Falcon Highlands

Final Drainage Report

Owner/Developer
Challenger Homes
8605 Explorer Drive Ste. 250
Colorado Springs, CO 80920
(719) 598-5192
Contact: Jim Byers

Engineer
Atwell, LLC
143 Union Blvd., Suite 700
Lakewood, CO 80228
303-462-1100
Contact: Kevin Blumhadt, PE

Atwell Project Number
24004308

Submitted by: Atwell, LLC

June 10, 2024

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 City/County for drainage reports and said report is in conformity with the 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.

____

Kevin Blumhardt, PE xxxxx   Date   Seal:

Developer's Statement:

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

Business Name: Challenger Homes

By: ____

Title: ____

Address: ____

El Paso County Approval:

Filed in accordance with requirements of Section 51.1 of the El Paso Land Development Code as amended.

____

Date

County Engineer,
Conditions:

Contents

INTRODUCTION

This Final Drainage Report (FDR) has been completed for Challenger Homes in order to present an effective storm water management plan for the Falcon Highlands South development, hereinafter referred to as the Site. This report is intended to guide the development of the site and recommend general drainage concepts that can be implemented as development progresses. Included within this report is a proposed drainage plan for the Site along with reference information for drainage basins and storm water conveyance facilities.

The Site was most recently studied in the Preliminary Drainage Report (PDR) level in the *Falcon Highlands South PUDSP Preliminary Drainage Report* by Atwell, LLC, approved May 17, 2024.

The site for Falcon Highlands South Filing 1 is approximately 19.66 acres and will include a total of approximately 24 single-family residential units.

Proposed herein is a network of storm infrastructure, temporary pond, and swales that will meet relevant criteria for storm water quality and detention.

GENERAL LOCATION AND DESCRIPTION

The Site is located within Section 12, Township 13 South, Range 65 West of the Sixth Principal Meridian, County of El Paso, State of Colorado. The Site is bounded by Antelope Meadows to the south, Bridal Vail Way to the west. Falcon Highlands Filing No. 2 is located to the north of the site.

The overall area consists of approximately 19.66 acres that is proposed to be developed into 24 single-family residential units, roadways, and open space.

The site is within the Sand Creek Drainage Basin.

A vicinity map showing the location of the site is included below.

The site is within the Falcon Highlands MDDP by Atwell, LLC, dated March 2022.

SOILS AND EXISTING CONDITIONS

Much of the Site is currently undeveloped. Of the development within the Site, there are existing dirt roadways and sanitary sewer infrastructure installed per the Construction Drawings for Falcon Highlands Filing No. 2 prepared by Terra Nova Engineering, most recent revised date of September 7, 2010. The ALTA survey conducted by Atwell, LLC., shows the existing conditions of Falcon Highlands and adjacent development of Filing No. 2. The Site is nearly 100% existing natural grass vegetation typical of the eastern plains with sparse vegetative cover at its outer limits to the south and southeast. There is an existing regional drainage pond south of the site, dedicated to water quality and detention of storm water from Falcon Highlands Filing No.2 and the future development of Falcon Highlands Filing No. 3. The on-site slopes range from 0 percent to 10 percent and generally sheet flows from west to east. An Existing Conditions Drainage Map is included in Appendix G showing the delineated drainage basins.

The site is made up of Blakeland-Fluvaquentic Haplaquolls soil, a loamy sand, with 60 percent being hydraulic soil group A and 38 percent being group D. The Natural Resources Conservation Service of the United State Department of Agriculture Web Soil Survey has been included in Appendix B for reference.

DRAINAGE DESIGN CRITERIA

The El Paso County Drainage Manual (EPC DCM) and El Paso County Engineering Criteria Manual (EPC ECM) were used in conjunction with the Colorado Springs Drainage Criteria Manual (DCM) Mile High Flood District (MHFD) Criteria Manual. The rational method was used for a drainage basin less than 100-acres. The 5-year design frequency was used for the minor storm and a 100-year design frequency was used for the major storm in calculation on-site storm hydraulics. The City of Colorado Springs IDF Curve has used for calculating the rainfall intensity of 1.50 inches for the 5-year and 2.52 inches for the 100-year.

EXISTING ONSITE NAD OFFSITE DRAINAGE BASINS

All off-site drainage basin runoff data and calculations have been updated per current codes and standards. The developments of Falcon Highlands Filings No. 1 and 2 remained consistent with there MDDP and therefore offsite basin descriptions are delineations provided are based on previous County approved reports.

The site has been broken down into several major existing drainage basins. An Existing Conditions Drainage Map is in appendix F.

Off-Site Basins (Existing):

OS-1 (2.17 ac, Q_5= 0.04 cfs , Q_{100}= 1.32 cfs) is located in the northern portion of the site and consists of developed lots. Stormwater flows south onto the site and into Basin EX-2 where it continues to flow south to a natural swale then southeast off-site and into an existing water quality pond.

OS-2 (1.28 ac, Q_5= 0.02 cfs, Q_{100}= 0.66 cfs) is located in the south east corner of the site and consists of developed lots. Stormwater flows south onto the site and into Basin EX-2 where is continues for flow south east into a natural swale, then into an existing water quality pond.

On-Site Basins (Existing):

This site has been broken down into three major existing drainage basins. An existing drainage map can be found in Appendix F.

EX-1 (3.38 ac, Q_5= 0.04 cfs, Q_{100}= 1.32 cfs) is located in the west portion of the site, and consists of undeveloped land. Stormwater flows south and west into the existing Bridal Vail Way then continues south via curb and gutter to a cross pan at the intersection of Bridal Vail Way and Antelope Meadows Circle and flows west to an exiting inlet (Design point C1).\

EX-2 (9.38 ac, Q_5= 0.11 cfs, Q_{100}= 4.05 cfs) is located in the northern part of the site, and consists of undeveloped land. Stormwater flows southwest to a natural swale and continues off-site and into an existing water quality pond.

EX-3 (9.14 ac, Q_5= 0.13 cfs, Q_{100}= 4.64 cfs) is located in the south portion of the site, and consists of undeveloped land. Stormwater flows south to a low point in the basin then continues south to an existing water quality pond.

PROPOSED DRAINAGE BASINS

Preliminary grading design on the site has been completed to include right-of-way design and assignment of lot type A, B, and Transition (T). The assigned lots drain per a typical lot template, into roadways where on-grade sump inlets are located to pick up and convey stormwater through public storm system and outfall to a temporary downstream detention pond.

The overreaching premise of the drainage design is to route overland flow from residential lots to adjacent right-of-ways where public storm infrastructure will be installed and ultimately convey the stormwater to the downstream temporary pond to provide water quality treatment as well ass flow attenuation and detention. This study has also designed a temporary water quality basin. The analysis in this report provides pond sizing requirements as well as locations and sizes for inlets, pipes, and swales.

There is a proposed grass-lined swale to capture flows in the open space behind the northern lots, there is also a proposed grass lined swale to provide a flow path from the proposed temporary pond to the existing full spectrum pond. The design of these swales are included in the report in Appendix E, to accurately access the width and depth of the drainage way for the minor and major storm events.

The temporary pond will overflow and discharge into the Existing full spectrum detention pond 2.

HLG calculations for both the 5-year and 100-year storms are provided in Appendix E.

On-Site Basins (Proposed):

A-1 (4.49 ac, Q_5= 0.15 cfs, Q_{100}= 2.05 cfs) is located in the north portion of the site along the back of the existing lots and the proposed lots, and consists of open space. Stormwater flows to a proposed swale in the open space and flows to and existing outlet (Design point A1). The existing Design point discharges to a natural swale that flows southwest to the existing detention pond 2 (Design point P.2).

B-1 (4.83 ac, Q_5= 4.47 cfs, Q_{100}= 12.74 cfs) is located in the north portion of the site south of Basin A-1 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed south via curb and gutter to a local low point in the roadway where it is then captured by a proposed 10' Type R sump inlet (Design point B1) and enters the proposed public storm infrastructure and is released into a proposed temporary water quality pond (Design point P.1). Emergency overflow from the inlet will overtop the crown in the roadway and continue to flow south and will be picked up by future inlets in Antelope Meadows Circle (Design Point B4) and will be released into the existing detention pond 2 (Design Point (EX.2).

B-2 (2.46 ac, Q_5= 2.29 cfs, Q_{100}= 6.54 cfs) is located on the west side on the site south of Basin B-1 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed south via curb and gutter to a local low point in the roadway where it is then captured by a proposed 10' Type R sump inlet (Design point A2) and enters the proposed public storm infrastructure and is released into a proposed temporary water quality pond (Design point P.1). Emergency overflow from the inlet will overtop the crown in the roadway and continue to flow south and will be picked up by future inlets in Antelope Meadows Circle (Design Point C2) and will be released into the existing detention pond 2 (Design Point EX.2).

B-3 (1.98 ac, Q_5= 2.39 cfs, Q_{100}= 6.80 cfs) is located on the southwest side on the site south of Basin B-2 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed east via curb and gutter to a local low point in the roadway where it is then captured by a proposed 5' Type R sump inlet (Design point B3) and enters the proposed public storm infrastructure and is released into a proposed temporary water quality pond (Design point P.1) and will be released into the existing detention pond 2 (Design Point EX.2).

B-4 (3.52 ac, Q_5= 3.28 cfs, Q_{100}= 9.34 cfs) is located on the southeast side on the site south of Basin B-1 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed west via curb and gutter to a local low point in the roadway where it is then captured by a proposed 10' Type R sump inlet (Design point B4) and enters the proposed public storm infrastructure and is released into a proposed temporary water quality pond (Design point P.1) and will be released into the existing detention pond 2 (Design Point EX.2).

C-1 (1.63 ac, Q_5= 2.45 cfs, Q_{100}= 6.99 cfs) is located on the western boundary of the site and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows west toward the public right-of-way, and is conveyed south via curb and gutter to a local low point in the roadway where it is captured by an existing 20' inlet (Design point C1), where it will enter existing storm infrastructure and be release into the existing detention pond 1 (Design point EX.1).

STORMWATER CONVEYANCE AND STORAGE FACILITIES

The proposed on-site conveyance facilities will consist of a combination of storm pipe, swales/channels, curb and gutter, and inlets, and has been designed using runoff data from the calculations shown in Appendix D. Proposed drainage patterns will generally follow historic drainage patterns outlined in the previous section of this report. At sump conditions, inlets will be sized to collect 100-year flows. Runoff entering the inlets will be conveyed within the public storm sewer system to the proposed temporary detention and water quality public full-spectrum extended detention facility. The private temporary water quality facility will release into a proposed swale that flows to an existing full-spectrum extended detention facility.

The site will send storm water runoff to both Existing Detention ponds 1 and 2. Both Existing Detention basins were sized and designed by Tera Nova Engineering in a master drainage plan Revised November 2005. A table below has been provided to show the proposed flows entering the Existing Detention Ponds. The MHFD UD-Detention calculator was used to determine these proposed flows.

Proposed Flows to Existing Ponds				
	WQCV	**EURV-WQCV**	**100-year - EURV-WQCV**	**Total Volume Required**
Existing Pond 1	0.038 ac-ft	0.058 ac-ft	0.070 ac-ft	0.166 ac-ft
Existing Pong 2	0.247 ac-ft	0.374 ac-ft	0.454 ac-ft	1.075 ac-ft

Existing Pond 1 was calculated to require 8.96 ac-ft using Haestad's Pondpack Program and HEC modeling according the Tera Nova Report. The as-built conditions of the constructed pond yield a total pond size of 15.89 ac-ft, with a spillway weir elevation at 6416.5 and top of pond berm at 6817.0.

Existing Pond 2 was calculated to require 9.43 ac-ft using Haestad's Pondpack Program and HEC modeling according the Tera Nova Report. The as-built conditions of the constructed pond yield a total pond size of 10.51 ac-ft, with a spillway weir elevation at 6416.5 and top of pond berm at 6817.5.

MHFD-Inlet_v5.03 software was used to analyze and design the street and inlet capacities throughout the Site. The results of the software is included in the appendices for reference. Chapter 7 of the City of Colorado Springs Drainage Criteria Manual, Volume 1 was used for street flow design criteria.

A proposed grass lined swale is designed to convey stormwater to an outfall point for tributary areas within the northern open space portion of the Site. This swale is to be designed to El Paso County and Colorado Springs Drainage standards with one foot of freeboard. Design calculations and cross sections are included within the appendix.

The temporary private Water Quality facility is calculated to require 0.145 ac-ft of total volume and is designed to meet this volume at a stage of 2 feet. The temporary private Water Quality facility has a total of 0.172 ac-ft. An outlet pipe with a restrictor plate shall be used to control the release rated for the WQCV. 5-year and 100-year will overflow and overtop and eventually flow to the existing full-spectrum detention basin 2.

The proposed temporary Water Quality Pond will outfall through an outlet pipe with a restrictor plate to control the release rate of the WQCV. This will then enter a grass-lined swale and enter the existing full-spectrum detention pond 2. Over flow from the pond will over top the temporary pond and enter the grass lined swale. The swale has been sized for the 100-year undetained storm event.

It is planned that the temporary Water Quality Pond will be removed with the construction of the following phases of Falcon Highlands, including the storm pipe and FES into the pond, the pond itself, the outlet pipe, and the swale. The proposed storm infrastructure will then connect to the future Falcon Highlands storm infrastructure and outfall into the existing full-spectrum detention basin 2.

FOUR STEP PROCESS

The Four Step Process focuses on reducing runoff volumes, treating the WQCV, stabilizing drainageways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring events, as opposed to larger storms for which drainage and flood control infrastructure are sized. The Four Step Process is summarized below, and elements of the designed development are presented as a means to address and follow this process.

1. Step 1: Employ Runoff Reduction Practices

The Site is developed to capture runoff from impervious areas at sump locations and local low points within the public storm system. Impervious area is avoided where functional hardscape is not needed and open space is provided within the subdivision and remains undisturbed where developed lots are not laid out. Pervious landscaped areas are proposed where feasible in order to reduce runoff. Typical lot layouts will include pervious landscape areas surrounding the residences including front yards, rear yards, and side yard swales for drainage. The exact future ratio of pervious to impervious area per lot may vary per lot depending on future homebuilding activity. In order to calculate estimated runoff reduction for each lot for this project, lots were assumed to have 35% imperviousness as specified by the DCM Volume 1, Table 6-6 for residential lots sized as 0-3 dwelling per acre.

Runoff calculations were completed for two separate areas, the basins tributary to the temporary pond and the basins that flow offsite, eventually ending up in the existing pond. The WQCV was reduced by 73% for the area tributary to the temporary pond, 100% for basins flowing offsite, and 86% for the total disturbed area. The remaining untreated WQCV tributary to the temporary pond was a user-override in the UD-Detention pond design spreadsheet, (included in Appendix D).

All runoff reduction calculations and results are included in Appendix D. Runoff reduction areas are shown and can be found in the Green Infrastructure Maps, included in Appendix G.

2. Step 2: Implement Control Measures That Provide a Water Quality Capture Volume with Slow Release.

An outlet pipe with an orifice plate is proposed for the temporary pond 1 to control the release rates of the WQCV, EURV, and the 100-year volumes. The WQCV is released to meet the standard 40 hour drain time using an orifice plate.

The proposed temporary pond will provide water quality treatment for 70.13% disturbed area, the existing pond 1 will provide water quality treatment for 7.96% of the disturbed area, and 21.91% will be treated for water quality within a Separate Pervious Area (SPA). Basin A-1 is being treated by the SPA and will flow through a vegetated swale and outfall to Design Point A1 and will eventually flow into the existing pond 1. Below is a table summarizing the water quality treatments.

Water Quality Treatment Summary Table		
Treatment Method	Disturbed Area (acres)	Percent of Site (%)
Extended Detention Basin (Temp Pond 1)	14.37	70.13%
Extended Detention Basin (Existing Pond 1)	1.63	7.96%
Separate Pervious Area (SPA)	4.49	21.91%
Total Treated	20.49	100%
Total Untreated	0	0%
Total	20.49	100%

3. Step 3: Stabilized Drainageways

The site utilizes concrete curb and gutter to channel stormwater from impervious runoff, mostly paved roadways, and residential lots. Landscaped areas are to be permanently stabilized with native seeding and mulching as well as trees and shrubbery according to the landscaping plans. Sloped landscaped areas will not exceed 3H:1V grades. The proposed grass lined swale follows

El Paso Country and City of Colorado Springs drainage criteria. The site will outfall into the Existing Detention Pond 2.

4. Step 4: Implement Site Specific and Other Control Measures

Site construction is to follow a Stormwater Management Report and Grading and Erosion Control Plan that includes non-structural control measures during the initial, interim, and final phases of construction. As the development is multifamily residential land use, there are no anticipated site-specific permanent source control measures required for the Site.

WATER QUALITY ENHANCEMENT CONTROL MEASURES

The proposed temporary detention basin discussed in previous sections is to have infrastructure in place that meets El Paso County and MHFD Urban Storm Drainage Criteria Manuals. The proposed temporary pond is designed to provide WQCV and detain the EURV and the 100-year detention volumes as well as meet release rate criteria. Runoff from the upstream tributary areas will be conveyed to the temporary pond via storm sewer. A developed drainage plan showing developed areas and their drainage patterns to the temporary PCM is included in Appendix G.

Non-structural Best Management Practices that will be incorporated into the project are anticipated to include grass swales. Water quality is provided via side yard grass swales between lots in developed areas throughout the subdivision. It is provided for basins that drain directly offsite and are not tributary to the ponds by way of grass-lined swales, and by having minimal grading with no developed imperviousness in these areas as either open space or permanently seeded and landscaped rear yard areas.

Structural Best Management Practices that are incorporated in the Site design include storm infrastructure within the extended detention basins such as outlet structures and spillways.

MAINTENENANCE

The proposed temporary pond will be maintained by El Paso County. The proposed storm sewer system in the internal streets will be owned and maintained by El Paso County.

FLOODPLAIN MODIFICATION

There are no floodplain modifications required or proposed for the Site, see Appendix C for the FEMA Flood Zone Map.

DRAINAGE/BRIDGE FEES AND COST ESTIMATES

The Site lies within the Falcon Highlands Drainage Basin. The El Paso County Drainage Basin Fees were last updated in 2023 and were used.

The project site has a total area of 19.66 acres. The following calculations for the imperviousness of the development is shown below.

Average Housing Footprint: =3,400 sf

Total Housing Footprint Area: 3,400 x 24 =21,600 sf

Total ROW Area: =155,700 sf

ROW and Housing Footprint areas are 100% impervious

Total Impervious Area: (21,600 + 155,700) / 43,560 = 4.07 ac

Drainage Fees:

$37,256 x 4.07 Imp. Acres = $151,631.92

Bridge Fees:

$5,118 x 4.07 Imp. Acres = $20,830.26

The table below summarizes these costs.

Drainage Basin	Area Impervious (acres)	2023 Drainage Fee (per impervious acre $)	2023 Bridge Fee (per impervious acre)	Drainage fees ($)	Bridge Fees ($)	Total ($)
Falcon	4.07	$ 37,256.00	$ 5,118.00	$ 151,631.92	$ 20,830.26	$ 172,462.18

Below is a cost estimate for the proposed storm infrastructure proposed within the filing.

Item	Quantity	Unit	Unit Cost	Cost
5' CDOT Type R Inlet	1	EA	$ 9,200.00	$ 9,200.00
10' CDOT Type R Inlet	3	EA	$ 12,800.00	$ 38,400.00
18" RCP	54	LF	$ 93.00	$ 5,022.00
24" RCP	127	LF	$ 130.00	$ 16,510.00
30" RCP	152	LF	$ 155.00	$ 23,560.00
36" RCP	360	LF	$ 212.00	$ 76,320.00
5' Manhole	5	EA	$ 8,200.00	$ 41,000.00
			Subtotal	$ 210,012.00
		Contingency (15%)		$ 31,501.80
			Total	$ 241,513.80

CONCLUSION

This Final Drainage Plan report covers the proposed storm water management plan for the Falcon Highlands South development filing 1. This document will provide guidance so that the drainage infrastructure constructed throughout the Falcon Highlands South Filing 1 development will function efficiently and effectively. This report follows all standard criteria set forth by the El Paso County Drainage Criteria Manual, El Paso County Engineering Criteria Manual, the City of Colorado Springs Drainage Criteria Manuals Volumes 1, 2, and 3, and the Mile High Flood District Urban Storm Drainage Criteria Manual, with no requested variances. Downstream drainage facilities will not be negatively affected, as existing drainage patterns and allowable release rates are planned to be maintained. It has been concluded that the proposed Falcon Highlands South Filing 1 development will have no negative impact to the existing Pond and downstream infrastructure and development.

REFERENCES

1) Urban Storm Drainage Criteria Manuals; Mile High Flood District; latest edition

2) El Paso County Engineering Criteria Manual (ECM), latest revision October 14, 2020

3) El Paso County Drainage Criteria Manual (DCM), October 1991; latest revision October 31, 2018

4) City of Colorado Springs Drainage Criteria Manuals, Volumes 1, 2, and 3, latest revision May 2014 (Not Adopted by El Paso County)

5) Flood Insurance Rate Map of El Paso County Colorado, Federal Emergency Management Agency, Flood Insurance Rate Map No. 08041C0561G and 08041C0545G dated December 7, 2018.

6) Hydrologic Soil Group – El Paso County, Colorado, Web Soil Survey, National Cooperative Soils Survey, May 21, 2021

7) *Falcon Highlands Filing No. 2 & 3 Final Drainage Report* by Terra Nova Engineering, Inc., latest revision August 2010.

8) *Falcon Highlands Phase 2, Filing No. 2 & 3 Master Development Drainage Plan and Preliminary Drainage Report* by Terra Nova Engineering, Inc. latest revision September 2005

9) *Bent Grass Residential Subdivision Filing No. 2* (SF-19-014) Final Drainage Report, latest revision March 2020.

10) URS Section for Regional Detention Pond WU, developed by Galloway & Company

11) Sand Creek DBPS, developed by Stantec, HDR, and Dewberry dated January 2021 (Not Adopted by El Paso County)

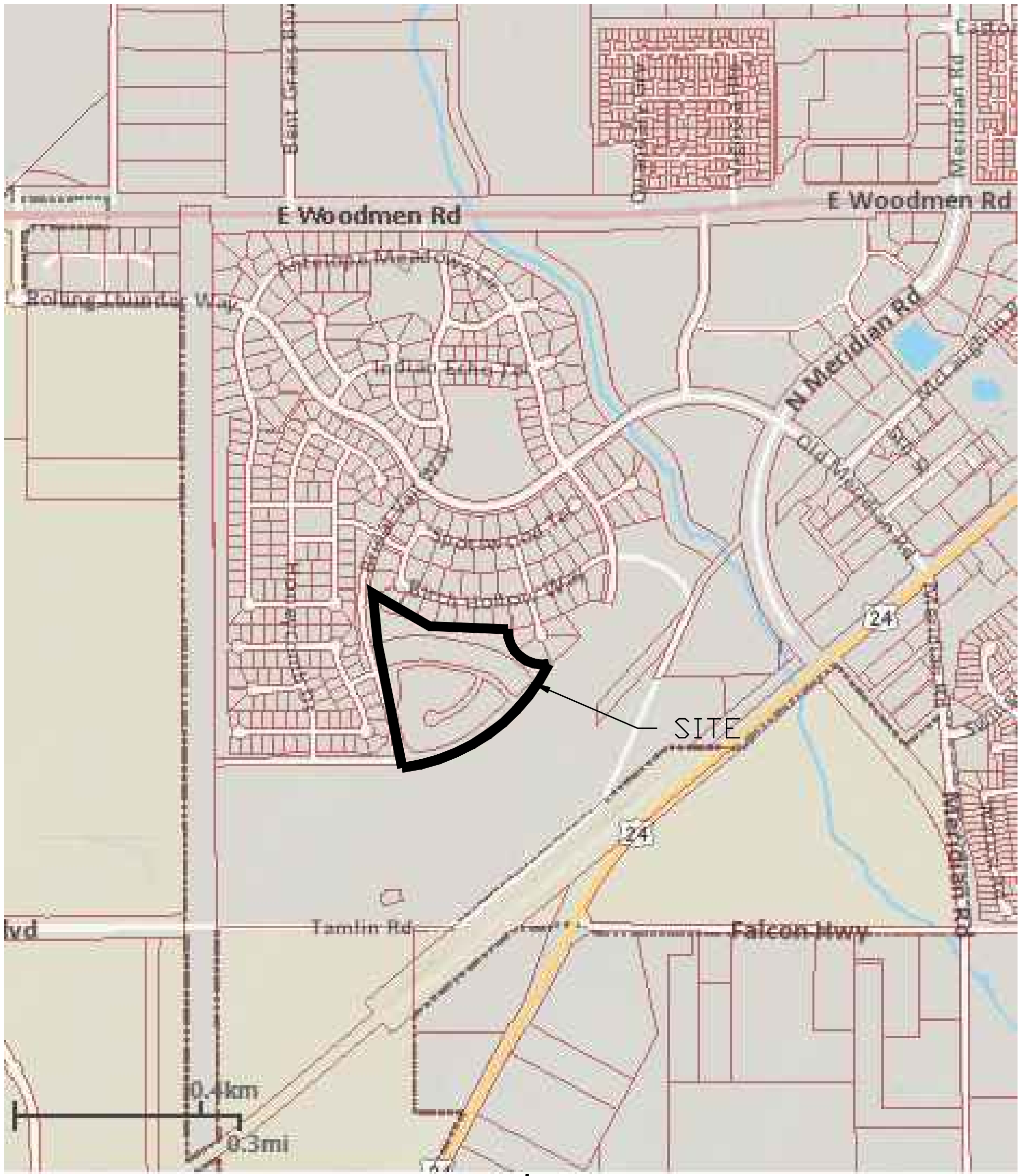
12) Falcon DBS, developed by Matrix Design Group dated September 2015

Appendix A

Vicinity map

Falcon Highlands - Filing No. 3

A PART OF SECTION 12, TOWNSHIP 13 SOUTH, RANGE 65 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
COUNTY OF EL PASO,
STATE OF COLORADO



PROJECT NO.: 24004308
DATE: 07/01/24

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100
CONTACT: DANIEL MADRUGA
DMADRUGA@ATWELL-GROUP.COM

Appendix B

Soils Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

June 7, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,860 if printed on A landscape (11" x 8.5") sheet.

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 21, Aug 24, 2023

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 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
9	Blakeland-Fluvaquentic Haplaquolls	19.0	100.0%
Totals for Area of Interest		**19.0**	**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

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 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: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

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
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 content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable
H2 - 12 to 60 inches: stratified very gravelly sand to loam

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Minor Components

Other soils

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

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Water Features

This folder contains tabular reports that present soil hydrology information. The reports (tables) include all selected map units and components for each map unit. Water Features include ponding frequency, flooding frequency, and depth to water table.

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–El Paso County Area, Colorado

Map symbol and soil name	Pct. of map unit	Surface Runoff	Hydrologic Soil Group
9—Blakeland-Fluvaquentic Haplaquolls			
Blakeland	60	Low	A
Fluvaquentic haplaquolls	38	Very high	D

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Appendix C

FEMA Map

National Flood Hazard Layer FIRMette

FEMA

104°37'40"W 38°56'3"N

104°37'3"W 38°55'35"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- B 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — 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

N

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 5/21/2021 at 11:21 AM 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.

Appendix D

Hydrologic Calculations

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B-1	B-2	B-3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	4.5	2.3	2.4
Major Q_{Known} (cfs)	12.7	6.5	6.8

Bypass (Carry-Over) Flow from Upstream

Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**4.5**	**2.3**	**2.4**
Major Total Design Peak Flow, Q (cfs)	**12.7**	**6.5**	**6.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B-4
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.3
Major Q_{Known} (cfs)	9.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

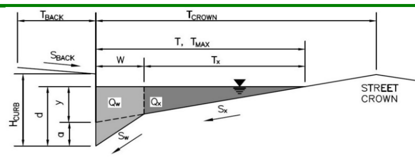
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.3**
Major Total Design Peak Flow, Q (cfs)	**9.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A

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

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

Project:
Inlet ID: **B-1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.7	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

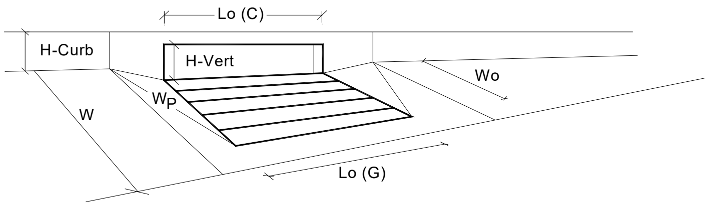
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

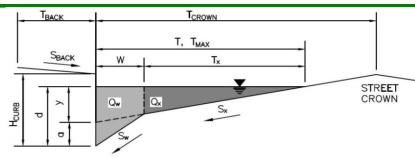


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	7.2	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
Open Area 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	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.91	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	$\mathbf{Q_a}$ **=**	**6.9**	**13.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.5	12.7	cfs

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

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

Project:
Inlet ID: **B-2**



Gutter Geometry:

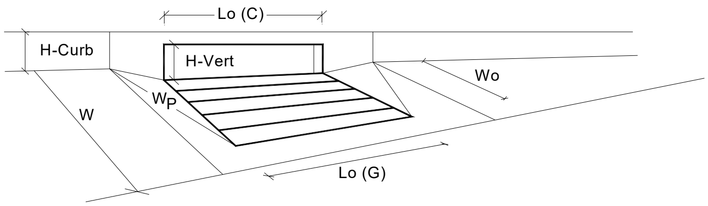
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.7	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

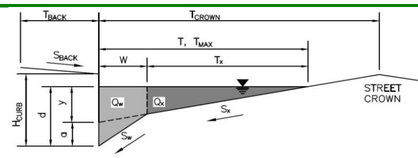


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	7.2	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
Open Area 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		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.30	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.91	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**6.9**	**13.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	2.3	6.5	cfs

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

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

Project:
Inlet ID: **B-3**



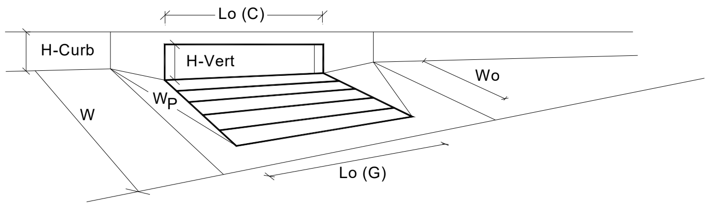
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.7		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

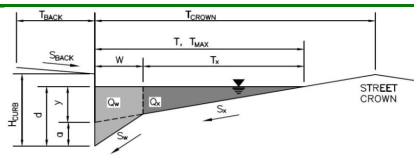


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	7.2	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
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.6**	**8.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.4	6.8	cfs

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

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

Project:
Inlet ID: **B-4**



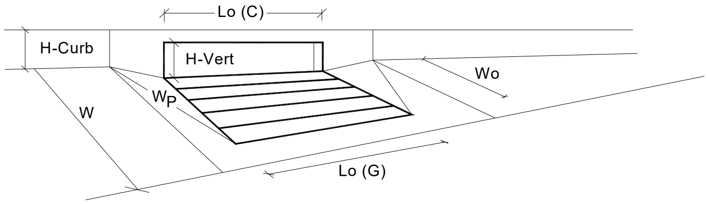
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.7		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	7.2	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
Open Area 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	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.91	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.9**	**13.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.3	9.3	cfs

Appendix E

Hydraulic Calculations

Calculation of Peak Runoff using Rational Method

Designer: LMS
Company: Atwell, LLC
Date: 7/1/2024
Project: Falcon Highlands
Location:

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

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

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.16	1.44	1.68	1.92	2.16	2.42	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
EX-1	3.38	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
EX-2	9.38	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
EX-3	9.14	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
OS-1	2.17	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
OS-2	1.28	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27

Subcatchment Name	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
EX-1	300.00			0.050	20.12	1250.00			0.020	5	0.71	29.46
EX-2	300.00			0.090	16.57	975.00			0.030	5	0.87	18.76
EX-3	300.00			0.090	16.57	440.00			0.020	5	0.71	10.37
OS-1	300.00			0.020	27.22	975.00			0.030	5	0.87	18.76
OS-2	300.00			0.020	27.22	50.00			0.020	5	0.71	1.18

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
EX-1	49.58	41.53	41.53	1.49	1.85	2.16	2.47	2.78	3.11	
EX-2	35.33	35.77	35.33	1.65	2.05	2.39	2.73	3.07	3.44	
EX-3	26.94	31.25	26.94	1.94	2.41	2.81	3.21	3.61	4.04	
OS-1	45.98	35.77	35.77	1.64	2.03	2.37	2.71	3.05	3.42	
OS-2	28.40	26.29	26.29	1.96	2.44	2.85	3.25	3.66	4.10	

Subcatchment Name	Peak Flow, Q (cfs) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
EX-1	0.03	0.04	0.05	0.09	0.39	1.32	
EX-2	0.08	0.11	0.16	0.28	1.21	4.05	
EX-3	0.09	0.13	0.18	0.32	1.39	4.64	
OS-1	0.02	0.03	0.04	0.06	0.28	0.93	
OS-2	0.01	0.02	0.03	0.05	0.20	0.66	

Calculation of Peak Runoff using Rational Method

Designer: LMS
Company: Atwell, LLC
Date: 7/1/2024
Project: Falcon Highlands
Location:

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

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

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.16	1.44	1.68	1.92	2.16	2.42	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A-1	4.49	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29
B-1	4.83	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
B-2	2.46	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
C-1	2.75	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
B-3	2.55	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
B-4	3.52	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
OS-1	2.17	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48
OS-2	1.28	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48

Subcatchment Name	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
A-1	200.00			2.000	4.80	1600.00			0.005	10	0.71	37.71
B-1	200.00			2.000	3.89	650.00			0.013	20	2.24	4.84
B-2	200.00			2.000	3.89	625.00			0.013	20	2.24	4.66
C-1	200.00			2.000	3.89	975.00			0.020	20	2.83	5.75
B-3	200.00			2.000	3.89	550.00			0.010	20	2.00	4.58
B-4	100.00			2.000	2.75	700.00			0.010	20	2.00	5.83
OS-1	100.00			2.000	2.75	1900.00			0.005	20	1.41	22.39
OS-2	40.00			2.000	1.74	600.00			0.005	20	1.41	7.07
										10		
										10		

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A-1	42.52	64.03	42.52	1.47	1.82	2.13	2.43	2.74	3.07	
B-1	8.73	27.02	8.73	3.30	4.10	4.79	5.47	6.15	6.89	
B-2	8.54	26.75	8.54	3.33	4.13	4.82	5.51	6.20	6.95	
C-1	9.63	28.32	9.63	3.18	3.95	4.61	5.27	5.93	6.64	
B-3	8.47	26.64	8.47	3.34	4.15	4.84	5.53	6.22	6.97	
B-4	8.58	28.44	8.58	3.33	4.13	4.82	5.50	6.19	6.94	
OS-1	25.14	52.27	25.14	2.02	2.50	2.92	3.34	3.75	4.20	
OS-2	8.81	30.22	8.81	3.29	4.09	4.77	5.45	6.13	6.87	

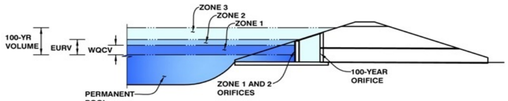
Subcatchment Name	Peak Flow, Q (cfs) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A-1	0.11	0.15	0.21	0.33	0.83	2.05	
B-1	3.42	4.47	5.54	7.18	9.63	12.74	
B-2	1.75	2.29	2.84	3.68	4.94	6.54	
C-1	1.88	2.45	3.04	3.94	5.28	6.99	
B-3	1.82	2.39	2.96	3.83	5.14	6.80	
B-4	2.51	3.28	4.06	5.26	7.06	9.34	
OS-1	0.94	1.22	1.52	1.97	2.64	3.49	
OS-2	0.90	1.18	1.46	1.90	2.54	3.37	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Falcon Highlands**

Basin ID: **Temporary Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	14.37	acres
Watershed Length =	1,350	ft
Watershed Length to Centroid =	675	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	35.00%	percent
Percentage Hydrologic Soil Group A =	60.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	40.0%	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) =	0.145	acre-feet	0.145	acre-feet
Excess Urban Runoff Volume (EURV) =	0.500	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.249	acre-feet		inches
5-yr Runoff Volume (P1 = 1.19 in.) =	0.418	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.5 in.) =	0.607	acre-feet	1.50	inches
25-yr Runoff Volume (P1 = 1.75 in.) =	0.931	acre-feet	1.75	inches
50-yr Runoff Volume (P1 = 2 in.) =	1.186	acre-feet	2.00	inches
100-yr Runoff Volume (P1 = 2.25 in.) =	1.536	acre-feet	2.25	inches
500-yr Runoff Volume (P1 = 2.52 in.) =	1.850	acre-feet	2.52	inches
Approximate 2-yr Detention Volume =	0.249	acre-feet		
Approximate 5-yr Detention Volume =	0.415	acre-feet		
Approximate 10-yr Detention Volume =	0.536	acre-feet		
Approximate 25-yr Detention Volume =	0.648	acre-feet		
Approximate 50-yr Detention Volume =	0.723	acre-feet		
Approximate 100-yr Detention Volume =	0.865	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.145	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.355	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.365	acre-feet
Total Detention Basin Volume =	0.865	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 = 0.50 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	--	--	--	10	0.000		
0.5	--	0.50	--	--	--	3,666	0.084	919	0.021
1	--	1.00	--	--	--	4,134	0.095	2,869	0.066
1.5	--	1.50	--	--	--	4,626	0.106	5,059	0.116
2	--	2.00	--	--	--	5,144	0.118	7,501	0.172
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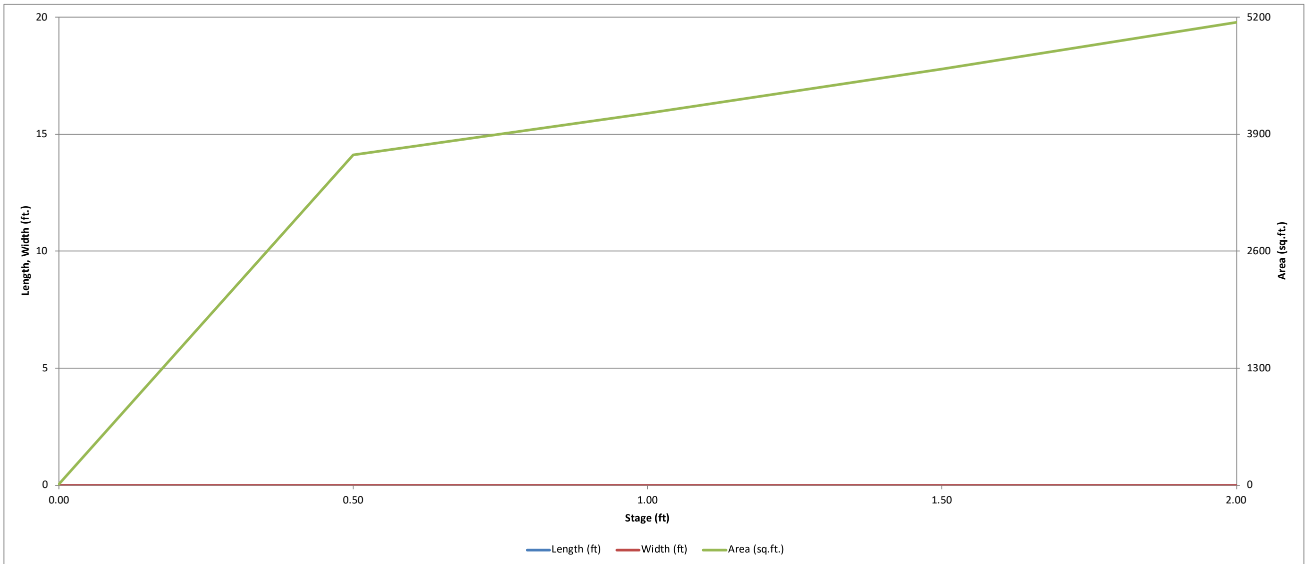
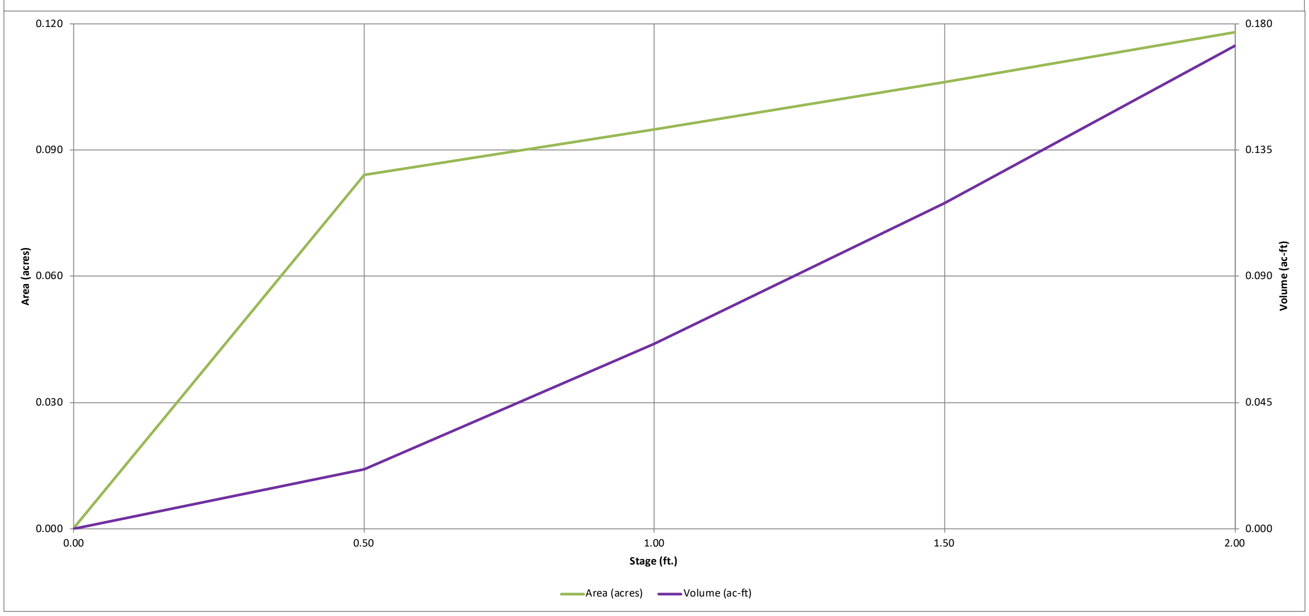
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

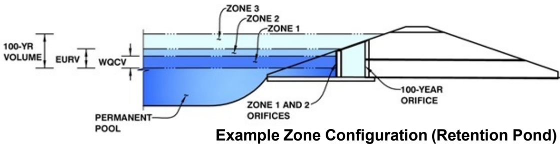




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands
Basin ID: Temporary Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.77	0.145	Orifice Plate
Zone 2 (EURV)	#VALUE!	0.355	Not Utilized
Zone 3 (100-year)	#VALUE!	0.365	Not Utilized
Total (all zones)		0.865	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.77	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	1.60					
Orifice Area (sq. inches)	1.25	1.25	1.25					

	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)

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

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Slope Length =	N/A	N/A	feet
Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Overflow Grate Open Area w/o Debris =	N/A	N/A	ft^2
Overflow Grate Open Area w/ Debris =	N/A	N/A	ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =		N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

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

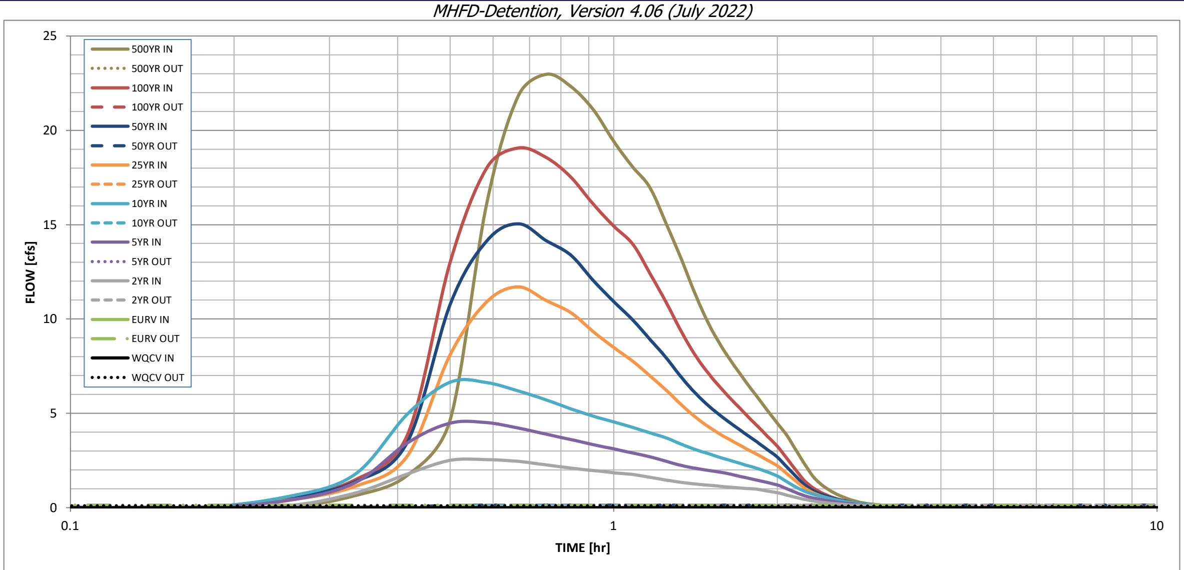
Routed Hydrograph Results

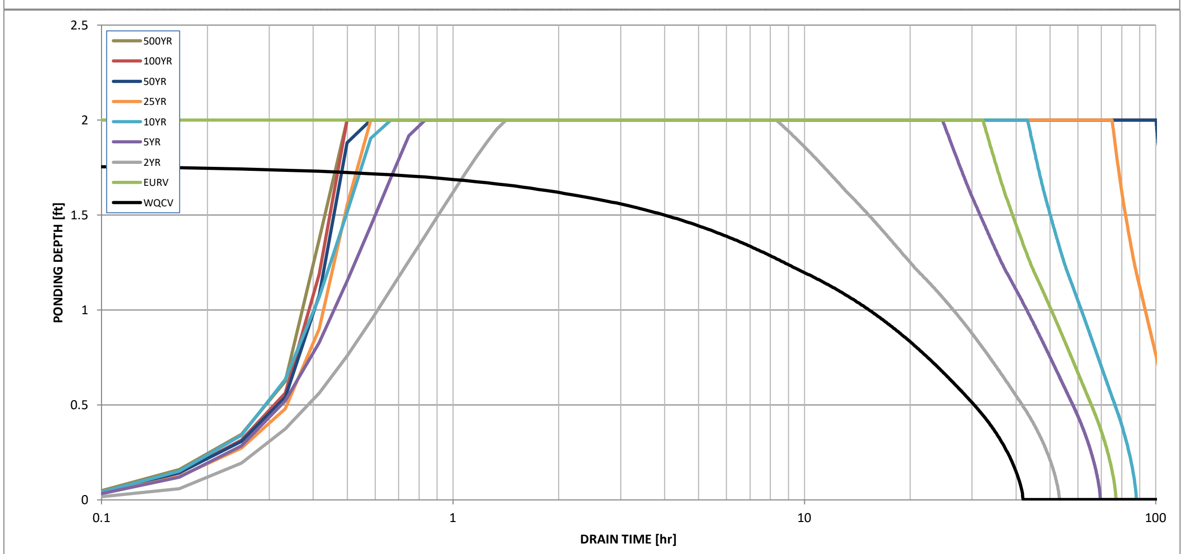
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

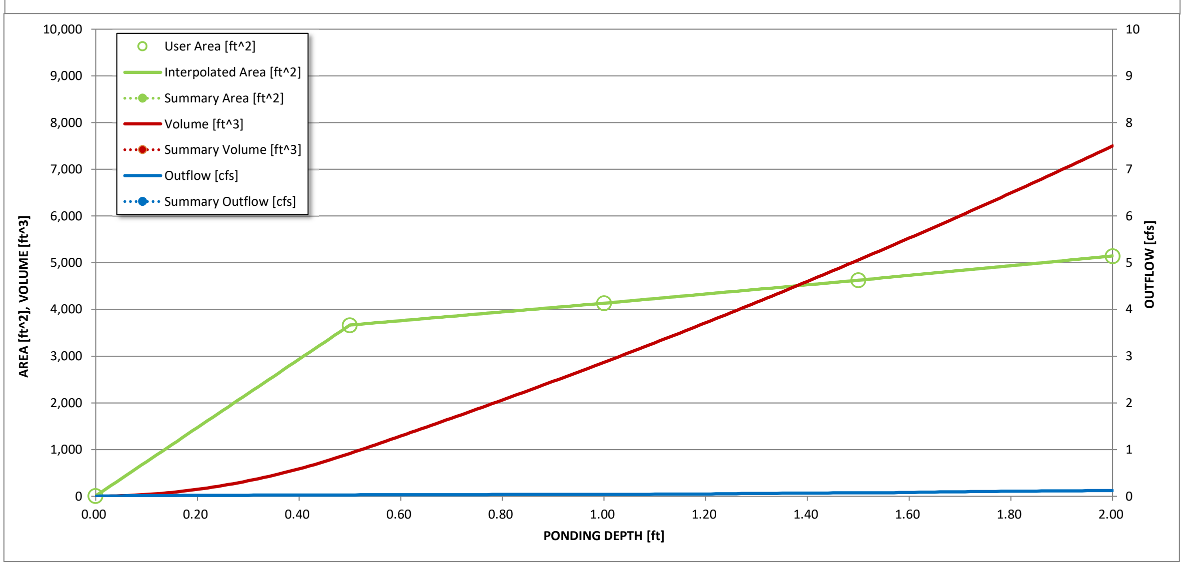
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.83	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.145	0.500	0.249	0.418	0.607	0.931	1.186	1.536	1.850
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.249	0.418	0.607	0.931	1.186	1.536	1.850
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.2	0.8	4.4	6.8	10.1	13.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.06	0.31	0.47	0.71	0.91
Peak Inflow Q (cfs) =	N/A	N/A	2.5	4.5	6.6	11.7	15.0	19.1	23.0
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.1	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	48	62	78	106	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	51	66	84	114	>120	>120	>120
Maximum Ponding Depth (ft) =	1.77	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Area at Maximum Ponding Depth (acres) =	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Maximum Volume Stored (acre-ft) =	0.146	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.10	0.37	0.57	0.38	0.51	0.50	0.63
	0:20:00	0.00	0.00	0.76	1.29	1.74	1.11	1.35	1.46	1.70
	0:25:00	0.00	0.00	1.78	3.42	4.94	2.73	3.46	3.83	4.64
	0:30:00	0.00	0.00	2.50	4.48	6.65	8.10	10.77	13.01	16.09
	0:35:00	0.00	0.00	2.54	4.50	6.63	10.90	14.12	17.99	21.80
	0:40:00	0.00	0.00	2.45	4.22	6.18	11.70	15.05	19.06	22.97
	0:45:00	0.00	0.00	2.26	3.89	5.72	10.98	14.17	18.57	22.33
	0:50:00	0.00	0.00	2.10	3.61	5.24	10.34	13.39	17.53	21.10
	0:55:00	0.00	0.00	1.96	3.34	4.85	9.33	12.05	16.09	19.42
	1:00:00	0.00	0.00	1.85	3.11	4.54	8.49	10.92	14.92	18.06
	1:05:00	0.00	0.00	1.75	2.90	4.25	7.76	9.95	13.98	16.96
	1:10:00	0.00	0.00	1.61	2.69	3.96	6.98	8.92	12.41	15.04
	1:15:00	0.00	0.00	1.46	2.45	3.69	6.22	7.93	10.87	13.15
	1:20:00	0.00	0.00	1.33	2.23	3.35	5.44	6.89	9.30	11.22
	1:25:00	0.00	0.00	1.24	2.07	3.07	4.77	6.04	8.02	9.67
	1:30:00	0.00	0.00	1.18	1.96	2.84	4.25	5.36	7.05	8.49
	1:35:00	0.00	0.00	1.12	1.86	2.63	3.83	4.82	6.26	7.53
	1:40:00	0.00	0.00	1.07	1.72	2.44	3.47	4.34	5.58	6.68
	1:45:00	0.00	0.00	1.02	1.59	2.26	3.14	3.90	4.95	5.90
	1:50:00	0.00	0.00	0.97	1.46	2.08	2.82	3.48	4.35	5.17
	1:55:00	0.00	0.00	0.88	1.33	1.89	2.51	3.08	3.79	4.48
	2:00:00	0.00	0.00	0.79	1.20	1.67	2.21	2.68	3.26	3.82
	2:05:00	0.00	0.00	0.66	0.99	1.36	1.80	2.15	2.60	3.03
	2:10:00	0.00	0.00	0.53	0.79	1.08	1.39	1.65	1.97	2.28
	2:15:00	0.00	0.00	0.43	0.62	0.86	1.03	1.20	1.40	1.62
	2:20:00	0.00	0.00	0.35	0.50	0.70	0.77	0.89	1.03	1.20
	2:25:00	0.00	0.00	0.28	0.42	0.58	0.60	0.69	0.78	0.90
	2:30:00	0.00	0.00	0.24	0.35	0.48	0.47	0.55	0.59	0.69
	2:35:00	0.00	0.00	0.20	0.29	0.40	0.38	0.43	0.45	0.52
	2:40:00	0.00	0.00	0.16	0.24	0.32	0.30	0.34	0.34	0.39
	2:45:00	0.00	0.00	0.13	0.19	0.26	0.24	0.27	0.26	0.29
	2:50:00	0.00	0.00	0.11	0.16	0.21	0.19	0.21	0.19	0.22
	2:55:00	0.00	0.00	0.09	0.13	0.17	0.15	0.17	0.16	0.17
	3:00:00	0.00	0.00	0.07	0.10	0.13	0.12	0.13	0.13	0.14
	3:05:00	0.00	0.00	0.06	0.08	0.10	0.10	0.11	0.10	0.11
	3:10:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.08	0.09
	3:15:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.06
	3:20:00	0.00	0.00	0.03	0.03	0.04	0.04	0.04	0.04	0.05
	3:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
	3:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	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 4.06 (July 2022)

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]

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'.

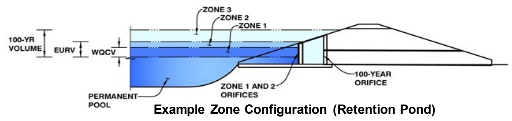
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Falcon Highlands**

Basin ID: **Temporary Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	2.75	acres
Watershed Length =	850	ft
Watershed Length to Centroid =	400	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	35.00%	percent
Percentage Hydrologic Soil Group A =	60.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	40.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Area Tributary to Existing Pond 1

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) =	0.038	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.096	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.047	acre-feet		inches
5-yr Runoff Volume (P1 = 1.19 in.) =	0.080	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.5 in.) =	0.115	acre-feet	1.50	inches
25-yr Runoff Volume (P1 = 1.75 in.) =	0.177	acre-feet	1.75	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.225	acre-feet	2.00	inches
100-yr Runoff Volume (P1 = 2.25 in.) =	0.292	acre-feet	2.25	inches
500-yr Runoff Volume (P1 = 2.52 in.) =	0.352	acre-feet	2.52	inches
Approximate 2-yr Detention Volume =	0.048	acre-feet		
Approximate 5-yr Detention Volume =	0.079	acre-feet		
Approximate 10-yr Detention Volume =	0.103	acre-feet		
Approximate 25-yr Detention Volume =	0.124	acre-feet		
Approximate 50-yr Detention Volume =	0.138	acre-feet		
Approximate 100-yr Detention Volume =	0.166	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.038	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.058	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.070	acre-feet
Total Detention Basin Volume =	0.166	acre-feet
Initial Surcharge Volume (ISV) =		ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Values only used to compare to master drainage report by Terra Nova

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = 0.50 ft

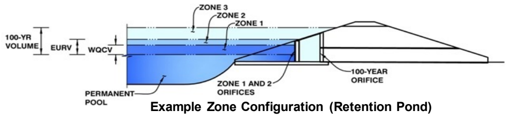
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Falcon Highlands**

Basin ID: **Temporary Pond**



Example Zone Configuration (Retention Pond)

Depth Increment = 0.50 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									

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	17.85	acres
Watershed Length =	1,000	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	35.00%	percent
Percentage Hydrologic Soil Group A =	60.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	40.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Area Tributary to Existing Pond 2

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) =	0.247	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.621	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	0.306	acre-feet		inches
5-yr Runoff Volume (P1 = 1.19 in.) =	0.514	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.5 in.) =	0.744	acre-feet	1.50	inches
25-yr Runoff Volume (P1 = 1.75 in.) =	1.141	acre-feet	1.75	inches
50-yr Runoff Volume (P1 = 2 in.) =	1.453	acre-feet	2.00	inches
100-yr Runoff Volume (P1 = 2.25 in.) =	1.882	acre-feet	2.25	inches
500-yr Runoff Volume (P1 = 2.52 in.) =	2.268	acre-feet	2.52	inches
Approximate 2-yr Detention Volume =	0.310	acre-feet		
Approximate 5-yr Detention Volume =	0.515	acre-feet		
Approximate 10-yr Detention Volume =	0.666	acre-feet		
Approximate 25-yr Detention Volume =	0.805	acre-feet		
Approximate 50-yr Detention Volume =	0.898	acre-feet		
Approximate 100-yr Detention Volume =	1.075	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.247	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.374	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.454	acre-feet
Total Detention Basin Volume =	1.075	acre-feet
Initial Surcharge Volume (ISV) =		ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Values only used to compare to master drainage report by Terra Nova

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

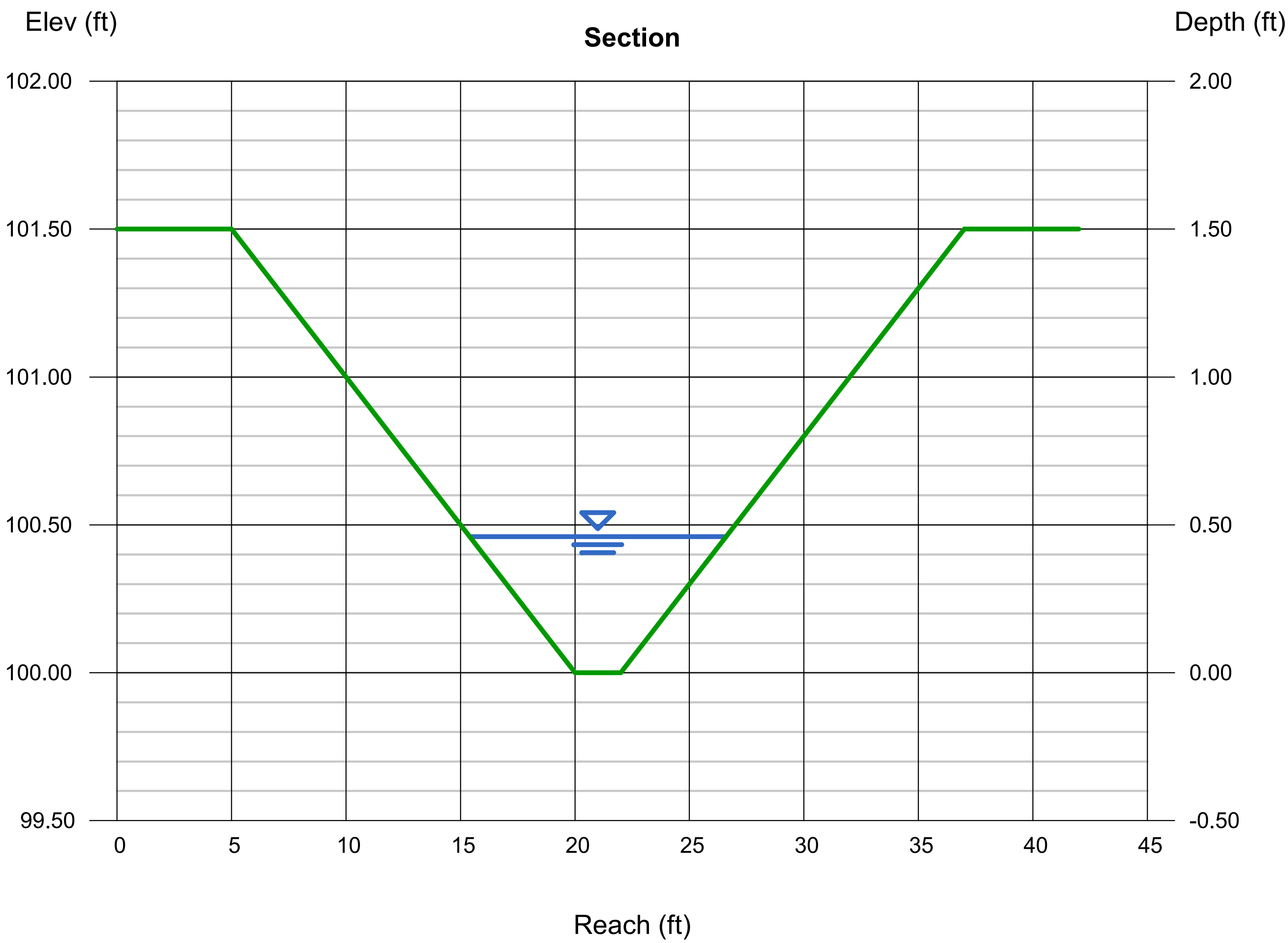
Channel Report

<Name>

Trapezoidal	
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 10.00, 10.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 6.18

Highlighted	
Depth (ft)	= 0.46
Q (cfs)	= 6.180
Area (sqft)	= 3.04
Velocity (ft/s)	= 2.04
Wetted Perim (ft)	= 11.25
Crit Depth, Yc (ft)	= 0.39
Top Width (ft)	= 11.20
EGL (ft)	= 0.52



Channel Report

<Name>

Trapezoidal

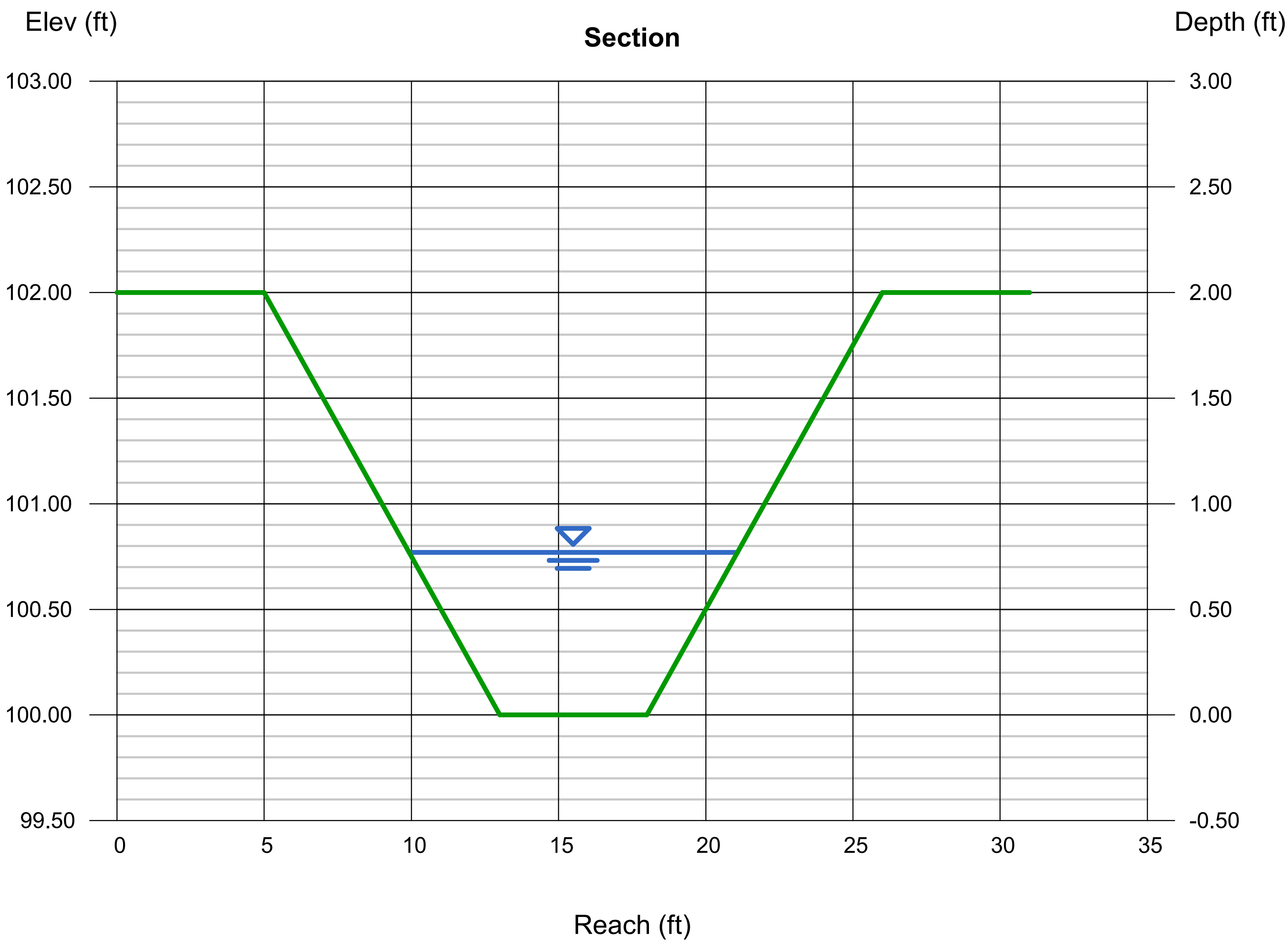
Bottom Width (ft)	=	5.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.90
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	19.10

Highlighted

Depth (ft)	=	0.77
Q (cfs)	=	19.10
Area (sqft)	=	6.22
Velocity (ft/s)	=	3.07
Wetted Perim (ft)	=	11.35
Crit Depth, Yc (ft)	=	0.65
Top Width (ft)	=	11.16
EGL (ft)	=	0.92



Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: **LMS**
Company: **Atwell, LLC**
Date: **July 10, 2024**
Project: **Falcon Highlands**
Location: **El Paso County**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth	0.60	inches
Depth of Average Runoff Producing Storm, d_6 =	0.43	inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	SPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	DCIA	UIA:RPA	UIA:RPA	DCIA	UIA:RPA	DCIA	
Area ID	A-1.1	B-1.1	B-1.2	B-1.3	B-1.4	B-1.5	B-2.1	B-2.2	B-2.3	B-3.1		
Downstream Design Point ID	P2	P1	P1	P1	P1	P1	P1	P1	P1	P1	P1	
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB	EDB	EDB	EDB	EDB	EDB	EDB	
DCIA (ft^2)	--	--	--	--	--	26,350	--	--	22,954	--	13,934	
UIA (ft^2)	--	14,728	20,206	14,773	17,055	--	19,750	12,606	--	31,116	--	
RPA (ft^2)	--	24,579	32,188	27,814	34,929	--	35,120	19,080	--	18,856	--	
SPA (ft^2)	199,586	--	--	--	--	--	--	--	--	--	--	
HSG A (%)	60%	60%	60%	60%	60%	--	60%	60%	--	60%	--	
HSG B (%)	0%	0%	0%	0%	0%	--	0%	0%	--	0%	--	
HSG C/D (%)	40%	40%	40%	40%	40%	--	40%	40%	--	40%	--	
Average Slope of RPA (ft/ft)	--	0.020	0.020	0.020	0.020	--	0.020	0.020	--	0.020	--	
UIA:RPA Interface Width (ft)	--	177.00	225.00	232.00	260.00	--	407.00	200.00	--	442.00	--	

CALCULATED RUNOFF RESULTS

Area ID	A-1.1	B-1.1	B-1.2	B-1.3	B-1.4	B-1.5	B-2.1	B-2.2	B-2.3	B-3.1	#REF!	
UIA:RPA Area (ft^2)	--	39,307	52,394	42,587	51,984	--	54,870	31,686	--	49,972	--	
L / W Ratio	--	1.25	1.03	0.79	0.77	--	0.33	0.79	--	0.26	--	
UIA / Area	--	0.3747	0.3857	0.3469	0.3281	--	0.3599	0.3978	--	0.6227	--	
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.02	0.50	
Runoff (ft^3)	0	0	0	0	0	1098	0	0	956	104	#REF!	
Runoff Reduction (ft^3)	9979	614	842	616	711	0	823	525	0	1192	0	

CALCULATED WQCV RESULTS

Area ID	A-1.1	B-1.1	B-1.2	B-1.3	B-1.4	B-1.5	B-2.1	B-2.2	B-2.3	B-3.1	#REF!	
WQCV (ft^3)	0	614	842	616	711	1098	823	525	956	1297	#REF!	
WQCV Reduction (ft^3)	0	614	842	616	711	0	823	525	0	1192	#REF!	
WQCV Reduction (%)	0%	100%	100%	100%	100%	0%	100%	100%	0%	92%	#REF!	
Untreated WQCV (ft^3)	0	0	0	0	0	1098	0	0	956	104	#REF!	

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	P2	P1										
DCIA (ft^2)	0	63,238										
UIA (ft^2)	0	130,234										
RPA (ft^2)	0	192,566										
SPA (ft^2)	199,586	0										
Total Area (ft^2)	199,586	386,038										
Total Impervious Area (ft^2)	0	193,472										
WQCV (ft^3)	0	#REF!										
WQCV Reduction (ft^3)	0	#REF!										
WQCV Reduction (%)	0%	#REF!										
Untreated WQCV (ft^3)	0	#REF!										

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	585,624
Total Impervious Area (ft^2)	193,472
WQCV (ft^3)	#REF!
WQCV Reduction (ft^3)	#REF!
WQCV Reduction (%)	#REF!
Untreated WQCV (ft^3)	#REF!

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: LMS
Company: Atwell, LLC
Date: July 10, 2024
Project: Falcon Highlands
Location: El Paso County

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	DCIA	UIA:RPA	UIA:RPA	UIA:RPA						
Area ID	B-4.1	B-4.2	B-4.3	C-1	C-2	C-3						
Downstream Design Point ID	P1	P1	P1	P2	P2	P2						
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB	EDB						
DCIA (ft^2)	--	--	17,055	--	--	--						
UIA (ft^2)	32,403	20,070	--	16,253	14,240	14,923						
RPA (ft^2)	40,861	26,236	--	22,241	18,870	22,180						
SPA (ft^2)	--	--	--	--	--	--						
HSG A (%)	60%	60%	--	60%	60%	60%						
HSG B (%)	0%	0%	--	0%	0%	0%						
HSG C/D (%)	40%	40%	--	40%	40%	40%						
Average Slope of RPA (ft/ft)	0.020	0.020	--	0.020	0.020	0.020						
UIA:RPA Interface Width (ft)	365.00	223.00	--	409.00	161.00	180.00						

CALCULATED RUNOFF RESULTS

Area ID	B-4.1	B-4.2	B-4.3	C-1	C-2	C-3						
UIA:RPA Area (ft^2)	73,264	46,306	--	38,494	33,110	37,103						
L / W Ratio	0.55	0.93	--	0.23	1.28	1.15						
UIA / Area	0.4423	0.4334	--	0.4222	0.4301	0.4022						
Runoff (in)	0.00	0.00	0.50	0.00	0.00	0.00						
Runoff (ft^3)	0	0	711	0	0	0						
Runoff Reduction (ft^3)	1350	836	0	677	593	622						

CALCULATED WQCV RESULTS

Area ID	B-4.1	B-4.2	B-4.3	C-1	C-2	C-3						
WQCV (ft^3)	1350	836	711	677	593	622						
WQCV Reduction (ft^3)	1350	836	0	677	593	622						
WQCV Reduction (%)	100%	100%	0%	100%	100%	100%						
Untreated WQCV (ft^3)	0	0	711	0	0	0						

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	P1	P2										
DCIA (ft^2)	17,055	0										
UIA (ft^2)	52,473	45,416										
RPA (ft^2)	67,097	63,291										
SPA (ft^2)	0	0										
Total Area (ft^2)	136,625	108,707										
Total Impervious Area (ft^2)	69,528	45,416										
WQCV (ft^3)	2,897	1,892										
WQCV Reduction (ft^3)	2,186	1,892										
WQCV Reduction (%)	75%	100%										
Untreated WQCV (ft^3)	711	0										

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	245,332
Total Impervious Area (ft^2)	114,944
WQCV (ft^3)	4,789
WQCV Reduction (ft^3)	4,079
WQCV Reduction (%)	85%
Untreated WQCV (ft^3)	711

Calculated Site Results	Basin A-B		Basin B-C	
Downstream Design Point ID	P.1	P.2	P1	P2
DCIA (ft2)	63238.0	0.0	17055	0.0
UIA (ft2)	162996.0	0.0	52473	27710.0
RPA (ft2)	203567.0	0.0	67097	37464.0
SPA (ft2)	0.0	199586.0	0	0.0
Total Area (ft2)	429801.0	199586.0	136625	65174.0
Total Impervious Area (ft2)	226234.0	0.0	69528	27710.0
WQCV (ft3)	9426.4	0.0	2897	1154.6
WQCV Reduction (ft3)	6573.6	0.0	2186.375	1154.6
WQCV Reduction (%)	70%	0%	75%	100%
Untreated WQCV (ft3)	2852.8	0.0	710.625	0.0

Calculated Site Results	Basin A-B		Basin B-C	
Downstream Design Point ID	P.1	P.2	P.1	P.2
Total Area (ft2)	446856.0	199586.0	136625.0	65174.0
Total Impervious Area (ft2)	226234.0	0.0	69528.0	27710.0
WQCV (ft3)	9426.4	0.0	2897.0	1154.6
WQCV Reduction (ft3)	6573.6	0.0	2186.4	1154.6
WQCV Reduction (%)	70%	0%	75%	100%
Untreated WQCV (ft3)	2852.8	0.0	710.6	0.0

Calculated Site Results	Tributary to Temp Pond	Offsite	Total Site
WQCV (ft3)	12323.4	1154.6	13478.0
WQCV Reduction (ft3)	8760.0	1154.6	9914.6
WQCV Reduction (%)	73%	100%	86%
Untreated WQCV (ft3)	3563.4	0.0	3563.4

RUNOFF REDUCTION SUMMARY TABLE	
TRIBUTARY TO TEMPORARY POND	
TOTAL AREA (AC)	583481.0
TOTAL IMPERVIOUS AREA (AC)	295762.0
UIA (AC)	12323.4
RPA (AC)	8760.0
DCIA (AC)	1.5
SPA (AC)	3563.4
WQCV (CF)	12323.4
WQCV REDUCTION (CF)	8760.0
WQCV REDUCTION (%)	73%
UNTREATED WQCV (CF)	3563.4
FLOWING OFFSITE	
TOTAL AREA (AC)	264760.0
TOTAL IMPERVIOUS AREA (AC)	27710.0
UIA (AC)	1154.6
RPA (AC)	1154.6
DCIA (AC)	1.0
SPA (AC)	0.0
WQCV (CF)	1154.6
WQCV REDUCTION (CF)	1154.6
WQCV REDUCTION (%)	100%
UNTREATED WQCV (CF)	0.0
TOTAL SITE	
TOTAL AREA (AC)	848241.0
TOTAL IMPERVIOUS AREA (AC)	323472.0
UIA (AC)	13478.0
RPA (AC)	9914.6
DCIA (AC)	2.5
SPA (AC)	3563.4
WQCV (CF)	13478.0
WQCV REDUCTION (CF)	9914.6
WQCV REDUCTION (%)	86%
UNTREATED WQCV (CF)	3563.4

FlexTable: Catch Basin Table

Active Scenario: 5-year

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Inlet Location	Flow (Total Out) (cfs)
CB-1	6,827.51	6,823.74	6,824.59	6,824.59	In Sag	4.91
CB-2	6,827.42	6,823.51	6,824.11	6,824.11	In Sag	2.53
CB-3	6,823.56	6,819.81	6,820.51	6,820.51	In Sag	2.63
CB-4	6,823.56	6,819.87	6,820.54	6,820.54	In Sag	3.61

FlexTable: Conduit Table

Active Scenario: 5-year

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Flow (cfs)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STRM (5) (STRM)	STRM 5 (STRM)	O-1	6,817.09	6,816.00	12.77	72.8	0.015	36.0	0.013	8.40	81.60	15.6	6,818.23	6,816.82
STRM (1) (STRM)	CB-1	STRM 2 (STRM)	6,823.74	6,822.71	4.91	29.3	0.035	18.0	0.013	9.25	19.68	25.0	6,824.59	6,823.67
STRM (6) (STRM)	CB-2	STRM 8 (STRM)	6,823.51	6,822.68	2.53	29.3	0.028	18.0	0.013	7.10	17.67	14.3	6,824.11	6,823.30
STRM (2) (STRM)	STRM 2 (STRM)	STRM 3 (STRM)	6,822.51	6,821.63	4.90	35.2	0.025	24.0	0.013	7.98	35.77	13.7	6,823.29	6,822.54
STRM (7) (STRM)	STRM 8 (STRM)	STRM 3 (STRM)	6,822.49	6,821.63	2.52	57.0	0.015	24.0	0.013	5.50	27.79	9.1	6,823.04	6,822.54
STRM (3) (STRM)	STRM 3 (STRM)	STRM 10 (STRM)	6,821.13	6,819.22	7.37	152.7	0.013	30.0	0.013	6.86	45.87	16.1	6,822.03	6,820.54
STRM (9) (STRM)	CB-4	STRM 10 (STRM)	6,819.87	6,819.72	3.61	29.2	0.005	24.0	0.013	4.16	16.22	22.3	6,820.54	6,820.54
STRM (8) (STRM)	CB-3	STRM 10 (STRM)	6,819.81	6,819.72	2.63	9.2	0.010	24.0	0.013	4.78	22.42	11.8	6,820.51	6,820.54
STRM (3) (1) (STRM)	STRM 10 (STRM)	STRM 5 (STRM)	6,818.72	6,817.29	13.28	286.4	0.005	36.0	0.013	5.73	47.13	28.2	6,819.88	6,818.50

FlexTable: Manhole Table

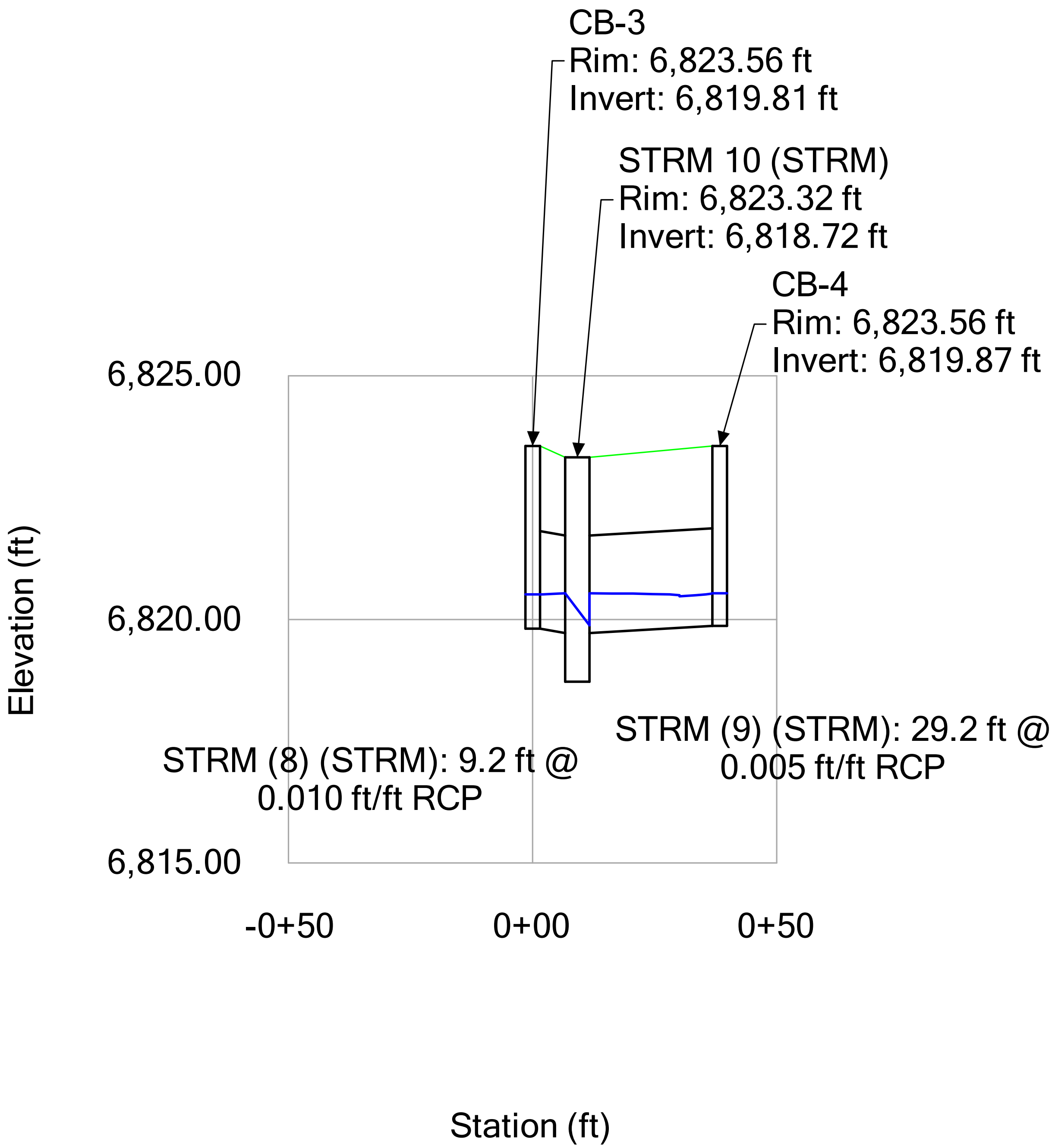
Active Scenario: 5-year

Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Elevation (Invert Out) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Headloss (ft)
6,827.27	6,822.71	6,822.51	4.90	6,823.29	6,823.67	0.38
6,827.17	6,822.68	6,822.49	2.52	6,823.04	6,823.30	0.26
6,826.73	6,821.63	6,821.13	7.37	6,822.03	6,822.54	0.50
6,823.32	6,819.22	6,818.72	13.28	6,819.88	6,820.54	0.66
6,823.17	6,817.29	6,817.09	12.77	6,818.23	6,818.50	0.27

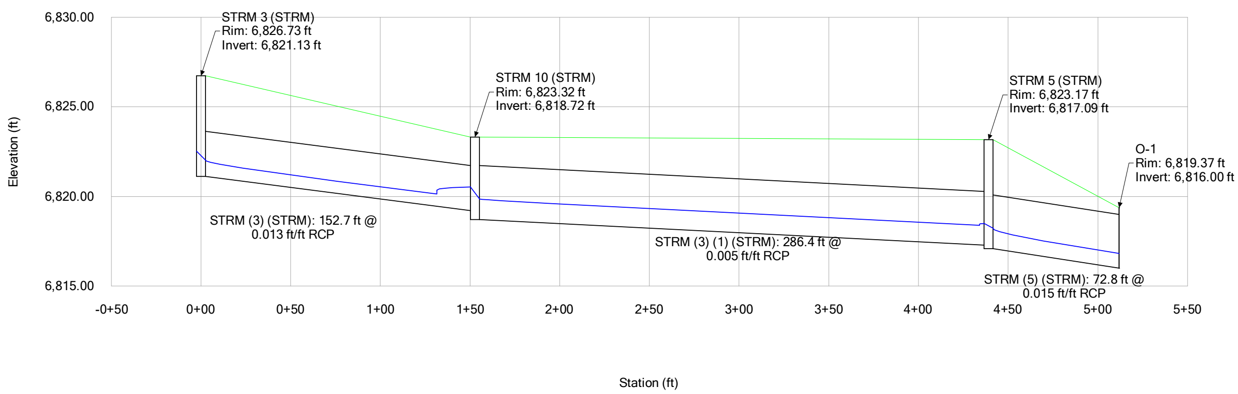
FlexTable: Outfall Table
Active Scenario: 5-year

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	6,819.37	6,816.00	Free Outfall	6,816.82	12.71

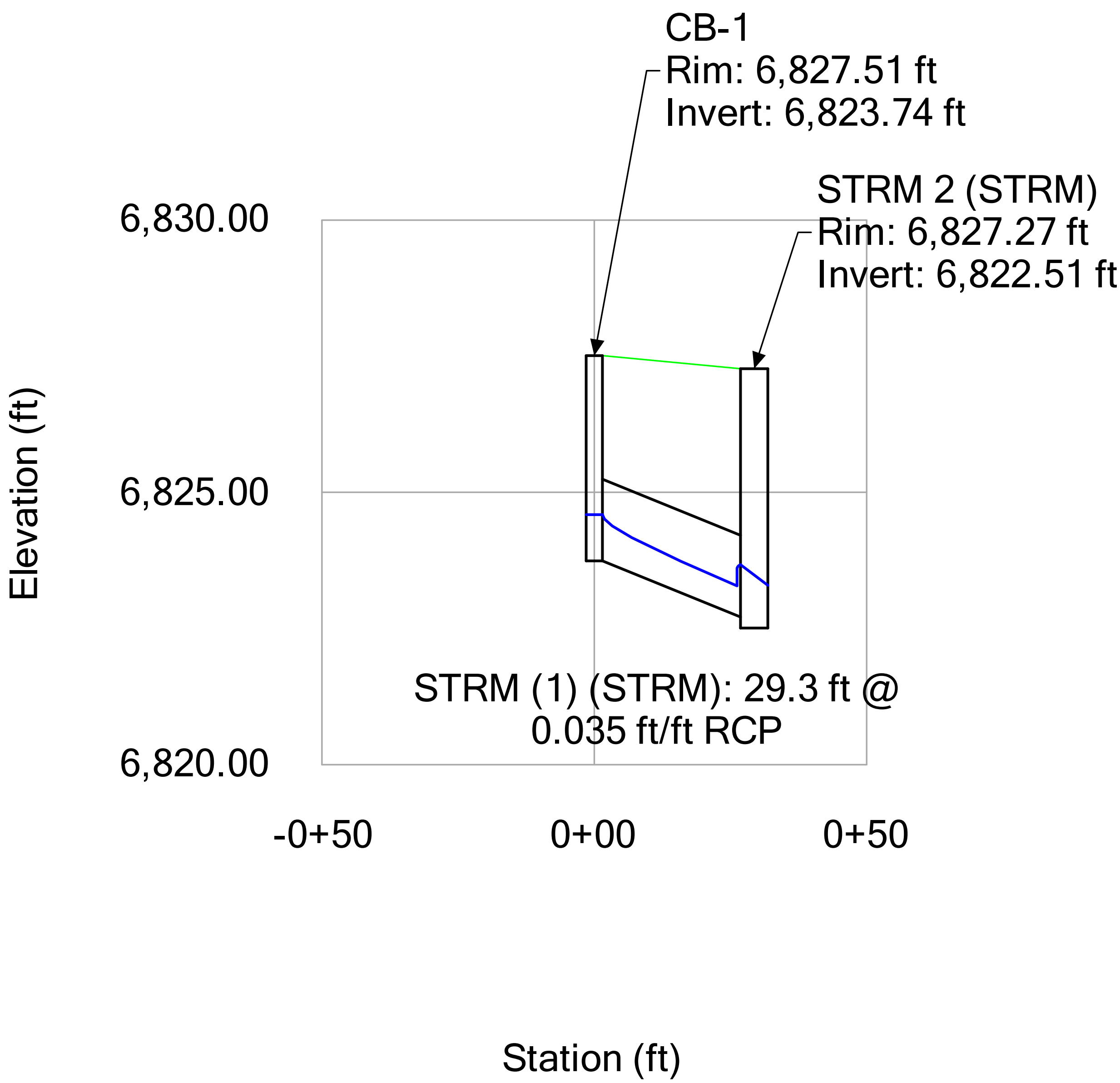
Profile Report
Engineering Profile - STREET A-LAT 1 (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



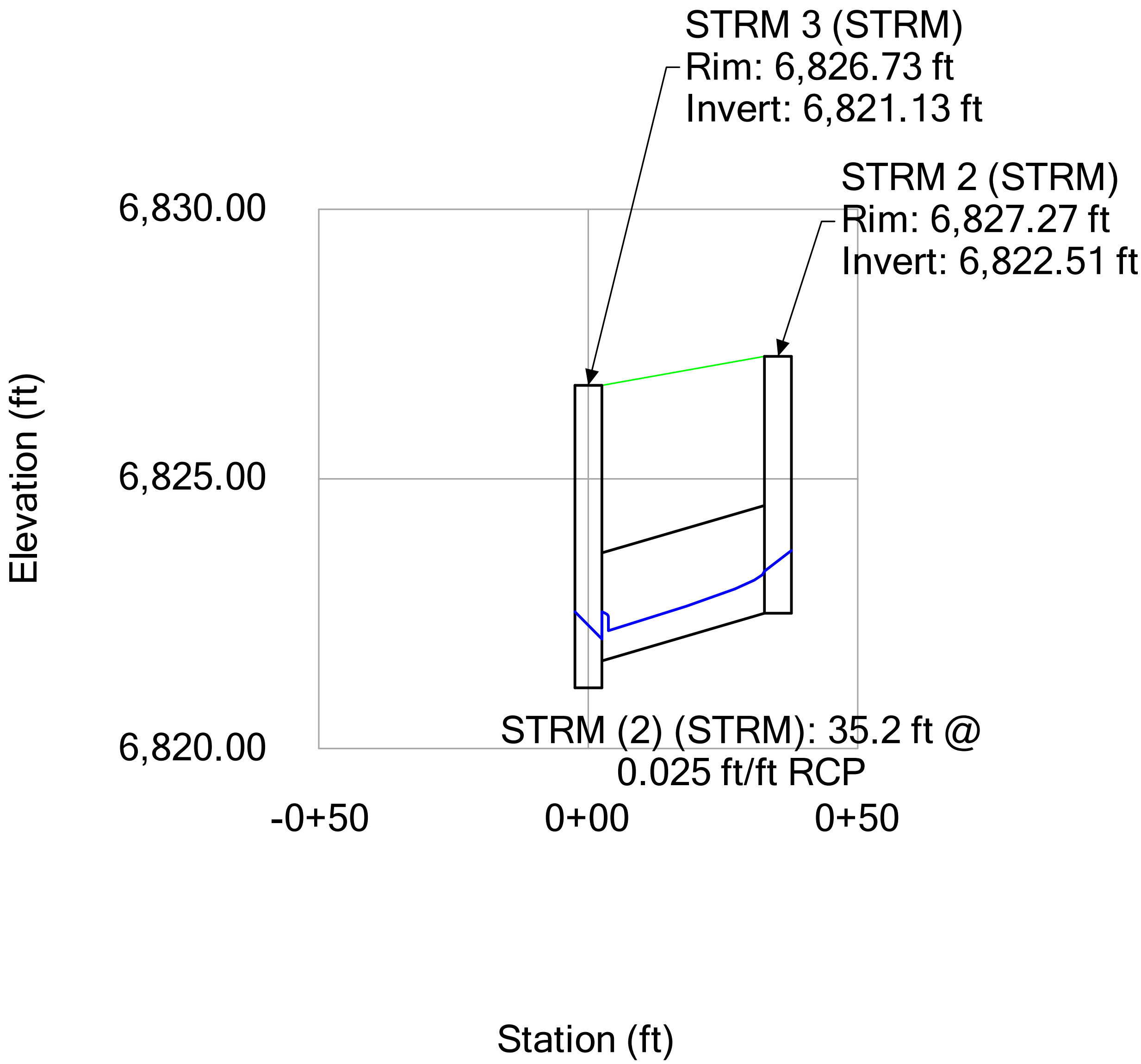
Profile Report
Engineering Profile - STREET A (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



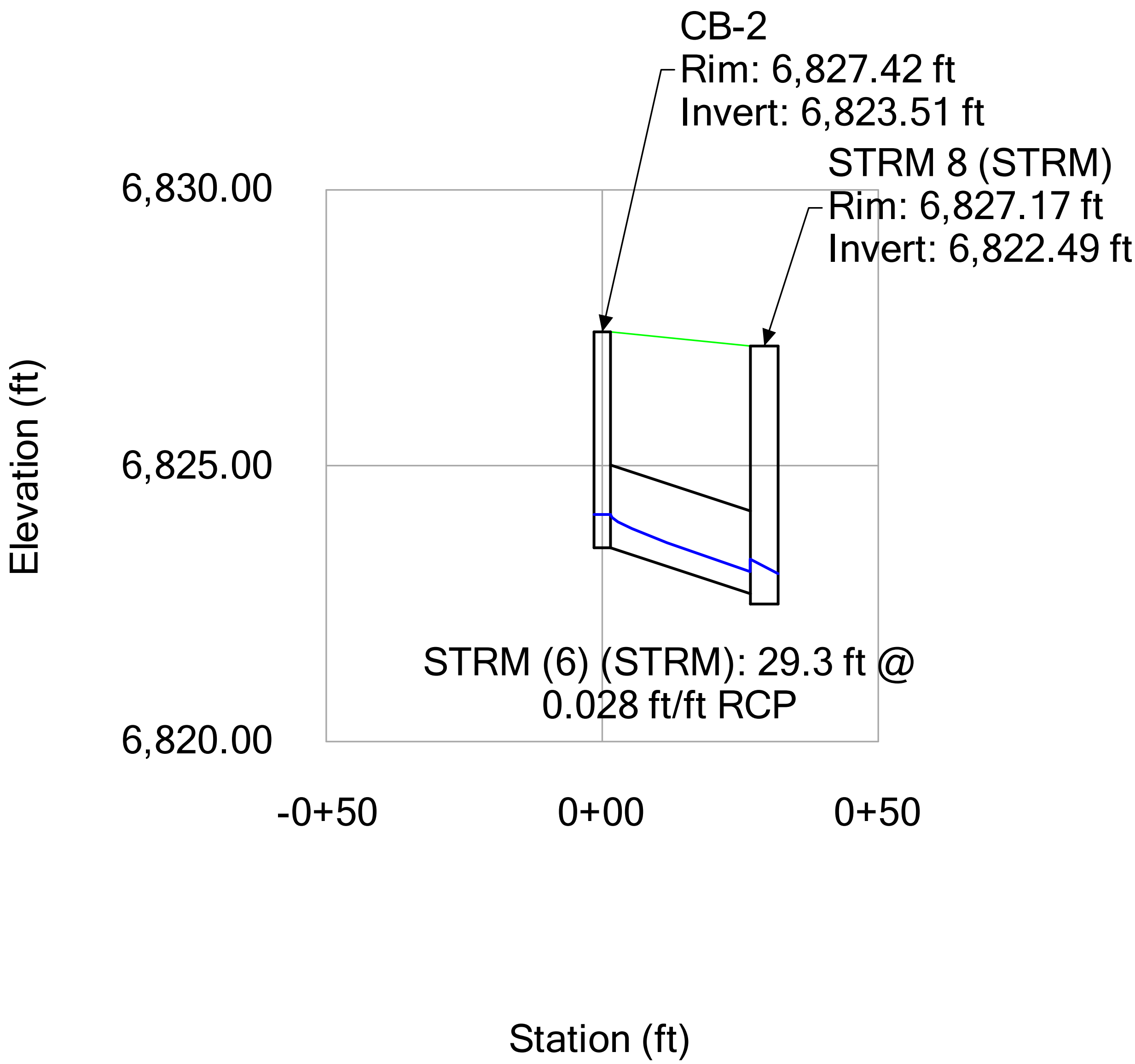
Profile Report
Engineering Profile - STREET B-LAT 1 (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



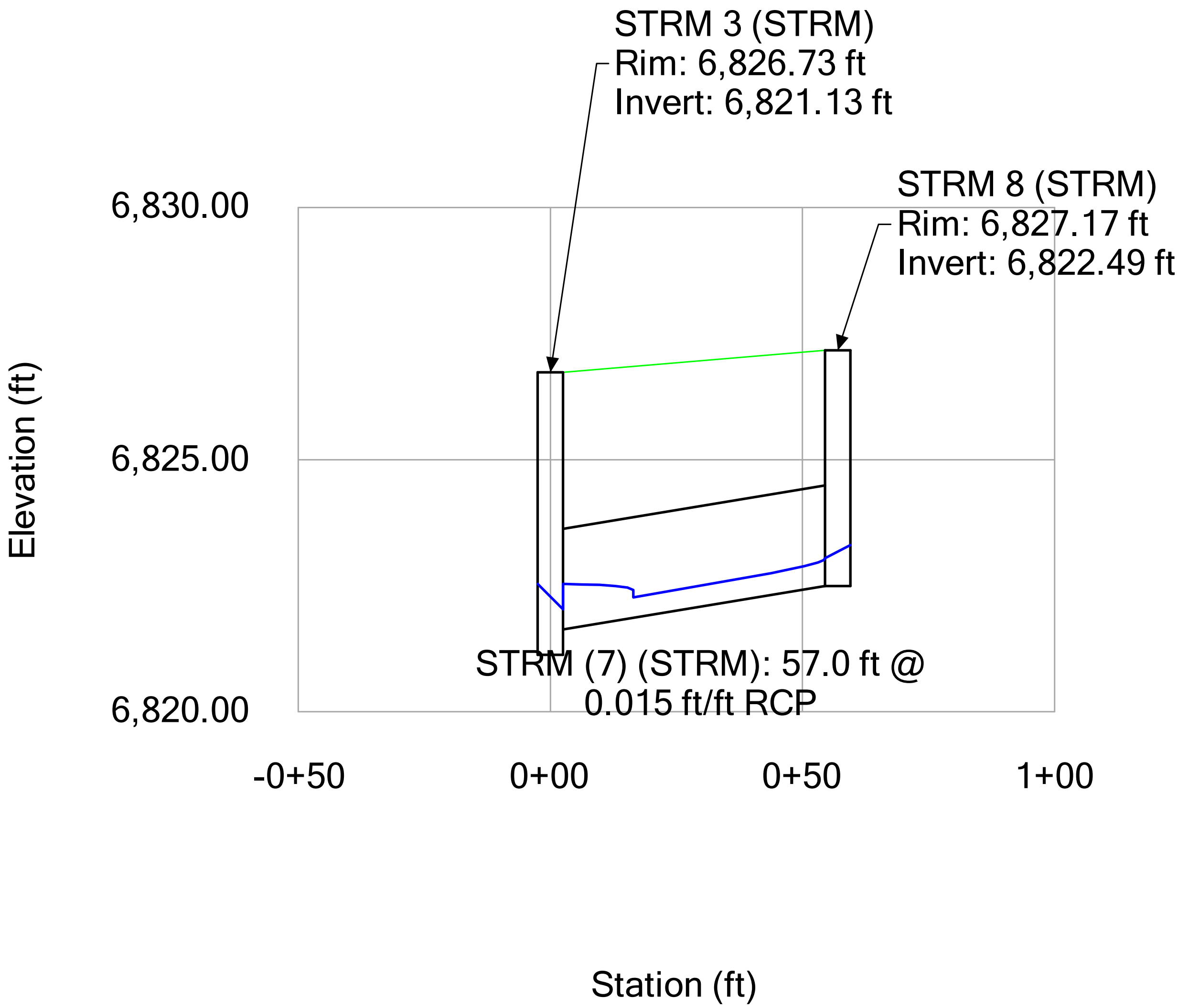
Profile Report
Engineering Profile - STREET B (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



Profile Report
Engineering Profile - STREET C-LAT 1 (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



Profile Report
Engineering Profile - STREET C (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 5-year



FlexTable: Catch Basin Table

Active Scenario: 100-year

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Inlet Location	Flow (Total Out) (cfs)
CB-1	6,827.51	6,823.74	6,825.11	6,825.11	In Sag	13.63
CB-2	6,827.42	6,823.51	6,824.54	6,824.54	In Sag	7.02
CB-3	6,823.56	6,819.81	6,822.02	6,822.02	In Sag	7.30
CB-4	6,823.56	6,819.87	6,822.07	6,822.07	In Sag	10.02

FlexTable: Conduit Table

Active Scenario: 100-year

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Flow (cfs)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
STRM (5) (STRM)	STRM 5 (STRM)	O-1	6,817.09	6,816.00	35.89	72.8	0.015	36.0	0.013	11.17	81.60	44.0	6,819.04	6,818.00
STRM (1) (STRM)	CB-1	STRM 2 (STRM)	6,823.74	6,822.71	13.63	29.3	0.035	18.0	0.013	12.02	19.68	69.2	6,825.11	6,824.61
STRM (6) (STRM)	CB-2	STRM 8 (STRM)	6,823.51	6,822.68	7.02	29.3	0.028	18.0	0.013	9.42	17.67	39.7	6,824.54	6,823.90
STRM (2) (STRM)	STRM 2 (STRM)	STRM 3 (STRM)	6,822.51	6,821.63	13.60	35.2	0.025	24.0	0.013	10.61	35.77	38.0	6,823.84	6,823.66
STRM (7) (STRM)	STRM 8 (STRM)	STRM 3 (STRM)	6,822.49	6,821.63	7.01	57.0	0.015	24.0	0.013	7.37	27.79	25.2	6,823.53	6,823.66
STRM (3) (STRM)	STRM 3 (STRM)	STRM 10 (STRM)	6,821.13	6,819.22	20.48	152.7	0.013	30.0	0.013	9.08	45.87	44.6	6,822.67	6,822.01
STRM (9) (STRM)	CB-4	STRM 10 (STRM)	6,819.87	6,819.72	10.02	29.2	0.005	24.0	0.013	3.19	16.22	61.8	6,822.07	6,822.01
STRM (8) (STRM)	CB-3	STRM 10 (STRM)	6,819.81	6,819.72	7.30	9.2	0.010	24.0	0.013	2.32	22.42	32.6	6,822.02	6,822.01
STRM (3) (1) (STRM)	STRM 10 (STRM)	STRM 5 (STRM)	6,818.72	6,817.29	37.04	286.4	0.005	36.0	0.013	7.38	47.13	78.6	6,820.72	6,819.58

FlexTable: Manhole Table

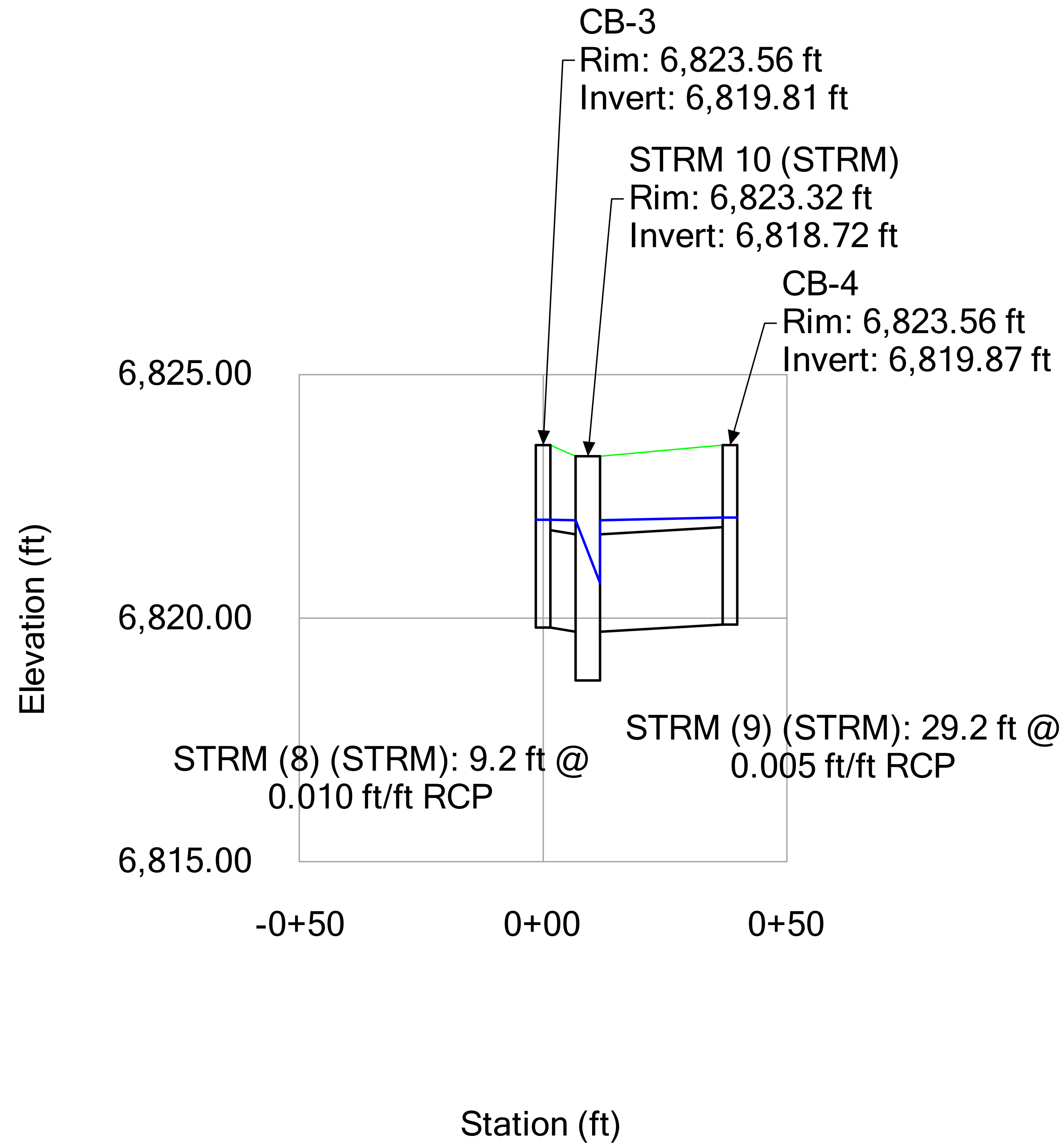
Active Scenario: 100-year

Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Elevation (Invert Out) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Headloss (ft)
6,827.27	6,822.71	6,822.51	13.60	6,823.84	6,824.61	0.77
6,827.17	6,822.68	6,822.49	7.01	6,823.53	6,823.90	0.37
6,826.73	6,821.63	6,821.13	20.48	6,822.67	6,823.66	0.99
6,823.32	6,819.22	6,818.72	37.04	6,820.72	6,822.01	1.29
6,823.17	6,817.29	6,817.09	35.89	6,819.04	6,819.58	0.54

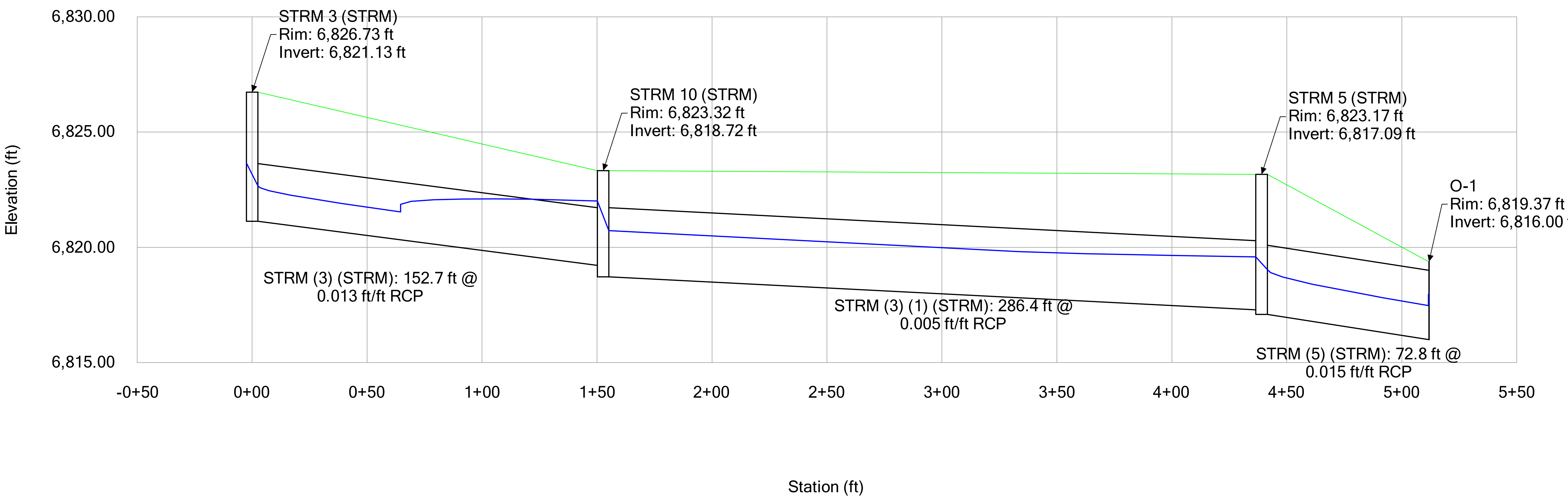
FlexTable: Outfall Table
Active Scenario: 100-year

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	6,819.37	6,816.00	User Defined Tailwater	6,818.00	35.69

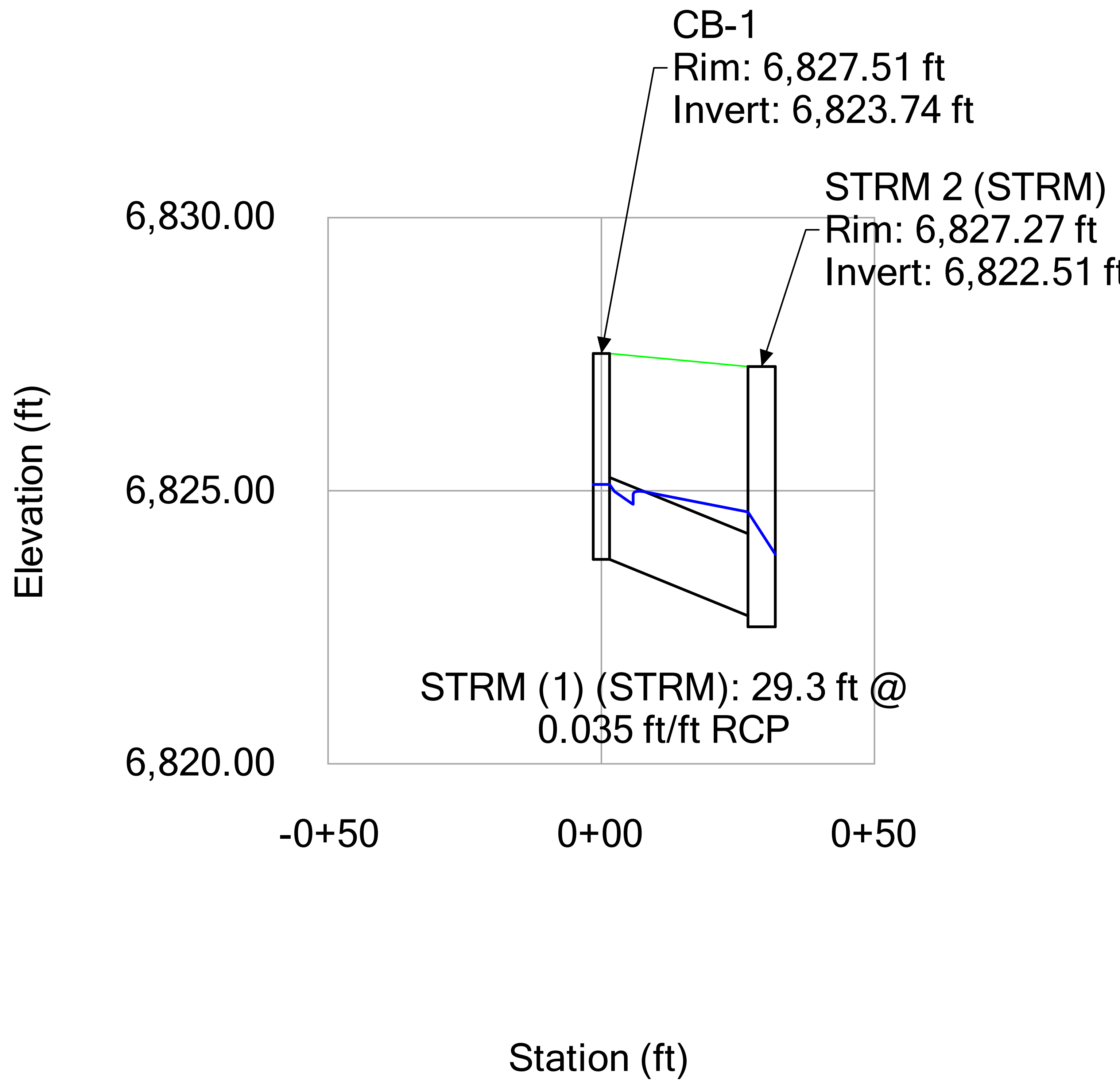
Profile Report
Engineering Profile - STREET A-LAT 1 (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 100-year



Profile Report
Engineering Profile - STREET A (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 100-year



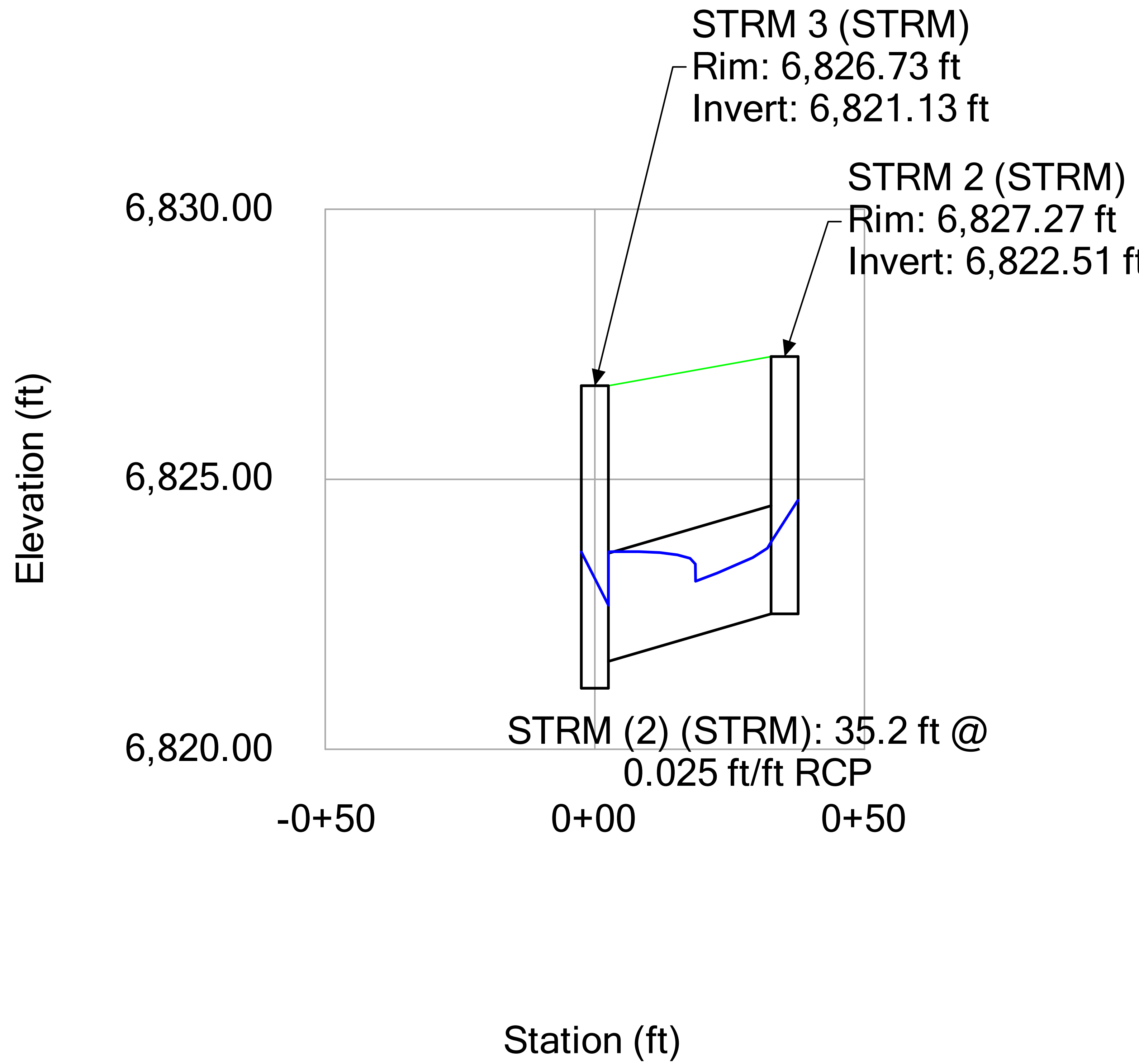
Profile Report
Engineering Profile - STREET B-LAT 1 (24004308-StormCAD-2024-07-09.stsw)
Active Scenario: 100-year



Profile Report

Engineering Profile - STREET B (24004308-StormCAD-2024-07-09.stsw)

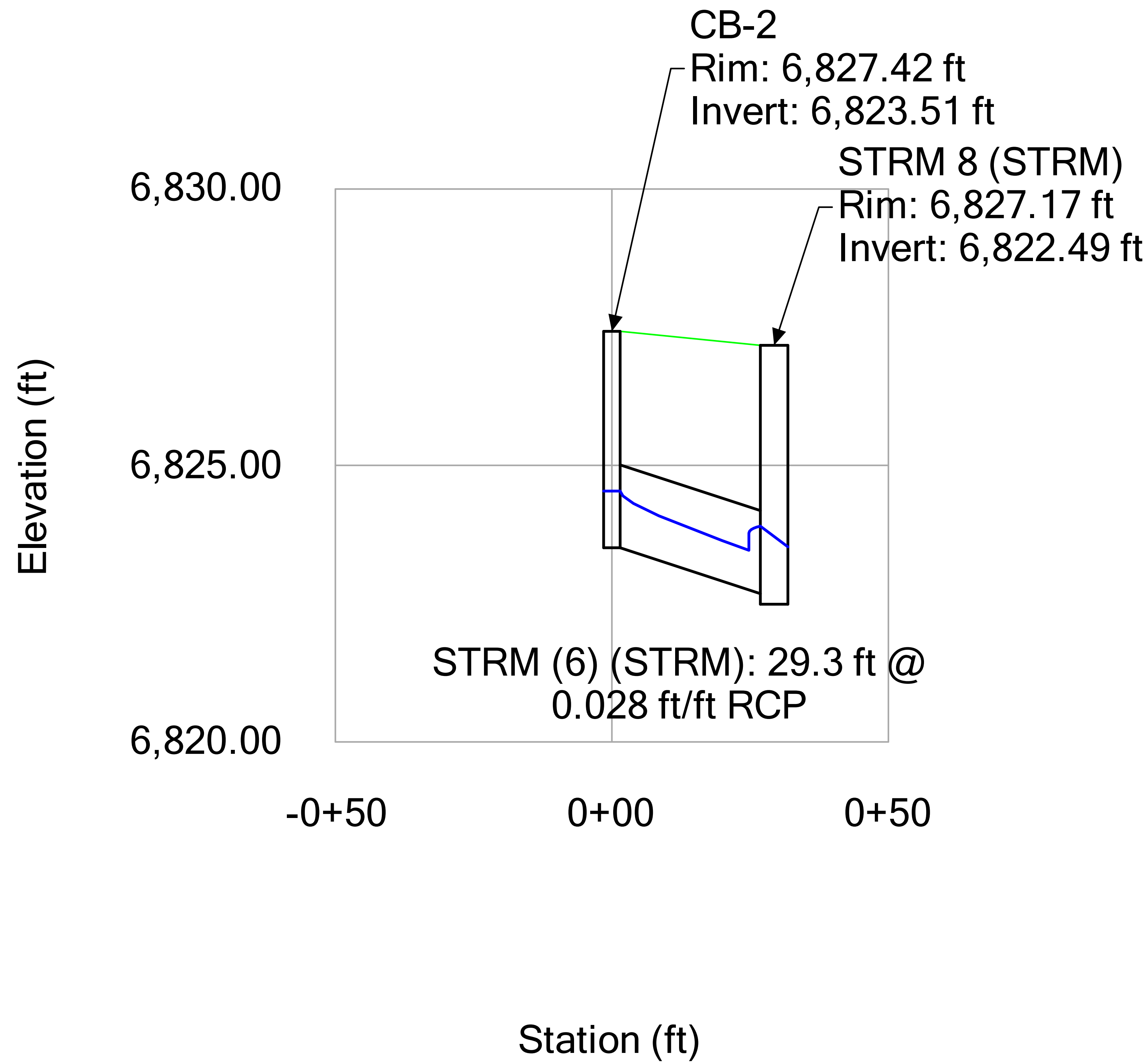
Active Scenario: 100-year



Profile Report

Engineering Profile - STREET C-LAT 1 (24004308-StormCAD-2024-07-09.stsw)

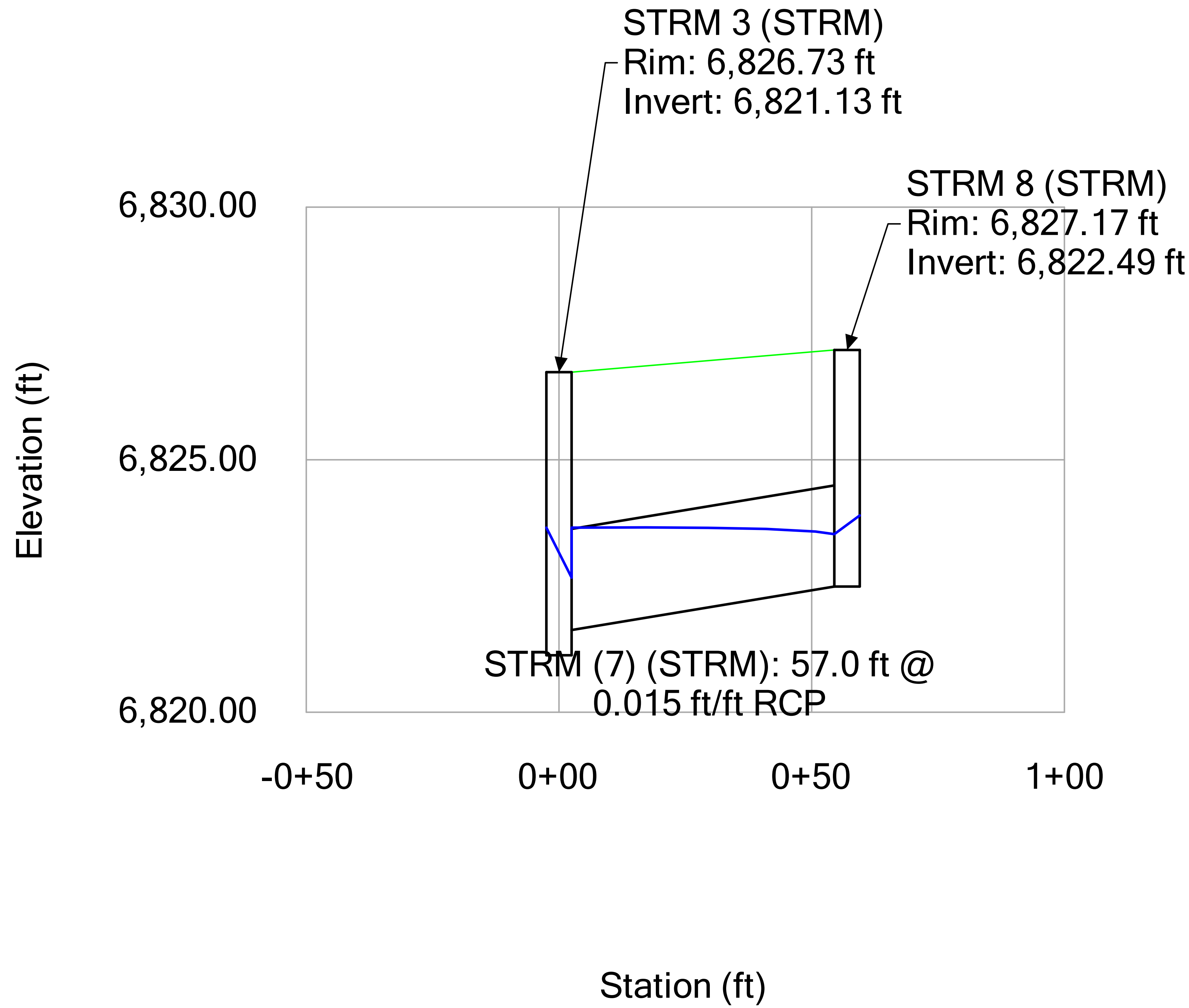
Active Scenario: 100-year



Profile Report

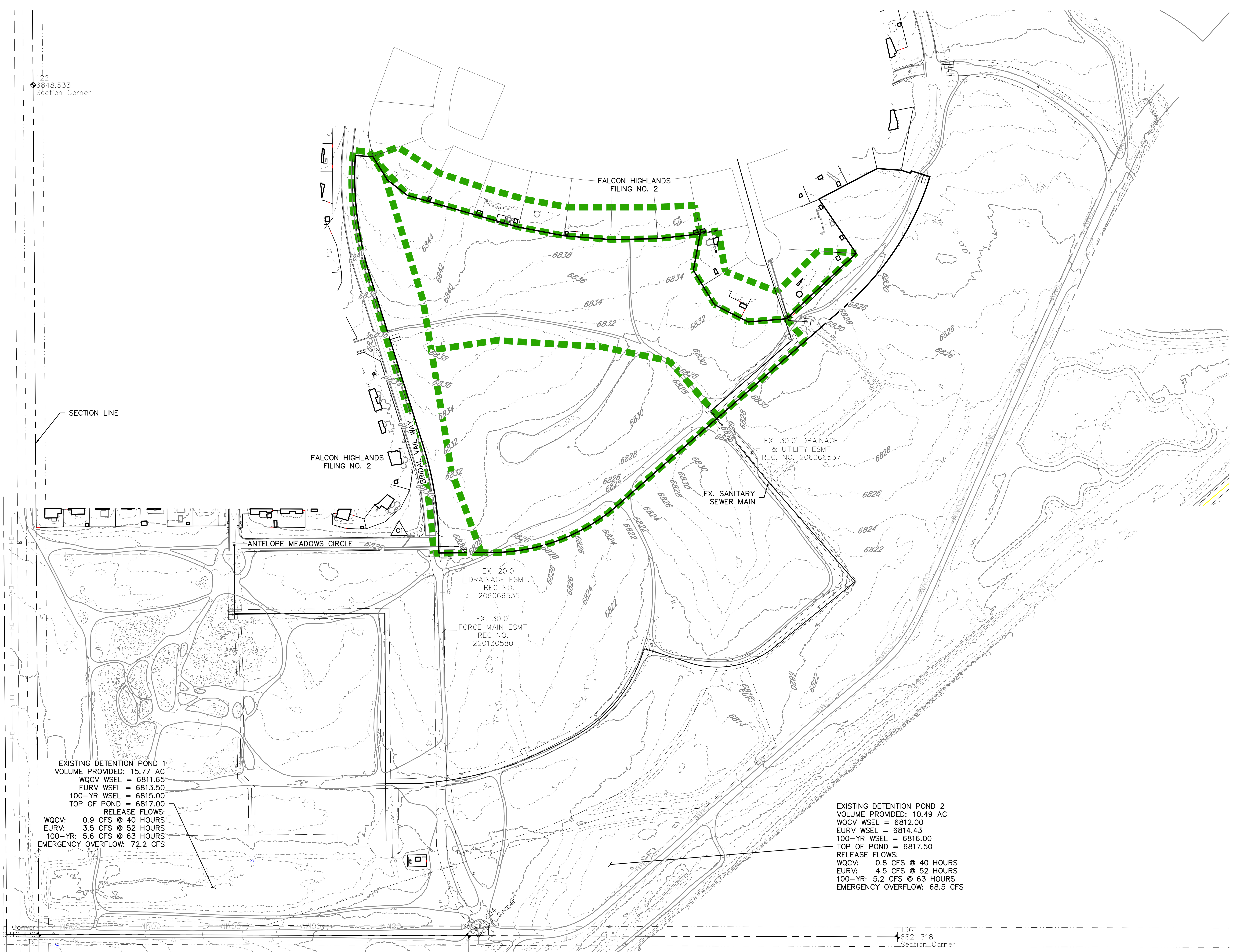
Engineering Profile - STREET C (24004308-StormCAD-2024-07-09.stsw)

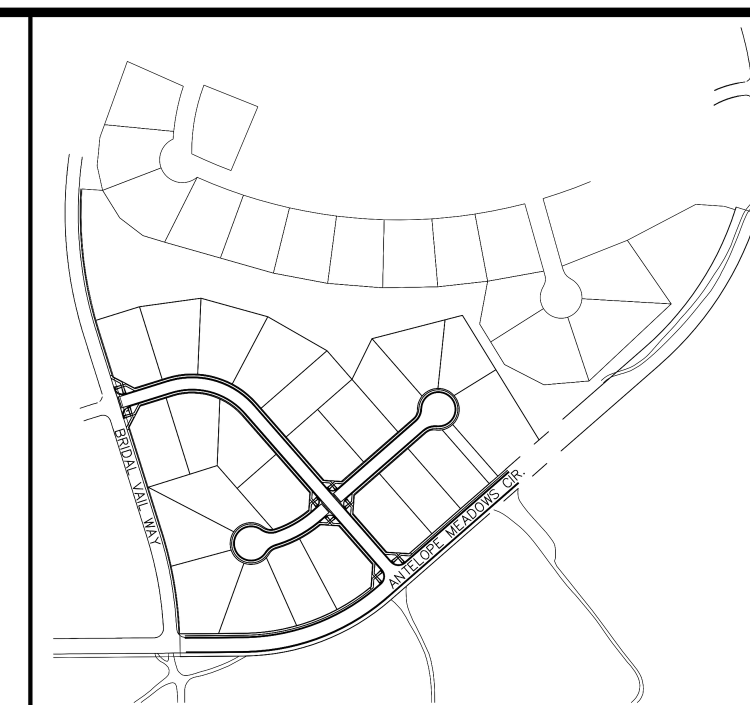
Active Scenario: 100-year



Appendix F

Drainage Maps





KEY MAP
1" = 400'

LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING SECTION LINE
- EXISTING EASEMENT
- EXISTING CONTOURS
- PROPOSED CONTOURS
- A-1 / 1.2 / 0.50 / 0.75: BASIN ID; 5-YR RATIONAL C COEFFICIENT; 5-YR RATIONAL C COEFFICIENT; BASIN SIZE IN ACRES
- DESIGN POINT ID
- MAJOR BASIN BOUNDARY
- FLOW ARROW

BENCHMARK:
ELEVATIONS ARE BASED UPON SW COR SEC. 12, T13S, R65W, 6TH PM, FND. 3.25" ALUM. CAP.
(ELEVATION: 6810.43=NAVD88).

BASIS OF BEARINGS:
BEARINGS ARE BASED UPON THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 12, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, MONUMENTED AT THE SOUTH END BY A FOUND3-1/4" ALUMINUM CAP STAMPED "AZTEC CONSULTANTS PLS 38256" AND AT THE NORTH END BY A FOUND 3-1/4" ALUMINUM CAP STAMPED "PLS 4842".

811. Know what's **below.** **Call** before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

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SUITE 250
COLORADO SPRINGS, CO 80920
719-598-5192
JIM BYERS

CLIENT
CHALLENGER HOMES
FALCON HIGHLANDS SOUTH – FILING 1
EL PASO COUNTY, COLORADO
DRAINAGE MAPS

EXISTING DRAINAGE MAP

DATE --

A	1ST SUBMITTAL TO JURISDICTION 07/08/2024 – KMB

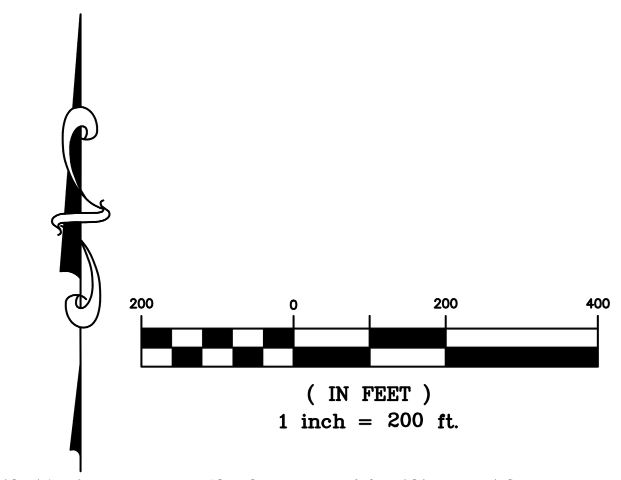
REVISIONS

COUNTY FILE NO.:

DR. TN | CH. KB
P.M. DM
JOB 24004308
SHEET NO.

CAD FILE: EX DRAINAGE MAP.DWG

KEY MAP
1" = 400'



LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING SECTION LINE
- EXISTING EASEMENT
- EXISTING CONTOURS
- PROPOSED CONTOURS

A-1 — BASIN ID
1.2 — BASIN SIZE IN ACRES
0.50 — 5-YR RATIONAL C COEFFICIENT
0.75 — 5-YR RATIONAL C COEFFICIENT

DESIGN POINT ID
MAJOR BASIN BOUNDARY
FLOW ARROW

BENCHMARK:

ELEVATIONS ARE BASED UPON SW COR SEC. 12, T13S, R65W, 6TH PM, FND. 3.25" ALUM. CAP.
(ELEVATION: 6810.43=NAVD88).

BASIS OF BEARINGS:

BEARINGS ARE BASED UPON THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 12, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, MONUMENTED AT THE SOUTH END BY A FOUND3-1/4" ALUMINUM CAP STAMPED "AZTEC CONSULTANTS PLS 38256" AND AT THE NORTH END BY A FOUND 3-1/4" ALUMINUM CAP STAMPED "PLS 4842".

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JIM BYERS

CLIENT
CHALLENGER HOMES
FALCON HIGHLANDS SOUTH - FILING 1
EL PASO COUNTY, COLORADO
DRAINAGE MAPS

OVERALL MAP

DATE --

A 1ST SUBMITTAL TO JURISDICTION 07/08/2024 - KMB

REVISIONS

COUNTY FILE NO.:

DR. TN | CH. KB
P.M. DM
JOB 24004308
SHEET NO.
2

CAD FILE: PROPOSED DRAINAGE MAP.DWG


KEY MAP
1" = 400'

LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING SECTION LINE
- EXISTING EASEMENT
- EXISTING CONTOURS
- PROPOSED CONTOURS
- BASIN ID
- 5-YR RATIONAL C COEFFICIENT
- 5-YR RATIONAL C COEFFICIENT
- BASIN SIZE IN ACRES
- DESIGN POINT ID
- MAJOR BASIN BOUNDARY
- FLOW ARROW

BENCHMARK:
ELEVATIONS ARE BASED UPON SW COR SEC. 12, T13S, R65W, 6TH PM, FND. 3.25" ALUM. CAP. (ELEVATION: 6810.43=NAVD88).

BASIS OF BEARINGS:
BEARINGS ARE BASED UPON THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 12, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, MONUMENTED AT THE SOUTH END BY A FOUND3-1/4" ALUMINUM CAP STAMPED "AZTEC CONSULTANTS PLS 38256" AND AT THE NORTH END BY A FOUND 3-1/4" ALUMINUM CAP STAMPED "PLS 4842".

811 Know what's below. Call before you dig.

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NOTICE:
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143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

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EL PASO COUNTY, COLORADO
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PROPOSED MAP

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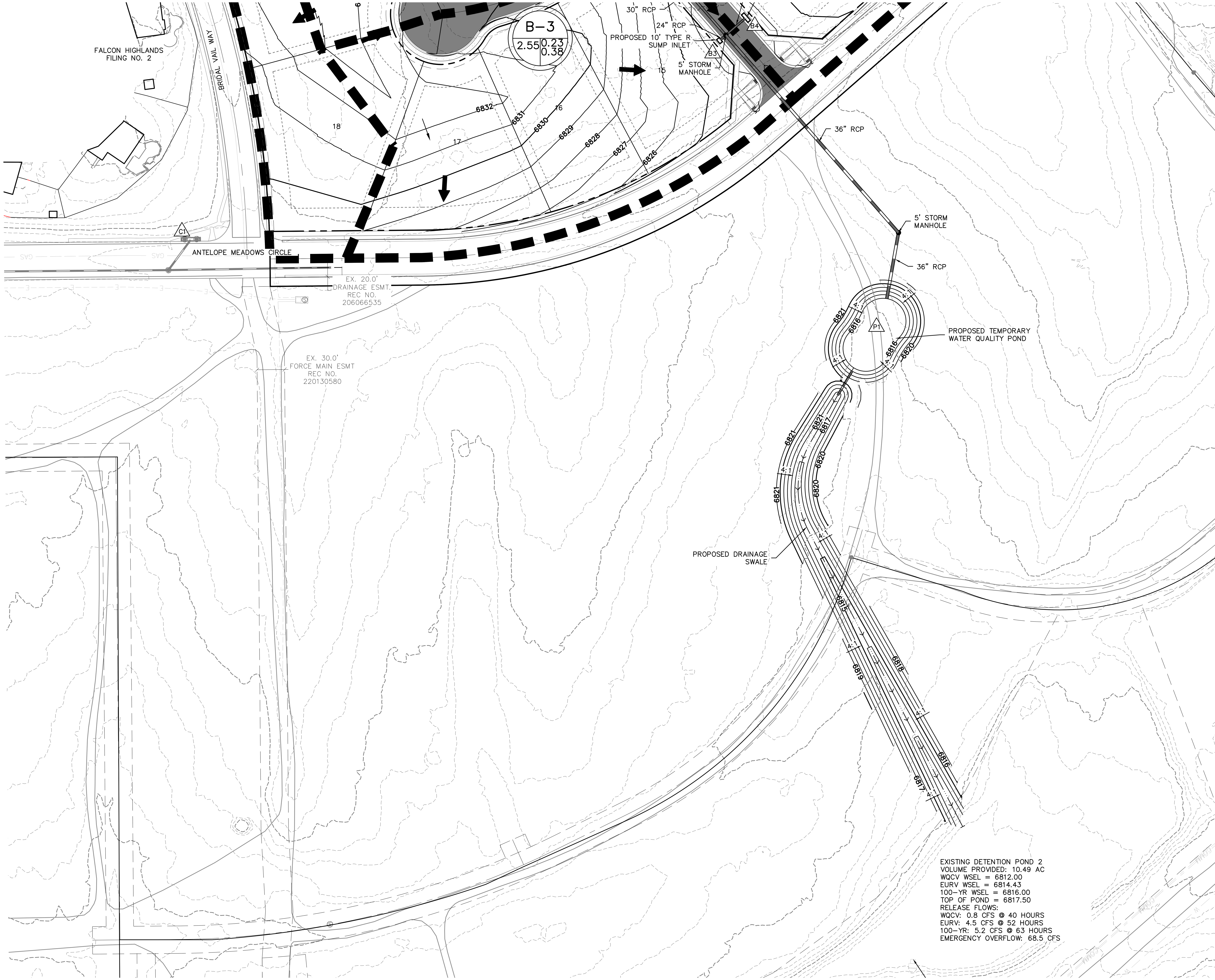
CAD FILE: PROPOSED DRAINAGE MAP.DWG



(IN FEET)
1 inch = 200 ft.

LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING SECTION LINE
- EXISTING EASEMENT
- EXISTING CONTOURS
- PROPOSED CONTOURS
- A-1 / 1.2 / 0.50 / 0.75: BASIN ID; BASIN SIZE IN ACRES; 5-YR RATIONAL C COEFFICIENT; 5-YR RATIONAL C COEFFICIENT
- DESIGN POINT ID
- MAJOR BASIN BOUNDARY
- FLOW ARROW

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EL PASO COUNTY, COLORADO
DRAINAGE MAPS

PROPOSED MAP

DATE

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REVISIONS

COUNTY FILE NO.:

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SHEET NO.
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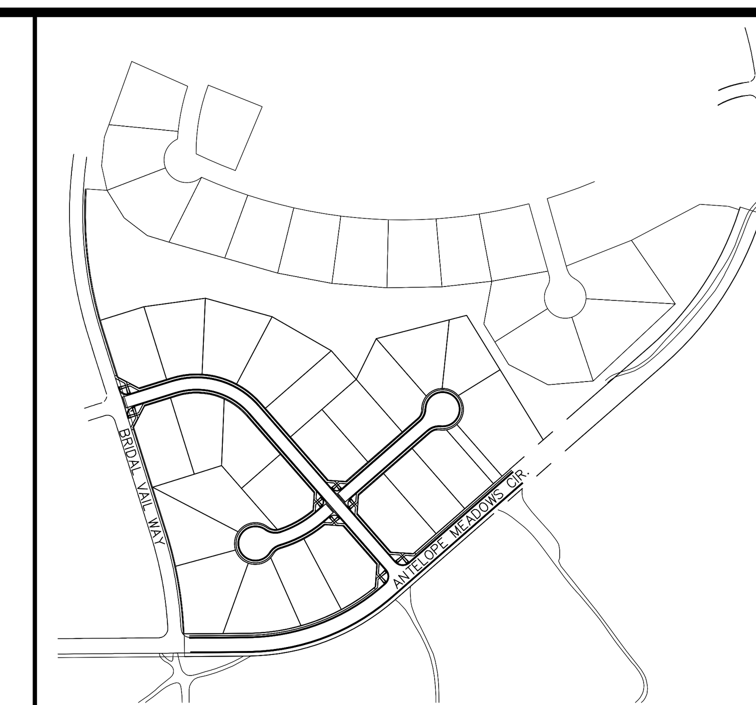
CAD FILE: PROPOSED DRAINAGE MAP.DWG

LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING SECTION LINE
- EXISTING EASEMENT
- EXISTING CONTOURS
- PROPOSED CONTOURS

BASIN ID — A-1; BASIN SIZE IN ACRES — 1.2; 5-YR RATIONAL C COEFFICIENT — 0.50; 5-YR RATIONAL C COEFFICIENT — 0.75

- DESIGN POINT ID
- MAJOR BASIN BOUNDARY
- FLOW ARROW
- UIA:RPA INTERFACE LENGTH
- UNCONNECTED IMPERVIOUS AREA (UIA)
- RECEIVING PERVIOUS AREA (RPA)
- DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA)
- SEPARATE PERVIOUS AREA (SPA)



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DRAINAGE MAPS
GREEN INFRASTRUCUTRE MAP

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A 1st SUBMITTAL TO JURISDICTION 07/08/2024 - KMB
REVISIONS

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P.M. DM	
JOB 24004308	
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CAD FILE: GREEN INFRASTRUCTURE MAP.DWG