INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT

HANNAH RIDGE AT FEATHERGRASS
FILINGS 5, 6 & 7

October 2018

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

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
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(719) 785-0790

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

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

____________________________________ ____________________
Date

Title: ____________________________________

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. All proposed storm facilities within the public Right-of-way will be public with ownership and maintenance by El Paso County. All 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,

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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 developed flows to a rip-rap chute and then 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 northerly direction directly into Winslow Park Dr. **Basin B** (Q_5 = 2 cfs and Q_{100} = 4 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. These areas are mainly landscaped backyards with any impervious areas

There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility. Or adjust the overall plan accordingly.

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routed through these landscaped areas (sod) prior to exiting the basins. **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 5 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**

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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.

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 erosive levels.

Non-Erosive

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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.

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 08041C0752F, with effective dates of March 17, 1997 (See Appendix).

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 & 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:

There needs to be a section that discusses the upstream abandoned Chicago and Rock Island Pacific railroad embankment and the concrete box. Please clearly state in this report:
A. What the hazard is. (the amount of ponding, box and/or embankment failure, etc.)
B. The importance that the box culvert and embankment are periodically observed and maintained and who is responsible for this work.

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

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<u>FILING 6:</u>

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

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

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

<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>

<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.

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FILING 7 FEE TOTALS:

Bridge Fees

$ 5,210.00 x 8.23 Impervious Ac. = $ 42,878.30

Drainage Fees

$ 17,751.00 x 8.23 Impervious Ac. = $ 146,090.73

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

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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. "Final Drainage Report for Hannah Ridge at Feathergrass", by MVE, Inc. December 2013.

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

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APPENDIX

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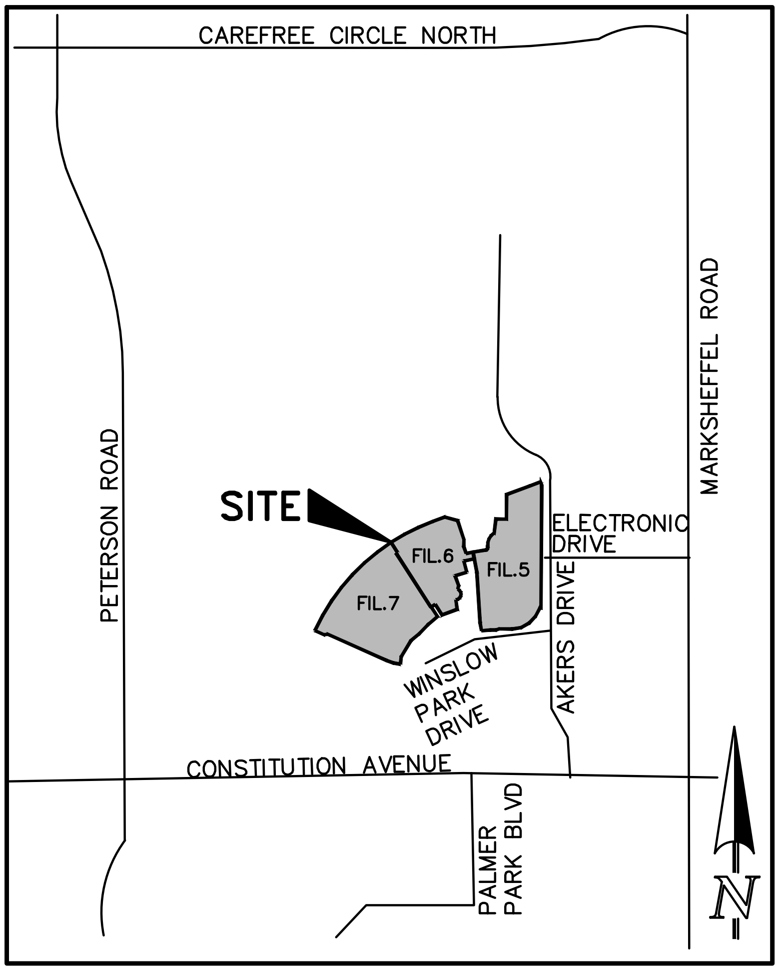
VICINITY MAP



VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

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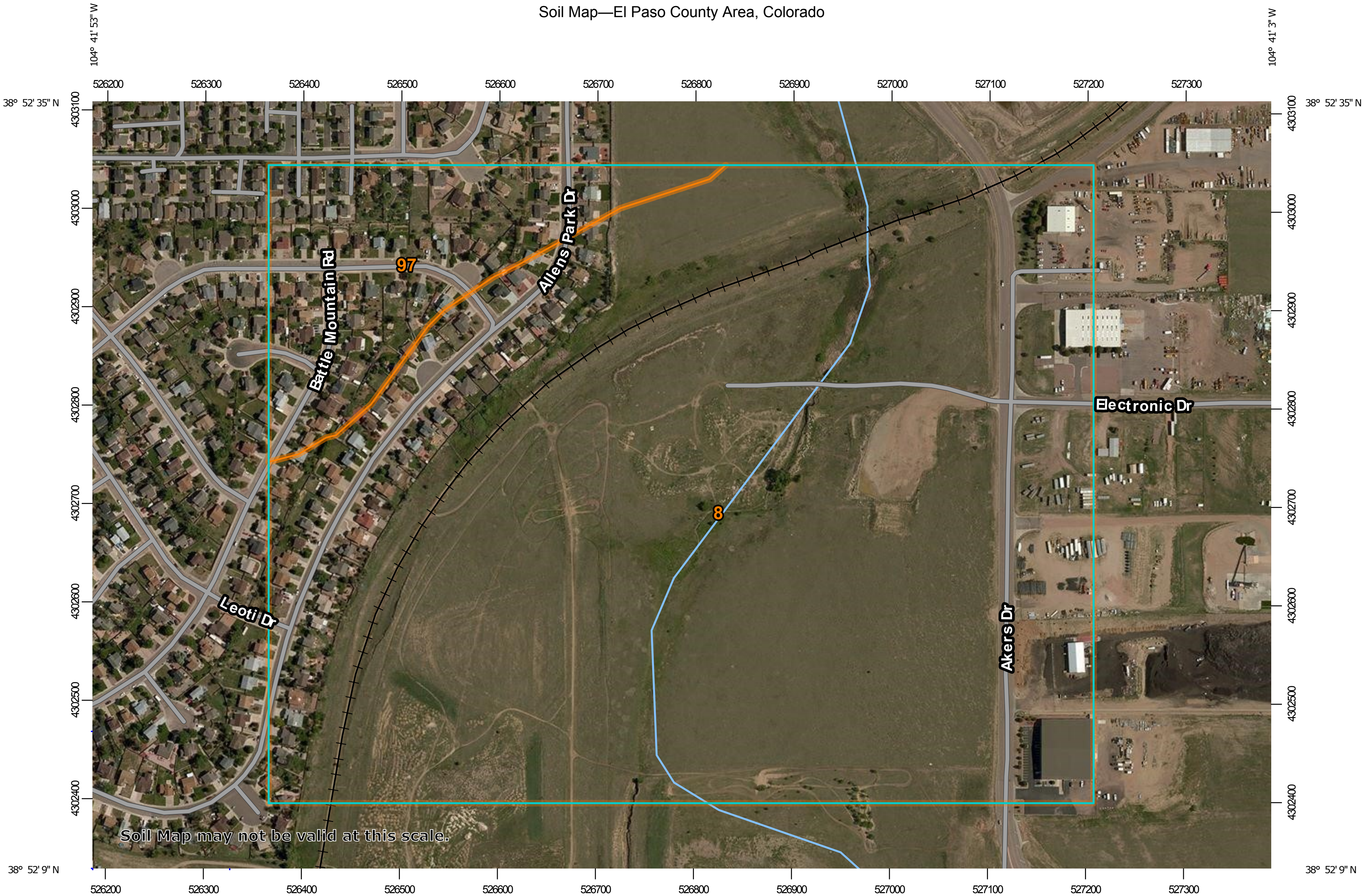
Soil Map—El Paso County Area, Colorado



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

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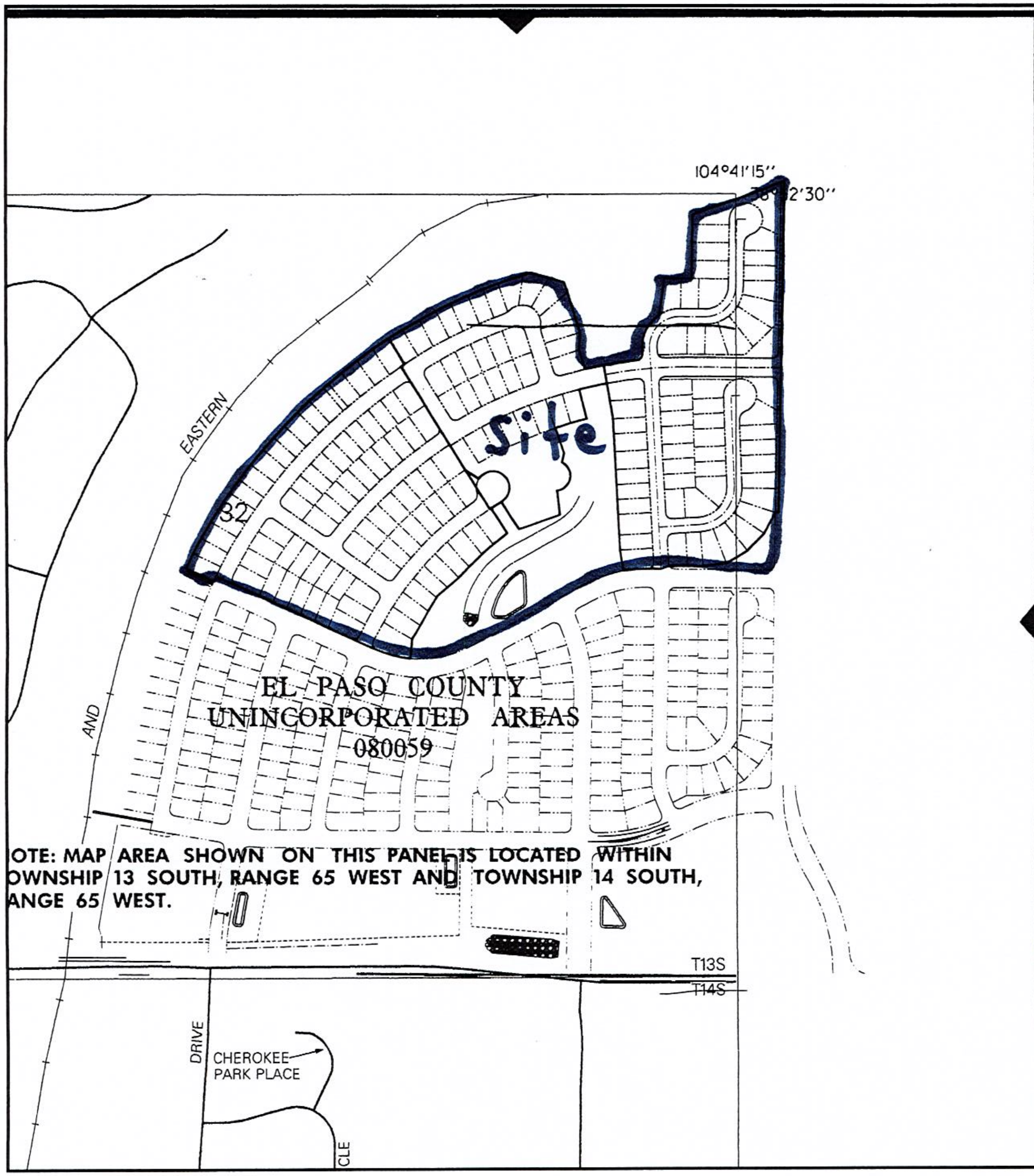

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 752 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0752	F

MAP NUMBER
08041C0752 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

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

HYDROLOGIC / HYDRAULIC CALCULATIONS

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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	0.80	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.80	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	**0.31**	**0.34**	**0.46**
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

BASIN	WEIGHTED CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	TOTAL FLOWS 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	0.31	0.34	0.38	0.42	0.44	0.46	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	2	4
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		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
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		Flow			
					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	9.7
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

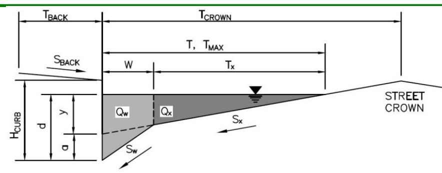
Version 4.05 Released March 2017

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



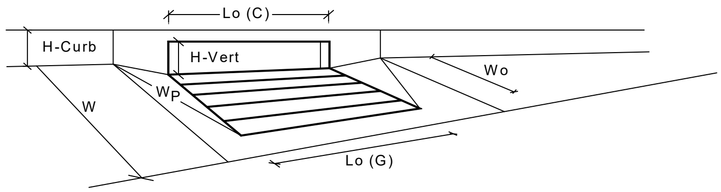
Gutter Geometry (Enter data in the blue cells)

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



		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) =	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

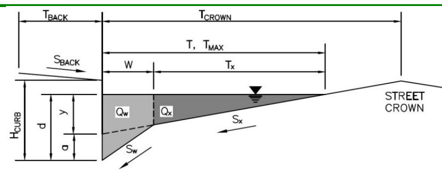
Version 4.05 Released March 2017

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



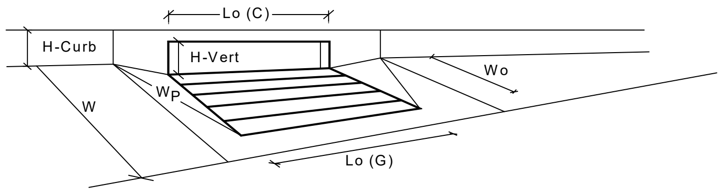
Gutter Geometry (Enter data in the blue cells)

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

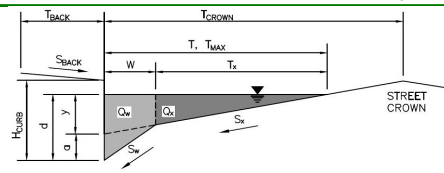
Version 4.05 Released March 2017

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)

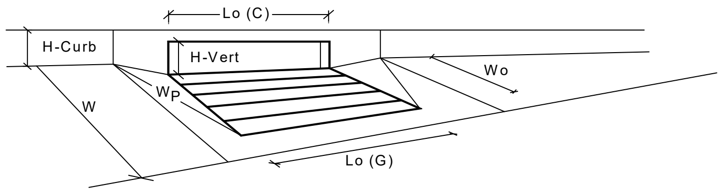
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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



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) =	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

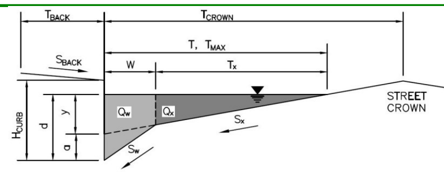
Version 4.05 Released March 2017

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)

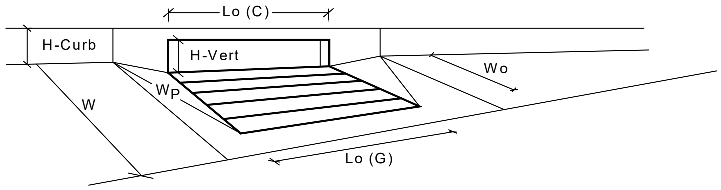
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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**

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	4.0	cfs

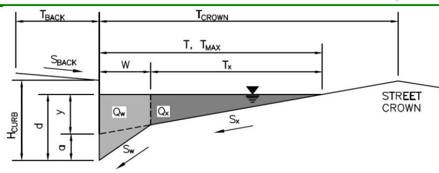
Version 4.05 Released March 2017

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)

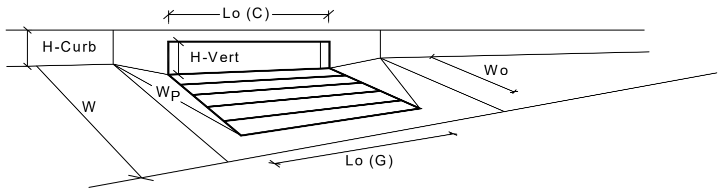
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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**

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 =	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

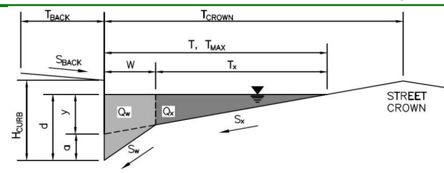
Version 4.05 Released March 2017

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-6



Gutter Geometry (Enter data in the blue cells)

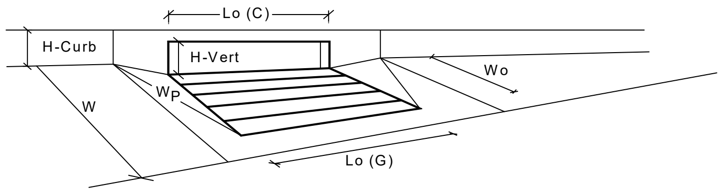
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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



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) =	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

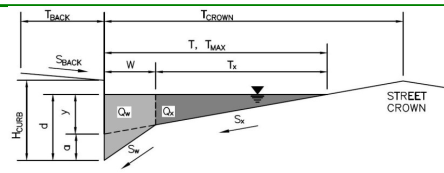
Version 4.05 Released March 2017

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)

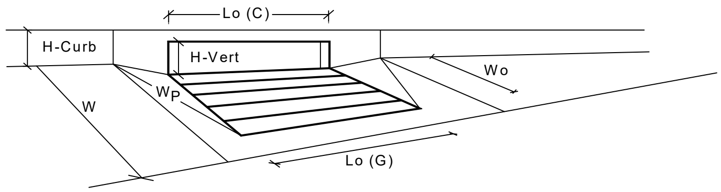
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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)		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)	$Q_{PEAK\ REQUIRED}$ =	4.0	12.0	cfs

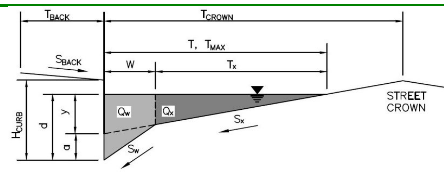
Version 4.05 Released March 2017

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)

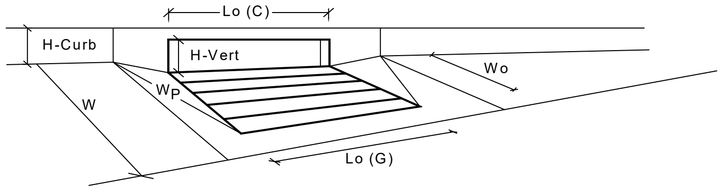
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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

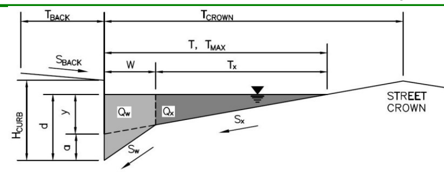
Version 4.05 Released March 2017

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)

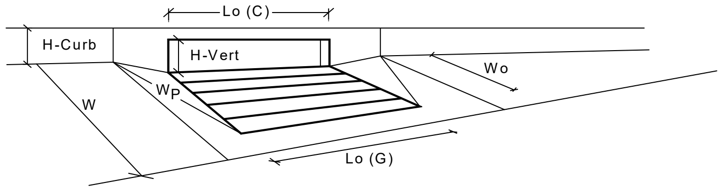
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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)		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) =	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

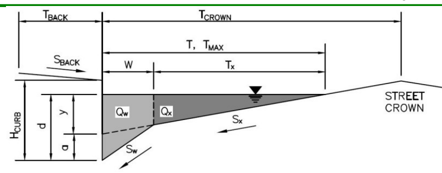
Version 4.05 Released March 2017

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)

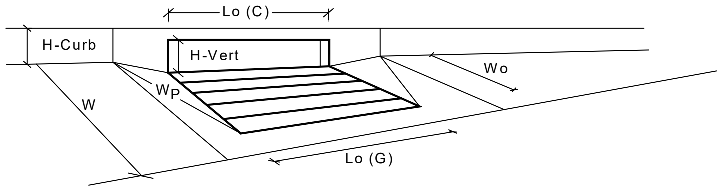
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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**

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)		$Q_{PEAK\ REQUIRED}$ =	2.0	5.0	cfs

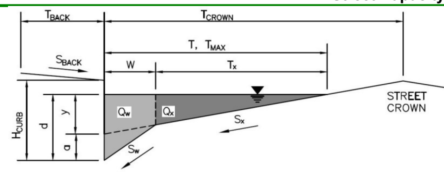
Version 4.05 Released March 2017

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 ≥ 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	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
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'

Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *Hannah Ridge at Feathergrass Fil. 5-7* **County:** *EL Paso*
Designer: *Marc Whorton* **Checked by:**
Date: 10/3/2018 **Date:**

Input Channel Geometry

Inlet Channel		Chute		Outlet Channel	
Bw =	*6.0* ft.	Bw =	*8.0* ft.	Bw =	*8.0* ft.
Side slopes =	*4.0* (m:1)	Factor of safety =	*1.20* (F_s)	Side slopes =	*4.0* (m:1)
n-value =	*0.035*	Side slopes =	*4.0* (m:1) → ***2.0:1 max.***	n-value =	*0.013*
Bed slope =	*0.0100* ft./ft.	Bed slope (3:1) =	*0.330* ft./ft. → ***2.5:1 max.***	Bed slope =	*0.0100* ft./ft.
Freeboard =	*1.0* ft.	Outlet apron depth, d =	*1.5* ft.	Base flow =	*17.0* cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = acres Rainfall = ○ 0 - 3 in. ◉ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = *6475.0* ft. --- Outlet = *6464.5* ft. --- (H_{drop} = 9 ft.)

Chute capacity = Q10-year
Total capacity = Q25-year

Minimum capacity (based on a 5-year, 24-hour storm with a 3 - 5 inch rainfall)

Note: *The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

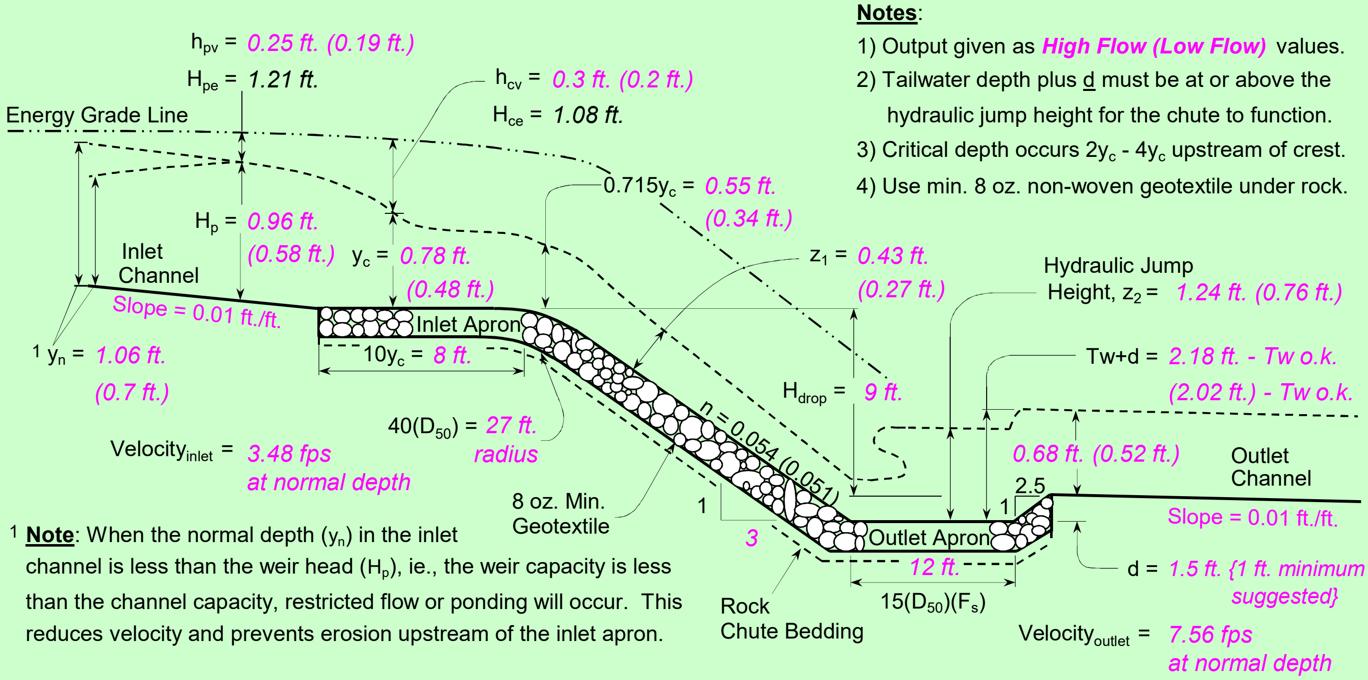
Input tailwater (Tw):

Q_{high} = *38.0* cfs High flow storm through chute → Tw (ft.) = *Program*

Q_{low} = *17.0* cfs Low flow storm through chute → Tw (ft.) = *Program*

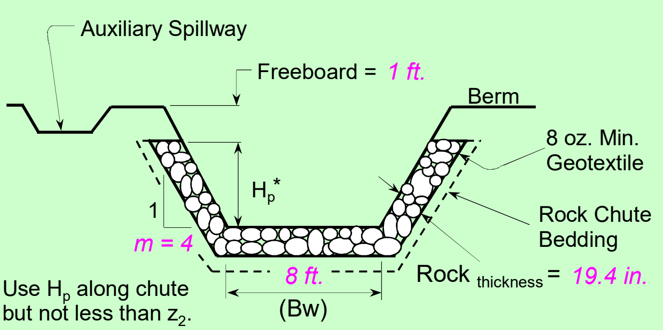
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

q_t =	3.87 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	0.43 ft.	Normal depth in chute
n-value =	0.054	Manning's roughness coefficient
$D_{50}(F_s)$ =	9.7 in. (66 lbs. - 50% round / 50% angular)	
$2(D_{50})(F_s)$ =	19.4 in.	Rock chute thickness
Tw + d =	2.18 ft.	Tailwater above outlet apron
z_2 =	1.24 ft.	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

Typical Cross Section **High Flow Storm Information**

Rock Chute Design - Plan Sheet

(Version 4.0 - 07/10/00, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Hannah Ridge at Feathergrass Fil. 5-7 **County:** EL Paso
Designer: Marc Whorton **Checked by:**
Date: 10/3/2018 **Date:**

Design Values

Angular D_{50} dia. =	9.7 in.
$Rock_{chute}$ thickness =	19.4 in.
Inlet apron length =	8 ft.
Outlet apron length =	12 ft.
Radius =	27 ft.
Will bedding be used?	Yes ---------- Depth (in.) = 6.0

Rock Gradation Envelope

% Passing		*Diameter, in. (weight, lbs.)*
D_{100}	---------	15 - 19 (224 - 532)
D_{85}	---------	13 - 17 (146 - 388)
D_{50}	---------	10 - 15 (67 - 224)
D_{10}	---------	8 - 13 (34 - 146)

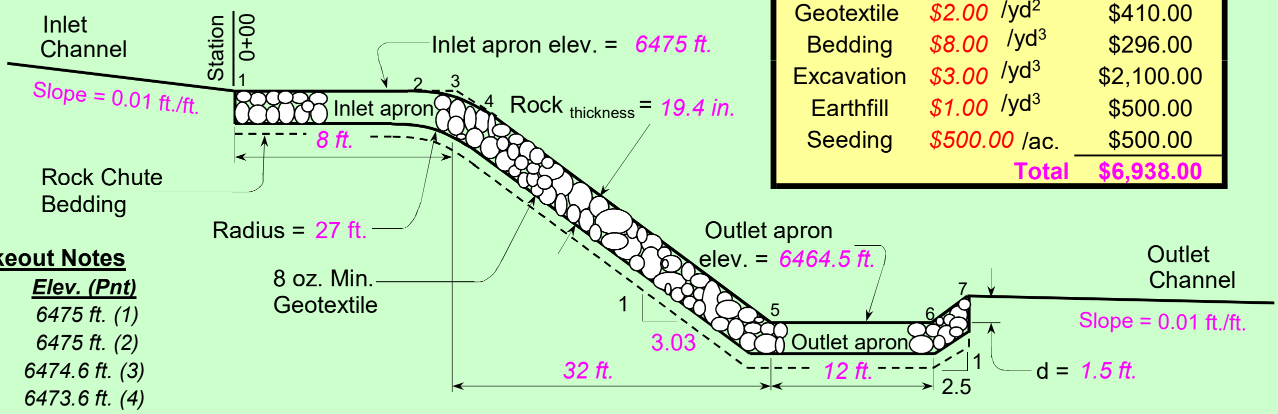
Quantities [a]

Angular Rock =	87	yd^3
Geotextile (8 oz.)[b] =	205	yd^2
Bedding (6 in.) =	37	yd^3
Excavation =	700	yd^3
Earthfill =	500	yd^3
Seeding =	1.0	acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).*
[b] *Geotextile shall be overlapped (18-in. min.) and anchored (18-in. min. along sides and 24-in. min. on the ends).*

Rock Chute Cost Estimate

Unit	*Unit Cost*	*Cost*
Rock	$36.00 /$yd^3$	$3,132.00
Geotextile	$2.00 /$yd^2$	$410.00
Bedding	$8.00 /$yd^3$	$296.00
Excavation	$3.00 /$yd^3$	$2,100.00
Earthfill	$1.00 /$yd^3$	$500.00
Seeding	$500.00 /ac.	$500.00
	Total	**$6,938.00**

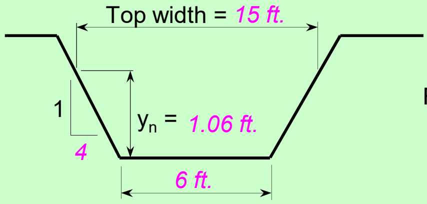


Stakeout Notes

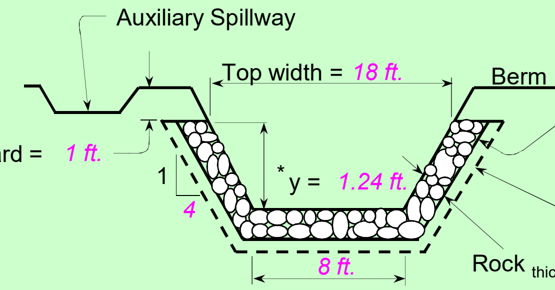
Sta.	***Elev. (Pnt)***
0+00	*6475 ft. (1)*
0+3.7	*6475 ft. (2)*
0+8	*6474.6 ft. (3)*
0+12.1	*6473.6 ft. (4)*
0+40	*6464.5 ft. (5)*
0+52	*6464.5 ft. (6)*
0+55.8	*6466 ft. (7)*

Profile Along Centerline of Rock Chute

*******Note*: ***The outlet will function adequately***

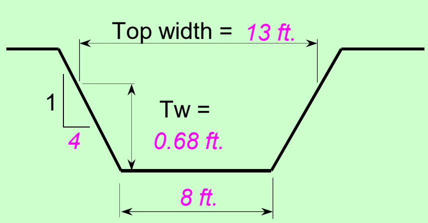


Inlet Channel Cross Section



Rock Chute Cross Section

* Use H_p throughout chute but not less than z_2.



Outlet Channel Cross Section

Profile, Cross Sections, and Quantities

Project: Hannah Ridge at Feathergrass Fil. 5-7
Location: EL Paso County

U.S. Department of Agriculture
Natural Resources Conservation Service

Designed: Marc Whorton	Approved by:	
Drawn: NRCS Standard Dwg.	Title:	
	Title:	
Traced:	Sheet No.	Drawing No.
Checked:	of	

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	ft^3/s

Results

Normal Depth	1.19	ft
Flow Area	1.95	ft^2
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	ft^3/s
Discharge Full	22.62	ft^3/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	ft^3/s

Results

Normal Depth		0.90	ft
Flow Area		1.11	ft^2
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	ft^3/s
Discharge Full		7.43	ft^3/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	ft^3/s

Results

Normal Depth	1.48	ft
Flow Area	3.47	ft^2
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	ft^3/s
Discharge Full	47.16	ft^3/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

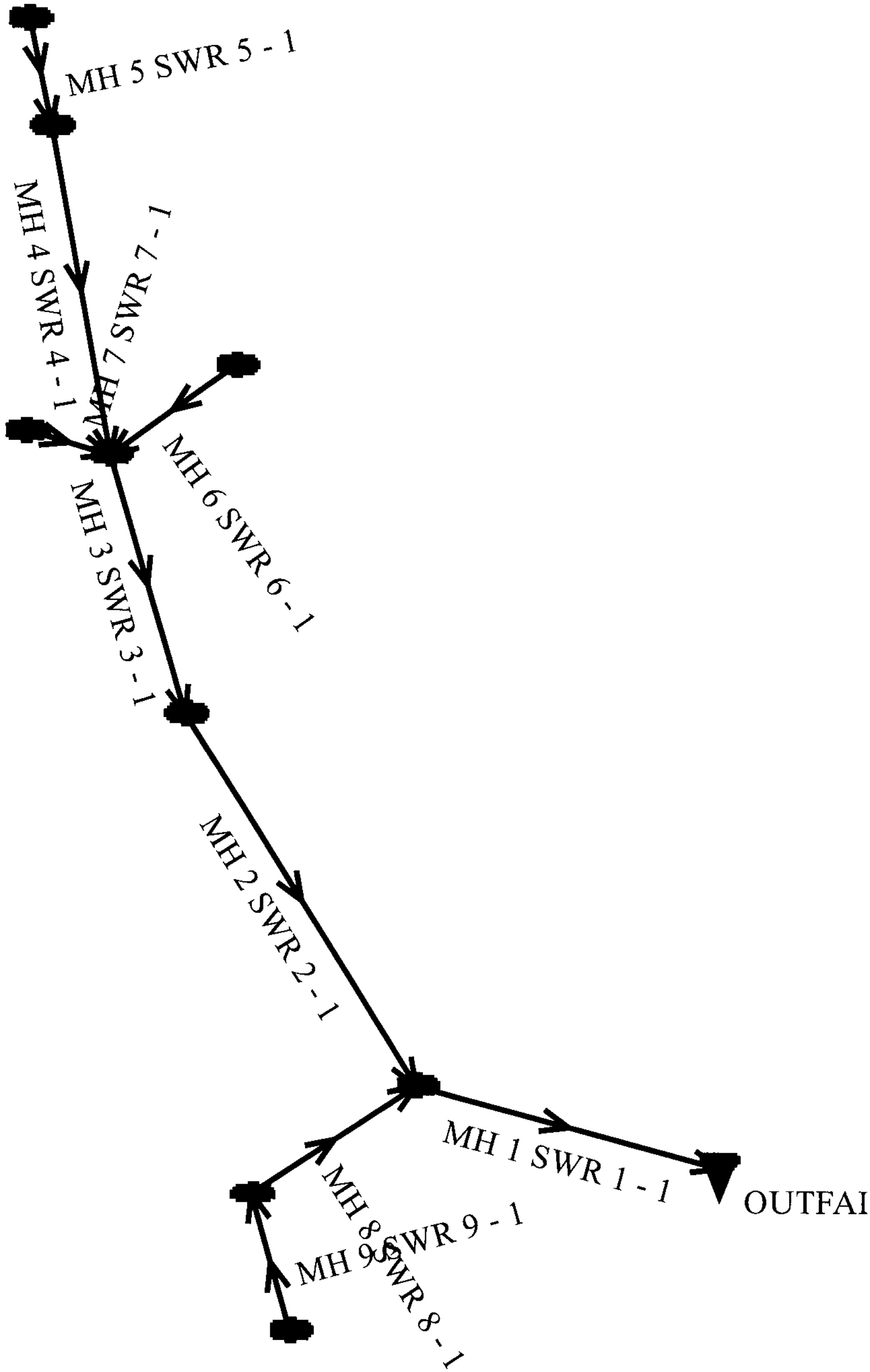
Normal Depth	2.54	ft
Flow Area	7.47	ft²
Wetted Perimeter	7.13	ft
Hydraulic Radius	1.05	ft
Top Width	3.13	ft
Critical Depth	2.64	ft
Percent Full	72.5	%
Critical Slope	0.00591	ft/ft
Velocity	9.50	ft/s
Velocity Head	1.40	ft
Specific Energy	3.94	ft
Froude Number	1.08	
Maximum Discharge	87.25	ft³/s
Discharge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


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
OUTFAI
MH 8 SWR 8 - 1
MH 9 SWR 9 - 1

Westerly Storm Outfall

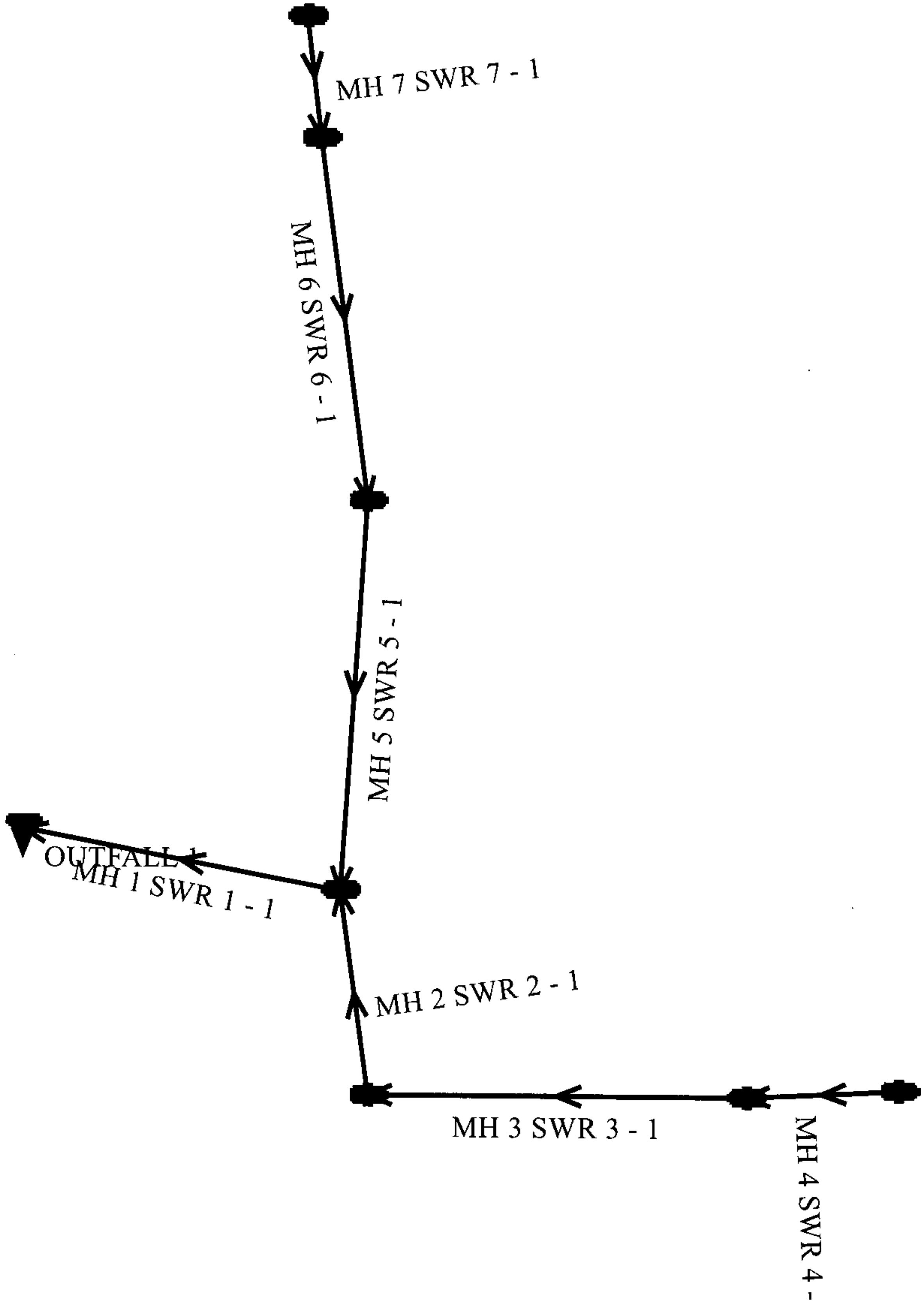
Sewer Input Summary:

		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
OUTFALL 1
MH 1 SWR 1 - 1
MH 2 SWR 2 - 1
MH 3 SWR 3 - 1
MH 4 SWR 4 - 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	56.15	6475.00	1.0	6475.56	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
MH 2 SWR 2 - 1	116.19	6476.00	1.9	6478.21	0.013	0.83	0.29	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	0.25	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): 6476.62

	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	6475.00	6475.56	0.00	0.00	6476.62	6477.57	6478.10	0.36	6478.45
MH 2 SWR 2 - 1	6476.00	6478.21	0.31	0.34	6478.73	6479.88	6479.10	1.51	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	0.35	6478.45	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

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: B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Weir with rip-rap 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

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 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

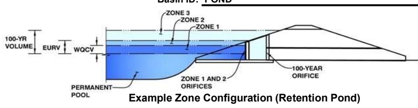
E) Total Outlet Area — A_{ot} = ______ square inches

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			
Water Quality Capture Volume (WQCV) =	0.738	acre-feet	Optional User Override 1-hr Precipitation	
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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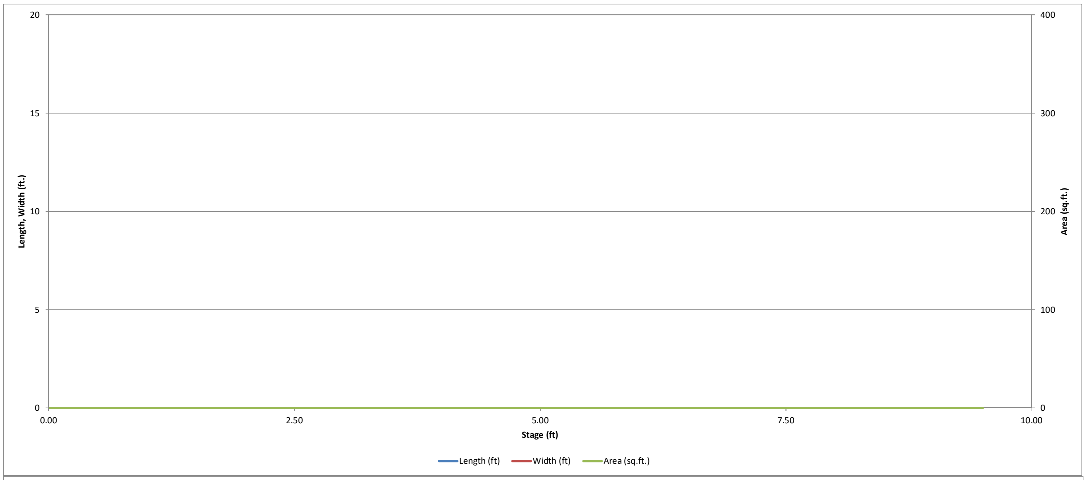
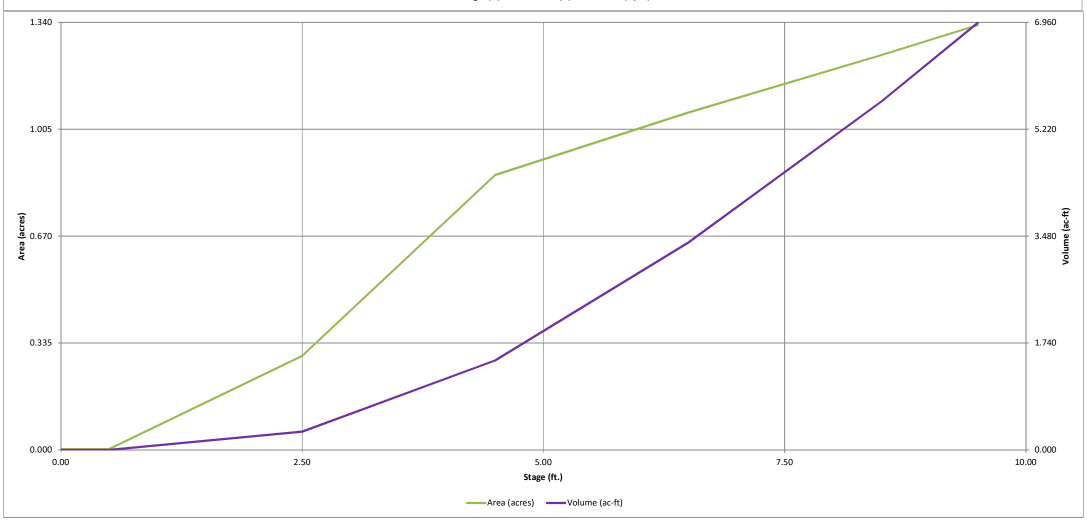
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



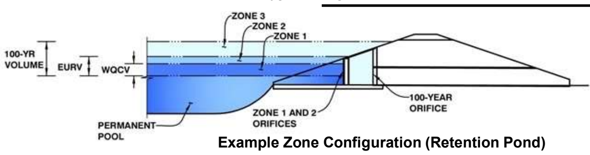


Detention Basin Outlet Structure Design

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

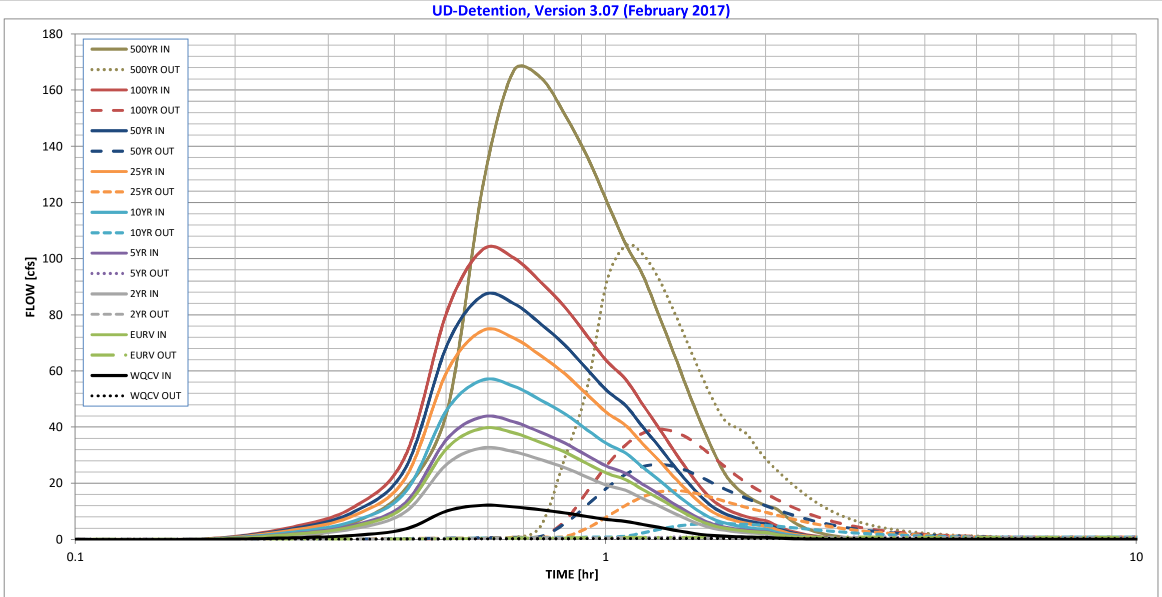
Spillway Design Flow Depth=	0.87	feet
Stage at Top of Freeboard =	9.37	feet
Basin Area at Top of Freeboard =	1.32	acres

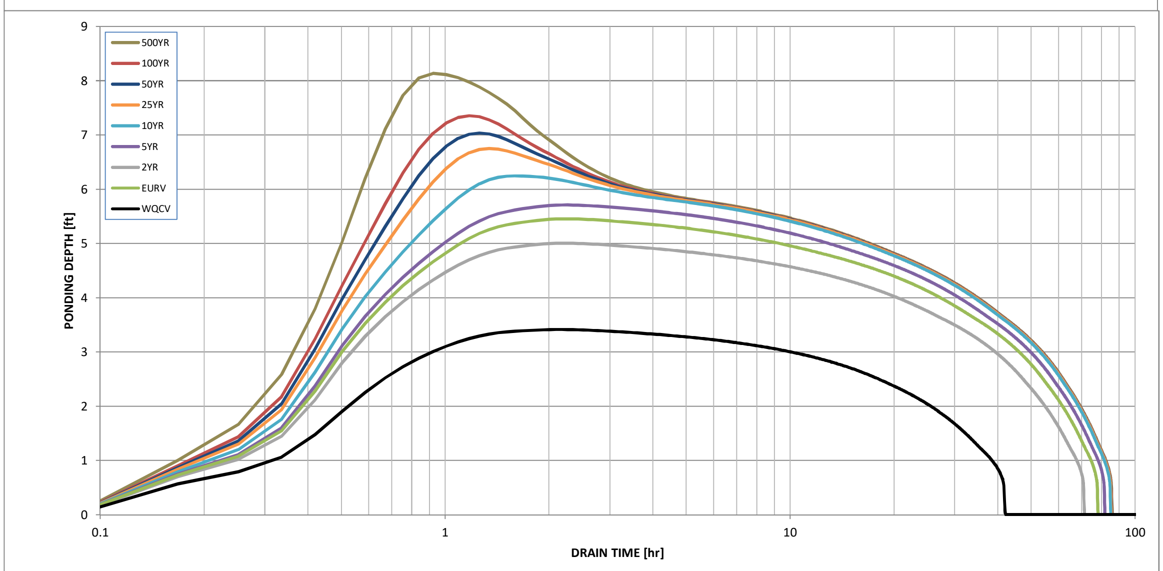
Routed Hydrograph Results

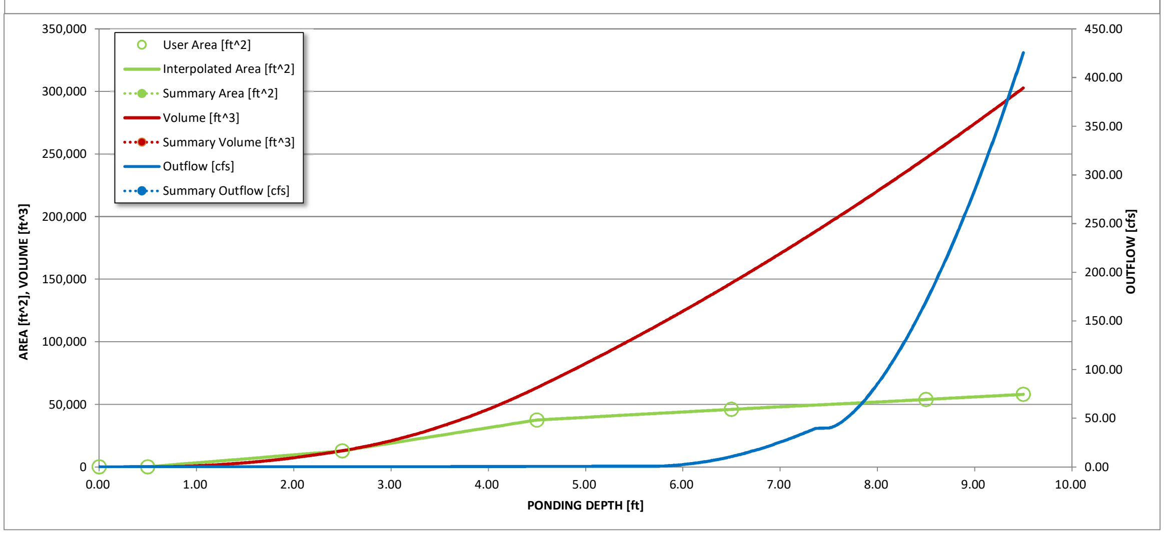
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.738	2.441	2.004	2.697	3.518	4.635	5.434	6.483	10.626
OPTIONAL Override Runoff Volume (acre-ft) =									
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
5.03 min

Hydrograph Constant
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

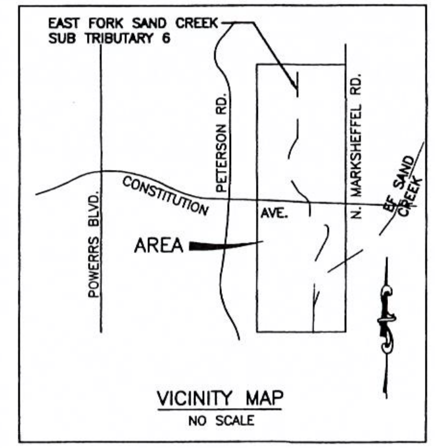
DRAINAGE MAPS

SUMMARY OF DISCHARGES

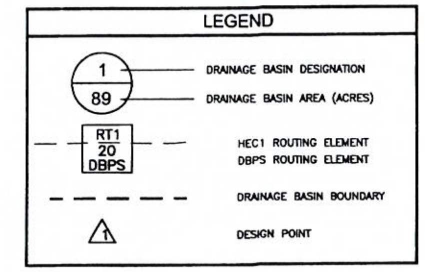
DESIGN POINT LOCATION	DRAINAGE AREA (SM)	Q_{100}/Q_{10} (cfs)
1 AT N. CAREFREE CIR.	0.34	551/255
14 AT RAILROAD GRADE (INFLOW)	0.66	915/374
14 AT RAILROAD GRADE (OUTFLOW)	0.66	640/360
8 AT CONSTITUTION	1.07	1076/457
8A AT CONFLUENCE WITH EF SAND CREEK	1.91	2088/925

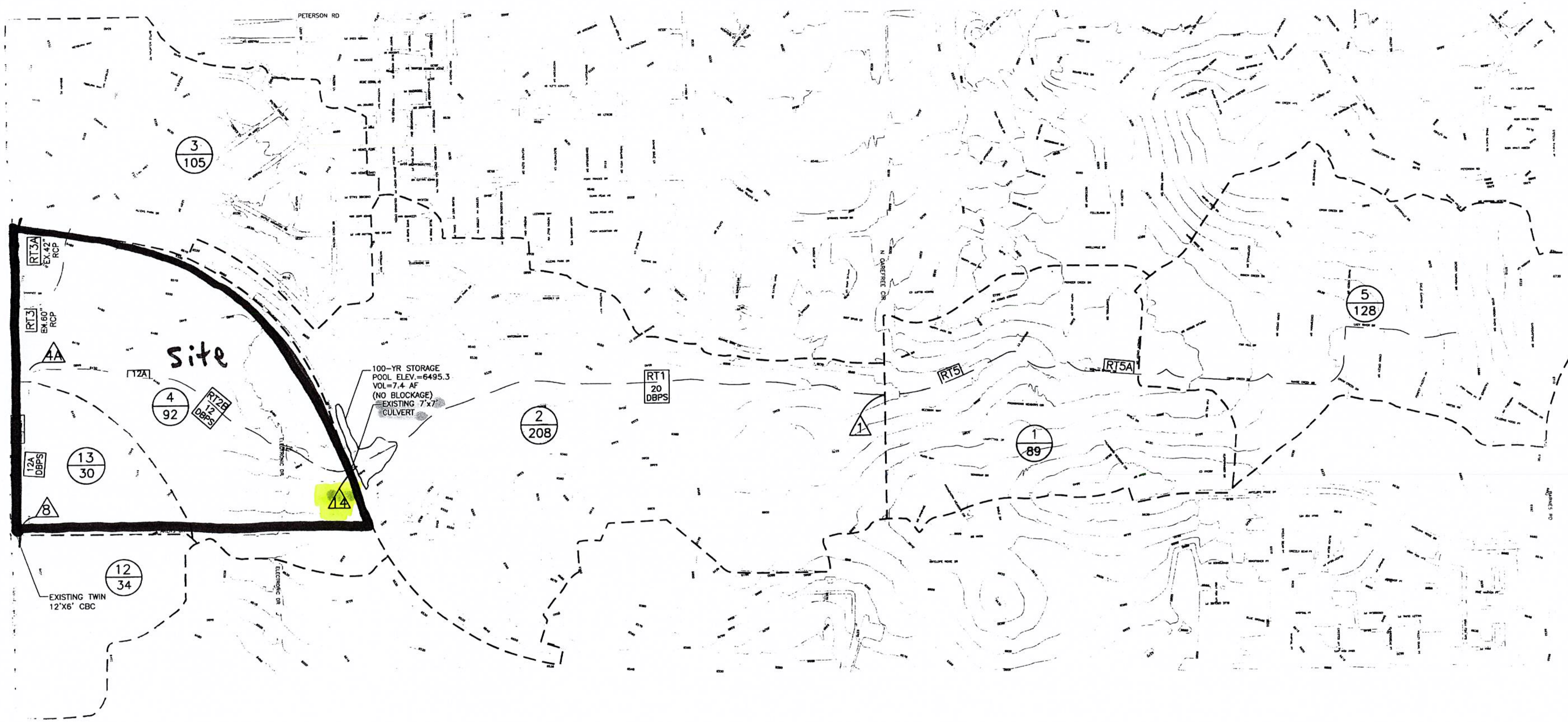
SUMMARY OF ROUTING ELEMENTS

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%



0' 400' 800'





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/Jan 17, 2007

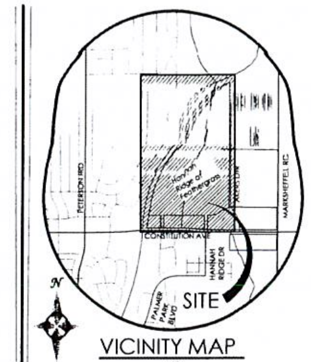
BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)
OSA1 (IN)		425	360 *	886 (IN)
1 (OUT)	OSA1	425	351 *	627 (OUT)
OSA2		1.9	2	5
OSA3		0.3	1	2
OSC1		3.4	5	11
A4		38.1	31	71
2	OSA1, OSA2, OSA3, OSC1, A4	468.7	351 *	627
3	OSF1	105	130 *	283
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

Caption: EXISTING SUMMARY RUNOFF TABLE

* 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
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



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	0.31	0.34	0.38	0.42	0.44	0.46	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	2	4
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

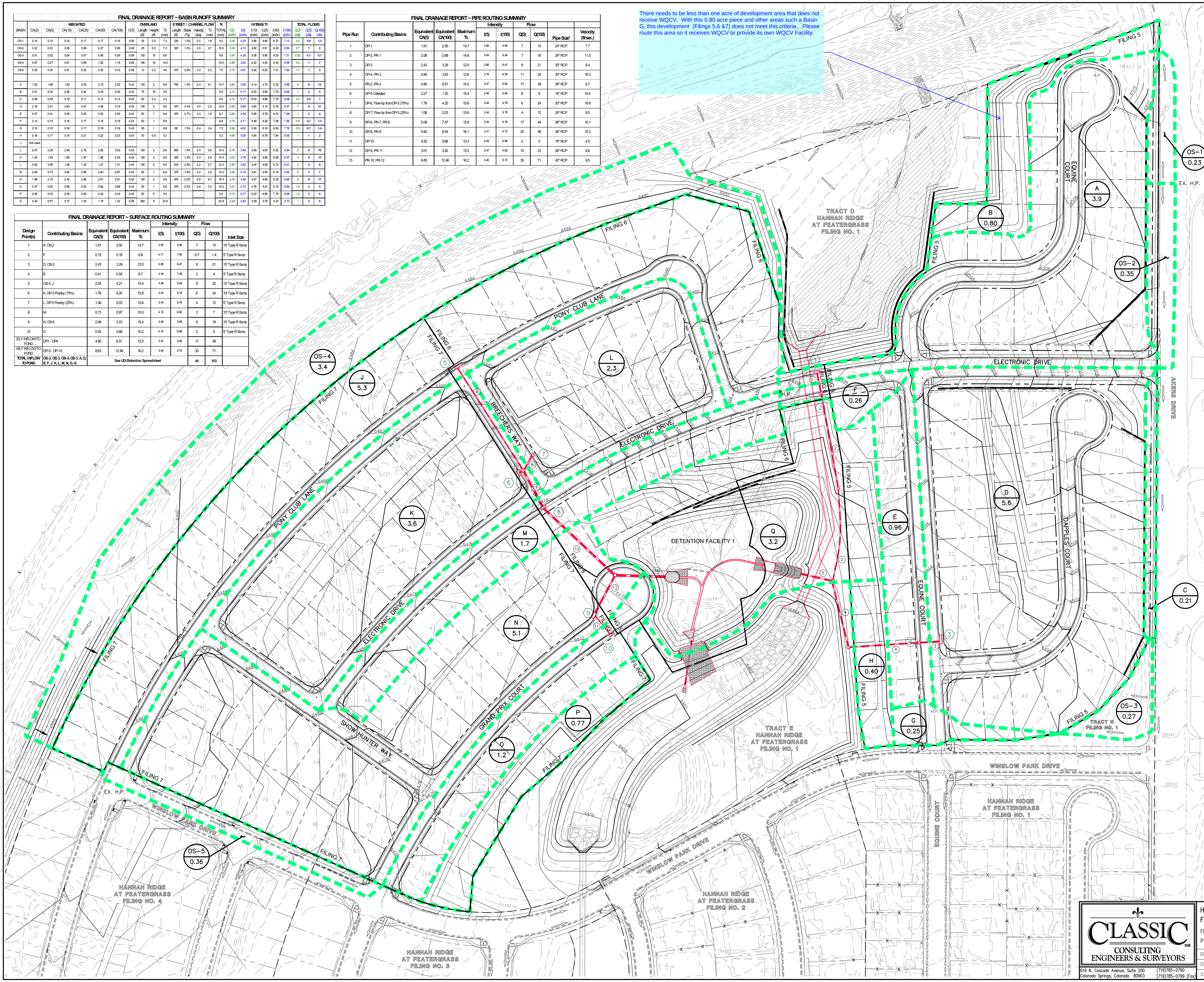
FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

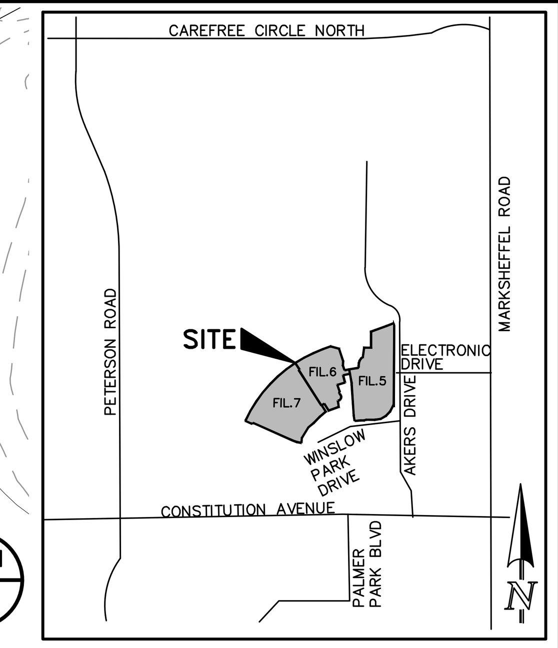
					Intensity		Flow			
Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Pipe Size*	Velocity (ft/sec.)
1	DP-1	1.91	2.50	14.7	3.55	5.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	14.8	3.54	5.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	12.0	3.85	6.47	9	21	30" RCP	8.4
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	9.7
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

There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility.

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

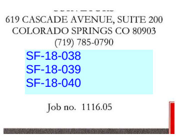
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

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 (5)



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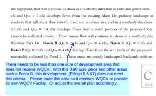
SF-18-038
SF-18-039
SF-18-040



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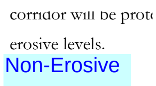
There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility. Or adjust the overall plan accordingly.



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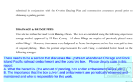
Non-Erosive



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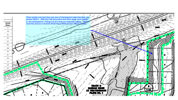
Author: Steve Kuehster
Date: 11/19/2018 3:26:59 PM
Color: ■

There needs to be a section that discusses the upstream abandoned Chicago and Rock Island Pacific railroad embankment and the concrete box. Please clearly state in this report:
A. What the hazard is. (the amount of ponding, box and/or embankment failure, etc.)
B. The importance that the box culvert and embankment are periodically observed and maintained and who is responsible for this work.



Subject: arrow & box
Page Label: 91
Author: Steve Kuehster
Date: 11/19/2018 3:28:24 PM
Color: ■

There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility.