	0.6	5.3					5.3	4.06	5.09	5.94	6.79	7.64	8.55	1	1	2
I	Not Used																							
J	2.07	2.28	2.49	2.76	2.92	3.02	0.43	100	2	9.6	850	1.5%	2.4	5.8	15.4	2.78	3.48	4.06	4.64	5.22	5.84	6	8	18
K	1.40	1.55	1.69	1.87	1.98	2.05	0.43	100	2	9.6	425	1.5%	2.4	2.9	12.5	3.03	3.79	4.42	5.06	5.69	6.37	4	6	13
L	0.90	0.99	1.08	1.20	1.27	1.31	0.43	100	2	9.6	510	2.5%	3.2	2.7	12.3	3.05	3.82	4.45	5.09	5.73	6.41	3	4	8
M	0.66	0.73	0.80	0.88	0.94	0.97	0.43	50	1	6.8	475	1.5%	2.4	3.2	10.0	3.29	4.12	4.81	5.50	6.19	6.92	2	3	7
N	1.99	2.19	2.40	2.65	2.81	2.91	0.43	100	2	9.6	975	2.0%	2.8	5.7	15.4	2.78	3.48	4.07	4.65	5.23	5.85	6	8	17
O	0.47	0.52	0.56	0.62	0.66	0.68	0.43	50	1	6.8	575	2.0%	2.8	3.4	10.2	3.27	4.10	4.78	5.47	6.15	6.88	1.5	2	5
P	0.30	0.33	0.36	0.40	0.42	0.44	0.43	50	6	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.2	2	4
Q	0.40	0.57	0.77	1.04	1.19	1.32	0.08	260	5	23.9					23.9	2.26	2.82	3.29	3.76	4.23	4.73	1	2	6

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY										
					Intensity		Flow			
Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Pipe Size*	Velocity (ft/sec.)
1	DP-1	1.91	2.50	14.7	3.55	5.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	14.8	3.54	5.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	12.0	3.85	6.47	9	21	30" RCP	8.4
4	DP-4, PR-3	2.84	3.83	12.6	3.78	6.35	11	24	30" RCP	16.3
5	PR-2, PR-4	4.90	6.51	15.5	3.47	5.82	17	38	36" RCP	23.6 (Use Class 5 RCP w/ Rstrnts)
6	DP-5 Collected	2.27	1.35	15.4	3.48	5.84	8	8	18" RCP	10.4
7	DP-6, Flow-by from DP-5 (75%)	1.76	4.20	15.8	3.44	5.78	6	24	30" RCP	16.8
8	DP-7, Flow-by from DP-5 (25%)	1.06	2.03	15.8	3.44	5.78	4	12	24" RCP	9.5
9	RP-6, PR-7, PR-8	5.09	7.57	15.9	3.43	5.76	17	44	36" RCP	10.1
10	DP-8, PR-9	5.82	8.54	16.1	3.41	5.73	20	49	36" RCP	10.3
11	DP-10	0.52	0.68	10.3	4.09	6.86	2	5	18" RCP	4.5
12	DP-9, PR-11	3.01	3.92	15.5	3.47	5.83	10	23	36" RCP	6.6
13	PR-10, PR-12	8.83	12.46	16.2	3.40	5.72	30	71	42" RCP	9.5

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY									
					Intensity		Flow		
Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Inlet Size
1	A, OS-2	1.91	2.50	14.7	3.55	5.96	7	15	10' Type R Sump
2	F	0.15	0.18	6.8	4.71	7.90	0.7	1.4	5' Type R Sump
3	D, OS-3	2.43	3.29	12.0	3.85	6.47	9	21	15' Type R Sump
4	E	0.41	0.55	8.7	4.34	7.28	2	4	5' Type R Sump
5	OS-4, J	2.55	4.21	15.4	3.48	5.84	9	25	15' Type R Sump
6	K, DP-5 Flowby (75%)	1.76	4.20	15.8	3.44	5.78	6	24	10' Type R Sump
7	L, DP-5 Flowby (25%)	1.06	2.03	15.8	3.44	5.78	4	12	5' Type R Sump
8	M	0.73	0.97	10.0	4.12	6.92	3	7	10' Type R Sump
9	N, OS-5	2.49	3.23	15.4	3.48	5.85	9	19	10' Type R Sump
10	O	0.52	0.68	10.2	4.10	6.88	2	5	5' Type R Sump
E'LY INFLOW TO POND	DP1 - DP4	4.90	6.51	15.5	3.47	5.82	17	38	
W'LY INFLOW TO POND	DP-5 - DP-10	8.83	12.46	16.2	3.40	5.72	30	71	
TOTAL INFLOW TO POND	**OS-2, OS-3, OS-4, OS-5, A, D, E, F, J, K, L, M, N, O, Q**	**See UD-Detention Spreadsheet**					**44**	**103**	





VICINITY MAP
N.T.S.

FLOOD PLAIN STATEMENT:
NO PORTION OF THIS SITE IS LOCATED WITHIN A FEMA FLOODPLAIN AS DETERMINED BY THE FLOOD INSURANCE RATE MAPS (F.I.R.M.) MAP NUMBERS 08041C 0752F, WITH EFFECTIVE DATES OF MARCH 17, 1997 (SEE APPENDIX).

NOTES:
THIS MAP IS FOR DRAINAGE PURPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.

POND DESIGN DATA:
TRIBUTARY ACREAGE = 37.5 AC. @ 60% IMP
WQCV REQ. = 0.74 AC–FT
EURV REQ. = 2.44 AC–FT

RELEASE:
Q5 = 0.85 cfs @ WSE = 6467.21 (2.6 AC–FT)
Q100 = 38 cfs @ WSE = 6468.90 (4.4 AC–FT)

EMERGENCY SPILLWAY ELEV. = 6469.00
EMERGENCY OVERFLOW ELEV. = 6469.87

SCALE: 1" = 60'

LEGEND
EXISTING GROUND CONTOUR — 6650
PROPOSED FINISHED CONTOUR — 6650
SUBDIVISION BOUNDARY
LOT LINE
PROPOSED BASIN BOUNDARY
EXISTING FLOW DIRECTION
DIRECTION OF DRAINAGE
EXISTING STORM SEWER
EXISTING STORM INLET
PROPOSED STORM SEWER
PROPOSED STORM INLET
LOW POINT/HIGH POINT — LP/HP
BASIN IDENTIFIER / AREA IN ACRES — DD 1.41
PIPE RUN — 1
DESIGN POINT — 3

CLASSIC CONSULTING ENGINEERS & SURVEYORS

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Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

HANNAH RIDGE AT FEATHERGRASS
FILING NO. 5, 6 AND 7
FINAL DRAINAGE REPORT
PROPOSED CONDITIONS DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 08/27/18
DRAWN BY	KC	(H) 1"= 60'	SHEET 1 OF 1
CHECKED BY		(V) 1"= N/A	JOB NO. 1116.05

Markup Summary

Steve Kuehster (17)

Subject: Highlight
Page Label: 11
Author: Steve Kuehster
Date: 3/11/2019 1:05:23 PM
Color:

check structures and rip-rap channel lining as presented in the DBPS

Subject: Highlight
Page Label: 16
Author: Steve Kuehster
Date: 3/11/2019 1:09:43 PM
Color:

Subject: arrow & box
Page Label: 11
Author: Steve Kuehster
Date: 3/11/2019 12:15:38 PM
Color:

Still need acceptance of repairs letter from The City of Colorado Springs.

Subject: Pen
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 10:24:30 AM
Color:

Subject: Pen
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 10:24:32 AM
Color:

Subject: Pen
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 10:24:35 AM
Color:

Subject: Pen
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 10:43:34 AM
Color:

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Date: 3/12/2019 10:43:40 AM
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Author: Steve Kuehster
Date: 3/12/2019 10:50:54 AM
Color:

Subject: Arrow
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 11:18:31 AM
Color:

Subject: text box
Page Label: 13
Author: Steve Kuehster
Date: 3/12/2019 11:19:55 AM
Color:

Only the amount of channel improvements that were proposed in the 1996 DBPS for the specific length carried forward to today through approved fee increases would be allowed to be Deferred. If you wish to do this, call these numbers out in the report and show your calculations. It must also be stated that these improvement costs were not previously deferred in previous filings.
if you wish to get the box culvert reimbursed (along with an associated drainage fee increase) through the drainage board that would be a separate item.

Subject: text box
Page Label: 16
Author: Steve Kuehster
Date: 3/12/2019 11:21:03 AM
Color:

There is not a planned regional system downstream, therefore, the reduction of fees is not allowed. per ECM 3.10.4a.

Subject: Highlight
Page Label: 11
Author: Steve Kuehster
Date: 3/12/2019 9:36:10 AM
Color:

cost as presented in the DBPS

Subject: arrow & box
Page Label: 11
Author: Steve Kuehster
Date: 3/12/2019 9:37:40 AM
Color:

Include the cost presented in the DBPS for this specific reach of channel improvements.

Subject: text box
Page Label: 11
Author: Steve Kuehster
Date: 3/12/2019 9:39:07 AM
Color:

Still unresolved, the comment that the owner of the Box Culvert, The City of Colorado Springs has in writing accepted the improvements is still outstanding.

Subject: Pen
Page Label: 16
Author: Steve Kuehster
Date: 3/12/2019 9:42:56 AM
Color:

Subject: Pen
Page Label: 16
Author: Steve Kuehster
Date: 3/12/2019 9:42:57 AM
Color:

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