INNOVATIVE DESIGN. CLASSIC RESULTS.

PRELIMINARY/FINAL DRAINAGE REPORT

MIDTOWN COLLECTION AT HANNAH RIDGE FILING No. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)

PUDSP-20-007

DECEMBER 2021

Prepared for:
ELITE PROPERTIES OF AMERICA, INC.
2138 FLYING HORSE CLUB DRIVE
COLORADO SPRINGS, CO 80921

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 CASCADE AVENUE, SUITE 200
COLORADO SPRINGS, CO 80903
(719) 785-0790

Job no. 1116.35

PRELIMINARY/FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)

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

COLORADO LICENSED KYLE RAYE CAMPBELL 29794 PROFESSIONAL ENGINEER

Kyle R. Campbell, Colorado P.E. #29794 — 04/22/2022 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: Elite Properties of America, Inc.

12/13/21 Date

Title: Vice President

Address: 2138 Flying Horse Club Drive

Colorado Springs, CO 80921

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.

APPROVED
Engineering Department
05/04/2022 9:43:46 AM
dsdnijkamp
EPC Planning & Community Development Department

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

PRELIMINARY/FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)

TABLE OF CONTENTS:

PURPOSE

This document is the Preliminary and Final Drainage Report for Midtown Collection at Hannah Ridge Filing No. 3. 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 3 and discuss the construction details, and more specifically, the design details of the proposed sub-regional public detention/water quality facility located within Filing 3 that will handle the treatment for this site as well as Hannah Ridge at Feathergrass Filings No. 1 & 2. Design information for the Filing No. 3 detention/water quality facility is included in this report.

It is anticipated that an amendment to this report will be provided when the Final Plat and Construction Drawings details are processed for review.

GENERAL DESCRIPTION

The overall 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 development includes a total of 345 single-family residences that will be developed in seven filings, as well as two small lot PUD single family developments and one commercial parcel, Tract CC. Tract CC is now proposed for a small lot PUD single family development which is prompting the PUD rezone and PUD site plan applications. Midtown Collection at Hannah Ridge Filing No. 3 (Tract CC) is 7.44 acres in size and contains 42 proposed small lot, single-family detached lots.

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).

EXISTING DRAINAGE CONDITIONS

The site is located within the Sand Creek Drainage Basin. More specifically, it is situated in the far southeast portion of the overall Hannah Ridge at Feathergrass development. This site was previously studied in the "Final Drainage Report for Hannah Ridge at Feathergrass Subdivision Filing No. 1", by MVE, Inc. dated January 2014 this proposed residential filing is located in Basin D9, D11 and G1 from the Filing No. 1 report as shown on the developed drainage map provided by MVE, Inc. (See Appendix). Existing Hannah Ridge Drive along the west edge of the development serves as the westerly basin boundary and Hunter Jumper Drive to the north as the northerly basin boundary. The construction of Hannah Ridge at Feathergrass Filing 1 and 2 improvements included the public storm under Hunter Jumper Drive and Hannah Ridge Drive out-falling into the existing drainageway that runs parallel to Constitution. The 84" RCP public storm from Hunter Jumper Drive to Hannah Ridge Drive was previously constructed. The on-site pre-development drainage patterns are generally sheet flowing towards Constitution Avenue where existing inlets intercept the flows and transfer them to an existing stormwater quality only facility located on the east side of Hannah Ridge Drive also constructed with Filing No. 1 and Filing No. 2. Filing No. 1 existing flows generally drain as street flow in a westerly direction towards the existing public drainage facilities within Hannah Ridge Drive. The prior report anticipated released of fully developed flows downstream into the dual cell box culverts under Constitution Avenue.

DEVELOPED DRAINAGE CONDITIONS

Based upon City/County Drainage Criteria, the drainage approach for this development now reflects current criteria for stormwater quality and Full Spectrum Detention requirements. The existing pond on the site will be redesigned as a Full Spectrum facility to accommodate the development of this site and all of northerly Hannah Ridge at Feathergrass Filing 1 and portions of Filing No. 2. This will include the design of concrete forebays, concrete trickle channels, concrete micro-pool and an outlet structure designed to release flows based on full spectrum criteria. The attached developed conditions drainage map contains the design points related to proposed sump conditions. All public and private 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 other proposed storm facilities are either public or private (as labeled on map and described below) and are within easements or tracts. The proposed modified Pond 1 will be owned and maintained by the Hannah Ridge Midtown Collection HOA. All existing public storm facilities are located within existing easements as reflected on the drainage map.

Design Point 1 (Q_5 = 1.9 cfs and Q_{100} = 4.1 cfs) is comprised of 0.76 acres of proposed on-site developed flows from Basin A. These single-family lots and private street flows travel west to the proposed intersection at Equine Court. The flows are intercepted by a 6' cross pan and routed south into Basin B-1 along the east side of proposed public Equine Court.

Design Point 2 (Q_5 = 4.3 cfs and Q_{100} = 10.5 cfs) collects developed flows from Basin B-1 and C and the flows from Design Point 1. Basin B-1 (Q_5 = 2.6 cfs and Q_{100} = 15.8 cfs) and C (Q_5 = 0.9 cfs and Q_{100} = 1.7 cfs) flows are comprised of proposed single-family homes and public and private street flows. At this sump condition, a 10' public 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 6 inches and will then be conveyed via a 24" RCP public storm sewer in a northerly direction towards the Tract A Pond. The total flow within the pipe at this location is given by **Pipe Run 2 (Q_5 = 5.0 cfs and Q_{100} = 12.0 cfs)** which includes flows from Design Point 4 (Q_5 = 0.8 cfs and Q_{100} = 1.7 cfs), a small 0.34-acre basin of a portion of 7 proposed lots and landscape area**.** The emergency overflow route at Design Point 2 is in the southerly direction directly into the southerly drainage channel that will route the flows south under Constitution Avenue.

Design Point 3 (Q_5 = 3.1 cfs and Q_{100} = 6.2 cfs) is developed flows from Basin D, 1.08 acres of proposed single-family homes and public and private street flows. At this sump condition, a 10' private Type R private 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 6 inches and then be conveyed via an 18" PVC or ADS private storm sewer towards the Tract A Pond. The total flow within the pipe at this location is given by **Pipe Run 3 (Q_5 = 3.1 cfs and Q_{100} = 6.2 cfs).** The emergency overflow route at this location is south directly into the proposed expanded Pond.

Design Point 5 (Q_5 = 27.2 cfs and Q_{100} = 53.5 cfs) represents the combined pipe flows from Design Points 3 and all northerly off-site developed flows (the southerly curb line along Hunter Jumper Drive west of proposed Equine Court, and the easterly curb line of Hannah Ridge Drive south of Hunter Jumper Drive and north of Constitution Avenue). A 48" RCP public storm sewer (**Pipe Run 4**) will route these combined developed flows directly into the Pond after being intercepted by an existing 15' public sump inlet.

Design Point 4 (Q_5 = 0.8 cfs and Q_{100} = 1.7 cfs) collects developed flows from Basin B-2 (0.34 acres of a portion of seven homes and landscape area). At this sump condition, a private CDOT Type C sump grated inlet will be installed to completely collect both the 5-year and 100-year developed flows. These flows being collected have a maximum ponding depth of 0.13' and then be conveyed via a private 12" PVC or ADS storm sewer towards Design Point 2. The presence of a Froude number slightly more than 1.0 is not a concern for this landscape area with less than 2 inches of 100-year flow depth. The total flow within the pipe at this location is given by **Pipe Run 1 (Q_5 = 0.8 cfs and Q_{100} = 1.7 cfs).** The emergency overflow route at this location is via Tract A directly into the drainage channel along Constitution.

Basin E (Q_5 = 2.1 cfs and Q_{100} = 4.1 cfs) are flows from a portion of 8 homes along Hunter Jumper Drive and landscape areas that drain into Hannah Ridge Drive and are collected by the existing public 15' Type R sump inlet and also routed to the expanded Tract A Pond.

Runoff from **Basin F** (1.23 Acres) (Q_5 = 1.5 cfs and Q_{100} = 5.0 cfs) and **Basin G** (1.87 Acres) (Q_5 = 1.2 cfs and Q_{100} = 6.6 cfs) flow directly into the proposed expanded pond or into the southerly drainage channel. The areas draining directly into the channel are comprised of the channel itself or directly tributary landscape areas.

Basin H (Q_5 = 0.2 cfs and Q_{100} = 1.4 cfs) is a small 0.42-acre landscape parcel at the southeast corner of the site that sheet flows directly into Akers Drive and Constitution Avenue similar to existing conditions. Basin H will remain undeveloped land without pavement or structures, therefore water quality is not required for this area per current El Paso County ECM.

The total inflow into the expanded Pond is Q_5 = 34.7 cfs and Q_{100} = 70.6 cfs from both outfalls into the pond. The total proposed flow into the pond is comprised of off-site existing developed Basins D-1, D-2, D-3, D-4, D-5, D-6, D-7, D-8, D-9, D-10 and D-12 (15.25 acres total). See Drainage Map from prior approved report in the Appendix. Runoff Coefficients used for this composite off-site are (Q_5 = 0.49 cfs and Q_{100} = 0.57 cfs). The existing facility will be expanded with the proposed Filing 3 development. This facility will have two inflow points. Both inflow points will outfall into proposed concrete forebays. The west inflow will be from a proposed 48" RCP into a proposed concrete forebay with a required size of .010 ac-ft based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 7.4" notch and a 30" wide concrete trickle channel routing the flows towards the pond outlet. The east inflow will be from a proposed 24" RCP into a proposed concrete forebay with a required size of .010 ac-ft based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 3.3" notch and a 30" wide concrete trickle channel routing the flows toward the pond outlet. The outlet structure consists of a 6'x5' concrete box with an integral 100 Square Foot micro-pool allowing for 6" initial surcharge depth. The micro-pool total depth of 2.5' provides the required 0.3% of the WQCV. The outlet box will have a height of 4.60' above the micro-pool water elevation. (See UD-BMP Spreadsheets in the Appendix). The orifice plate on the front of the outlet box consists of a series of 3 – 1 5/8" holes, 17.80" apart (see UD Detention Spreadsheets in Appendix) this facility will be owned and maintained by the Hannah Ridge Midtown Collection HOA.

Pond 1 has the following design parameters as a Full Spectrum Facility:

0.331 Ac.-ft. WQCV required

0.677 Ac.-ft. EURV required

0.661Ac.-ft. 100-year storage required

Pond Design Release:	Q_5 = 0.3 cfs, Q_{100} = 10.5 cfs (Design Point 5)
Pre-development Release:	Q_5 = 0.4 cfs, Q_{100} = 16.6 cfs
Maximum 100-Year Ponding Elevation:	6448.22

An existing 24” HDPE storm pipe currently conveys the released flows and will continue to do so (Pipe Run Outfall). A 5’ long by 3’ wide rip-rap (Type VL) dissipator will be provided at the existing pipe outlet.

Hydrologic Soil Group A was used for FSD Calculations.

In the event of an emergency (outlet structure blockage or failure), an emergency spillway will convey flows form the pond in a southerly direction into the existing (and proposed to be improved) drainage channel. A proposed emergency spillway with a 65’ wire base and 4:1 side slopes will convey the 10-5 cfs in a 100 year event. Buried soil rip-rap over compacted subbase is proposed. As this expanded facility is neither a sub-regional or regional facility, a cut off wall is not required per the DCM. See typical emergency spillway section on enclosed Proposed Conditions Drainage Map, and rip -rap sizing form (Type VL required) in appendix.

All existing storm infrastructure that will not be utilized due to the upstream off-site flows being redirected will be capped at the disconnect point. Details will be provided on future Construction Drawings detailing the location.

The release from the pond will be discharged into the proposed public improved drainage corridor that runs parallel to Constitution Avenue towards an existing public storm outfall under Constitution Avenue contained within multiple El Paso County public drainage easements per Book 5122 and, Page 995 and Rec. No. 214713468. With the public box culverts and headwalls under Hannah Ridge Drive (dual 6’ x 10’) and Constitution Avenue (dual 6’ x 12’) being existing, the only remaining public improvements between the existing public outlet and inlet is approximately 450 linear feet of public rip-rap trapezoidal channel. As defined in the DBPS as a Rip Rap channel with a bottom width of 30’, depth of 4’ and projected flow of 1,580 cfs in the 100-year event (DBPS segment number 12-A). The inclusion of on-site Full Spectrum Detention (not anticipated with DBPS flows) will decrease the amount flowing into the proposed channel corridor. The subsequent Hannah Ridge MDDP further defined the tributary flows and required channel improvement as approved within the Filing No. 2 Construction Drawings. Pricing for the DBPS public channel (Reimbursable Public facility) is included in the report after the on-site cost opinion. Using the prior approved and constructed MVE, Inc. Design Drawings (west of this site), the same 20' base with 3:1 side slope channel will be built connecting the existing improvements based upon a 100-year flow depth of 5.06' for the approved MDDP flow rate of Q_{100} = 1076 cfs (using a 30' base instead of 20'). These public rip-rap channel improvements are identified as reimbursable facilities per the Drainage Basin Planning Study and will be used to off-set proposed drainage fees. In no location along this proposed public channel is the freeboard less than 2'. The proposed public channel will be maintained by El Paso County within the existing public drainage easement corridor until acceptance of the public improvements. Per the DBPS the existing downstream public box culvert under Constitution is "to remain". The existing public dual 6' x 12' box culvert was built prior to the 1989 DBPS. Using the approved MDDP flows of Q_{100} = 1076 cfs, a headwater depth calculation is included in the appendix (D = 6.9') which is easily contained within the existing conditions headwall and grading associated with the inlet control condition.

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 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 and ultimately released into a proposed stabilized drainage channel.

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 Number 08041C0752G and 756G, with effective dates of December 7, 2018 (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. Early grading is not being requested with these applications.

Midtown Collection at Hannah Ridge Filing No. 3 Drainage Improvement Costs (Non-Reimbursable)

ITEM	DESCRIPTION	QUANTITY	UNIT COST	COST
1.	2'x2' Type C Grated Inlet	1 EACH	$3,791/EA	$ 3,791.00
2.	10' Type R Inlet	2 EACH	$5,950/EA	$ 11,900.00
3.	12" PVC Storm Drain	125 LF	$60/LF	$ 7,500.00
4.	18" RCP Storm Drain	30 LF	$69/LF	$ 2,070.00
5.	24" RCP Storm Drain	215 LF	$84/LF	$ 18,060.00
6.	48" RCP Storm Drain	60 LF	$122/LF	$ 7,320.00
7.	Type I MH	1 EACH	$8,592/EA	$ 8,592.00
8.	Type II MH	2 EACH	$4,575/EA	$ 9,150.00
9.	Pond FSD	1 EACH	$83,000/EA	$ 83,000.00
SUB-TOTAL				$ 151,383.00
10% ENGINEERING				$ 15,138.30
5% CONTINGENCIES				$ 7,569.15
GRAND-TOTAL				**$ 174,090.45**

Midtown Collection at Hannah Ridge Filing No. 3 Drainage Improvement Costs (Reimbursable)

ITEM	DESCRIPTION	QUANTITY	UNIT COST	COST
1.	Channel Imps	450 LF	$234/LF*	$ 105,300.00
SUB-TOTAL				$ 105,300.00
10% ENGINEERING				$ 10,530.00
5% CONTINGENCIES				$ 5,265.00
GRAND-TOTAL				**$ 121,095.00**

*Per Drainage Basin Planning Study excerpt attached. Unit cost not adjusted for inflation. After Construction Drawing design approval and construction. Reimbursable costs will be verified and an application made to the county and the Drainage Boards to perfect any available credit.

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

DRAINAGE & BRIDGE FEES

This site lies within the Sand Creek Drainage Basin. The fees are calculated using the following impervious acreage method approved by El Paso County. Filing No. 3 is a re-plat of previously platted Tract CC within Filing 1. However, Tract CC was 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 acreage:

Filing 3: 7.44 ac.

The total development area is broken into different residential uses:

PUD zone (1/8 acre or less SF lots – 65% Impervious)

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

The following calculations are based on the 2021 drainage/bridge fees for the Sand Creek Basin:

FILING 3:

2158 SF avg. lots (1/8 acre or less)

(Per El Paso County Percent Impervious Chart for 1/8 acre or less SF lots: 65**%**)

7.44 Ac. x 65% = 4**.84 Impervious Ac.**

Open Space Tracts

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

2.60 Ac. x 2% = **0.05 Impervious Ac.**

Total Impervious Acreage: 4.89 Imp. Ac.

FILING 3 FEE TOTALS:

Bridge Fees

$ 989.00 x 4.89 Impervious Ac. = $ 4,836.21

Drainage Fees

$ 21,134.00 x 4.89 Impervious Ac. = $ 103,345.26

These Drainage Fees will be off-set by the public channel improvements.

Fees will be recalculated based upon fees at time of Final Plat submittal. Based upon the required drainage fees being less than the reimbursable drainage channel costs (not adjusted for inflation), no drainage fees will be required with ultimate Final Plat recordation, and only payment of bridge fees will be requested. The appendix of this report includes a summary of all recent plat recordings (everything in the community in now recorded, except this filing) and the offsets used. Reimbursable public facility costs exceed drainage fee obligations. As final costs are tabulated, the credits will be "perfected" per an application to the drainage board.

SUMMARY

This proposed development remains consistent with the previously approved MDDP and Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 1. The existing storm facilities continue to adequately handle both the 5-yr. and 100-yr. developed flows. The proposed detention facility meets current criteria and provides full spectrum design. The proposed development will not adversely impact surrounding developments.

A future Final Plat application will include Construction Drawings and amendment to this report to provide further Final Design details associated with the more detailed design.

PREPARED BY:
Classic Consulting

Kyle R. Campbell, P.E.
Division Manager

db/111635/REPORTS/fdr

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 Subdivision Filing No. 1”, by MVE, Inc. January 2014.

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

6. “Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 3”, by MVE, Inc. October 2017.

7. “Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 4”, by MVE, Inc. October 2017.

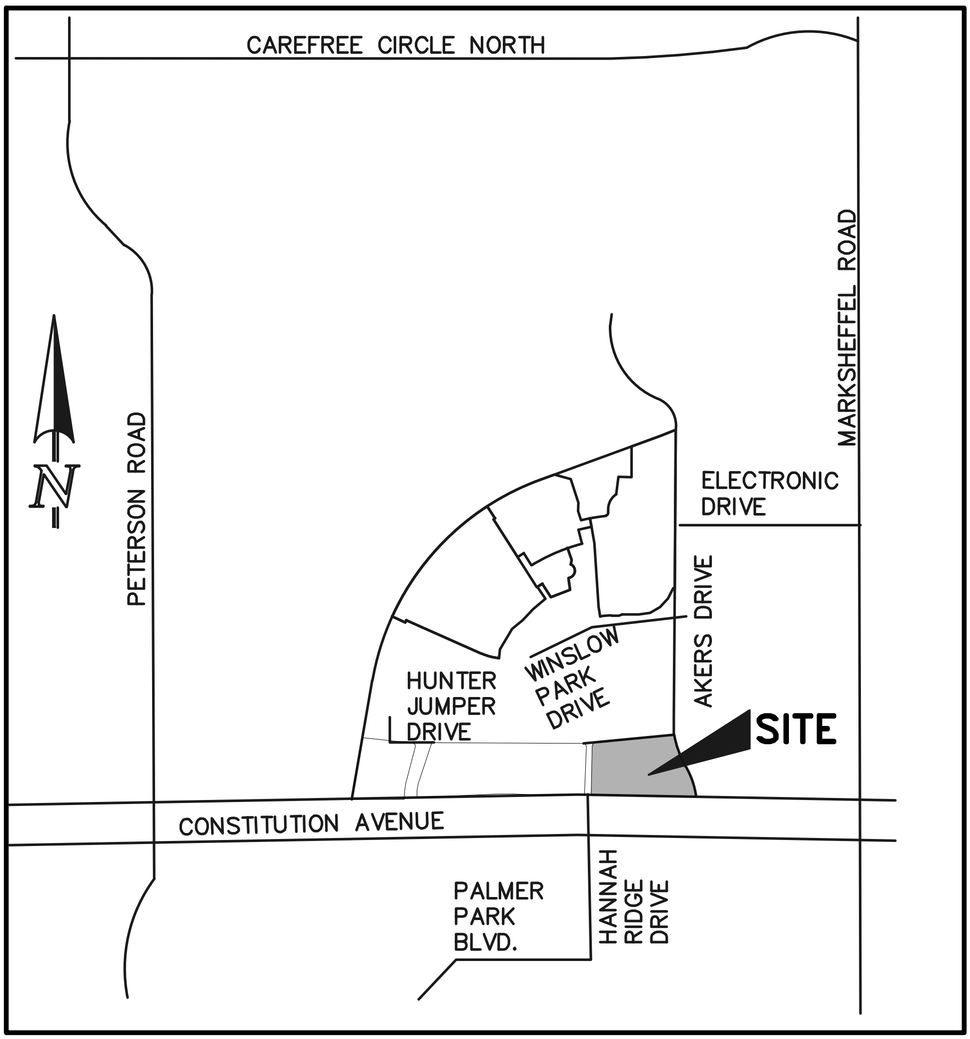
8. El Paso County Engineering Criteria Manual, Resolution No. 20-222, June 23, 2020 (Supp. No.2).

*EPC Board Resolution NO. 15-042 (El Paso County adoption of Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria manual dated May 2014, hydrology and full-spectrum detention)

APPENDIX

VICINITY MAP

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

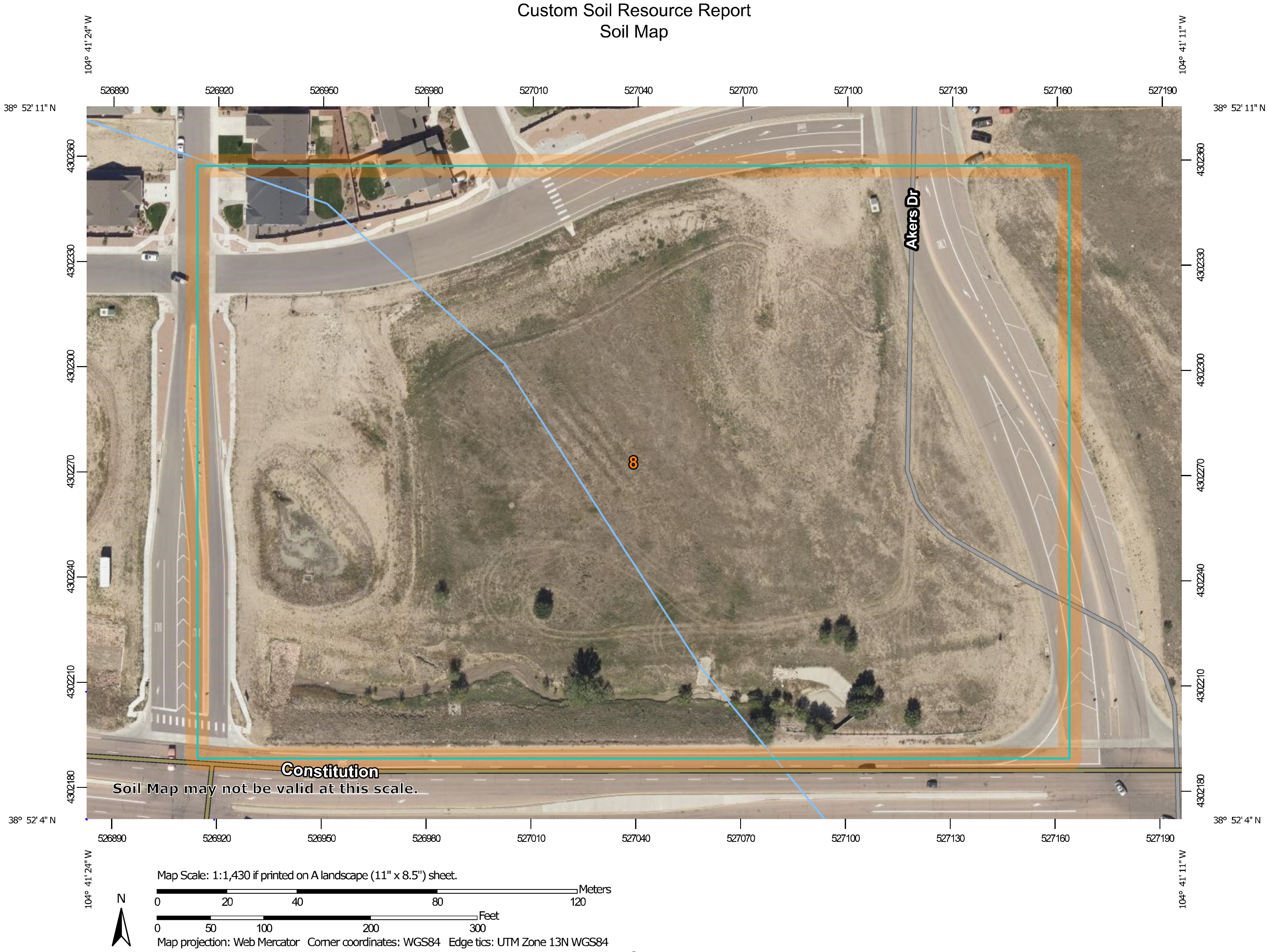


VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

Soil Map


104° 41' 24" W
104° 41' 11" W
38° 52' 11" N
38° 52' 4" N
526890
526920
526950
526980
527010
527040
527070
527100
527130
527160
527190
4302360
4302330
4302300
4302270
4302240
4302210
4302180
8
Akers Dr
Constitution
Soil Map may not be valid at this scale.
Map Scale: 1:1,430 if printed on A landscape (11" x 8.5") sheet.
Meters
0
20
40
80
120
Feet
0
50
100
200
300
N
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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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	10.5	100.0%
Totals for Area of Interest		**10.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

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: 98 percent
Minor components: 2 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 (R049XB210CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

F.E.M.A. MAP

National Flood Hazard Layer FIRMette

FEMA

104°41'36"W 38°52'22"N

104°40'59"W 38°51'54"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
	Coastal Transect
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/3/2020 at 6:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

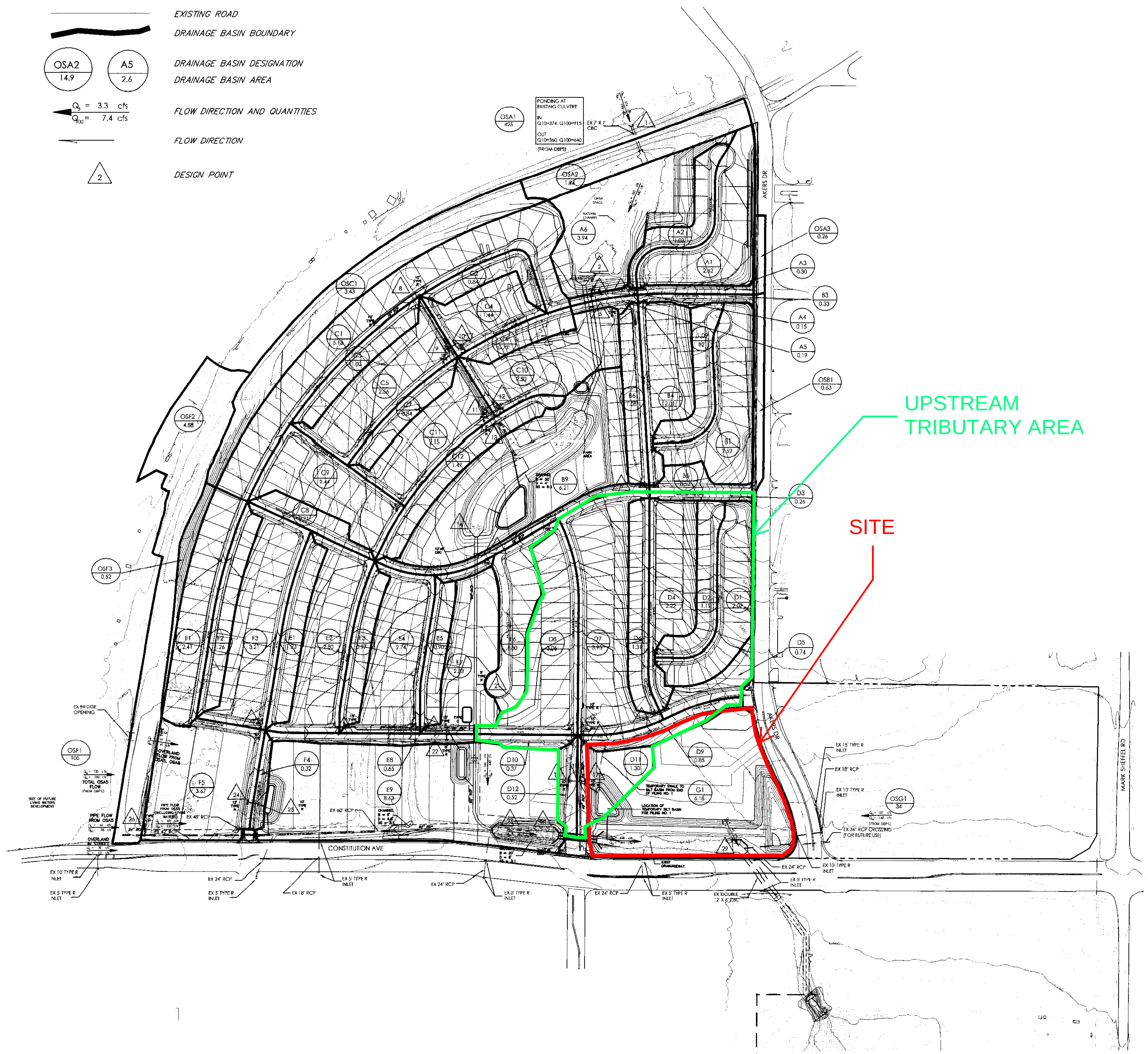
REFERENCE MATERIAL FROM ADJACENT STUDIES

EXISTING CONDITIONS DRAINAGE MAP

AND CALCULATIONS

LEGEND

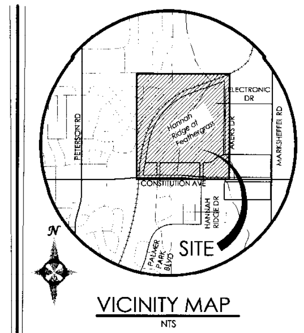
	EXISTING INDEX CONTOUR
	EXISTING STORM DRAIN CURB INLET
24" RCP	EXISTING STORM DRAIN LINE
	EXISTING PROPERTY LINE
	EXISTING ROAD
	DRAINAGE BASIN BOUNDARY
OSA2 14.9 / A5 2.6	DRAINAGE BASIN DESIGNATION DRAINAGE BASIN AREA
Q_5 = 3.3 cfs Q_{100} = 7.4 cfs	FLOW DIRECTION AND QUANTITIES
	FLOW DIRECTION
2	DESIGN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



DEVELOPED SUMMARY RUNOFF TABLE					
BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA (AC)	5-YR(Q5) RUNOFF (CFS)*	100-YR (Q100) RUNOFF (CFS)	DESCRIPTION
OSA1 (IN)		425	374 *	915 (IN)	
1 (OUT)	OSA1	425	360 *	640 (OUT)	EX 7x7 CBC
2	OSA1, OSA2, A6	430.8	360 *	640 *	12'Wx6'H CBC
3	A1,A2,OSA3,A3	4.2	9.4	18.8	CROSS PAN
4	A1,A2,OSA3,A3,A4	4.4	9.7	19.2	10' TYPE R INLET (SUMP)
5	A5	0.2	0.7	1.3	5' TYPE R INLET (SUMP)
6	OSB1,B1,B2,B3,B4,B5,B6	8.2	19.5	38.5	CROSS PAN
7	OSB1,B1,B2,B3,B4,B5,B6,B7	8.9	20.4	40.1	15' TYPE R (SUMP),15' TYPE R INLETS
8	OSC1,C1	8.6	15.0	31.1	10' TYPE R (SUMP),10' TYPE R INLETS
9	C3,C5	3.6	8.9	17.8	15' TYPE R INLET (SUMP)
10	C2,C4	2.3	5.5	10.9	10' TYPE R INLET (SUMP)
11	C7,C8,C9,C11	6.1	13.4	26.6	15' TYPE R INLET (SUMP)
12	C6,C10	3.2	6.6	14.1	10' TYPE R INLET (SUMP)
13	C12	1.5	3.7	7.4	5' TYPE R INLET (SUMP)
14	OSA1-A6,OSB1-B9, OSC1-C12	476	360 *	640 *	10'Wx6'H CBC & 90" RCP
15	D1,D2,D3,D4,D5,D6	7.8	19.2	38.0	CROSS PAN
16	D1,D2,D3,D4,D5,D6,D7	11.7	26.6	52.8	10' TYPE R & 15' TYPE R INLETS
17	D1-D7,D9,D11	13.9	29.6	59.0	15' TYPE R INLET (SUMP)
18	D8,D10,D12	4.0	8.7	17.1	10' TYPE R INLET (SUMP)
19	E1,E2,E3	5.0	11.9	23.7	15' TYPE R INLET
20	E1,E2,E3,E4,E5,E7	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
21	E6	1.8	4.5	9.0	5' TYPE R INLET (SUMP)
22	E8	0.7	1.8	3.6	5' TYPE R INLET (SUMP)
23	OSF1,F1,F2,F3	7.4	16.2	32.5	CROSS PAN
24	OSF1,F1,F2,F3,F5	11.0	23.4	48.4	15' TYPE R (SUMP),TYPE C INLETS
25	F4	0.3	0.9	1.9	5' TYPE R INLET (SUMP)
26	OSF2	4.9	4.2	9.6	TYPE D INLET (SUMP)
27	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5	619	428 *	991 *	OPEN CHANNEL
28	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12	647	428 *	991 *	DBL 10'Wx6'H CBC
29	OSA1-A6,OSB1-B9, OSC1-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12, G1	685	457 *	1076 *	EXISTING DBL 12'Wx6'H CBC

* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE 10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY

Existing Conditions Drainage Map



VICINITY MAP
NTS

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

N

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 DRG August 21, 2013
CHECKED BY
AS-BUILTS BY
CHECKED BY

Hannah Ridge at Feathergrass

DEVELOPED
Drainage Map

MVE PROJECT 60970
MVE DRAWING 60970110

December 12, 2013
SHEET 1 OF 1

*OFF-SITE FLOW SUMMARY
FROM MVE FILING NO. 1 REPORT

Basin Label	Channel Type or Basin	Cont. Area A_c (Ac)	5 Year Coef. C_5	100 Yr Coef or Curve No C_{100} or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow* Q (cfs)	Flow Depth d (ft)	Flow Area A (ft²)	Flow Velocity v (ft/s)	Time of Conc** T_c (min)	Total Time T_t (min)	5 Year Intensity I_5 (in/hr)	100 Year Intensity I_{100} (in/hr)	5 Year Discharge Q_5 (cfs)	100 Year Discharge Q_{100} (cfs)
D1+D2+D3+D4	3	5.7	0.61	0.71	0.016	0	0	0.250	31.76	0.33	2.39	13.31	0.0	10.0	4.09	7.00	14.3	28.3
D5	0	0.7	0.57	0.66	–	140	6	0.043	–	–	–	–	7.2	–	–	–	–	–
D5	3	0.7	0.57	0.66	0.016	310	13	0.040	3.87	0.22	0.97	3.98	1.3	8.5	4.36	7.46	1.9	3.6
D1+D2+D3+D4+D5	D1+D2+D3+D4	5.7	0.61	0.71	–	–	–	–	–	–	–	–	10.0	–	–	–	–	–
D1+D2+D3+D4+D5	3	6.5	0.60	0.70	0.016	0	0	0.250	35.58	0.34	2.60	13.69	0.0	10.0	4.09	7.00	16.0	31.7
D6	0	1.3	0.60	0.70	–	60	1	0.013	–	–	–	–	6.6	–	–	–	–	–
D6	3	1.3	0.60	0.70	0.016	535	22	0.040	7.52	0.27	1.60	4.69	1.9	–	–	–	–	–
D6	3	1.3	0.60	0.70	0.016	210	4	0.020	7.52	0.31	2.07	3.63	1.0	9.5	4.18	7.15	3.3	6.6
D1+D2+D3+D4+D5+D6	D1+D2+D3+D4+D5	6.5	0.60	0.70	–	–	–	–	–	–	–	–	10.0	–	–	–	–	–
D1+D2+D3+D4+D5+D6	3	7.8	0.60	0.70	0.016	35	1	0.040	42.78	0.51	5.94	7.20	0.1	10.0	4.08	6.97	19.2	38.0
D7	0	4.0	0.60	0.70	–	140	2	0.015	–	–	–	–	9.7	–	–	–	–	–
D7	3	4.0	0.60	0.70	0.016	475	19	0.040	19.58	0.38	3.32	5.90	1.3	–	–	–	–	–
D7	3	4.0	0.60	0.70	0.016	270	4	0.015	19.58	0.46	4.80	4.08	1.1	12.1	3.77	6.43	8.9	17.8
D1+D2+D3+D4+D5+D6+D7	D7	4.0	0.60	0.70	–	–	–	–	–	–	–	–	12.1	–	–	–	–	–
D1+D2+D3+D4+D5+D6+D7	3	11.7	0.60	0.70	0.016	0	0	0.250	58.18	0.41	3.76	15.47	0.0	12.1	3.77	6.43	26.6	52.8
D9	0	0.9	0.50	0.58	–	40	1	0.020	–	–	–	–	5.6	–	–	–	–	–
D9	3	0.9	0.50	0.58	0.016	585	20	0.034	4.28	0.23	1.12	3.83	2.5	8.2	4.42	7.58	1.9	3.8
D1+D2+D3+D4+D5+D6+D9	D1+D2+D3+D4+D5+D6	7.8	0.60	0.70	–	–	–	–	–	–	–	–	10.0	–	–	–	–	–
D1+D2+D3+D4+D5+D6+D9	3	8.6	0.59	0.69	0.016	300	11	0.036	46.67	0.53	6.60	7.07	0.7	10.7	3.97	6.78	20.3	40.3
D1+D2+D3+D4+D5+D6+D7+D9	D1+D2+D3+D4+D5+D6+D7	11.7	0.60	0.70	–	–	–	–	–	–	–	–	12.1	–	–	–	–	–
D1+D2+D3+D4+D5+D6+D7+D9	3	12.6	0.59	0.69	0.016	0	0	0.250	61.69	0.42	3.93	15.69	0.0	12.1	3.77	6.43	28.2	56.0
D8	0	3.1	0.60	0.70	–	120	1	0.010	–	–	–	–	10.2	–	–	–	–	–
D8	3	3.1	0.60	0.70	0.016	450	18	0.040	14.81	0.35	2.68	5.53	1.4	–	–	–	–	–
D8	3	3.1	0.60	0.70	0.016	270	4	0.015	14.81	0.41	3.89	3.81	1.2	12.8	3.68	6.28	6.8	13.4
D10	0	0.4	0.60	0.70	–	32	1	0.020	–	–	–	–	4.2	–	–	–	–	–
D10	3	0.4	0.60	0.70	0.016	330	7	0.020	2.33	0.21	0.87	2.68	2.1	6.2	4.85	8.35	1.1	2.2
D8+D10	D8	3.1	0.60	0.70	–	–	–	–	–	–	–	–	12.8	–	–	–	–	–
D8+D10	3	3.4	0.60	0.70	0.016	0	0	0.250	16.61	0.26	1.47	11.33	0.0	12.8	3.68	6.28	7.6	15.1
D11	0	1.3	0.38	0.47	–	210	4	0.019	–	–	–	–	15.9	–	–	–	–	–
D11	3	1.3	0.38	0.47	0.016	95	1	0.015	3.43	0.25	1.30	2.64	0.6	16.5	3.26	5.57	1.6	3.4
D1+D2+D3+D4+D5+D6+D9+D11	D1+D2+D3+D4+D5+D6+D9	8.6	0.59	0.69	–	–	–	–	–	–	–	–	10.7	–	–	–	–	–
D1+D2+D3+D4+D5+D6+D9+D11	3	9.9	0.56	0.66	0.016	130	2	0.015	51.42	0.64	9.77	5.27	0.4	11.2	3.90	6.87	21.9	43.7
* D1+D2+D3+D4+D5+D6+D7+D9+D11	D1+D2+D3+D4+D5+D6+D7+D9	12.6	0.59	0.69	–	–	–	–	–	–	–	–	12.1	–	–	–	–	–
D1+D2+D3+D4+D5+D6+D7+D9+D11	3	13.9	0.57	0.67	0.016	140	2	0.015	65.98	0.71	11.89	5.55	0.4	12.5	3.71	6.33	29.6	59.0
D12	0	0.5	0.65	0.72	–	85	3	0.035	–	–	–	–	5.1	–	–	–	–	–
D12	3	0.5	0.65	0.72	0.016	130	2	0.015	3.33	0.24	1.25	2.67	0.8	5.9	4.93	8.50	1.7	3.2
D8+D10+D12	D8+D10	3.4	0.60	0.70	–	–	–	–	–	–	–	–	12.8	–	–	–	–	–
D8+D10+D12	3	4.0	0.61	0.70	0.016	130	2	0.015	19.19	0.45	4.66	4.12	0.5	13.3	3.61	6.16	8.7	17.1
E1	0	1.2	0.60	0.70	–	65	1	0.015	–	–	–	–	6.5	–	–	–	–	–
E1	3	1.2	0.60	0.70	0.016	615	11	0.018	7.08	0.31	2.08	3.40	3.0	9.6	4.16	7.12	3.1	6.1
E2	0	2.8	0.60	0.70	–	130	3	0.020	–	–	–	–	8.5	–	–	–	–	–
E2	3	2.8	0.60	0.70	0.016	580	11	0.020	14.63	0.39	3.47	4.22	2.3	10.8	3.96	6.77	6.7	13.3
E1+E2	E2	2.8	0.60	0.70	–	–	–	–	–	–	–	–	10.8	–	–	–	–	–
E1+E2	3	4.0	0.60	0.70	0.016	0	0	0.250	21.06	0.29	1.75	12.02	0.0	10.8	3.96	6.77	9.6	19.1
E3	0	1.0	0.60	0.70	–	60	1	0.015	–	–	–	–	6.3	–	–	–	–	–
E3	3	1.0	0.60	0.70	0.016	515	10	0.020	5.64	0.28	1.68	3.37	2.6	8.9	4.28	7.33	2.5	5.0
E1+E2+E3	E1+E2	4.0	0.60	0.70	–	–	–	–	–	–	–	–	10.8	–	–	–	–	–
E1+E2+E3	3	5.0	0.60	0.70	0.016	0	0	0.250	26.13	0.31	2.06	12.68	0.0	10.8	3.96	6.77	11.9	23.7
E4	0	2.7	0.60	0.70	–	125	3	0.020	–	–	–	–	8.3	–	–	–	–	–
E4	3	2.7	0.60	0.70	0.016	500	11	0.023	14.43	0.38	3.24	4.45	1.9	10.2	4.06	6.93	6.7	13.3
E1+E2+E3+E4	E1+E2+E3	5.0	0.60	0.70	–	–	–	–	–	–	–	–	10.8	–	–	–	–	–
E1+E2+E3+E4	3	7.7	0.60	0.70	0.016	295	8	0.025	40.45	0.54	6.75	5.99	0.8	11.6	3.84	6.56	17.8	35.5
E5	0	0.9	0.60	0.70	–	60	1	0.015	–	–	–	–	6.3	–	–	–	–	–
E5	3	0.9	0.60	0.70	0.016	460	11	0.023	5.24	0.27	1.50	3.50	2.2	8.5	4.35	7.45	2.3	4.7
E1+E2+E3+E4+E5	E1+E2+E3+E4	7.7	0.60	0.70	–	–	–	–	–	–	–	–	11.6	–	–	–	–	–
E1+E2+E3+E4+E5	3	8.6	0.60	0.70	0.016	0	0	0.250	45.16	0.37	3.11	14.52	0.0	11.6	3.84	6.56	19.9	39.7
E6	0	1.8	0.60	0.70	–	105	3	0.029	–	–	–	–	6.8	–	–	–	–	–
E6	3	1.8	0.60	0.70	0.016	575	8	0.015	10.23	0.36	2.96	3.45	2.8	9.5	4.16	7.12	4.5	9.0
E7	0	2.3	0.43	0.61	–	200	4	0.020	–	–	–	–	14.1	–	–	–	–	–
E7	3	2.3	0.43	0.61	0.016	365	7	0.019	8.58	0.33	2.34	3.66	1.7	15.8	3.33	5.69	3.3	8.1
E4+E5	E4	2.7	0.60	0.70	–	–	–	–	–	–	–	–	10.2	–	–	–	–	–
E4+E5	3	3.6	0.60	0.70	0.016	0	0	0.250	19.17	0.28	1.63	11.74	0.0	10.2	4.06	6.93	8.9	17.7
E4+E5+E7	E4+E5	3.6	0.60	0.70	–	–	–	–	–	–	–	–	10.2	–	–	–	–	–
E4+E5+E7	3	6.0	0.53	0.67	0.016	100	3	0.025	29.94	0.49	5.42	5.52	0.3	10.5	4.01	6.85	12.8	27.2
E1+E2+E3+E4+E5+E7	E1+E2+E3+E4+E5	8.6	0.60	0.70	–	–	–	–	–	–	–	–	11.6	–	–	–	–	–
E1+E2+E3+E4+E5+E7	3	11.0	0.58	0.68	0.016	100	1	0.010	55.85	0.72	12.21	4.57	0.4	12.0	3.79	6.47	23.4	48.4

HANNAH RIDGE AT FEATHER GRASS REIMBURSABLE COST SUMMARY

Job 1116.05 (revised 5-22-20)

Filing	Acreage (AC)	% Impervious	Drainage Fee	Drainage Fee Pd.	Bridge Fee	Reimburable Drainage Facility Estimate	Possible 10% Engineering Reimbursable	DBPS Reimbursable Facility Costs From DBPS	DBPS Reimbursable Facility Costs From DBPS w/ Inflation Factor	Inflation Factor	Comment
NO. 1	31.22	38%			$ 51,689.71	N/A				N/A	
4/23/2014*	9.68	38%	$ 55,176.00	$ -	$ 16,714.65						SF-13-013
			$ 15,000.00		($4,357/ac)						
NO. 2	9.27	38%	$ 52,839.00	$ 89,046.43	$ 16,006.69	$ 159,068.00	$ 15,906.80	N/A	N/A	N/A	Facilities installed - DBPS 12A
10/6/2015			$ 15,000.00		($4,544/ac)						SF-15-013
NO. 3	8.31	51%	$ 68,953.89	$ -	$ 20,889.59	$ 589,961.00	$ 58,996.10	$462,600.00	$501,921.00	1.085 (2017)	Facilities installed - DBPS 12A
			$ 16,270.00		($4,929/ac)					1.085	SF-17-012
NO. 4	10.12	51%	$ 83,972.72	$ -	$ 25,439.55	N/A		N/A	N/A	N/A	
			$ 16,270.00		$ 4,929.00						SF-17-013
NO. 5	11.926	53%	$ 112,554.37		$ 35,192.92	$ 412,620.00	$ 41,262.00	$427,320.00	$522,612.36	1.223 (2019)	To be installed w/ Fil 5 - DBPS 12
	0.99	2%	$ 17,751.00		$ 5,559.00	**				1.223	SF-18-038
NO. 6	6.25	60%	$ 67,166.23		$ 21,186.46	N/A		N/A	N/A	N/A	
	1.69	2%	$ 17,751.00		$ 5,559.00						SF-18-039
NO. 7	13.71	60%	$ 146,019.73		$ 45,728.33	incl in above filing 5		$190,470.00	$232,944.81	1.223 (2019)	Facilities installed w/ Fil 7 - DBPS 195
		***	$ 17,751.00		$ 5,559.00					1.223	SF-18-040
Midtown Fil 1	5.4	65%	$ 67,805.20		$ 10,873.40	N/A		N/A	N/A	N/A	
(estimate)	3.72	2%	$ 18,940.00		$ 5,559.00						SF-19-007
Midtown Fil 2	2.27	65%	$ 28,410.00		$ 30,418.85	N/A		N/A	N/A	N/A	
(estimate)	0.99	2%	$ 18,940.00		$ 5,559.00						SF-19-006
TOTAL	115.546	45%	$ 682,897.14	$ 89,046.43	$ 274,140.15	$ 1,161,649.00	$ 116,164.90	$1,080,390.00	$1,257,478.17		
					Over-calculated			$ 1,080,390.00			

Entire Community Build-out Summary

Total possible Credit per estimates incl engineeering	$	1,277,813.90
Fee Offset	$	682,897.14
Fees Paid	$	89,046.43
Possible Credits in EPC Sand Creek Basin	$	683,963.19

To-date Summary with Constructed Facilities and Recorded Plats Only

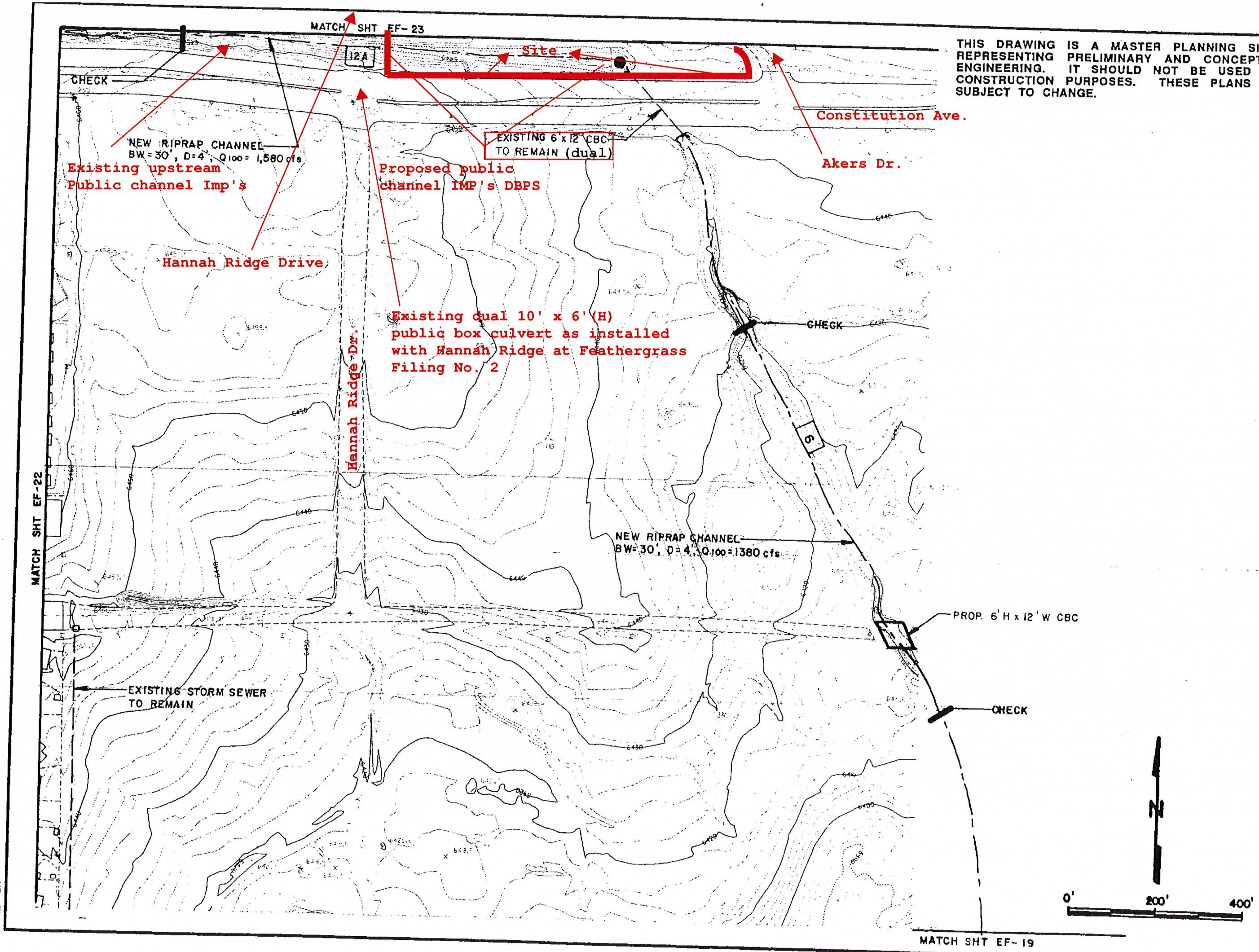
Total possible Credit per constructed reimbursable improvements	$	823,931.90
Fee Offset	$	682,897.14
Fees Paid	$	89,046.43
Offsets available for platting	$	230,081.19

NOTE: Total Reimburable Drainage Factous for Filing No. 1 to 7 = $2,476,616.00 (per MVE approved reports)

* Revised per Filing No. 2 Correction

** See Filing 5 Reimbursable Costs

*** See Fee breakdown based on Imp. Ac.



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.
Date:
Design:
Drawn:
Check:
Revisions:

EF-21

TABLE VIII-3: cont'd

SAND CREEK DRAINAGE BASIN PLANNING STUDY
TRIBUTARY DRAINAGEWAY CONVEYANCE COST ESTIMATE
EAST FORK SAND CREEK TRIBUTARIES

SEGMENT NUMBER	REACH NUMBER	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	LENGTH OF GRADE CONTROL (FT)	TOTAL REIMBURSABLE COSTS	TOTAL COST
EAST FORK SAND CREEK								
104	EF-2	100-YR RIPRAP	450	205	7	350	$0	$144,750
8	EF-2	100-YR RIPRAP	3540	120	4	120	$442,800	$442,800
8A	EF-2	100-YR RIPRAP	1920	234	2	70	$459,700	$459,780
6	EF-2	100-YR RIPRAP	5200	234	4	240	$1,252,800	$1,252,800
112	EF-2	EX. SYSTEM TO REMAIN	1150	0	0	0	$0	$0
12A	EF-2	100-YR RIPRAP	1900	234	2	120	$462,600	$462,600
195	EF-2	100-YR RIPRAP	980	189	1	35	$190,470	$190,470
12	EF-2	100-YR RIPRAP	1730	234	3	150	$427,320	$427,320
20	EF-2	100-YR RIPRAP	3650	234	10	500	$929,100	$929,100
17	EF-4	100-YR RIPRAP	1300	205	2	100	$281,500	$281,500
124A	EF-4	100-YR RIPRAP	1750	234	2	80	$421,500	$421,500
198	EF-4	100-YR RIPRAP	3650	205	4	160	$722,250	$772,250
30	EF-4	100-YR RIPRAP	4500	205	3	150	$945,000	$945,000
75	EF-7	100-YR RIPRAP	4200	234	10	700	$1,087,800	$1,087,800
173	EF-7	100-YR RIPRAP	1600	234	2	120	$392,400	$392,400
72	EF-7	100-YR RIPRAP	4500	205	8	560	$1,006,500	$1,006,500
57	EF-7	100-YR RIPRAP	3200	234	3	120	$766,800	$766,800
55	EF-6	100-YR RIPRAP	2800	234	3	135	$675,450	$675,450
31	EF-5	100-YR RIPRAP	2900	205	7	210	$626,000	$626,000
144	EF-6	100-YR RIPRAP	2050	189	3	60	$396,450	$396,450
82	EF-8	SELECTIVE RIPRAP LINING	5700	85	5	150	$507,000	$507,000
83	EF-8	SELECTIVE RIPRAP LINING	5400	93	6	180	$529,200	$529,200
194A	EF-8	SELECTIVE RIPRAP LINING	1900	93	2	60	$185,700	$185,700
88	EF-8	SELECTIVE RIPRAP LINING	5500	57	5	150	$336,000	$336,000
85	EF-8	SELECTIVE RIPRAP LINING	5900	93	7	210	$580,200	$580,200

HYDROLOGIC / HYDRAULIC CALCULATIONS

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

JOB NAME: *Midtown Collection at Hannah Ridge Filing No. 3*
JOB NUMBER: *1116.35*
DATE: *08/20/20*
CALCULATED BY: *KRC*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (PROPOSED CONDITIONS)

		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(5)**	**CA(100)**
A	0.76	0.48	0.89	0.90	0.92	0.94	0.95	0.96	0.28	0.04	0.15	0.25	0.37	0.44	0.5	0.58	0.62	0.79	**0.47**	**0.60**
B-1	1.36	0.79	0.89	0.90	0.92	0.94	0.95	0.96	0.57	0.04	0.15	0.25	0.37	0.44	0.5	0.53	0.59	0.77	**0.80**	**1.04**
B-2	0.34	0.20	0.89	0.90	0.92	0.94	0.95	0.96	0.14	0.04	0.15	0.25	0.37	0.44	0.5	0.54	0.59	0.77	**0.20**	**0.26**
C	0.29	0.21	0.89	0.90	0.92	0.94	0.95	0.96	0.08	0.04	0.15	0.25	0.37	0.44	0.5	0.66	0.69	0.83	**0.20**	**0.24**
D	1.08	0.79	0.89	0.90	0.92	0.94	0.95	0.96	0.29	0.04	0.15	0.25	0.37	0.44	0.5	0.66	0.70	0.84	**0.75**	**0.90**
E	0.89	0.67	0.89	0.90	0.92	0.94	0.95	0.96	0.22	0.04	0.15	0.25	0.37	0.44	0.5	0.68	0.71	0.85	**0.64**	**0.75**
F	1.23	0.22	0.89	0.90	0.92	0.94	0.95	0.96	1.01	0.04	0.15	0.25	0.37	0.44	0.5	0.19	0.28	0.58	**0.35**	**0.72**
G	1.87	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.87	0.04	0.15	0.25	0.37	0.44	0.5	0.04	0.15	0.50	**0.28**	**0.94**
H	0.42	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.42	0.04	0.15	0.25	0.37	0.44	0.5	0.04	0.15	0.50	**0.06**	**0.21**

JOB NAME: *Midtown Collection at Hannah Ridge Filing No. 3*
JOB NUMBER: *1116.35*
DATE: *08/20/20*
CALC'D BY: *KRC*

BASIN RUNOFF SUMMARY (PROPOSED CONDITIONS)

BASIN	WEIGHTED CA(2)	CA(5)	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(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	Q(100) (cfs)
A	0.44	0.47	0.60	0.15	80	3	9.9	150	4.0%	7.0	0.4	10.3	4.09	6.86	**1.9**	**4.1**
B-1	0.73	0.80	1.04	0.15	200	6	16.9	90	4.0%	7.0	0.2	17.1	3.32	5.58	**2.6**	**5.8**
B-2	0.18	0.20	0.26	0.15	130	5	12.5	0	0.0%	0.0	0.0	12.5	3.79	6.36	**0.8**	**1.7**
C	0.19	0.20	0.24	0.15	45	0.9	9.2	80	4.0%	7.0	0.2	9.3	4.23	7.10	**0.9**	**1.7**
D	0.71	0.75	0.90	0.15	50	1	9.6	290	3.0%	6.1	0.8	10.4	4.06	6.82	**3.1**	**6.2**
E	0.61	0.64	0.75	0.15	240	8	17.9	0	0.0%	0.0	0.0	17.9	3.26	5.47	**2.1**	**4.1**
F	0.24	0.35	0.72	0.15	50	1	9.6	0	0.0%	0.0	0.0	9.6	4.18	7.02	**1.5**	**5.0**
G	0.07	0.28	0.94	0.15	50	1	9.6	0	0.0%	0.0	0.0	9.6	4.18	7.02	**1.2**	**6.6**
H	0.02	0.06	0.21	0.15	95	3	11.4	0	0.0%	0.0	0.0	11.4	3.93	6.59	**0.2**	**1.4**

JOB NAME: *Midtown Collection at Hannah Ridge Filing No. 3*
JOB NUMBER: *1116.35*
DATE: *08/20/20*
CALC'D BY: *KRC*

SURFACE ROUTING SUMMARY (PROPOSED CONDITIONS)

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Inlet Size/Conveyance
1	BASIN A	0.47	0.60	10.3	4.08	6.86	1.9	4.1	Street flow south to DP #2
2	BASIN A, B-1 and C (Surface area tributary to east entry into pond)	1.31	1.89	17.1	3.32	5.58	4.3	10.5	Proposed 10' type R public inlet
3	BASIN D	0.75	0.90	10.4	4.06	6.82	3.1	6.2	Proposed 10' type R public inlet
4	BASIN B-2	0.20	0.26	12.5	3.79	6.36	0.8	1.7	Proposed 2'x2' type C priavte grated inlet
5	Off-site and DP 3 (North entry into pond)	8.18	9.59	17.1	3.32	5.58	27.2	53.5	North pond Entry
Total Pond Inflow	DP 2, 3, 4, 5 and Basin F	10.45	12.64	17.1	3.32	5.58	34.7	70.6	Total flow into pond

JOB NAME: *Midtown Collection at Hannah Ridge Filing No. 3*
JOB NUMBER: *1116.35*
DATE: *08/20/20*
CALC'D BY: *KRC*

* 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*
1	DP 4	0.20	0.26	12.5	3.79	6.36	0.8	1.7	12" Private PVC/ADS
2	DP 2 and DP 4	1.51	2.15	17.1	3.32	5.58	5.0	12.0	24" Public RCP
3	DP 3	0.75	0.90	10.4	4.06	6.82	3.1	6.2	18" Private PVC/ADS
4	DP 5	8.18	9.59	17.1	3.32	5.58	27.2	53.5	48" Public RCP

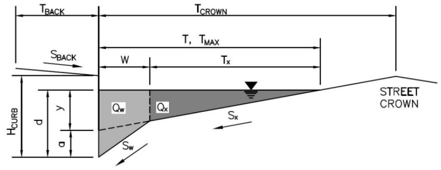
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 3

Inlet ID: DP #2



Gutter Geometry (Enter data in the blue cells)

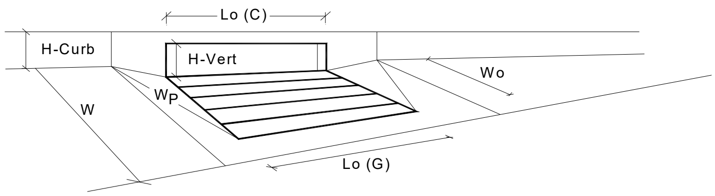
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	36.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.040	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} =	0.018	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	36.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.7	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	7.7	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 =	1.00	1.00	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} =	0.42	0.56	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.73	
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 =	**10.0**	**16.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.9	10.5	cfs

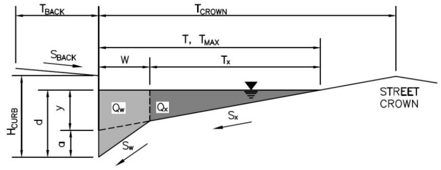
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 3

Inlet ID: DP #3



Gutter Geometry (Enter data in the blue cells)

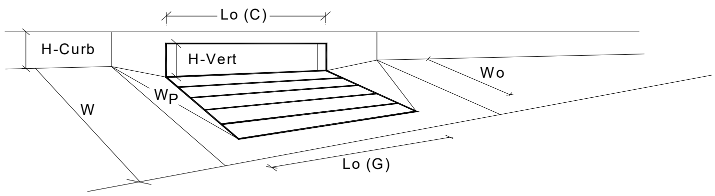
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	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} =	0.018	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	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**

INLEIN 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 =	1.00	1.00	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} =	0.42	0.42	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	

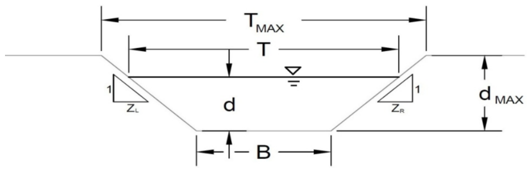
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.0**	**10.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.1	6.2	cfs

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Midtown Collection at Hannah Ridge Filing No. 3

DP #4



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0300	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	50.00	ft/ft
Right Side Slope	Z2 =	50.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ○ Non-Cohesive
- ● Cohesive
- ○ Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**20.00**	**30.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.40**	**0.60**	**feet**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**3.1**	**9.2**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.17**	**0.27**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.8**	**1.7**	**cfs**
Water Depth	d =	**0.09**	**0.13**	**feet**

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'

AREA INLET IN A SWALE

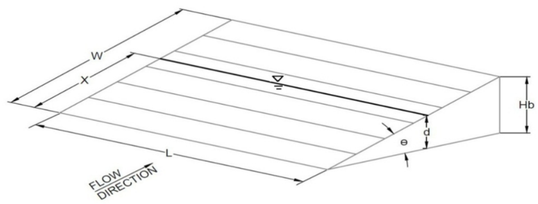
Midtown Collection at Hannah Ridge Filing No. 3

DP #4

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.09	1.13	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.9**	**15.1**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	cfs
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

PR 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Diameter	12.0 in
Discharge	1.70 cfs

Results	
Normal Depth	6.1 in
Flow Area	0.4 ft²
Wetted Perimeter	1.6 ft
Hydraulic Radius	3.0 in
Top Width	1.00 ft
Critical Depth	6.7 in
Percent Full	51.1 %
Critical Slope	0.004 ft/ft
Velocity	4.21 ft/s
Velocity Head	0.28 ft
Specific Energy	0.79 ft
Froude Number	1.168
Maximum Discharge	3.52 cfs
Discharge Full	3.27 cfs
Slope Full	0.001 ft/ft
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	51.1 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.1 in
Critical Depth	6.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft

PR 2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	12.00 cfs

Results	
Normal Depth	15.5 in
Flow Area	2.1 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	6.9 in
Top Width	1.91 ft
Critical Depth	14.9 in
Percent Full	64.6 %
Critical Slope	0.006 ft/ft
Velocity	5.59 ft/s
Velocity Head	0.49 ft
Specific Energy	1.78 ft
Froude Number	0.930
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	54.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	15.5 in
Critical Depth	14.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

PR 3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Diameter	18.0 in
Discharge	6.20 cfs

Results	
Normal Depth	9.9 in
Flow Area	1.0 ft^2
Wetted Perimeter	2.5 ft
Hydraulic Radius	4.8 in
Top Width	1.49 ft
Critical Depth	11.5 in
Percent Full	55.3 %
Critical Slope	0.006 ft/ft
Velocity	6.19 ft/s
Velocity Head	0.60 ft
Specific Energy	1.42 ft
Froude Number	1.332
Maximum Discharge	11.30 cfs
Discharge Full	10.50 cfs
Slope Full	0.003 ft/ft
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	55.3 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	9.9 in
Critical Depth	11.5 in
Channel Slope	0.010 ft/ft
Critical Slope	0.006 ft/ft

PR 4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	48.0 in
Discharge	53.50 cfs

Results	
Normal Depth	24.8 in
Flow Area	6.5 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	12.2 in
Top Width	4.00 ft
Critical Depth	26.4 in
Percent Full	51.6 %
Critical Slope	0.004 ft/ft
Velocity	8.19 ft/s
Velocity Head	1.04 ft
Specific Energy	3.10 ft
Froude Number	1.129
Maximum Discharge	109.25 cfs
Discharge Full	101.57 cfs
Slope Full	0.001 ft/ft
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	51.6 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	24.8 in
Critical Depth	26.4 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft

PR 5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	48.0 in
Discharge	53.50 cfs

Results	
Normal Depth	24.8 in
Flow Area	6.5 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	12.2 in
Top Width	4.00 ft
Critical Depth	26.4 in
Percent Full	51.6 %
Critical Slope	0.004 ft/ft
Velocity	8.19 ft/s
Velocity Head	1.04 ft
Specific Energy	3.10 ft
Froude Number	1.129
Maximum Discharge	109.25 cfs
Discharge Full	101.57 cfs
Slope Full	0.001 ft/ft
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	51.6 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	24.8 in
Critical Depth	26.4 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft

PR- Outfall

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010
Channel Slope	0.012 ft/ft
Diameter	24.0 in
Discharge	33.20 cfs

Results

Normal Depth	20.4 in
Flow Area	2.8 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	7.3 in
Top Width	1.43 ft
Critical Depth	22.8 in
Percent Full	85.0 %
Critical Slope	0.011 ft/ft
Velocity	11.66 ft/s
Velocity Head	2.11 ft
Specific Energy	3.81 ft
Froude Number	1.456
Maximum Discharge	34.65 cfs
Discharge Full	32.21 cfs
Slope Full	0.013 ft/ft
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

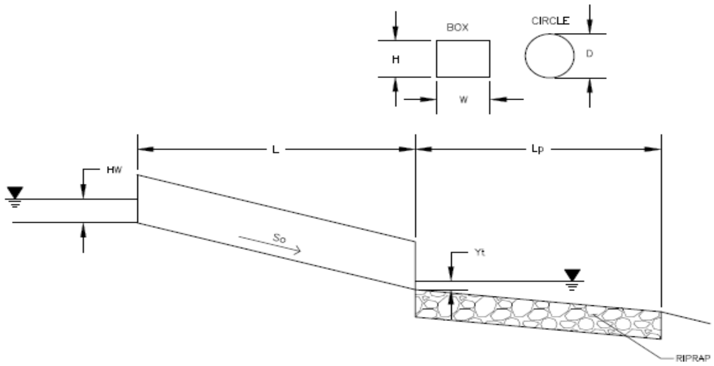
GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	85.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	20.4 in
Critical Depth	22.8 in
Channel Slope	0.012 ft/ft
Critical Slope	0.011 ft/ft

Determination of Culvert Headwater and Outlet Protection

Project: Midtown Collection at Hannah Ridge Fil. No. 3

Basin ID: FSD Outfall



Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

	Design Discharge	Q =	33.2	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	24	inches
	Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Beveled Edge	
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	Height (Rise) =		ft
	Barrel Width (Span) in Feet	Width (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	No =	1	
	Inlet Elevation	Elev IN =	100	ft
	Outlet Elevation **OR** Slope	Elev OUT =	99.85	ft
	Culvert Length	L =	100	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	Elev Y_t =		ft
	Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	5.70	ft
Flow Area at Max Channel Velocity	A_t =	0.58	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.97	
Sum of All Losses Coefficients	k_s =	2.17	ft
Culvert Normal Depth	Y_n =	0.64	ft
Culvert Critical Depth	Y_c =	0.65	ft
Tailwater Depth for Design	d =	1.07	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.07	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	1.05	ft$^{0.5}$/s
Froude Number	Fr =	1.01	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	5.32	
Inlet Control Headwater	HW_I =	0.90	ft
Outlet Control Headwater	HW_O =	0.88	
Design Headwater Elevation	**HW =**	**6,421.65**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.60**	
Minimum Theoretical Riprap Size	d_{50} =	0	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**5**	**ft**
Width of Protection	**T =**	**3**	**ft**

South Public Trapezoidal Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045
Channel Slope	0.007 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	20.00 ft
Discharge	1,076.00 cfs

Results

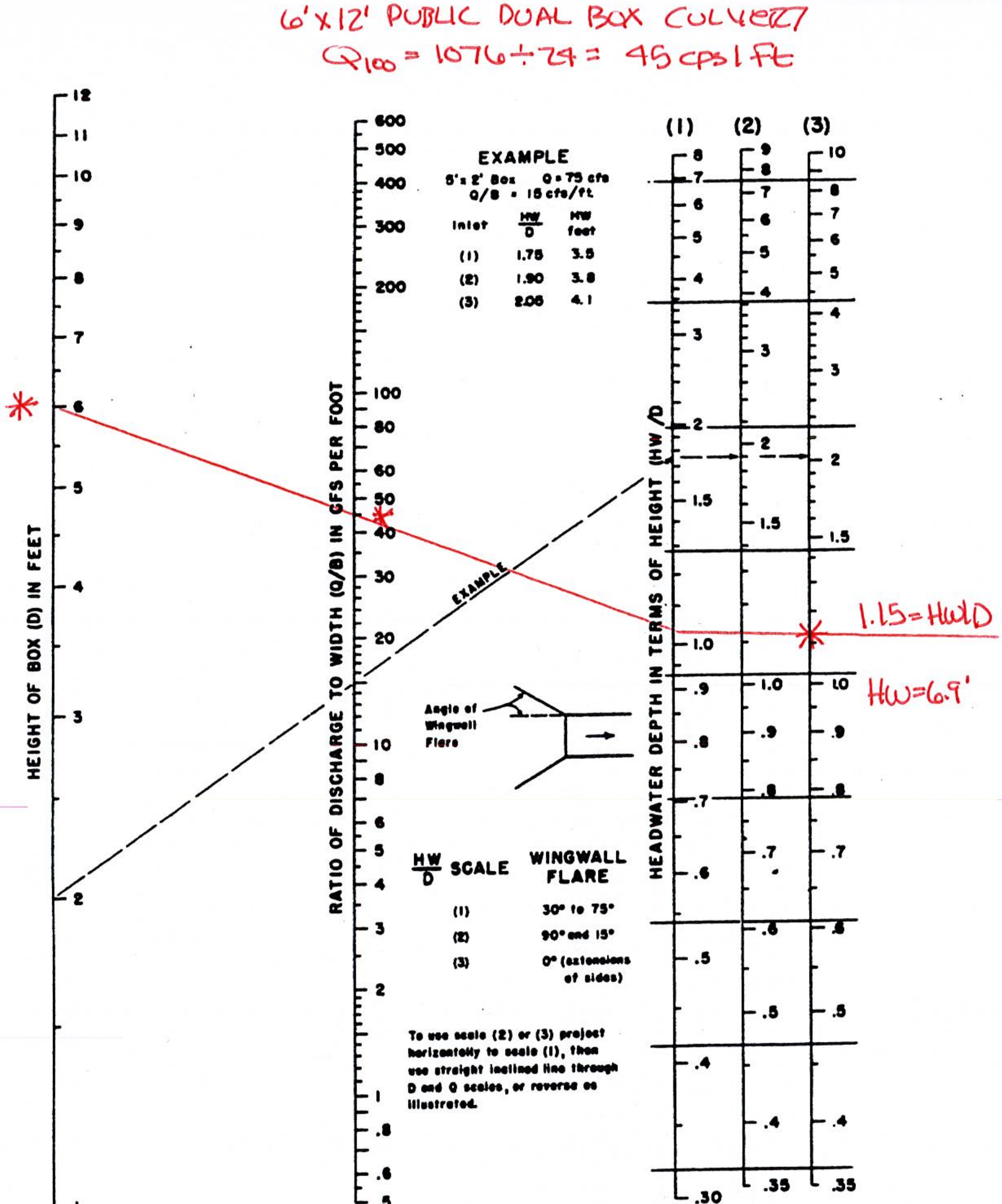
Normal Depth	60.7 in
Flow Area	178.0 ft²
Wetted Perimeter	52.0 ft
Hydraulic Radius	41.1 in
Top Width	50.35 ft
Critical Depth	44.4 in
Critical Slope	0.022 ft/ft
Velocity	6.05 ft/s
Velocity Head	0.57 ft
Specific Energy	5.63 ft
Froude Number	0.567
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	60.7 in
Critical Depth	44.4 in
Channel Slope	0.007 ft/ft
Critical Slope	0.022 ft/ft



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

SWQ / FULL SPECTRUM

DETENTION CALCULATIONS

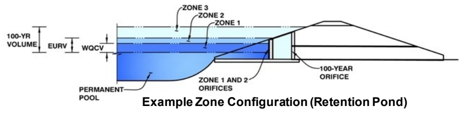
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **MIDTOWN AT HANNAH RIDGE FILING NO. 3**

Basin ID: **POND**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	21.08	acres		
Watershed Length =	1,200	ft		
Watershed Length to Centroid =	600	ft		
Watershed Slope =	0.050	ft/ft		
Watershed Imperviousness =	43.20%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.331	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.008	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.740	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.992	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.191	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.544	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.888	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.334	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	3.067	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.644	acre-feet		
Approximate 5-yr Detention Volume =	0.851	acre-feet		
Approximate 10-yr Detention Volume =	1.046	acre-feet		
Approximate 25-yr Detention Volume =	1.291	acre-feet		
Approximate 50-yr Detention Volume =	1.453	acre-feet		
Approximate 100-yr Detention Volume =	1.669	acre-feet		

Define Zones and Basin Geometry

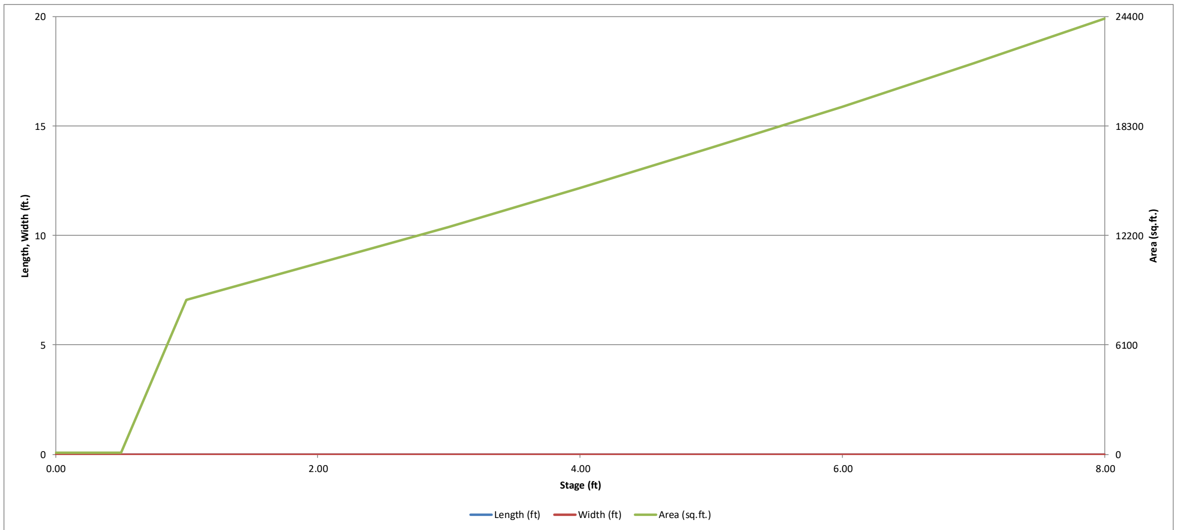
Zone 1 Volume (WQCV) =	0.331	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.677	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.661	acre-feet
Total Detention Basin Volume =	1.669	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

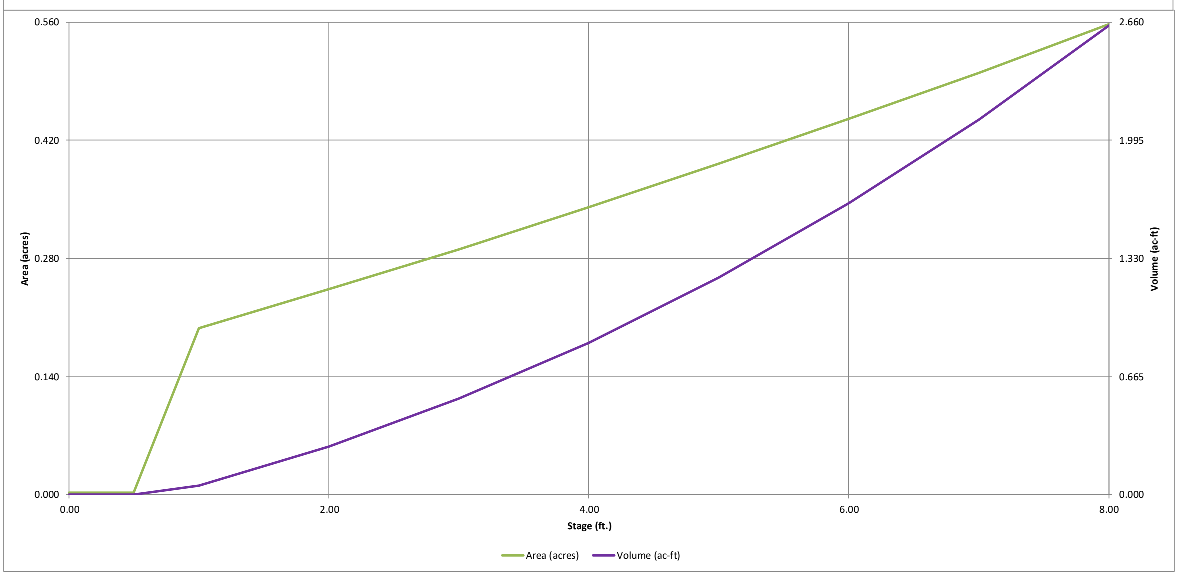
Depth Increment = 1.00 ft

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		
	--	0.50	--	--	--	100	0.002	50	0.001
	--	1.00	--	--	--	8,596	0.197	2,224	0.051
	--	2.00	--	--	--	10,617	0.244	11,830	0.272
	--	3.00	--	--	--	12,664	0.291	23,471	0.539
	--	4.00	--	--	--	14,842	0.341	37,224	0.855
	--	5.00	--	--	--	17,081	0.392	53,185	1.221
	--	6.00	--	--	--	19,386	0.445	71,419	1.640
	--	7.00	--	--	--	21,778	0.500	92,001	2.112
	--	8.00	--	--	--	24,304	0.558	115,042	2.641
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



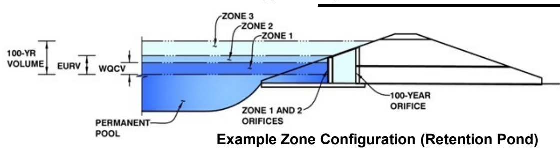


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: MIDTOWN AT HANNAH RIDGE FILING NO. 3

Basin ID: POND



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.24	0.331	Orifice Plate
Zone 2 (EURV)	4.44	0.677	Orifice Plate
Zone 3 (100-year)	6.07	0.661	Weir&Pipe (Restrict)
Total (all zones)		1.669	

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 =	4.60	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	17.80	inches
Orifice Plate: Orifice Area per Row =	2.18	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.514E-02	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	1.53	3.07					
Orifice Area (sq. inches)	2.18	2.18	2.18					

	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 with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	3.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.27	N/A	feet
Overflow Weir Slope Length =	5.27	N/A	feet
Grate Open Area / 100-yr Orifice Area =	12.45	N/A	
Overflow Grate Open Area w/o Debris =	22.01	N/A	ft^2
Overflow Grate Open Area w/ Debris =	11.00	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 =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.77	N/A	ft^2
Outlet Orifice Centroid =	0.75	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=	6.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	65.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.37	feet
Stage at Top of Freeboard =	7.87	feet
Basin Area at Top of Freeboard =	0.55	acres
Basin Volume at Top of Freeboard =	2.57	acre-ft

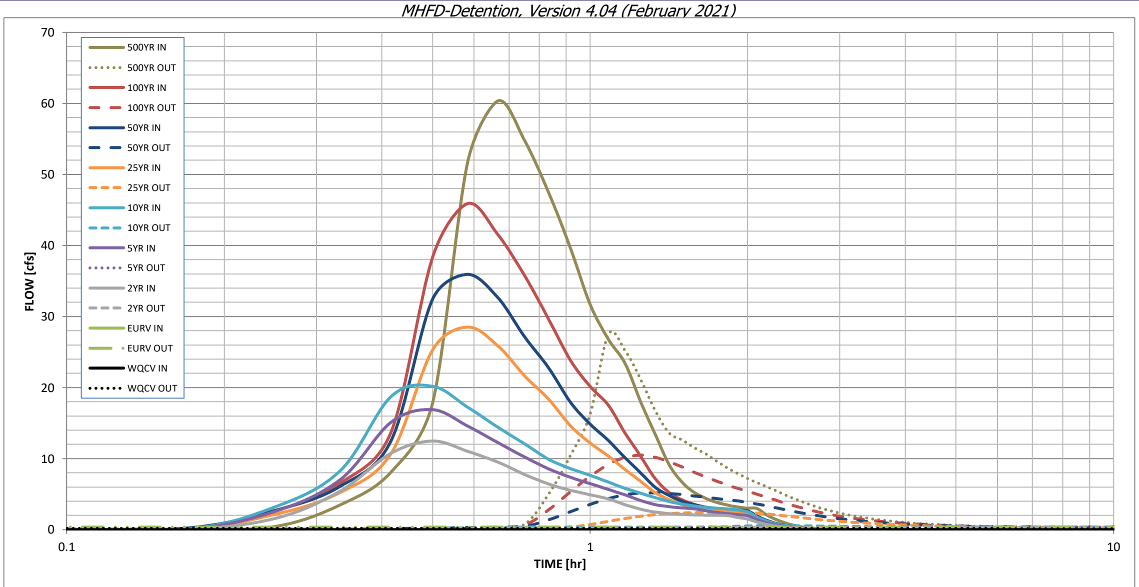
Routed Hydrograph Results

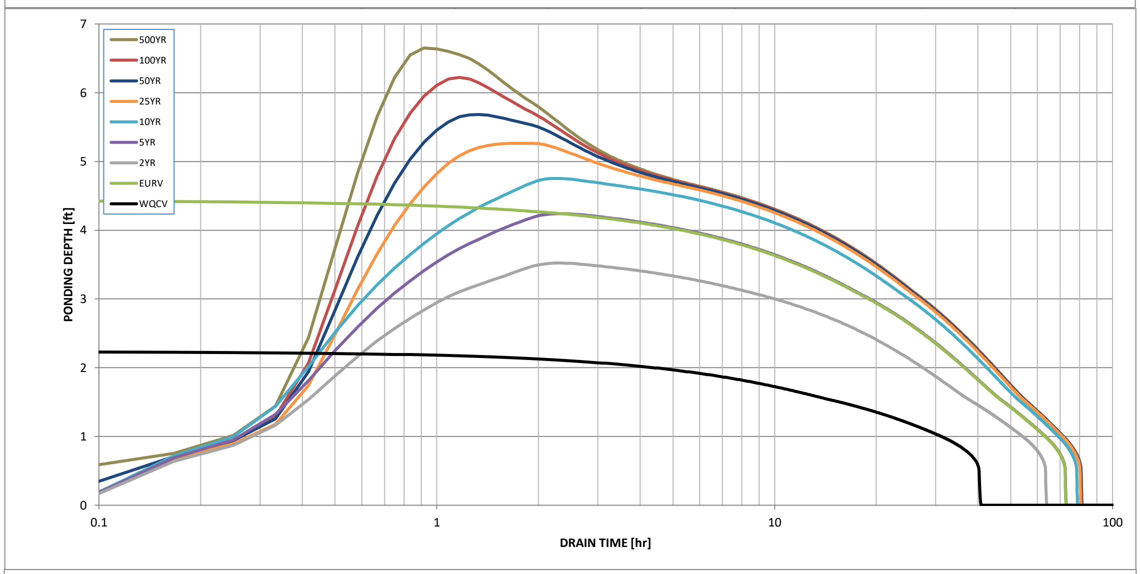
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

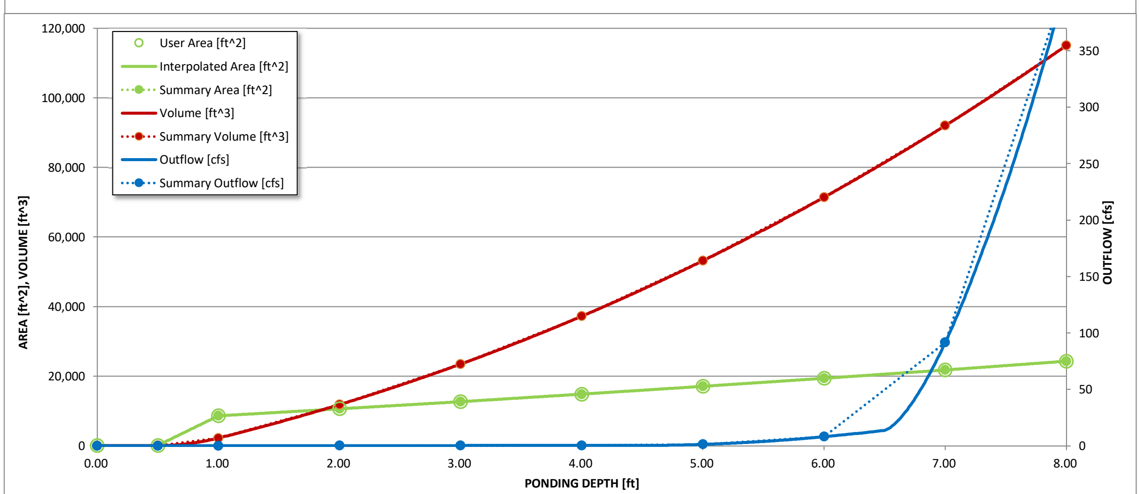
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.331	1.008	0.740	0.992	1.191	1.544	1.888	2.334	3.067
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.740	0.992	1.191	1.544	1.888	2.334	3.067
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	5.1	10.1	16.6	26.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.24	0.48	0.79	1.25
Peak Inflow Q (cfs) =	N/A	N/A	12.4	16.9	20.2	28.5	35.9	45.9	60.3
Peak Outflow Q (cfs) =	0.2	0.4	0.3	0.3	0.6	2.4	5.2	10.5	27.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.0	0.5	0.5	0.6	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.5	0.7
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) =	39	67	59	67	72	72	71	69	65
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	62	71	76	77	77	76	75
Maximum Ponding Depth (ft) =	2.24	4.44	3.52	4.24	4.75	5.27	5.68	6.22	6.65
Area at Maximum Ponding Depth (acres) =	0.26	0.36	0.32	0.35	0.38	0.41	0.43	0.46	0.48
Maximum Volume Stored (acre-ft) =	0.331	1.009	0.697	0.938	1.125	1.325	1.500	1.739	1.940

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.02	0.46
	0:15:00	0.00	0.00	1.57	2.56	3.19	2.15	2.67	2.64	3.49
	0:20:00	0.00	0.00	5.43	7.06	8.32	5.25	6.11	6.58	8.11
	0:25:00	0.00	0.00	10.74	15.10	18.74	10.70	12.52	13.74	17.85
	0:30:00	0.00	0.00	12.45	16.87	20.18	25.31	32.46	38.39	51.65
	0:35:00	0.00	0.00	11.01	14.57	17.24	28.52	35.92	45.89	60.33
	0:40:00	0.00	0.00	9.48	12.25	14.41	25.87	32.64	41.52	54.72
	0:45:00	0.00	0.00	7.75	10.20	12.04	21.62	27.09	35.70	47.45
	0:50:00	0.00	0.00	6.41	8.56	9.90	18.37	22.79	29.64	39.68
	0:55:00	0.00	0.00	5.54	7.36	8.60	14.64	17.94	23.85	31.71
	1:00:00	0.00	0.00	4.91	6.47	7.63	12.20	14.84	20.16	26.81
	1:05:00	0.00	0.00	4.32	5.65	6.68	10.37	12.54	17.52	23.42
	1:10:00	0.00	0.00	3.52	4.89	5.81	8.46	10.12	13.61	17.97
	1:15:00	0.00	0.00	2.87	4.09	5.11	6.79	7.97	10.30	13.36
	1:20:00	0.00	0.00	2.46	3.52	4.50	5.17	5.94	7.13	9.12
	1:25:00	0.00	0.00	2.25	3.22	3.95	4.21	4.79	5.23	6.63
	1:30:00	0.00	0.00	2.14	3.05	3.58	3.52	3.98	4.17	5.22
	1:35:00	0.00	0.00	2.08	2.94	3.32	3.10	3.49	3.55	4.37
	1:40:00	0.00	0.00	2.04	2.63	3.13	2.81	3.16	3.14	3.81
	1:45:00	0.00	0.00	2.00	2.40	3.00	2.63	2.96	2.86	3.45
	1:50:00	0.00	0.00	1.98	2.23	2.91	2.50	2.81	2.66	3.18
	1:55:00	0.00	0.00	1.70	2.10	2.76	2.42	2.71	2.55	3.02
	2:00:00	0.00	0.00	1.50	1.95	2.49	2.37	2.66	2.51	2.98
	2:05:00	0.00	0.00	1.08	1.41	1.79	1.70	1.91	1.80	2.14
	2:10:00	0.00	0.00	0.77	1.00	1.26	1.20	1.35	1.28	1.51
	2:15:00	0.00	0.00	0.53	0.70	0.88	0.84	0.94	0.90	1.06
	2:20:00	0.00	0.00	0.37	0.47	0.60	0.58	0.64	0.61	0.72
	2:25:00	0.00	0.00	0.24	0.31	0.40	0.38	0.43	0.41	0.48
	2:30:00	0.00	0.00	0.16	0.21	0.27	0.26	0.29	0.27	0.32
	2:35:00	0.00	0.00	0.09	0.13	0.16	0.16	0.18	0.16	0.19
	2:40:00	0.00	0.00	0.04	0.07	0.08	0.08	0.09	0.08	0.09
	2:45:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.03
	2:50:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
TOP OF MICROPOOL	0.00	100	0.002	0	0.000	0.00
42.5	0.50	100	0.002	50	0.001	0.05
43	1.00	8,596	0.197	2,224	0.051	0.07
44	2.00	10,617	0.244	11,830	0.272	0.15
45	3.00	12,664	0.291	23,471	0.539	0.21
46	4.00	14,842	0.341	37,224	0.855	0.33
47	5.00	17,081	0.392	53,185	1.221	1.26
48	6.00	19,386	0.445	71,419	1.640	8.03
49	7.00	21,778	0.500	92,001	2.112	91.46
50	8.00	24,304	0.558	115,042	2.641	411.26

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	
Company:	**Classic Consulting Engineers**
Date:	**February 18, 2022**
Project:	**Midtown Collection at Hannah Ridge Filing No. 3**
Location:	**EDB Forebay 1**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 43.2 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.432
C) Contributing Watershed Area	Area = 21.080 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.43 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}= 0.331 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.331 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 = 1.008 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 = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	
Company:	**Classic Consulting Engineers**
Date:	**February 18, 2022**
Project:	**Midtown Collection at Hannah Ridge Filing No. 3**
Location:	**EDB Forebay 1**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.010 ac-ft

B) Actual Forebay Volume — V_F = 0.012 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} = 69.50 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.39 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 = 7.4 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 = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 100 sq ft

C) Outlet Type

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

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.63 inches

E) Total Outlet Area — A_{ot} = 6.36 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	
Company:	Classic Consulting Engineers
Date:	February 18, 2022
Project:	Midtown Collection at Hannah Ridge Filing No. 3
Location:	EDB Forebay 1

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} =	43.2	cu ft
C) Initial Surcharge Provided Above Micropool	V_s=	50.0	cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t =	210	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} =	296	sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H=	4.5	feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}=	82	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:
Company: Classic Consulting Engineers
Date: February 18, 2022
Project: Midtown Collection at Hannah Ridge Filing No. 3
Location: EDB Forebay 1

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)

11. Vegetation

Choose One
- (●) Irrigated
- ( ) Not Irrigated

AVOID PLACING IRRIGATION HEADS
IN THE BOTTOM OF THE BASIN

12. Access

A) Describe Sediment Removal Procedures

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

Designer:
Company: Classic Consulting Engineers
Date: October 18, 2021
Project: Midtown Collection at Hannah Ridge Filing No. 3
Location: EDB Forebay 2

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.010 ac-ft

B) Actual Forebay Volume — V_F = 0.012 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} = 12.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.24 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 = 3.3 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 = 100 sq ft

C) Outlet Type

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

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.63 inches

E) Total Outlet Area — A_{ot} = 6.36 square inches

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

Designer: dlg
Company: CLASSIC CONSULTING ENGINEERS
Date: October 18, 2021
Project: MIDTOWN AT HANNAH RIDGE FIL 3
Location:

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**A**	**B-1**	**C**	**D**	**E**	**F**	**D8,D10**	**D1-D7**	**D12**					
Receiving Pervious Area Soil Type	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand					
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.760	1.360	0.290	1.080	0.890	1.230	3.300	11.740	0.430					
Directly Connected Impervious Area (DCIA, acres)	0.220	0.430	0.070	0.480	0.360	0.000	0.870	2.710	0.430					
Unconnected Impervious Area (UIA, acres)	0.340	0.240	0.030	0.170	0.090	0.060	0.680	2.580	0.000					
Receiving Pervious Area (RPA, acres)	0.000	0.530	0.190	0.430	0.320	0.280	1.750	6.290	0.000					
Separate Pervious Area (SPA, acres)	0.200	0.160	0.000	0.000	0.120	0.890	0.000	0.160	0.000					
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C					

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.760	1.360	0.290	1.080	0.890	1.230	3.300	11.740	0.430					
Directly Connected Impervious Area (DCIA, %)	28.9%	31.6%	24.1%	44.4%	40.4%	0.0%	26.4%	23.1%	100.0%					
Unconnected Impervious Area (UIA, %)	44.7%	17.6%	10.3%	15.7%	10.1%	4.9%	20.6%	22.0%	0.0%					
Receiving Pervious Area (RPA, %)	0.0%	39.0%	65.5%	39.8%	36.0%	22.8%	53.0%	53.6%	0.0%					
Separate Pervious Area (SPA, %)	26.3%	11.8%	0.0%	0.0%	13.5%	72.4%	0.0%	1.4%	0.0%					
A_R (RPA / UIA)	0.000	2.208	6.333	2.529	3.556	4.667	2.574	2.438	0.000					
I_a Check	1.000	0.310	0.140	0.280	0.220	0.180	0.280	0.290	1.000					
f / I for WQCV Event:	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0					
f / I for 5-Year Event:	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6					
f / I for 100-Year Event:	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6					
f / I for Optional User Defined Storm CUHP:	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57					
IRF for WQCV Event:	1.00	0.50	0.30	0.48	0.45	0.39	0.48	0.49	1.00					
IRF for 5-Year Event:	1.00	0.82	0.56	0.81	0.80	0.72	0.81	0.82	1.00					
IRF for 100-Year Event:	1.00	0.84	0.57	0.83	0.82	0.73	0.83	0.83	1.00					
IRF for Optional User Defined Storm CUHP:	1.00	0.84	0.57	0.83	0.82	0.73	0.83	0.83	1.00					
Total Site Imperviousness: I_{total}	73.7%	49.3%	34.5%	60.2%	50.6%	4.9%	47.0%	45.1%	100.0%					
Effective Imperviousness for WQCV Event:	73.7%	40.4%	27.3%	52.0%	45.0%	1.9%	36.3%	33.8%	100.0%					
Effective Imperviousness for 5-Year Event:	73.7%	46.1%	29.9%	57.3%	48.6%	3.5%	43.1%	41.0%	100.0%					
Effective Imperviousness for 100-Year Event:	73.7%	46.4%	30.1%	57.5%	48.7%	3.6%	43.5%	41.4%	100.0%					
Effective Imperviousness for Optional User Defined Storm CUHP:	73.7%	46.4%	30.1%	57.5%	48.7%	3.6%	43.5%	41.4%	100.0%					

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	11.4%	13.4%	10.6%	7.2%	59.4%	14.3%	15.7%	0.0%	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	5.8%	13.6%	4.3%	3.6%	45.9%	7.4%	8.2%	0.1%	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	0.0%	5.3%	9.5%	4.8%	3.4%	12.1%	6.5%	6.9%	0.0%					

Total Site Imperviousness:	**46.3%**
Total Site Effective Imperviousness for WQCV Event:	**36.8%**
Total Site Effective Imperviousness for 5-Year Event:	**42.9%**
Total Site Effective Imperviousness for 100-Year Event:	**43.2%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**43.2%**

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Figure 13-12c. Emergency Spillway Protection

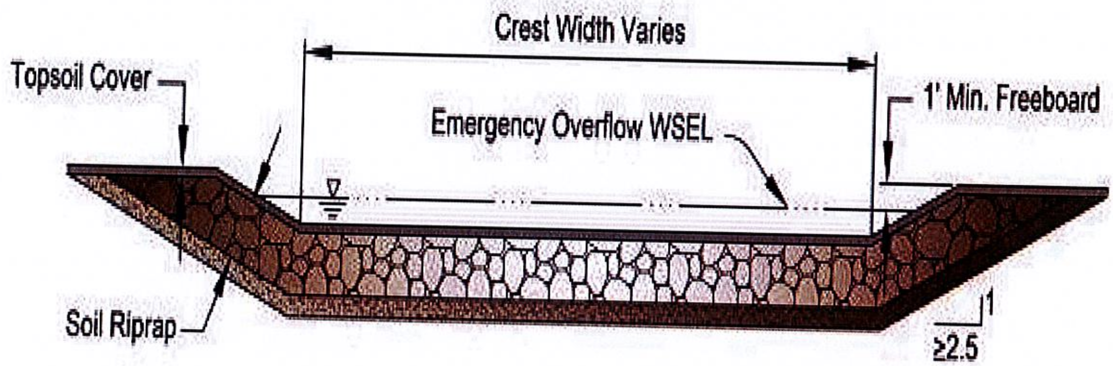
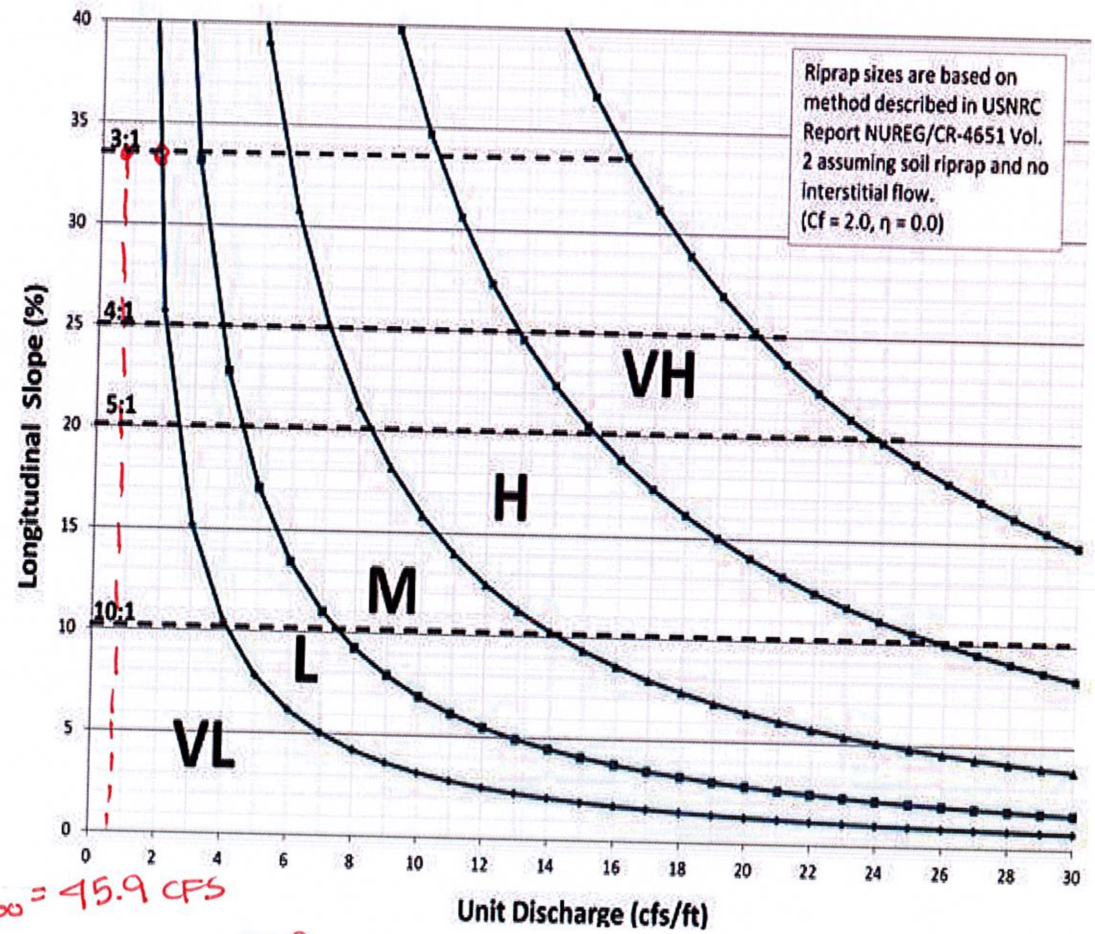


Figure 13-12d. Riprap Types for Emergency Spillway Protection

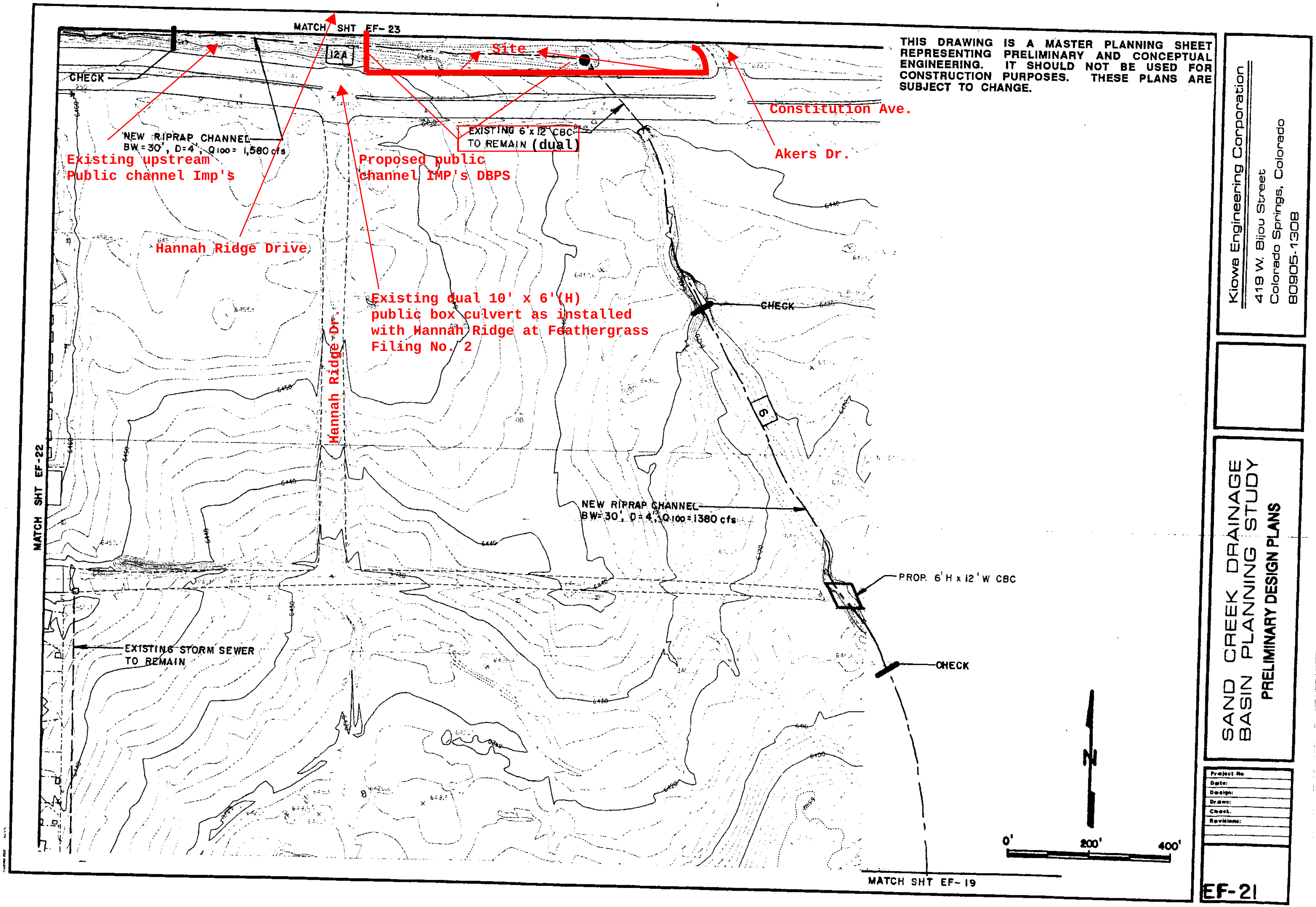


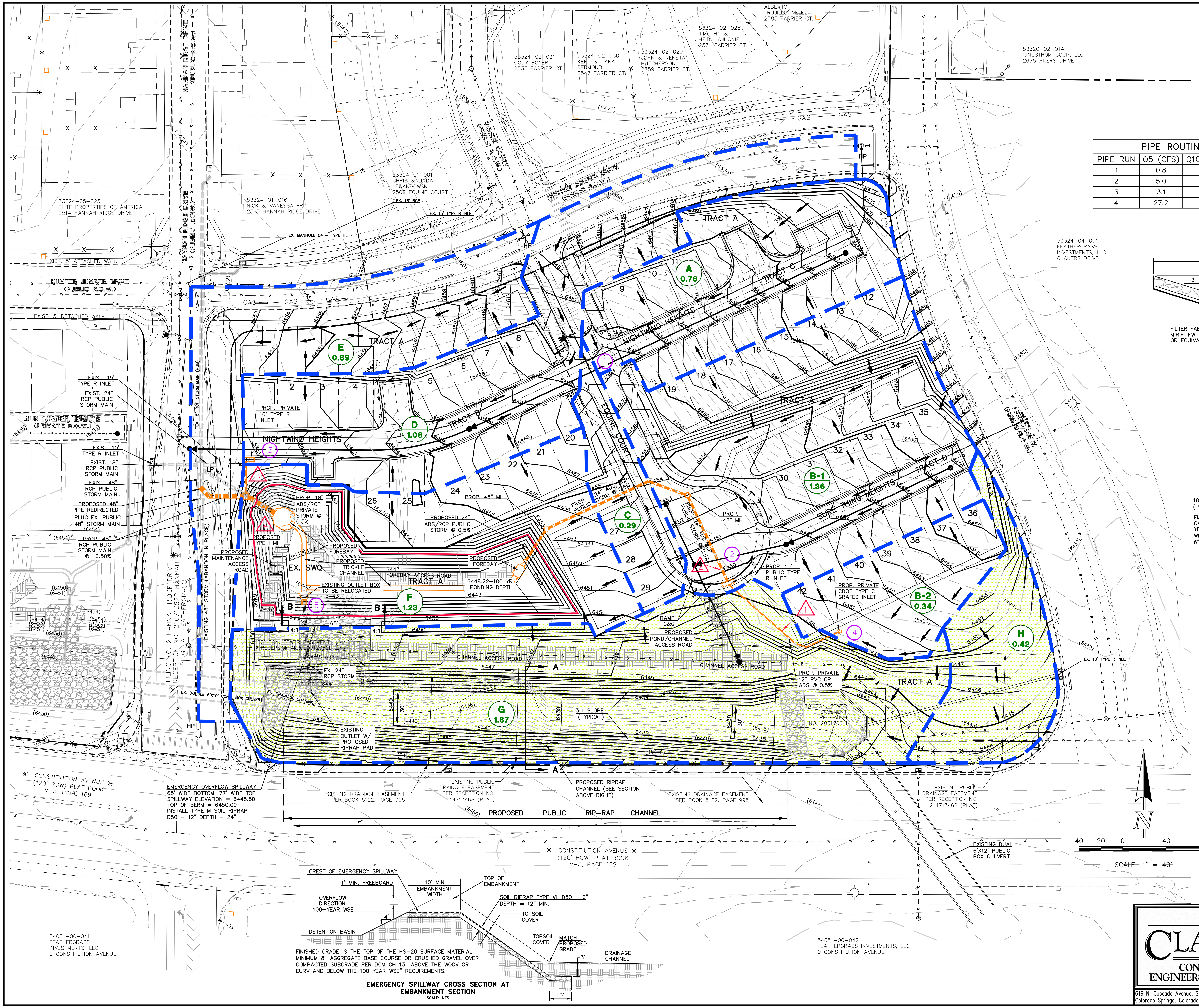
Q_{100} = 45.9 CFS

UNIT DISCHARGE = $\frac{45.9}{65}$ = 0.71

USE TYPE VL RIP-RAP

DRAINAGE MAP


MATCH SHT EF-23
THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. THESE PLANS ARE SUBJECT TO CHANGE.
Site
12A
CHECK
Constitution Ave.
EXISTING 6' x 12' CBC TO REMAIN (dual)
NEW RIPRAP CHANNEL BW = 30', D = 4', Q100 = 1,580 cfs
Existing upstream Public channel Imp's
Proposed public channel IMP's DBPS
Akers Dr.
Hannah Ridge Drive
Existing dual 10' x 6'(H) public box culvert as installed with Hannah Ridge at Feathergrass Filing No. 2
Hannah Ridge Dr.
CHECK
6
MATCH SHT EF-22
NEW RIPRAP CHANNEL BW = 30', D = 4', Q100 = 1380 cfs
PROP. 6' H x 12' W CBC
EXISTING STORM SEWER TO REMAIN
CHECK
N
0' 200' 400'
MATCH SHT EF-19
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308
SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS
Project No
Date:
Design:
Drawn:
Check.
Revisions:
EF-21



DESIGN POINT SUMMARY

DESIGN POINT	Q5 (CFS)	Q100 (CFS)	INLET SIZE
1	1.9	4.1	STREET FLOW TO DP2#
2	4.3	10.5	10' PUBLIC TYPE R SUMP
3	3.1	6.2	10' PUBLIC TYPE R SUMP
4	0.8	1.7	2'x2' PRIVATE TYPE C SUMP
5	27.2	53.5	NORTH POND ENTRY
POND INFLOW	33.4	69.5	TOTAL FLOW INTO POND

PIPE ROUTING SUMMARY

PIPE RUN	Q5 (CFS)	Q100 (CFS)	PIPE SIZE
1	0.8	1.7	12" PRIV PVC/ADS
2	5.0	12.0	24" PUBLIC RCP
3	3.1	6.2	18" PRIV PVC/ADS
4	27.2	53.5	48" PUB RCP

BASIN RUNOFF SUMMARY

BASIN	Q5 (CFS)	Q100 (CFS)
A	1.9	4.1
B-1	2.6	5.8
B-2	0.8	1.7
C	0.9	1.7
D	3.1	6.2
E	2.1	4.1
F	1.5	5.0
G	1.2	6.6
H	0.2	1.4

LEGEND

- (6770) EXISTING CONTOUR
- 6770 PROPOSED CONTOUR
- FILING LINE
- BOUNDARY/R.O.W. LINE
- EXISTING FLOW DIRECTION
- PROPOSED FLOW
- "A" A LOT
- "B" B LOT
- "W/O" WALKOUT LOT
- "T" TRANSITION LOT
- "G" GARDEN LOT
- PROPOSED INLET
- PROPOSED STORM SEWER PIPE
- HP PROPOSED HIGH POINT
- LP PROPOSED LOW POINT
- BASIN IDENTIFIER / AREA IN ACRES
- PIPE RUN
- DESIGN POINT
- OPEN SPACE / LANDSCAPE AREAS / CHANNEL AREA NOT DRAINING TO POND

PUD SP-20-007

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

MIDTOWN COLLECTION AT HANNAH RIDGE
FILING NO. 3
DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY	KRC	SCALE		DATE	03/17/22
DRAWN BY	KC	(H) 1"= 40'		SHEET	1 OF 1
CHECKED BY	KRC	(V) 1"= N/A		JOB NO.	1116.35