FINAL DRAINAGE REPORT
FOR
GATEWAY TRUCKING

Gateway Trucking, LLC
11260 West Lane
Colorado Springs, CO 80929
(719) 492-7658
Contact: Perry Hastings

November 9th, 2021
Project No. 25215.00

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive
Colorado Springs, CO 80919
719-593-2593

El Paso County PCD File No. PPR-21-033

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 El Paso 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.

Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

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: Gateway Trucking, LLC

By:

Title:
Address: 11260 West Lane
Colorado Springs, CO 80929

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

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

Conditions:

CONTENTS

PURPOSE

This document is the Drainage Report for Gateway Trucking, located along S. Franceville Coal Mine Road, County of El Paso, and State of Colorado. The project site is being developed for the purpose of having a parking area for commercial trucks and associated equipment. The land previous to this use was vacant and undeveloped. The purpose of this report is to:

1. Identify on-site and off-site drainage patterns.
2. Recommend storm water facilities to collect and convey storm runoff from the proposed development to adequate discharge and/or detention locations.
3. Recommend water quality and detention facilities to control discharge release rates to below historic.
4. Demonstrate compliance with surrounding major drainage basin planning studies, master development drainage plans and flood insurance studies.

GENERAL LOCATION AND DESCRIPTION

Location

The project property is approximately to the east of S. Franceville Coal Mine Road in the NW1/4, NW1/4 of Section 20, and that portion of the NE1/4, NE1/4 Section 19 T.14S., R.64W. of the 6th P.M. in El Paso County. The site consists of a portion of parcel 44000-00-531 totaling approximately 11.09 acres all bounded by fencing. The site is bounded to the west by S. Franceville Coal Mine Road, to the south by the remaining area of parcel 44000-00-531, to the east by the same parcel 44000-00-531, and to the north by parcel 44000-00-539 (same owner-Perry Hastings). A vicinity map is presented in Appendix A.

Description of Property

The subject site is currently a dirt area used as a parking area for commercial trucks with a surrounding undeveloped area consisting of sparse native vegetation coverage. There is an existing gravel access road from S. Franceville Coal Mine Road. This access road leads to the project site, existing dirt parking, and then continues to the east until it hits existing fence that encloses the project site. In general, the site slopes from the southeast to the northwest at slopes ranging from ~0-9% towards the existing low point and existing 30-inch CMP (corrugated metal pipe). That stormwater pipe is the only existing stormwater component located on the site. The ultimate outfall of this drainageway is Jimmy Camp Creek.

Per a NRCS web soil survey, the site is made up of Type B soils. Type B soils have a moderate infiltration when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

There are no known existing wells on the site.

Floodplain Statement

Based on the FEMA FIRM Map number 08041C0780G, dated December 7, 2018, the site lies within Zone X of the floodplain surrounding Jimmy Camp Creek. Zone X is defined as the area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 500-yr floodplain. All proposed development on the Gateway Trucking Site will occur within Zone X.
The FIRM Map has been presented in Appendix A.

DRAINAGE BASINS AND SUB-BASINS

Existing Major Basin Descriptions

The site lies within the Jimmy Camp Creek Drainage Basin based on the "*Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives & Design of Selected Plan Report*" prepared by Kiowa Engineering Corporation in March 2015. The Jimmy Camp Creek Drainage Basin is an east bank tributary to Fountain Creek and covers approximately 67.1 square miles located in El Paso County, CO. The basin generally slopes from north to south beginning near Garrett Road and outfalls into Fountain Creek just west of Old Pueblo Road (Main Street) near the City of Fountain's historic downtown. The main channel of Jimmy Camp Creek has an approximate slope of 1.0% over the channel length of 24 miles.

The site is closest to the Franceville Tributary of Jimmy Camp Creek. As is shown in the appendices, the FIRM map states that the project site is located within floodplain Zone X. Therefore, the project site improvement will be conducted outside of the limit of the 500-year floodplain. No off-site channel improvements are recommended to be completed with the development this report supports.

Existing Sub-basin Drainage

On-site existing sub-basin drainage patterns are generally from southeast to northwest. The existing project site overall varies in slope depending on the location. The undeveloped areas (surrounding flat parking area) of the project site tend to have greater slopes ranging from as low as 7% (existing area draining towards existing 30" CMP) to as high as over 70% (slope towards from dirt area to local depression). The existing dirt parking area is generally flat and has less than 1% slope. The flat area drains to both the north and south through undefined drainage paths and eventually reaches a low point encased by a berm. Continuing further west after that existing berm is the existing outfall for the site which is a 30-inch CMP. There are no other existing stormwater facilities located on the site, and no existing utilities. The existing 30-inch culvert transports water from the east to the west-side of S. Franceville Coal Mine Road and into the existing drainageway. From there the water will follow the existing drainage patterns until it's confluence with Jimmy Camp Creek, the ultimate receiving waters. There are no known wells or irrigation facilities located on-site. Below are existing basin descriptions. An existing drainage map is included in the appendices.

Existing off-site Basin OS1 is approximately 2.29 acres in area and consists completely of undeveloped, sparsely vegetated open space. Runoff generated (Q_5=0.7 cfs, and Q_{100}= 4.4 cfs), will flow west from the highpoint on the east to design point 1. Flow will then enter into existing Basin EX-A. Then it will follow the Basin EX-A flow path to the existing low point at design point 3.

Existing Basin EX-A is approximately 6.75 acres in area and consists of undeveloped, sparsely vegetated open space. Besides the undeveloped flat area, the surrounding sloped areas within the basin are also undeveloped. Runoff generated (Q_5=1.3 cfs, and Q_{100}= 12.8 cfs), will flow from east to west towards the existing basin low-point at design point 3. From design point 3, runoff will then enter into Basin EX-B flowing west to northwest and the flow will reach design point 5, which is the ultimate outfall for the project site.

Existing off-site Basin OS2 is approximately 4.68 acres in area and consists completely of undeveloped, sparsely vegetated open space. Runoff generated (Q_5=1.2 cfs, and Q_{100}= 8.1 cfs), will flow west from the highpoint on the east. Flow will then go from design point 2 into existing Basin EX-A. Then it will follow the Basin EX-A flow path to the existing low point at design point 3.

Existing off-site Basin OS3 is approximately 0.60 acres in area and consists of undeveloped, sparsely vegetated open space, as well as part of the existing S. Franceville Coal Mine Road. Runoff generated (Q_5=0.4 cfs, and Q_{100}= 1.5 cfs), will flow west from the highpoint on the south to design point 4. Runoff will then utilize the existing roadway swale along S. Franceville Coal Mine Road and flow into existing Basin EX-B. Then it will follow the Basin EX-B flow path to the existing site outfall at design point 5.

Existing Basin EX-B is approximately 3.76 acres in area and consists of undeveloped, sparsely vegetated open space. Part of Basin EX-B consists of runoff flowing from east to west along the south side of the existing gravel road. The apparent local depression to the north of the access road did not appear deep based on a site visit conducted. See the attached report for more information and pictures of the existing conditions. Runoff generated (Q_5=0.4 cfs, and Q_{100}= 8.0 cfs), will sheet flow from towards the ultimate outfall for the project site at design point 5. The other part of Basin EX-B consists of runoff from the southwest fence line to the north towards design point 5. This existing flow is directed by an existing berm that directs flows on the east and west sides, into either Basin EX-A or EX-B. Runoff flows towards the west side of S. Franceville Coal Mine Road and is directed by an existing swale running to the north towards the existing site outfall at design point 5.
The proposed grading will better use a berm near the existing outfall to separate on-site treated flows as well as off-site flows that will be directed to the existing outfall. The proposed grading will eliminate the local low-point in Basin EX-A and create an extended detention basin where on-site flows will be directed.

Proposed Sub-basin Drainage

The proposed improvements for the project site include creating a "flat" gravel area for commercial parking. The approximately 4.3 acre gravel parking area will start at the access from the paved roadway onto the project site and extends to the east, west, and south before meeting existing grade. Proposed grass-lined swales and berms will border the north and south edges of the parking area to direct runoff towards a common riprap rundown area. From there the runoff will flow down the protected riprap rundown to the forebay and into the proposed extended detention basin.
Below are the proposed sub-basin descriptions. Refer to the appendices for a proposed conditions drainage map.

Proposed off-site Basin OS1A is approximately 1.62 acres in area and consists of a southern portion of the previously defined Basin OS1 (totaling 2.29 acres). The area entirely is made up of undeveloped, sparsely vegetated open space. The Basin has no proposed grading and will remain in the existing condition. Runoff generated (Q_5= 0.5 cfs, and Q_{100}= 3.2 cfs) flows generally from the highpoint on the southeast and flows overland northwest towards design point 1. Flows will then enter into Basin A and follow that Basin drainage pattern towards design point 2.

Proposed Basin A is approximately 3.56 acres in area and consists of the south half of the gravel parking area as well as undeveloped land surrounding the parking area. The entirety of proposed Basin A is to be graded per the proposed contours shown on the proposed conditions drainage map. Runoff generated (Q_5=5.1 cfs, and Q_{100}= 12.7 cfs) flows overland from the highpoint located on the northern edge of the basin to the southwest towards a proposed earth berm. The proposed southern berm will transport the runoff west along the south edge of the gravel parking area at design point 2. Flows here will then enter into the proposed southern riprap armored swale located within Basin A and will combine flows (Q_5=9.7 cfs, and Q_{100}= 26.5 cfs) at design point 4.1, the pond riprap rundown. For all swale calculations, see Appendix B.

Proposed off-site Basin OS1B is approximately 0.66 acres in area and consists of a northern portion of the previously defined Basin OS1 (totaling 2.29 acres). The area entirely is made up of undeveloped, sparsely vegetated open space. The Basin has no proposed grading and will remain in the existing condition. Runoff generated (Q_5= 0.2 cfs, and Q_{100}= 1.4 cfs) flows overland generally from the southeast and flows northwest towards design point 3. Flows will then enter into Basin B and follow that Basin drainage pattern towards design point 4.

Proposed Basin B is approximately 3.55 acres in area and consists of the north half of the gravel parking area, part of the paved access road from S. Franceville Coal Mine Road, a proposed swale, and undeveloped land surrounding the parking area. The entirety of proposed Basin B is to be graded per the proposed contours shown on the proposed conditions drainage map. Runoff generated (Q_5=5.6 cfs, and Q_{100}= 13.4 cfs) flows overland from the highpoint located on the southern edge of the basin to the northwest towards a proposed earth berm. The proposed northern berm will transport runoff along the northern edge of the gravel parking area west towards the edge of the gravel parking area at design point 4. Flows here will then enter into the proposed northern riprap armored swale

located within Basin B and will combine flows (Q_5=9.7 cfs, and Q_{100}= 26.5 cfs) at design point 4.1, the pond riprap rundown. For all swale calculations, see Appendix B.

Proposed Basin C is approximately 1.23 acres in area and consists of part of the paved access road from S. Franceville Coal Mine Road, a proposed swale, and proposed undeveloped land bordering the southern edge of the basin containing a proposed swale. The area of proposed Basin C south of the paved road is to be graded per the proposed contours shown on the proposed conditions drainage map. Runoff generated (Q_5=1.6 cfs, and Q_{100}= 4.3 cfs) flows generally from northeast to southwest within the Basin. Runoff generated travels overland to the proposed grass swale along the southern edge of asphalt and flow in the swale is transported along the edge of asphalt until it reaches the proposed detention pond at design point 5. Flows here are combined with design point 6, the total inflow into the pond.

Proposed Basin D is approximately 1.48 acres in area and consists of a proposed extended detention pond and associated structures (earth forebay, outlet structure, riprap rundown, etc.). The entirety of proposed Basin D is to be graded per the proposed contours shown on the proposed conditions drainage map. Runoff generated (Q_5= 1.9 cfs, and Q_{100}= 5.9 cfs) flows from east to west into the proposed detention pond. Flows from both the north and south swales also will combine at the proposed riprap rundown (design point 4.1) and then flow into the proposed detention pond. Design point 6 is the total inflow into the proposed detention pond.

Proposed off-site Basins OS2 and OS3 have the same definition as listed above in the existing sub-basins section. These flows will be routed around the proposed detention pond and will flow to the existing outfall of the project site (existing 30-inch CMP). The runoff from these basins ultimately will flow to the same historical outfall following the existing drainage path, and is guided by the proposed berm.

Proposed Basin E is approximately 0.69 acres in area and consists of undeveloped land as well as part of the proposed driveway. Only a small portion of Basin E will be graded per the proposed contours shown on the proposed conditions drainage map. All of the proposed grading within this Basin is designed to create a berm to separate the flows that will enter into the detention pond and the flows that will not. Runoff generated (Q_5= 0.5 cfs, and Q_{100}= 2.4 cfs) flows from the southeast following the proposed berm around the proposed detention pond and into the existing drainage area for the project site (existing 30-inch CMP). This drainage path follows the historical drainage path from south to north as shown in the existing conditions drainage map. Development will be limited to up to 1 acre for areas that do not have a water quality feature downstream in order to satisfy Section I.7.1.B of the ECM Stormwater Quality Policy and Procedure. See highlighted areas on the proposed drainage map presented in Appendix D. The following from the PBMP applicability form applies: the project land disturbance to undeveloped land where undeveloped land remains undeveloped following the activity. A berm and swale is created on undeveloped land within Basin E which will separate flows and remain undeveloped once completed. The driveway acreage within

Basin E is 0.07 acres which is 0.9% of the development site, falling within the 20% limit listed in ECM Appendix I.7.1.C.1.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for this project were taken from the "*City of Colorado Springs/El Paso County Drainage Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual*" Volumes 1-3 (USDCM), dated June, 2001 and Chapter 6 and Section 3.2.1 of Chapter 13 of the "*Colorado Springs Drainage Criteria Manual*" (CCSDCM), dated May 2014, as adopted by El Paso County.

Hydrologic Criteria

All hydrologic data was obtained from the "*El Paso Drainage Criteria Manual*" Volumes 1 and 2, and the "*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*" Volumes 1-3. On-site drainage improvements were designed based on the 5-year (minor) storm event and the 100-year (major) storm event. Rational Method calculations were prepared, in accordance with Section 13.3.2.1 of the CCSDCM, for the sub-basins that directly impact the sizing of ditches and local street culverts. Rational Method calculations are presented in the appendices.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed runoff from proposed Basins A-D and Basins OS1A-B to a proposed private full spectrum extended detention basin. The pond was designed to detain the 100-year design storm or 0.88 acre-feet. Runoff generated on-site is tributary to the detention basin via several grass swales and earth berms that outfall into a proposed riprap rundown, and then into a low tailwater basin. The low tailwater basin was designed based on the guidance from the MHFD methodology with the proposed riprap rundown instead of an outlet pipe. See the attached calculations for the riprap rundown section and water depth for the design flow of 26.5 cfs. The full water depth section area was compared to the available design guidance on the MHFD attached calculation sheet and the sizing of the low tailwater basin was determined. The low tailwater basin outfalls onto the pond bottom and then into a 6-inch deep concrete trickle channel that slopes from the low tailwatear basin to the outlet structure. The outlet structure uses a standard Type-C inlet grate and has been designed to detain the WQCV for 40 hours, the EURV for 72 hours, and to release the 100-year storm at a maximum rate less than or equal to the pre-development rate. The outlet structure will release these flows through a 24-inch RCP (reinforced concrete pipe) to the existing site outfall and then drain across S. Franceville Coal Mine road (existing 30-inch CMP). A site visit was conducted and the existing conditions of the roadway and culvert are shown in the attached report. Also attached is the HY-8 analysis summary for the existing

30" CMP. For the design flow, a combination of the untreated flows and the pond released flows was used. The flows from DP9 in the 100-year storm are 10.9 cfs and combined with the 100-year release rate of the outlet structure of 14.1 cfs, the total design flow is 25 cfs. The HY-8 results show that at this flow, the water is contained within the culvert and does not overtop the roadway. The pre-development release rate of the tributary area to the pond was 23.5 cfs. Since the release rate is approximately half of the existing flow, the flow tributary to the existing 30" CMP is also lower.

The proposed pond also includes an emergency spillway which has been designed to pass the undetained, 100-year peak flow rate tributary to the pond at a flow depth of approximately 0.45 feet. The spillway will be armored with Type VL riprap at a minimum depth of 12 inches, sized per UDFCD Figure 12-21 as shown in Appendix B. The spillway includes over a foot of freeboard above the design water surface elevation at the crest of the spillway to the top of the pond.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual Appendix I.7.2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes employing runoff reduction practices, stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Employ Runoff Reduction Practices: As shown by the attached drainage maps and Rational Method calculations, the runoff leaving the subject site is less than the runoff presently leaving the site. The impervious area is minimized on the site and all impervious areas have runoff routed through pervious surfaces, thus reducing the runoff volumes generated from the site.

Step 2, Stabilize Drainageways: The proposed condition will reduce flows tributary to downstream drainageways to at or below pre-development rates. State Basin fees will be paid prior to construction/ development of the site. Therefore, no downstream stabilizations BMP's are proposed as part of this project.

Step 3, Provide WQCV: All developed flows from this site are treated via the proposed extended detention basin including a forebay, trickle channel, and full spectrum outlet structure. Therefore, the WQCV is treated.

Step 4 Consider the need for Industrial and Commercial BMP's: The proposed design utilizes site grading and a proposed extended detention basin to capture all developed flows, and treat them on-site. Per the El Paso County DCM Volume 2 fact sheet, spill containment and the covering of storage/handling areas will be utilized for all on-site activities. Using these BMPs will ensure that no adverse downstream or adjacent impacts are created as a result of the proposed project site.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. The Erosion Control Plan for this site is submitted concurrently with this report.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures will be maintained by the site owner/developer. A 10-foot wide earth berm has been included to access the trickle channel, low tailwater basin, and outlet structure of the Extended Detention Basin.

Drainage and Bridge Fees

Drainage fees are imposed with final plats, or vacate & replats, note site development plan; therefore, no drainage fees are due with this side development plan application.
The property is currently unplatted and therefore the basin drainage fees will be assessed on future plat application since no fees have been previously paid.

SUMMARY

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including berms, swales, and extended detention basin improvements. The proposed development will not adversely affect the offsite major Drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site and is in accordance with the previously approved reports.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

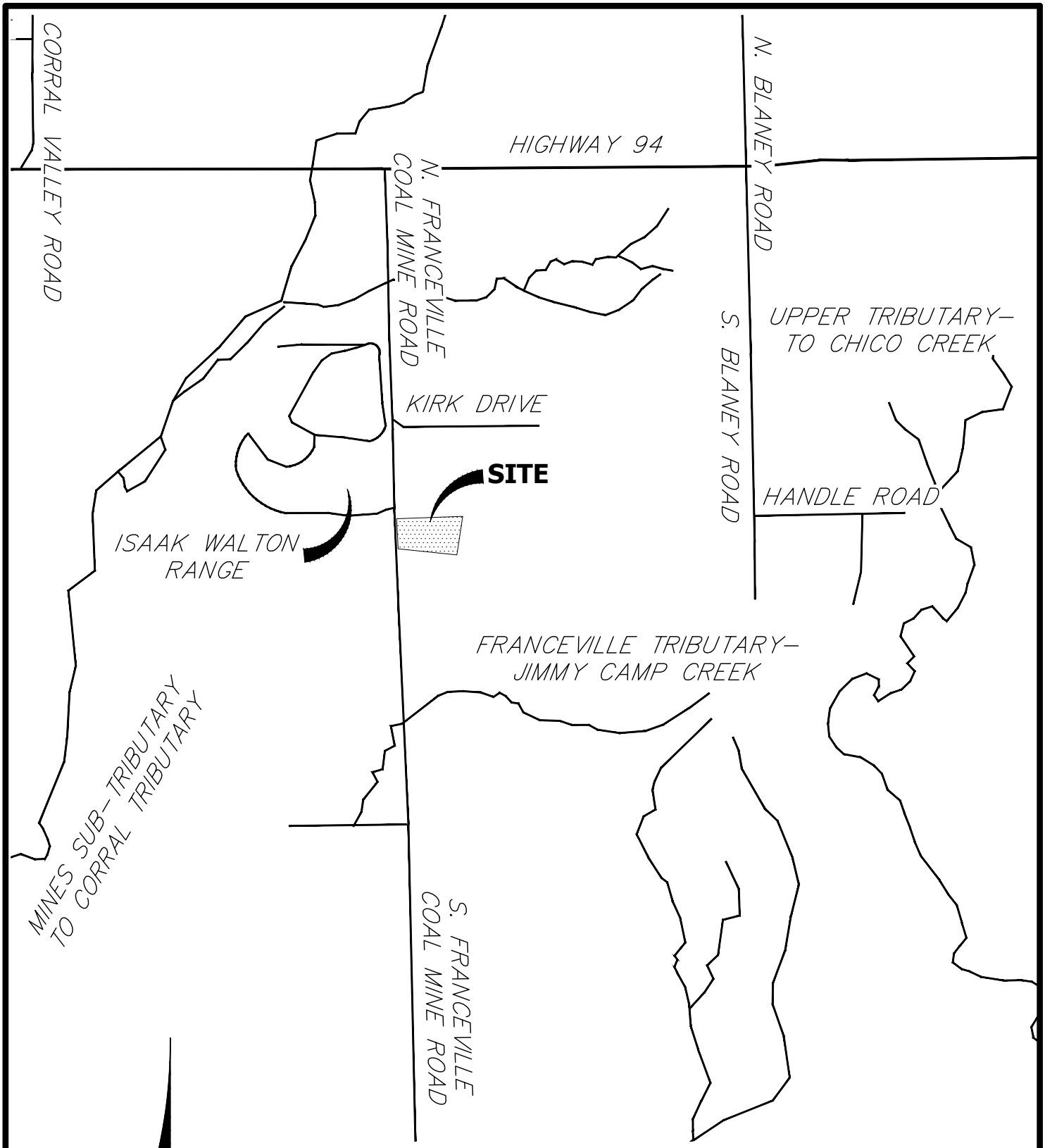
2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives & Design of Selected Plan Report, prepared by Kiowa Engineering Corporation in March 2015.

4. "Hydrologic Soil Group Rating for El Paso County Area, Colorado" , USDA-Natural Resources Conservation Service, National Cooperative Soil Survey, June 21, 2017

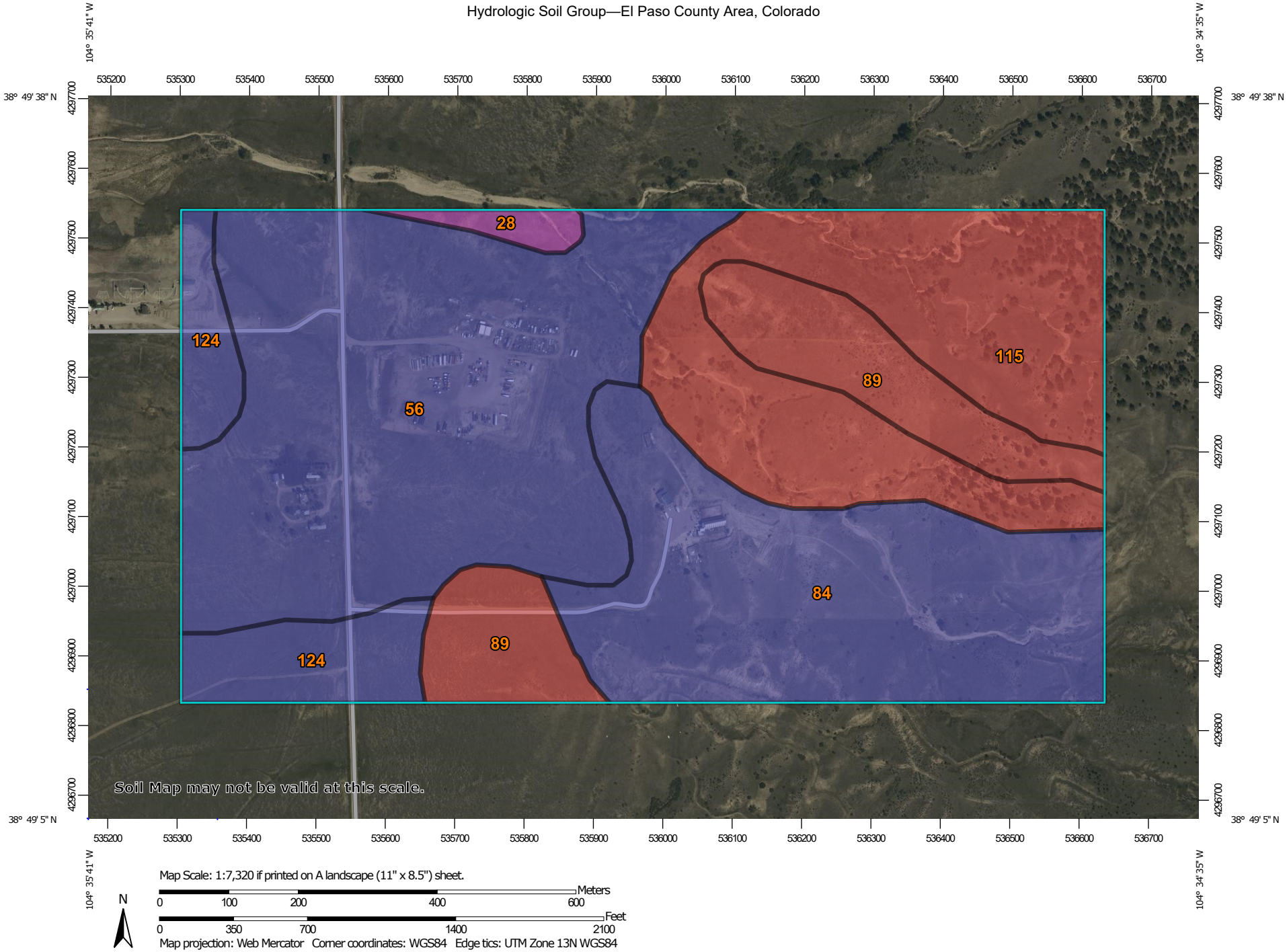
APPENDIX A

FIGURES AND EXHIBITS



VICINITY MAP
GATEWAY TRUCKING, LLC
JOB NO. 25215.00
04/05/21
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com


104° 35' 41" W
104° 34' 35" W
38° 49' 38" N
38° 49' 5" N
535200
535300
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535800
535900
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4296700
28
124
56
115
89
84
89
124
Soil Map may not be valid at this scale.
Map Scale: 1:7,320 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
100
200
400
600
Feet
0
350
700
1400
2100
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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	2.5	1.1%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	83.3	35.6%
84	Stapleton sandy loam, 8 to 15 percent slopes	B	55.9	23.9%
89	Tassel fine sandy loam, 3 to 18 percent slopes	D	25.1	10.7%
115	Lithic Haplustepts-Rock outcrop complex	D	50.8	21.8%
124	Olnest sandy loam, 0 to 3 percent slopes	B	16.1	6.9%
Totals for Area of Interest			**233.8**	**100.0%**

Description

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 soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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.

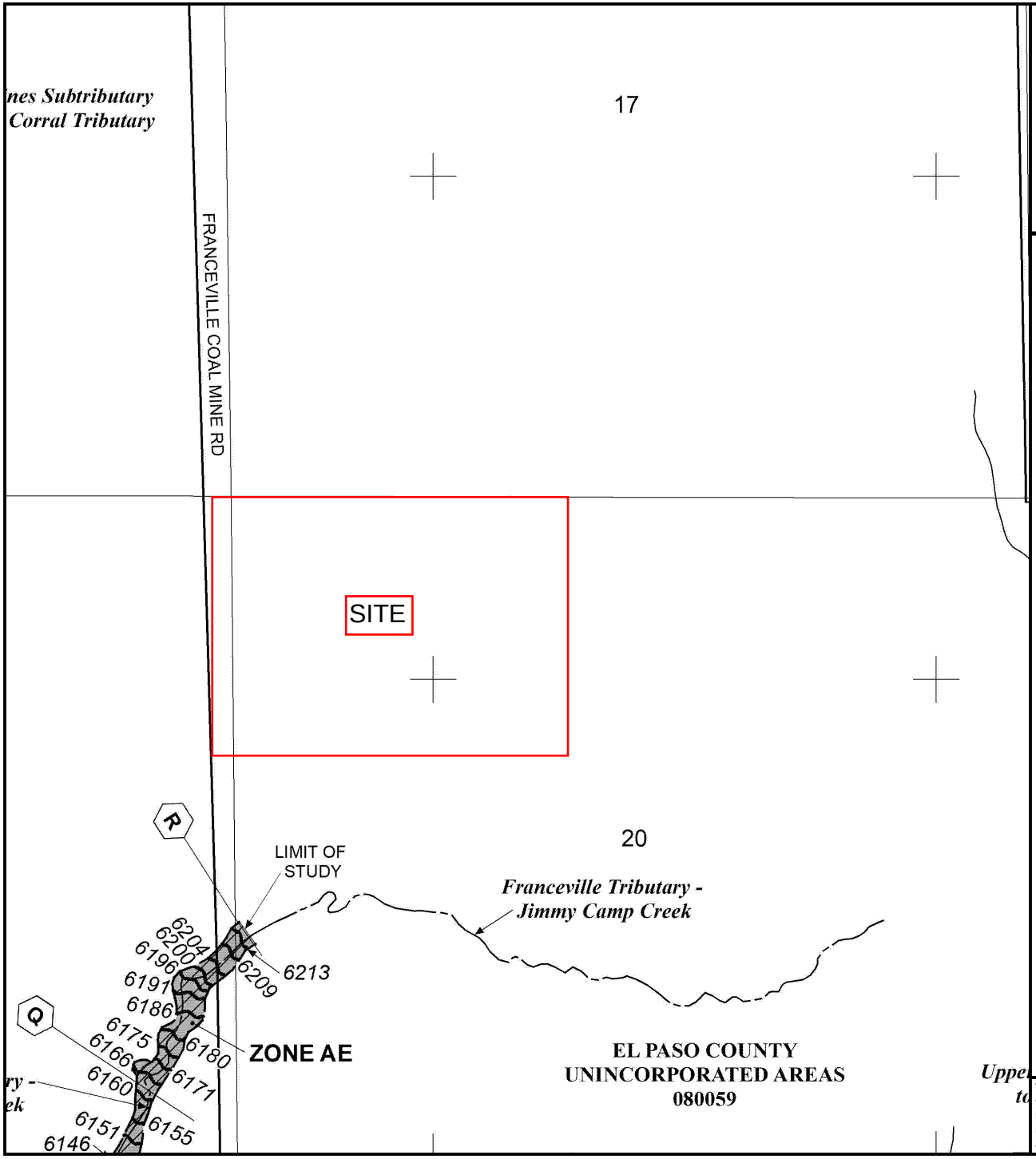
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 M

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0780G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 780 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0780	G
EL PASO COUNTY	080059	0780	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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

MAP NUMBER
08041C0780G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC/HYDRAULIC CALCULATIONS

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision:
Location: Colorado Springs
Date: 11/8/21

Project Name: Gateway Trucking-Existing
Project No.: 25215.00
Calculated By: GAG

	Basin ID	Total Area (ac)	Paved Roadway 100%					Gravel 80%					Undeveloped 2%					Basins Total Weighted C Values		Basins Total Weighted % Imp.
			C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	
	EX-A	6.75	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	6.75	2.0%	0.09	0.36	2.0%
	EX-B	3.76	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.50	10.6%	0.09	0.36	2%	3.26	1.7%	0.16	0.41	12.4%
	OS1	2.29	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	2.29	2.0%	0.09	0.36	2.0%
	OS2	4.68	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	4.68	2.0%	0.09	0.36	2.0%
	OS3	0.60	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.15	20.0%	0.09	0.36	2%	0.45	1.5%	0.22	0.45	21.5%
Total Existing Conditions		18.08																-	-	4.8%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: _____ Project Name: Gateway Trucking-Existing

Location: Colorado Springs Project No.: 25215.00

Date: 11/8/21 Calculated By: GAG

NOTES:

$$t_c = t_i + t_t \quad \text{Equation 6-2}$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \quad \text{Equation 6-3}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}} \quad \text{Equation 6-5}$$

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX-A	6.75	B	2.0%	0.09	0.36	115	16.5%	7.8	1125	2.7%	10	1.6	11.5	19.2	1240.0	38.0	19.2
EX-B	3.76	B	12.4%	0.16	0.41	70	1.2%	13.4	775	4.9%	10	2.2	5.8	19.3	845.0	29.3	19.3
OS1	2.29	B	2.0%	0.09	0.36	300	6.1%	17.4	245	6.1%	10	2.5	1.7	19.0	545.0	27.4	19.0
OS2	4.68	B	2.0%	0.09	0.36	300	6.1%	17.4	845	6.1%	10	2.5	5.7	23.1	1145.0	31.8	23.1
OS3	0.60	B	21.5%	0.22	0.45	300	5.1%	16.2	250	5.0%	10	2.2	1.9	18.0	550.0	23.9	18.0

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision:
Location: Colorado Springs
Design Storm: 5-Year (1-hr point precipitation = 1.12)

Project Name: Gateway Trucking-Existing
Project No.: 25215.00
Calculated By: GAG
Checked By:
Date: 11/8/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS1	2.29	0.09	19.0	0.21	3.16	0.7															Flows overland to DP1. Flows combine with Basin EX-A at DP3.
	2	OS2	4.68	0.09	23.1	0.42	2.87	1.2															Flows overland to DP2. Flows combine with Basin EX-A at DP3.
	3	EX-A	6.75	0.09	19.2	0.42	3.15	1.3	23.1	1.05	2.87	3.0											Flows overland to DP3. Flows combine with DP1, DP2, and EX-A.
	4	OS3	0.60	0.22	18.0	0.13	3.24	0.4															Flows overland to DP4. Flows combine with Basin EX-B at DP5.
	5	EX-B	3.76	0.16	19.3	0.13	3.15	0.4	23.1	1.31	2.87	3.8											Flows overland to DP5. Flows combine with DP3, DP4, and Basin EX-B.

NOTES:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision:
Location: Colorado Springs
Design Storm: 100-Year (1-hr point precipitation = 2.53)

Project Name: Gateway Trucking-Existing
Project No.: 25215.00
Calculated By: GAG
Checked By:
Date: 11/8/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS1	2.29	0.36	19.0	0.82	5.31	4.4															Flows overland to DP1. Flows combine with Basin EX-A at DP3.
	2	OS2	4.68	0.36	23.1	1.68	4.82	8.1															Flows overland to DP2. Flows combine with Basin EX-A at DP3.
	3	EX-A	6.75	0.36	19.2	2.43	5.28	12.8	23.1	4.93	4.82	23.8											Flows overland to DP3. Flows combine with DP1, DP2, and EX-A.
	4	OS3	0.60	0.45	18.0	0.27	5.45	1.5															Flows overland to DP4. Flows combine with Basin EX-B at DP5.
	5	EX-B	3.76	0.41	19.3	1.52	5.28	8.0	23.1	6.72	4.82	32.4											Flows overland to DP5. Flows combine with DP3, DP4, and Basin EX-B.

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision:
Location: Colorado Springs
Date: 11/8/21

Project Name: Gateway Trucking
Project No.: 25215.00
Calculated By: GAG

	Basin ID	Total Area (ac)	Paved Roadway/Water Surface 100%					Gravel 80%					Undeveloped 2%					Basins Total Weighted C Values		Basins Total Weighted % Imp.
			C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	% Imp.	Area (ac)	Weighted % Imp.	C_5	C_{100}	
	A	3.56	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	2.02	45.4%	0.09	0.36	2%	1.54	0.9%	0.37	0.55	46.3%
	B	3.55	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	2.16	48.7%	0.09	0.36	2%	1.39	0.8%	0.39	0.57	49.5%
	C	1.23	0.90	0.96	100%	0.35	28.5%	0.59	0.70	80%	0.05	3.3%	0.09	0.36	2%	0.83	1.3%	0.34	0.54	33.1%
	D	1.48	0.90	0.96	100%	0.32	21.6%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	1.16	1.6%	0.27	0.49	23.2%
	OS1A	1.62	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	1.62	2.0%	0.09	0.36	2.0%
	OS1B	0.66	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	0.66	2.0%	0.09	0.36	2.0%
Total Proposed Pond Conditions		12.10	Includes Basin A-D and OS1A-1B in the Proposed Conditions															-	-	34.7%
	E	0.69	0.90	0.96	100%	0.06	8.7%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	0.63	1.8%	0.16	0.45	10.5%
	OS2	4.68	0.90	0.96	100%	0.00	0.0%	0.59	0.70	80%	0.00	0.0%	0.09	0.36	2%	4.68	2.0%	0.09	0.36	2.0%
	OS3	0.60	0.90	0.96	100%	0.01	1.7%	0.59	0.70	80%	0.15	20.0%	0.09	0.36	2%	0.44	1.5%	0.23	0.46	23.1%
Total Existing Outfall Conditions		5.97	Includes Basin E and OS2-3 in the Proposed Conditions															-	-	5.1%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: _____ Project Name: Gateway Trucking

Location: Colorado Springs Project No.: 25215.00

Date: 11/8/21 Calculated By: GAG

NOTES:

$$t_c = t_i + t_t \quad \text{Equation 6-2}$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \quad \text{Equation 6-3}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}} \quad \text{Equation 6-5}$$

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	3.56	B	46%	0.37	0.55	180	12.8%	7.6	905	2.8%	20	3.3	4.5	12.1	1085.0	24.0	12.1
B	3.55	B	49%	0.39	0.57	180	12.8%	7.4	780	3.2%	20	3.6	3.6	11.0	960.0	22.2	11.0
C	1.23	B	33%	0.34	0.54	60	1.0%	10.6	460	6.5%	15	3.8	2.0	12.6	520.0	22.6	12.6
D	1.48	B	23%	0.27	0.49	40	25.0%	3.3	400	5.5%	10	2.3	2.8	6.1	440.0	24.4	6.1
E	0.69	B	11%	0.16	0.45	30	30.8%	3.0	585	4.5%	10	2.1	4.6	7.6	615.0	28.6	7.6
OS1A	1.62	B	2%	0.09	0.36	300	6.8%	16.8	125	6.8%	10	2.6	0.8	17.6	425.0	26.5	17.6
OS1B	0.66	B	2%	0.09	0.36	275	6.8%	16.1	0	0.0%	10	0.1	0.0	16.1	275.0	25.7	16.1
OS2	4.68	B	2%	0.09	0.36	300	6.1%	17.4	845	6.1%	10	2.5	5.7	23.1	1145.0	31.8	23.1
OS3	0.60	B	23%	0.23	0.46	225	4.3%	14.6	0	0.0%	10	0.1	0.0	14.6	225.0	22.1	14.6

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision:
Location: Colorado Springs
Design Storm: 5-Year (1-hr point precipitation = 1.12)

Project Name: Gateway Trucking
Project No.: 25215.00
Calculated By: GAG
Checked By:
Date: 11/8/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS1A	1.62	0.09	17.6	0.15	3.28	0.5															Flows overland to DP1. Flows combine with Basin A at DP2.
	2	A	3.56	0.37	12.1	1.33	3.84	5.1	17.6	1.48	3.28	4.9											Flows overland and parking area towards swale at DP2. Sized for berm/ swales. Flows are routed towards DP4.1.
	3	OS1B	0.66	0.09	16.1	0.06	3.42	0.2															Flows overland to DP3. Flows combine with Basin B at DP4.
	4	B	3.55	0.39	11.0	1.40	3.99	5.6	16.1	1.46	3.42	5.0											Flows overland and parking area towards swale at DP4. Sized for berm/ swales. Flows are routed towards DP4.1.
	4.1								17.6	2.94	3.28	9.7											Combination of DP2 and DP4. Combo, flow for riprap rundown. Flows enter into pond.
	5	C	1.23	0.34	12.6	0.42	3.78	1.6															Flows along driveway swale towards DP5. Flows combine at DP6.
	6	D	1.48	0.27	6.1	0.39	4.86	1.9	17.6	3.75	3.28	12.3											Flows overland into proposed pond at DP6. Combination of flows DP 4.1, DP5, and Basin D.
	7	OS2	4.68	0.09	23.1	0.42	2.87	1.2															Flows overland to DP7. Flows combine with Basin E at DP9.
	8	OS3	0.60	0.23	14.6	0.14	3.56	0.5															Flows overland to DP8. Flows combine with Basin E at DP9.
	9	E	0.69	0.16	7.6	0.11	4.54	0.5	23.1	0.67	2.87	1.9											Flows overland to existing 30" CMP at DP9. Combination of flows DP7, DP8, and Basin E.

NOTES:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision:
Location: Colorado Springs
Design Storm: 100-Year (1-hr point precipitation = 2.53)

Project Name: Gateway Trucking
Project No.: 25215.00
Calculated By: GAG
Checked By:
Date: 11/8/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	OS1A	1.62	0.36	17.6	0.58	5.51	3.2															Flows overland to DP1. Flows combine with Basin A at DP2.
	2	A	3.56	0.55	12.1	1.97	6.45	12.7	17.6	2.55	5.51	14.1											Flows overland and parking area towards swale at DP2. Sized for berm/ swales. Flows are routed towards DP4.1.
	3	OS1B	0.66	0.36	16.1	0.24	5.74	1.4															Flows overland to DP3. Flows combine with Basin B at DP4.
	4	B	3.55	0.57	11.0	2.01	6.69	13.4	16.1	2.25	5.74	12.9											Flows overland and parking area towards swale at DP4. Sized for berm/ swales. Flows are routed towards DP4.1.
	4.1								17.6	4.80	5.51	26.5											Combination of DP2 and DP4. Combo, flow for riprap rundown. Flows enter into pond.
	5	C	1.23	0.54	12.6	0.67	6.35	4.3															Flows along driveway swale towards DP5. Flows combine at DP6.
	6	D	1.48	0.49	6.1	0.72	8.16	5.9	17.6	6.19	5.51	34.1											Flows overland into proposed pond at DP6. Combination of flows DP 4.1, DP5, and Basin D.
	7	OS2	4.68	0.36	23.1	1.68	4.82	8.1															Flows overland to DP7. Flows combine with Basin E at DP9.
	8	OS3	0.60	0.46	14.6	0.27	5.98	1.6															Flows overland to DP8. Flows combine with Basin E at DP9.
	9	E	0.69	0.45	7.6	0.31	7.63	2.4	23.1	2.26	4.82	10.9											Flows overland to existing 30" CMP at DP9. Combination of flows DP7, DP8, and Basin E.

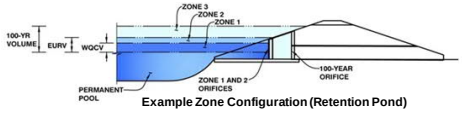
Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Gateway Trucking

Basin ID: Proposed Full Spectrum EDB Basins (A-D, OS1A, OS1B)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	12.10	acres
Watershed Length =	1,450	ft
Watershed Length to Centroid =	720	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	34.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
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) =	0.167	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.436	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.430	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.670	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.887	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.206	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.453	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.777	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	2.265	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.317	acre-feet		
Approximate 5-yr Detention Volume =	0.448	acre-feet		
Approximate 10-yr Detention Volume =	0.633	acre-feet		
Approximate 25-yr Detention Volume =	0.720	acre-feet		
Approximate 50-yr Detention Volume =	0.757	acre-feet		
Approximate 100-yr Detention Volume =	0.881	acre-feet		

Define Zones and Basin Geometry

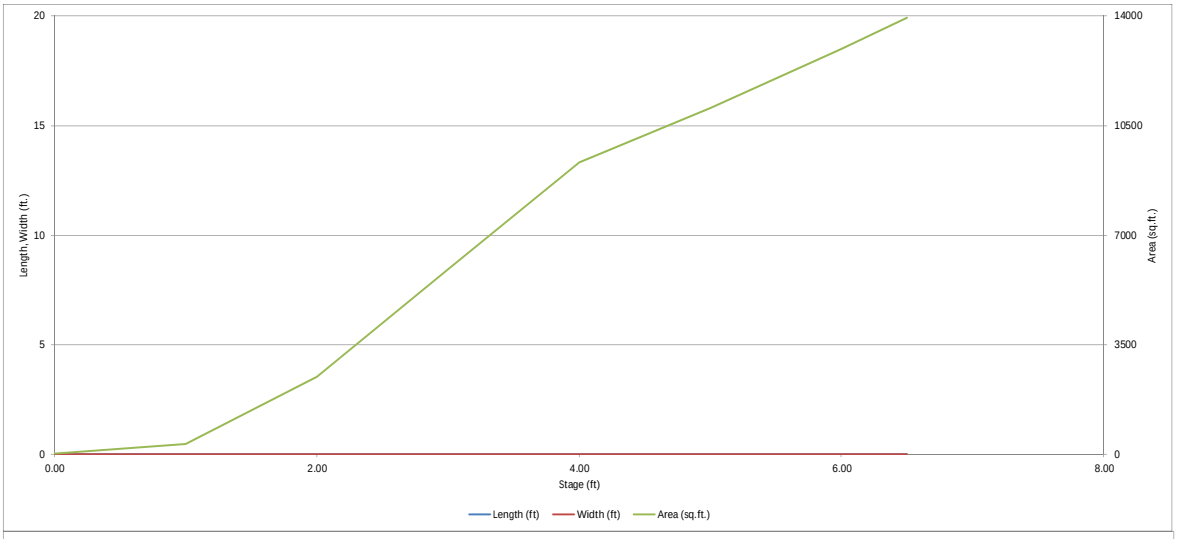
Zone 1 Volume (WQCV) =	0.167	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.269	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.445	acre-feet
Total Detention Basin Volume =	0.881	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

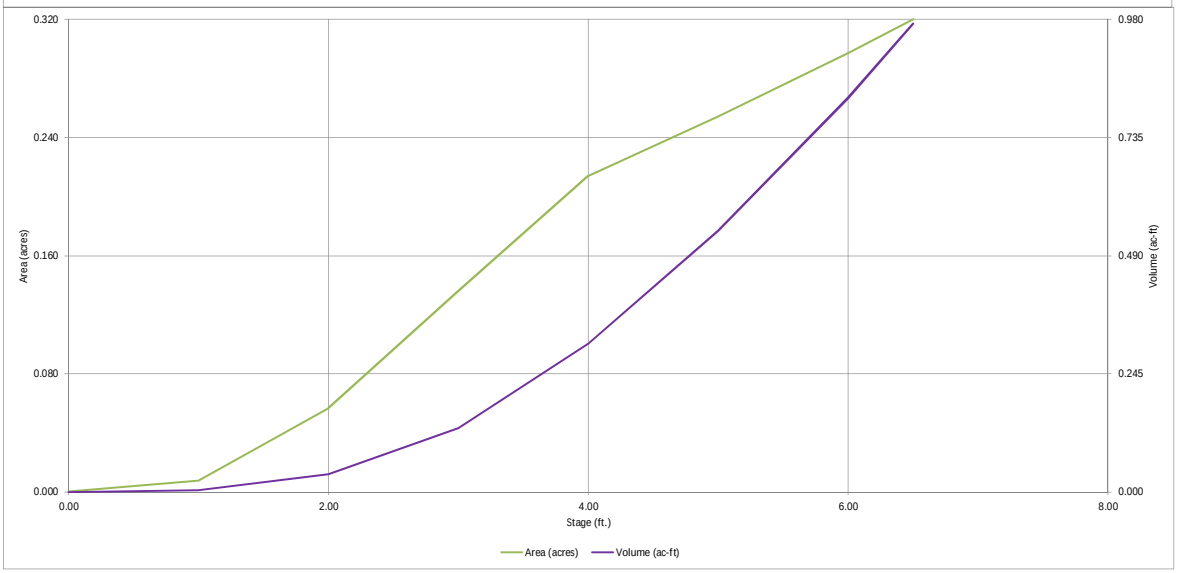
Depth Increment = 0.50 ft

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	--	--	--	13	0.000		
6232	--	1.00	--	--	--	331	0.008	172	0.004
6233	--	2.00	--	--	--	2,462	0.057	1,568	0.036
6234	--	3.00	--	--	--	5,916	0.136	5,757	0.132
6235	--	4.00	--	--	--	9,316	0.214	13,373	0.307
6236	--	5.00	--	--	--	11,071	0.254	23,566	0.541
6237	--	6.00	--	--	--	12,951	0.297	35,577	0.817
6237.5	--	6.50	--	--	--	13,939	0.320	42,300	0.971

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



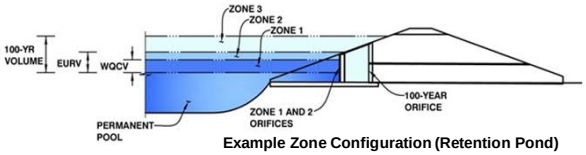


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Gateway Trucking

Basin ID: Proposed Full Spectrum EDB Basins (A-D, OS1A, OS1B)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.24	0.167	Orifice Plate
Zone 2 (EURV)	4.58	0.269	Circular Orifice
Zone 3 (100-year)	6.22	0.445	Weir&Pipe (Restrict)
Total (all zones)		0.881	

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.444E-03	ft^2
Depth at top of Zone using Orifice Plate =	4.54	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.64	sq. inches (diameter = 7/8 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.51	3.03					
Orifice Area (sq. inches)	0.64	0.64	0.64					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.54	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.51	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.55	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.55	N/A	feet
Overflow Weir Front Edge Length =	2.92	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.79	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	5.93	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.97	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.24	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.48	N/A	feet
Restrictor Plate Height Above Pipe Invert =	10.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.40	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.45	feet
Spillway Crest Length =	24.00	feet	Stage at Top of Freeboard =	7.95	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.32	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.97	acre-ft

Calculated Parameters for Spillway

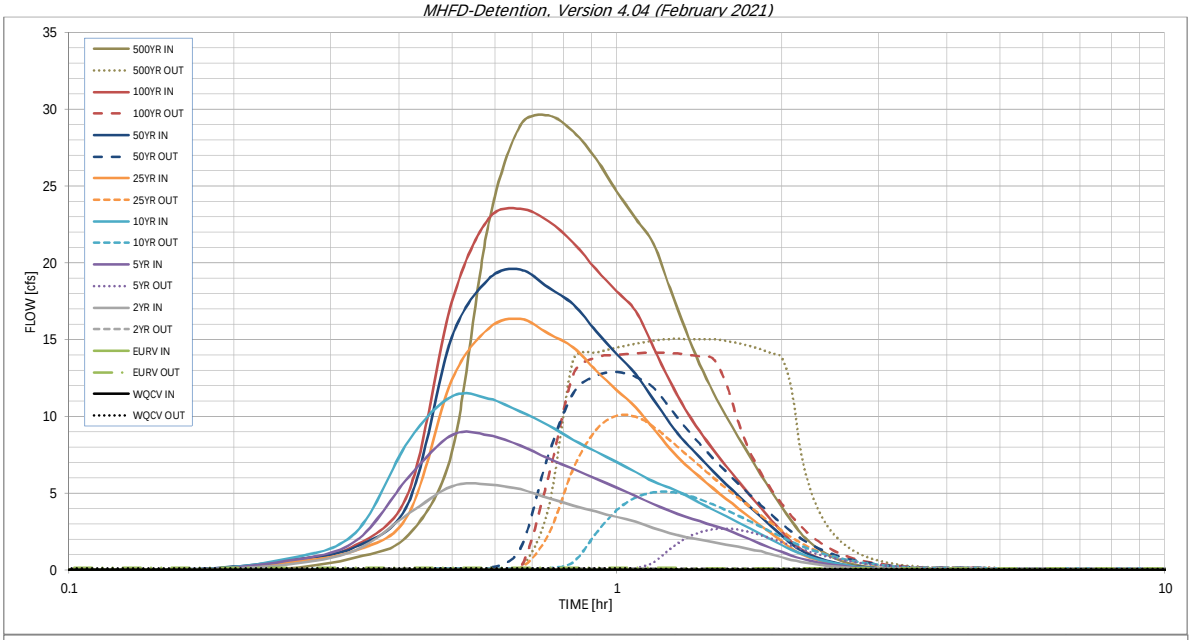
Routed Hydrograph Results

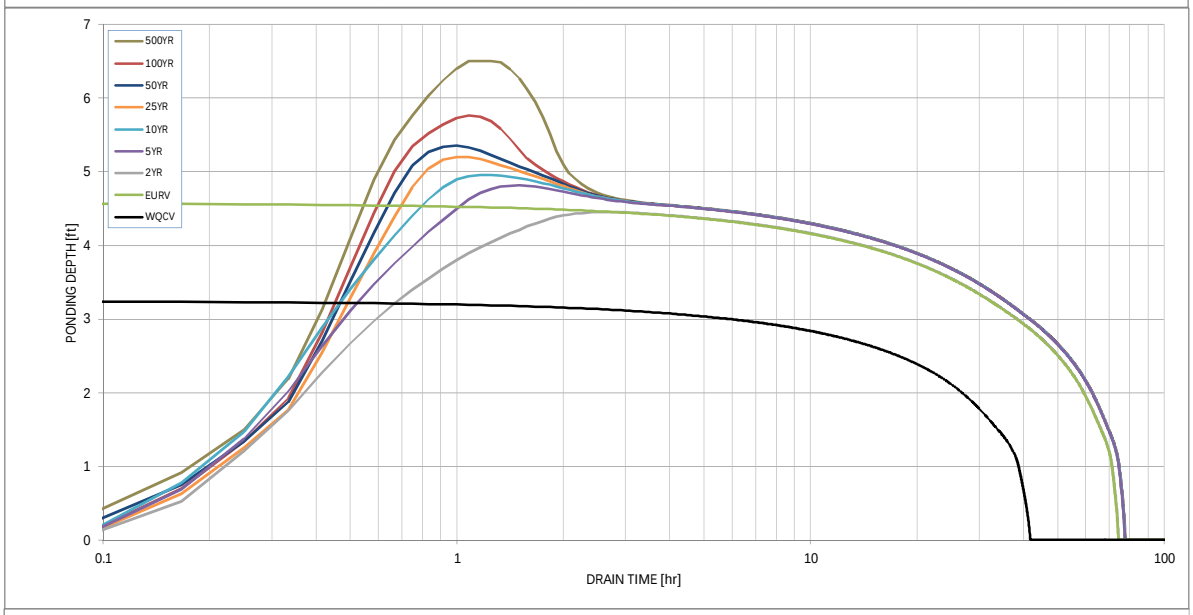
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

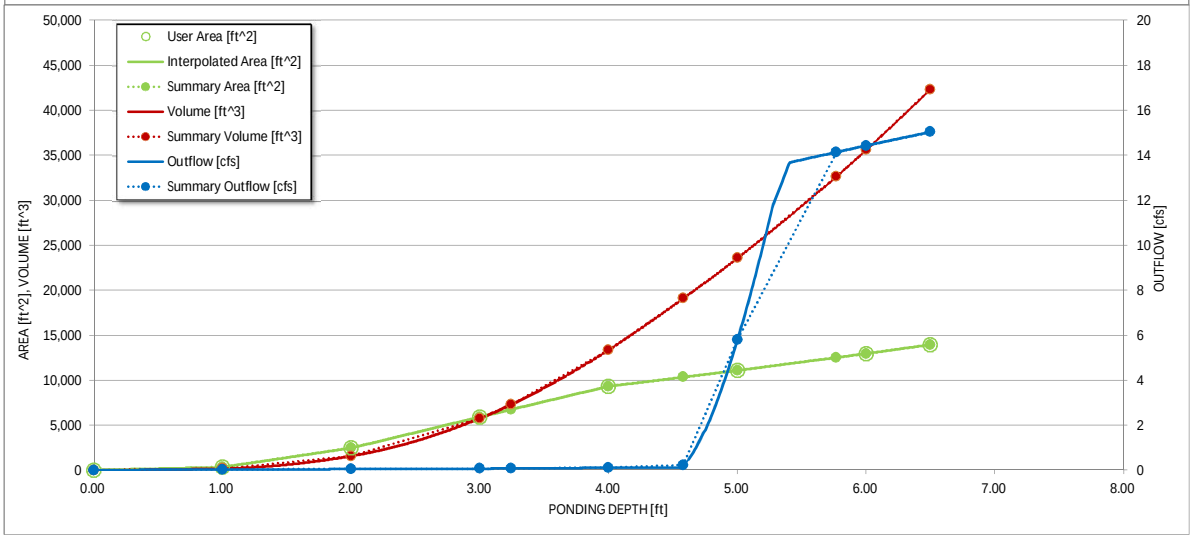
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.167	0.436	0.430	0.670	0.887	1.206	1.453	1.777	2.265
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.430	0.670	0.887	1.206	1.453	1.777	2.265
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.2	3.5	5.3	9.4	11.8	15.2	19.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.29	0.44	0.78	0.98	1.25	1.63
Peak Inflow Q (cfs) =	N/A	N/A	5.6	8.8	11.3	16.3	19.5	23.5	29.6
Peak Outflow Q (cfs) =	0.1	0.2	0.1	2.7	5.1	10.0	12.9	14.1	15.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.0	1.1	1.1	0.9	0.8
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.02	N/A	0.4	0.8	1.7	2.1	2.4	2.5
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	67	67	67	65	63	61	58	55
Time to Drain 99% of Inflow Volume (hours) =	40	71	71	73	72	71	69	68	67
Maximum Ponding Depth (ft) =	3.24	4.58	4.45	4.81	4.96	5.20	5.35	5.77	6.50
Area at Maximum Ponding Depth (acres) =	0.15	0.24	0.23	0.25	0.25	0.26	0.27	0.29	0.32
Maximum Volume Stored (acre-ft) =	0.167	0.438	0.407	0.493	0.531	0.593	0.633	0.747	0.971

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.10
	0:15:00	0.00	0.00	0.35	0.58	0.72	0.49	0.61	0.59	0.80
	0:20:00	0.00	0.00	1.27	1.86	2.42	1.27	1.49	1.59	2.27
	0:25:00	0.00	0.00	3.64	6.03	8.39	3.62	4.37	5.04	7.64
	0:30:00	0.00	0.00	5.43	8.77	11.29	12.36	15.13	17.43	22.54
	0:35:00	0.00	0.00	5.56	8.75	11.14	15.71	18.93	22.86	28.93
	0:40:00	0.00	0.00	5.24	8.08	10.31	16.34	19.54	23.50	29.57
	0:45:00	0.00	0.00	4.67	7.25	9.40	15.38	18.38	22.70	28.52
	0:50:00	0.00	0.00	4.18	6.57	8.46	14.47	17.27	21.28	26.74
	0:55:00	0.00	0.00	3.79	5.93	7.69	12.97	15.53	19.56	24.62
	1:00:00	0.00	0.00	3.45	5.35	7.01	11.70	14.05	18.13	22.85
	1:05:00	0.00	0.00	3.13	4.80	6.36	10.57	12.73	16.85	21.23
	1:10:00	0.00	0.00	2.73	4.29	5.75	9.19	11.08	14.49	18.34
	1:15:00	0.00	0.00	2.39	3.83	5.34	7.90	9.56	12.28	15.67
	1:20:00	0.00	0.00	2.15	3.46	4.88	6.87	8.32	10.46	13.39
	1:25:00	0.00	0.00	1.97	3.17	4.37	6.05	7.33	9.03	11.56
	1:30:00	0.00	0.00	1.80	2.90	3.91	5.30	6.42	7.82	10.01
	1:35:00	0.00	0.00	1.65	2.64	3.48	4.62	5.59	6.76	8.63
	1:40:00	0.00	0.00	1.50	2.31	3.08	4.01	4.84	5.78	7.37
	1:45:00	0.00	0.00	1.35	1.99	2.70	3.42	4.13	4.86	6.19
	1:50:00	0.00	0.00	1.20	1.68	2.33	2.87	3.46	4.01	5.09
	1:55:00	0.00	0.00	1.00	1.41	1.96	2.35	2.83	3.22	4.09
	2:00:00	0.00	0.00	0.83	1.17	1.62	1.87	2.26	2.51	3.20
	2:05:00	0.00	0.00	0.65	0.92	1.30	1.38	1.68	1.85	2.39
	2:10:00	0.00	0.00	0.52	0.74	1.05	1.04	1.28	1.38	1.80
	2:15:00	0.00	0.00	0.42	0.60	0.85	0.80	0.98	1.03	1.36
	2:20:00	0.00	0.00	0.34	0.48	0.69	0.62	0.76	0.77	1.02
	2:25:00	0.00	0.00	0.28	0.39	0.55	0.48	0.59	0.57	0.76
	2:30:00	0.00	0.00	0.22	0.31	0.44	0.37	0.45	0.42	0.56
	2:35:00	0.00	0.00	0.18	0.25	0.34	0.28	0.35	0.31	0.41
	2:40:00	0.00	0.00	0.14	0.19	0.26	0.22	0.26	0.23	0.31
	2:45:00	0.00	0.00	0.11	0.15	0.20	0.17	0.20	0.18	0.24
	2:50:00	0.00	0.00	0.09	0.11	0.15	0.13	0.16	0.14	0.19
	2:55:00	0.00	0.00	0.07	0.09	0.12	0.10	0.12	0.11	0.15
	3:00:00	0.00	0.00	0.05	0.06	0.09	0.08	0.09	0.09	0.11
	3:05:00	0.00	0.00	0.04	0.05	0.06	0.06	0.07	0.06	0.08
	3:10:00	0.00	0.00	0.03	0.03	0.04	0.04	0.05	0.04	0.05
	3:15:00	0.00	0.00	0.02	0.02	0.03	0.02	0.03	0.03	0.03
	3:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Top of Micropool- 6231	0.00	13	0.000	0	0.000	0.00
6232	1.00	331	0.008	172	0.004	0.02
6233	2.00	2,462	0.057	1,568	0.036	0.05
6234	3.00	5,916	0.136	5,757	0.132	0.06
WQCV- 6234.24	3.24	6,732	0.155	7,275	0.167	0.08
6235	4.00	9,316	0.214	13,373	0.307	0.10
EURV- 6235.58	4.58	10,334	0.237	19,071	0.438	0.22
6236	5.00	11,071	0.254	23,566	0.541	5.81
100-yr 6236.77	5.77	12,519	0.287	32,648	0.750	14.14
6237	6.00	12,951	0.297	35,577	0.817	14.42
Spillway Crest- 6237.50	6.50	13,939	0.320	42,300	0.971	15.03

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).

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

N. Berm

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.41
N-Value	= 0.040

Calculations

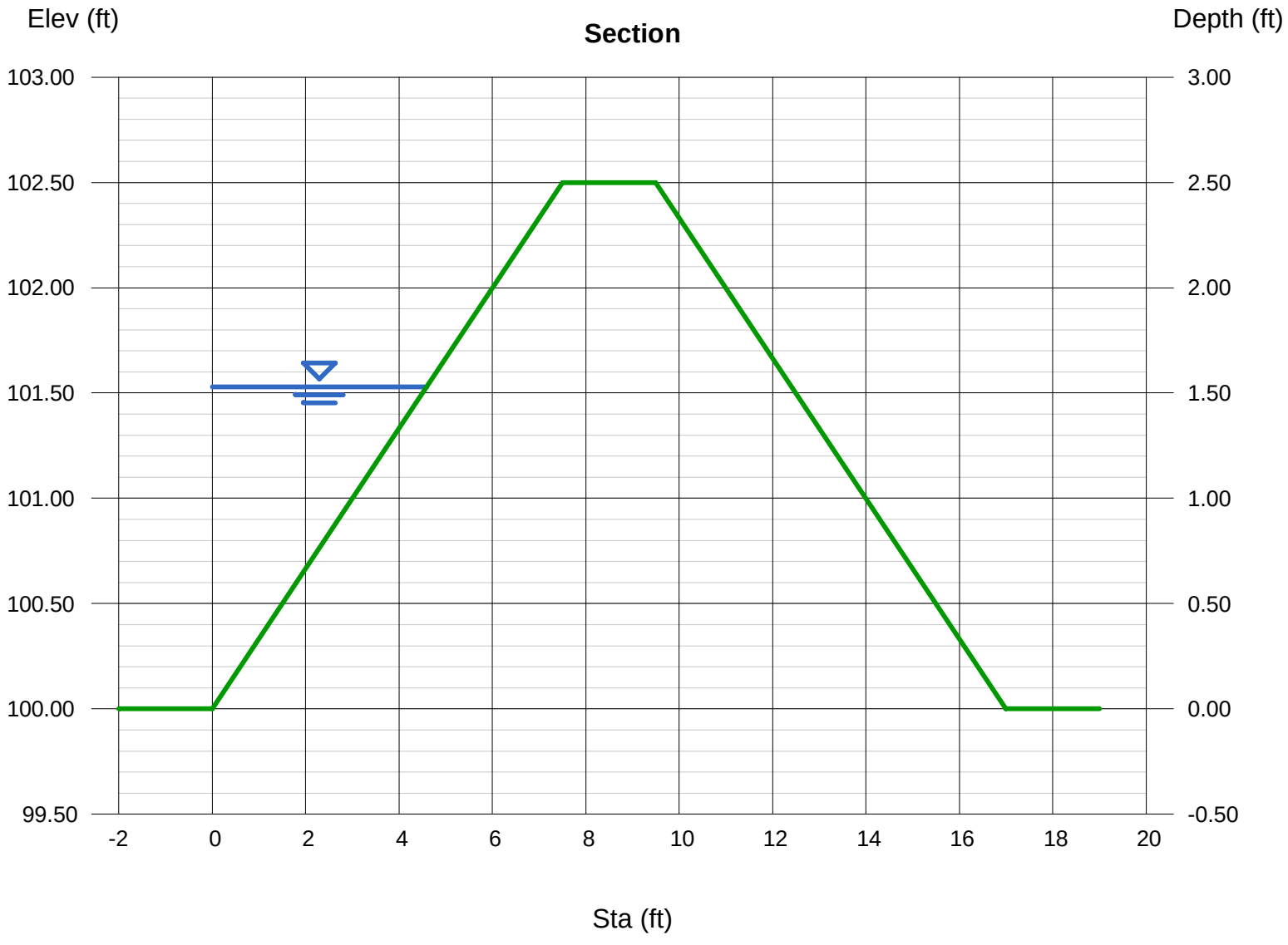
Compute by:	Known Q
Known Q (cfs)	= 13.40

Highlighted

Depth (ft)	= 1.53
Q (cfs)	= 13.40
Area (sqft)	= 7.02
Velocity (ft/s)	= 1.91
Wetted Perim (ft)	= 9.68
Crit Depth, Yc (ft)	= 1.05
Top Width (ft)	= 9.18
EGL (ft)	= 1.59

(Sta, El, n)-(Sta, El, n)...

(0.00, 100.00) -(7.50, 102.50, 0.040) -(9.50, 102.50, 0.040) -(17.00, 100.00, 0.040)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

N. Parking Area Swale (to combo)

Triangular

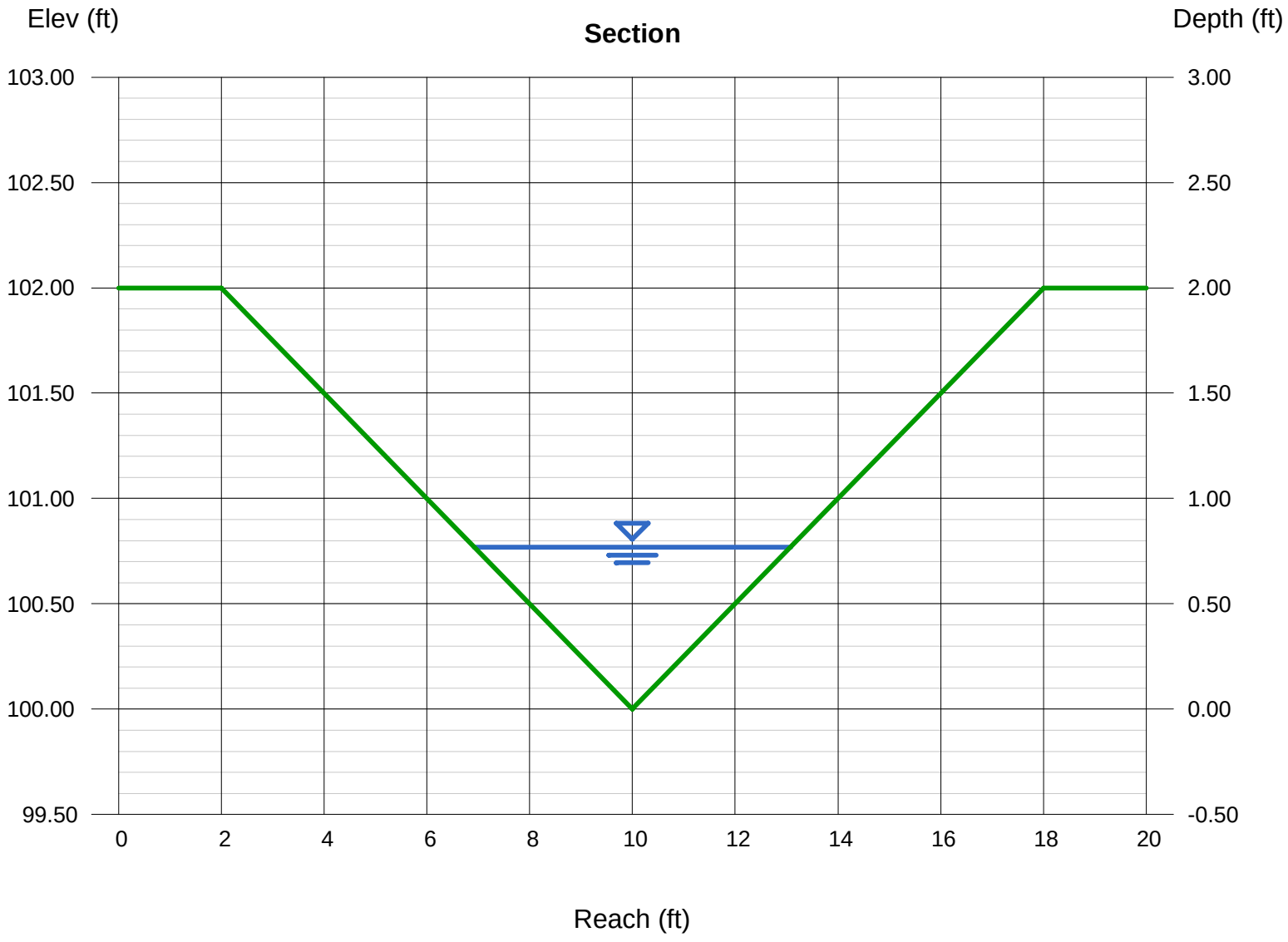
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 15.12
N-Value	= 0.053

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.40

Highlighted

Depth (ft)	= 0.77
Q (cfs)	= 13.40
Area (sqft)	= 2.37
Velocity (ft/s)	= 5.65
Wetted Perim (ft)	= 6.35
Crit Depth, Yc (ft)	= 0.94
Top Width (ft)	= 6.16
EGL (ft)	= 1.27



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

N. Driveway Swale

Triangular

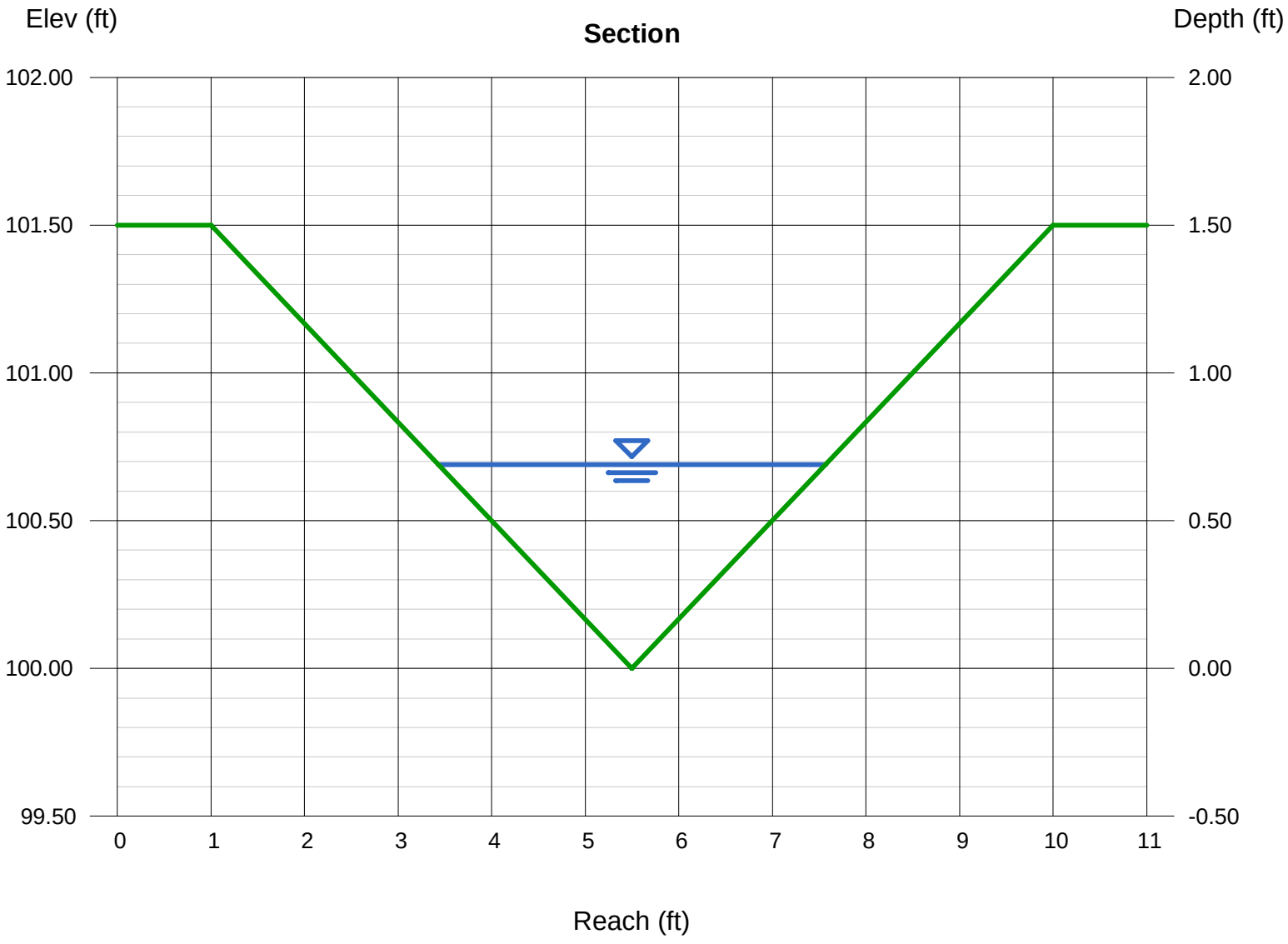
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 100.00
Slope (%)	= 3.07
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.30

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 4.300
Area (sqft)	= 1.43
Velocity (ft/s)	= 3.01
Wetted Perim (ft)	= 4.36
Crit Depth, Yc (ft)	= 0.67
Top Width (ft)	= 4.14
EGL (ft)	= 0.83



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

S. Berm

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.47
N-Value	= 0.040

Calculations

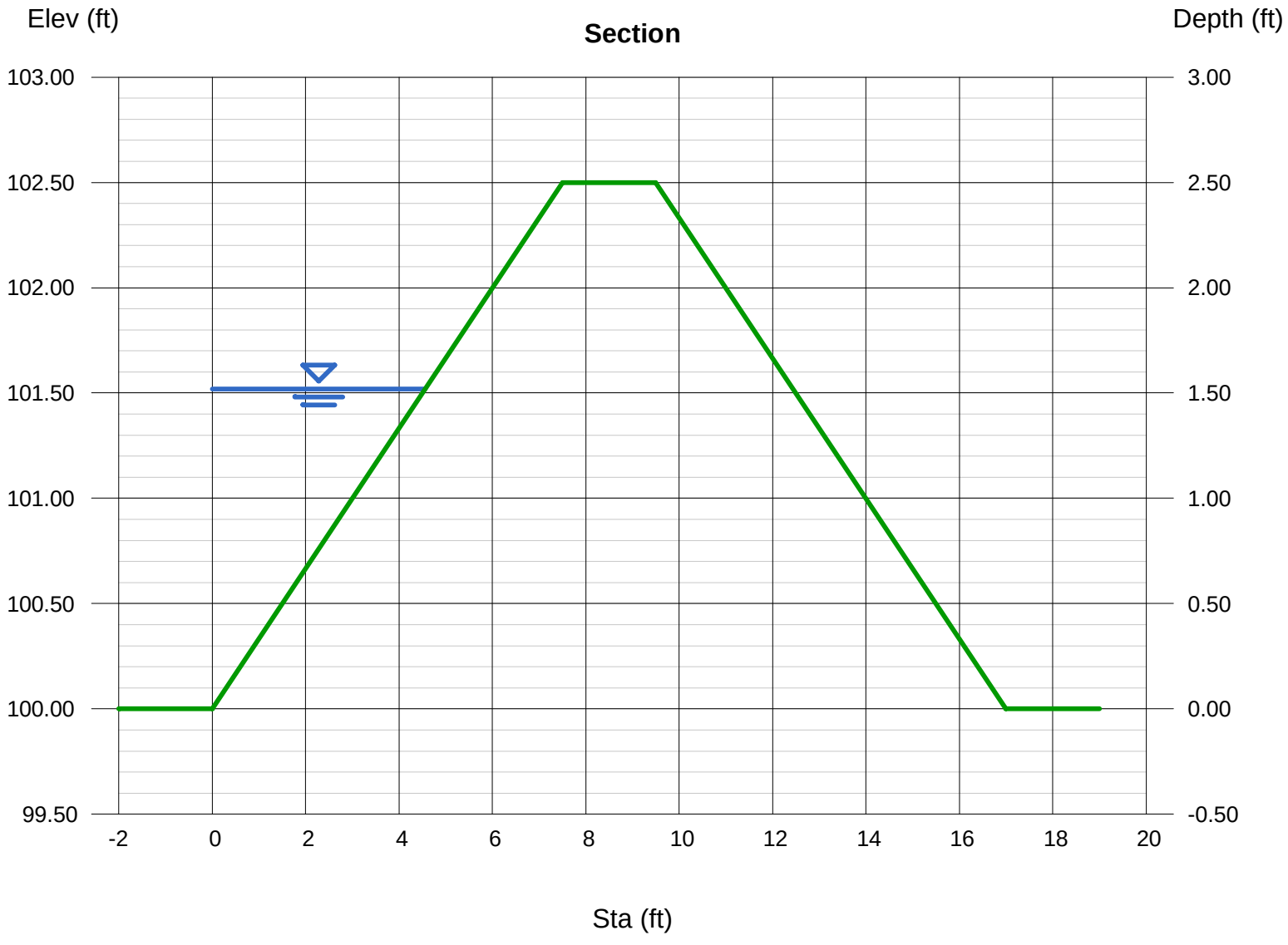
Compute by:	Known Q
Known Q (cfs)	= 14.10

Highlighted

Depth (ft)	= 1.52
Q (cfs)	= 14.10
Area (sqft)	= 6.93
Velocity (ft/s)	= 2.03
Wetted Perim (ft)	= 9.61
Crit Depth, Yc (ft)	= 1.07
Top Width (ft)	= 9.12
EGL (ft)	= 1.58

(Sta, El, n)-(Sta, El, n)...

(0.00, 100.00) -(7.50, 102.50, 0.040) -(9.50, 102.50, 0.040) -(17.00, 100.00, 0.040)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

S. Parking Area Swale (to combo)

Triangular

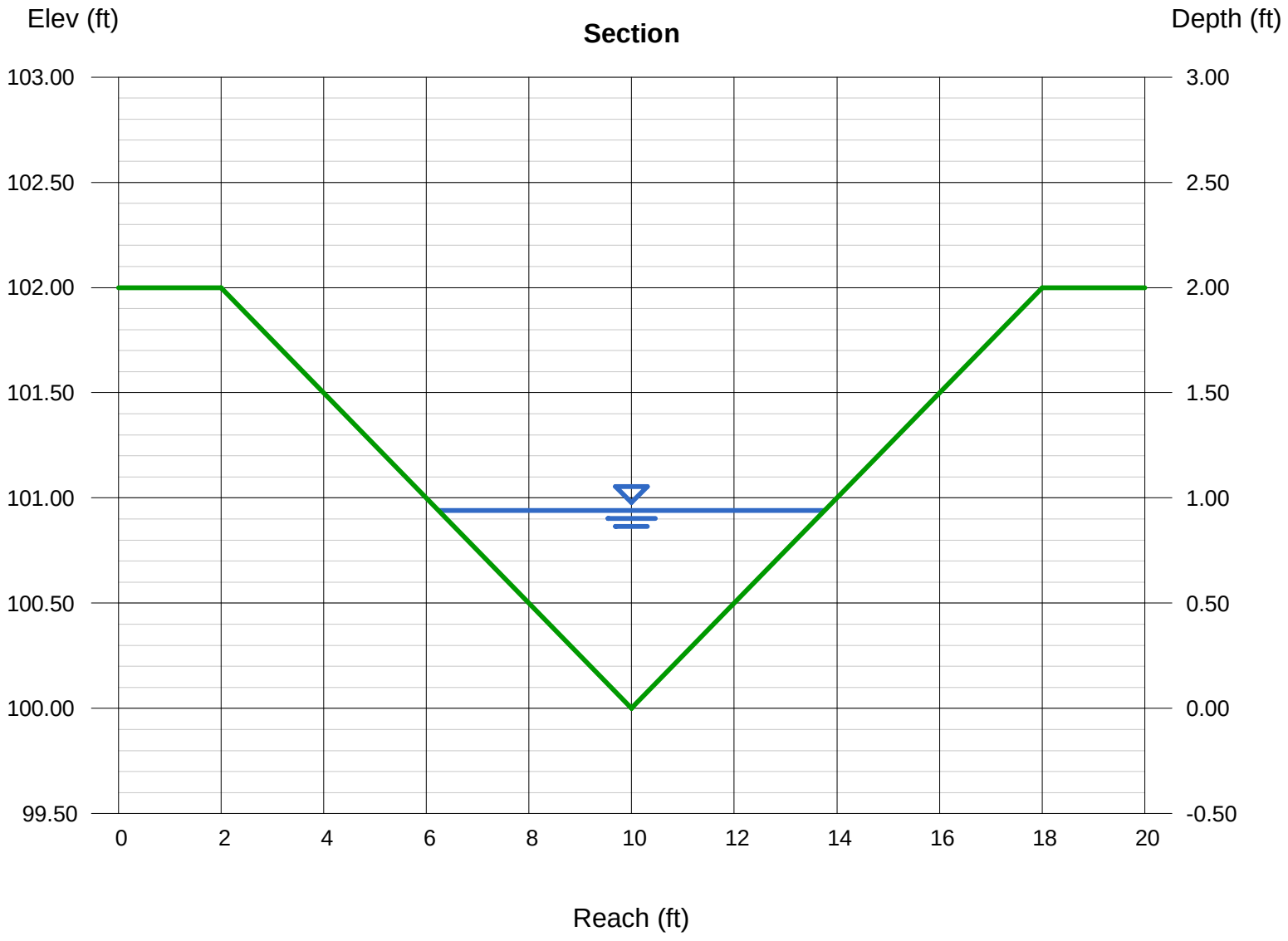
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 6.00
N-Value	= 0.053

Calculations

Compute by:	Known Q
Known Q (cfs)	= 14.10

Highlighted

Depth (ft)	= 0.94
Q (cfs)	= 14.10
Area (sqft)	= 3.53
Velocity (ft/s)	= 3.99
Wetted Perim (ft)	= 7.75
Crit Depth, Yc (ft)	= 0.95
Top Width (ft)	= 7.52
EGL (ft)	= 1.19



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 8 2021

Riprap Rundown (combo swale)

Triangular

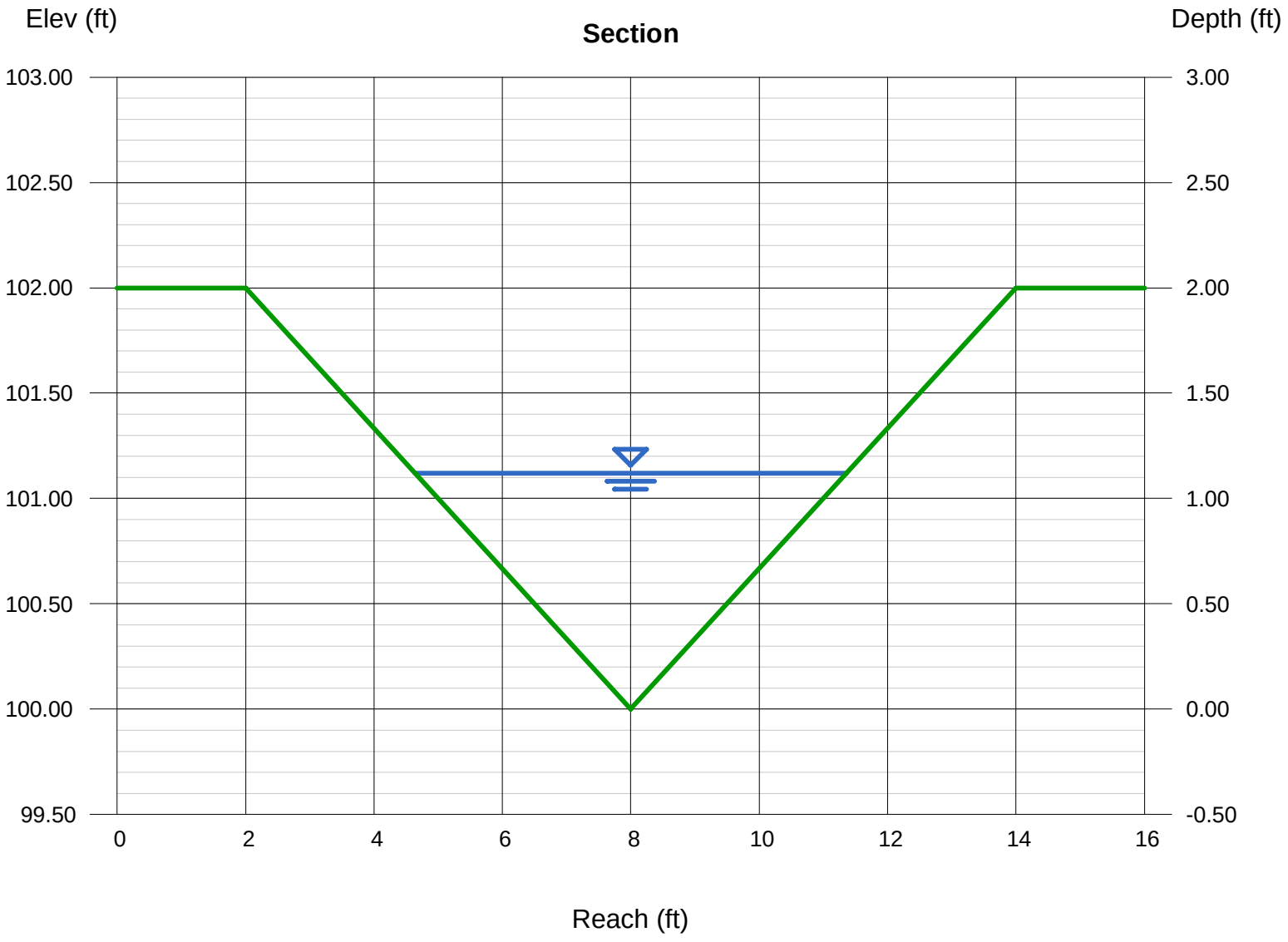
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 17.13
N-Value	= 0.057

Calculations

Compute by:	Known Q
Known Q (cfs)	= 26.50

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 26.50
Area (sqft)	= 3.76
Velocity (ft/s)	= 7.04
Wetted Perim (ft)	= 7.08
Crit Depth, Yc (ft)	= 1.38
Top Width (ft)	= 6.72
EGL (ft)	= 1.89



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 9 2021

Outlet Structure Pipe- 5 Year

Circular

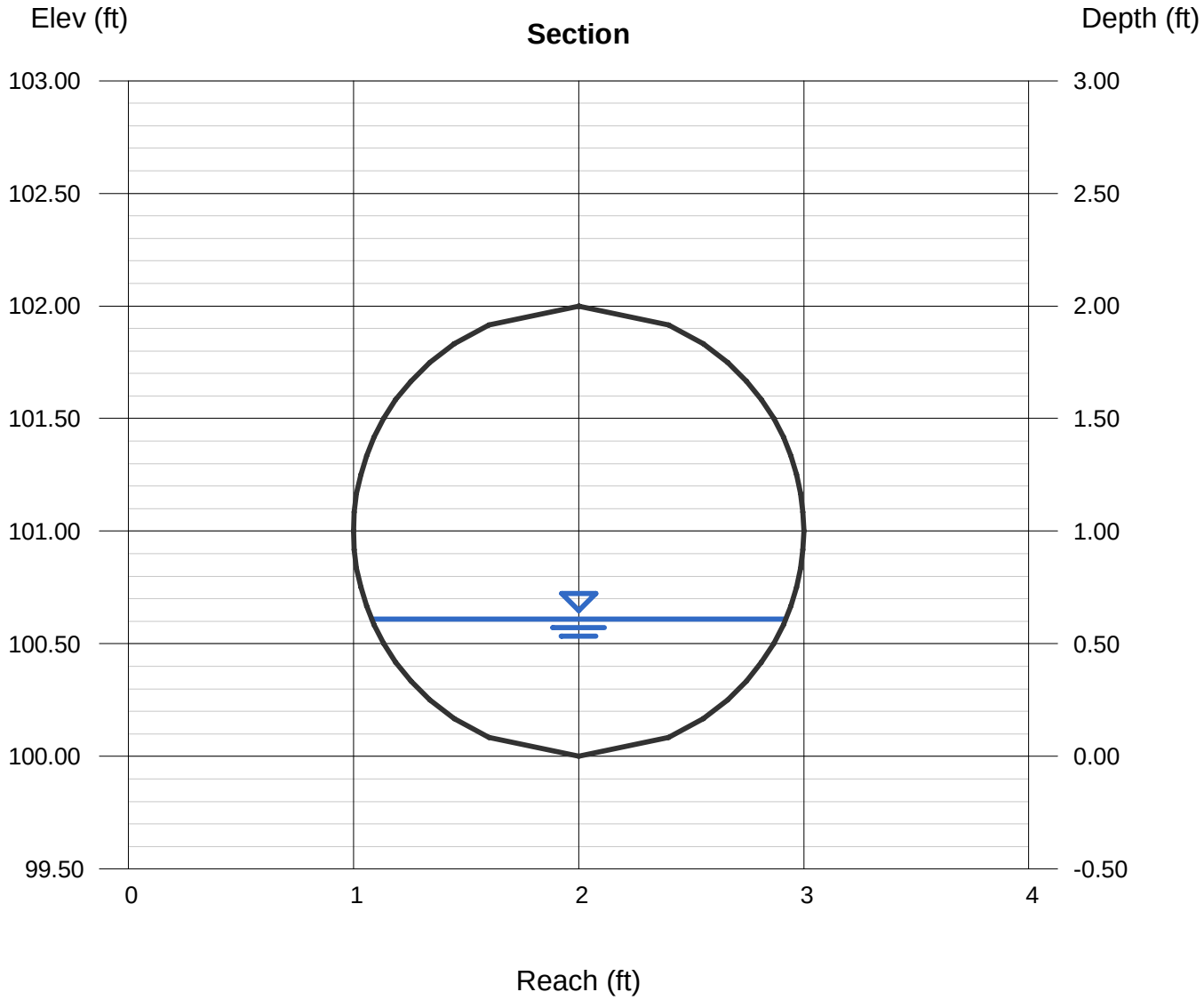
Diameter (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.36
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.70

Highlighted

Depth (ft)	= 0.61
Q (cfs)	= 2.700
Area (sqft)	= 0.82
Velocity (ft/s)	= 3.30
Wetted Perim (ft)	= 2.35
Crit Depth, Yc (ft)	= 0.57
Top Width (ft)	= 1.85
EGL (ft)	= 0.78



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 9 2021

Outlet Structure Pipe- 100 Year

Circular

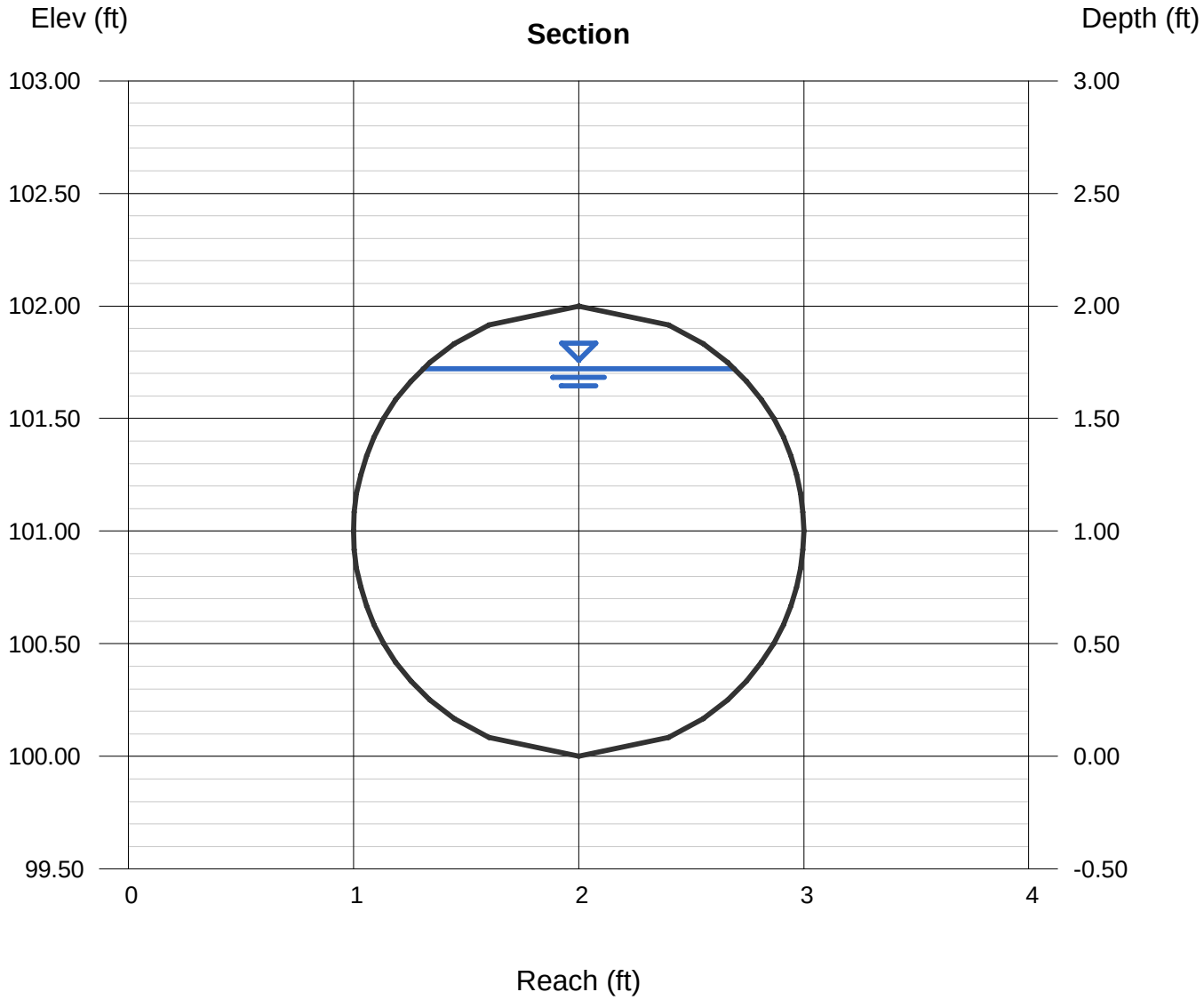
Diameter (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.36
N-Value	= 0.013

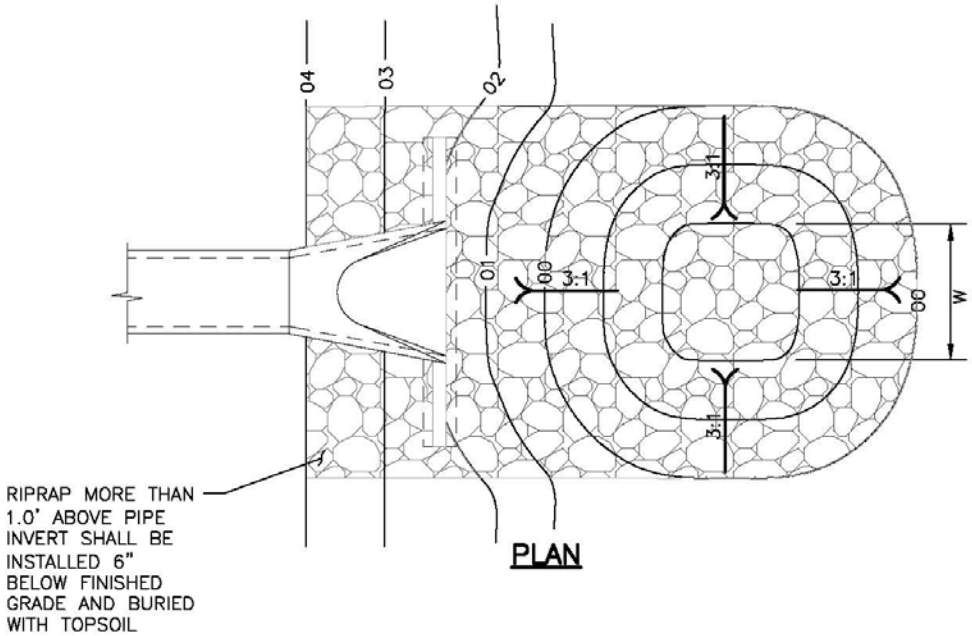
Calculations

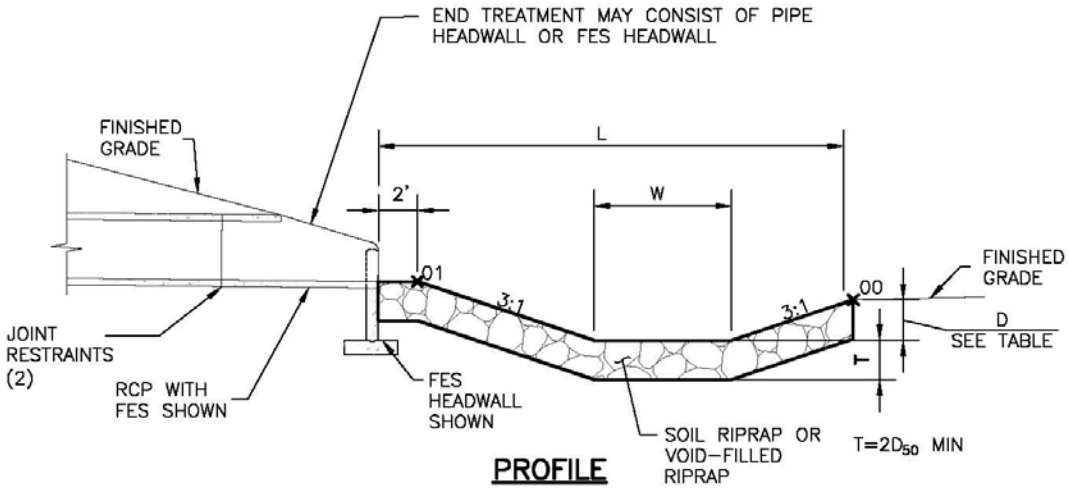
Compute by:	Known Q
Known Q (cfs)	= 14.10

Highlighted

Depth (ft)	= 1.72
Q (cfs)	= 14.10
Area (sqft)	= 2.87
Velocity (ft/s)	= 4.90
Wetted Perim (ft)	= 4.75
Crit Depth, Yc (ft)	= 1.36
Top Width (ft)	= 1.39
EGL (ft)	= 2.09







PIPE SIZE OR BOX HEIGHT	D	W*	L
18" – 24"	1'–0"	4'	15'
30" – 36"	1'–6"	6'	20'
42" – 48"	2'–0"	7'	24'
54" – 60"	2'–6"	8'	28'
66" – 72"	3'–0"	9'	32'

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-37. Low tailwater riprap basin

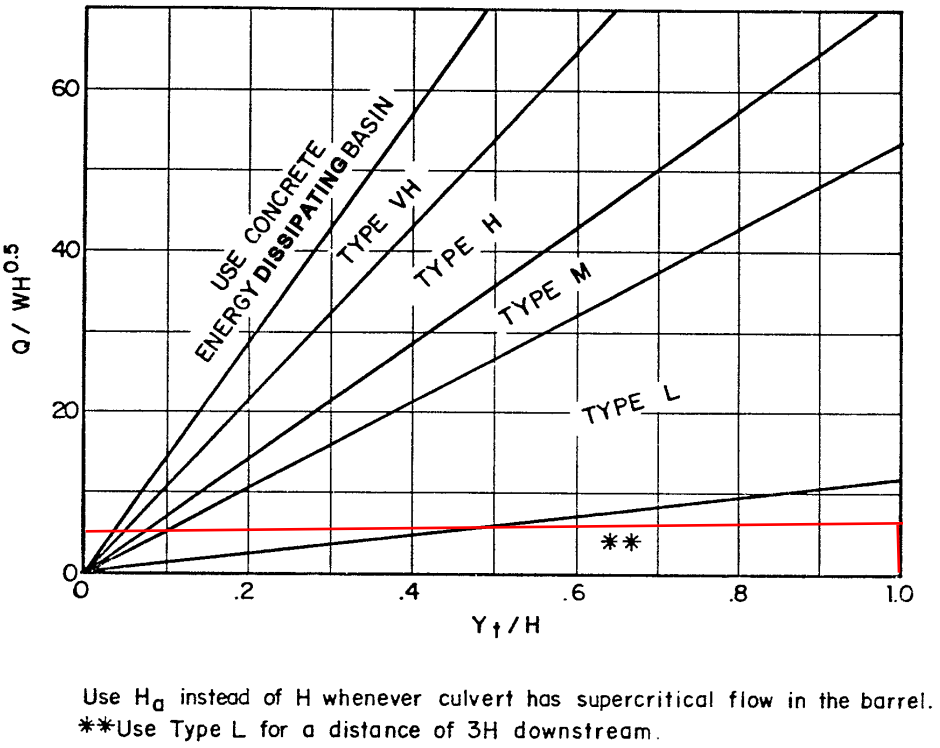
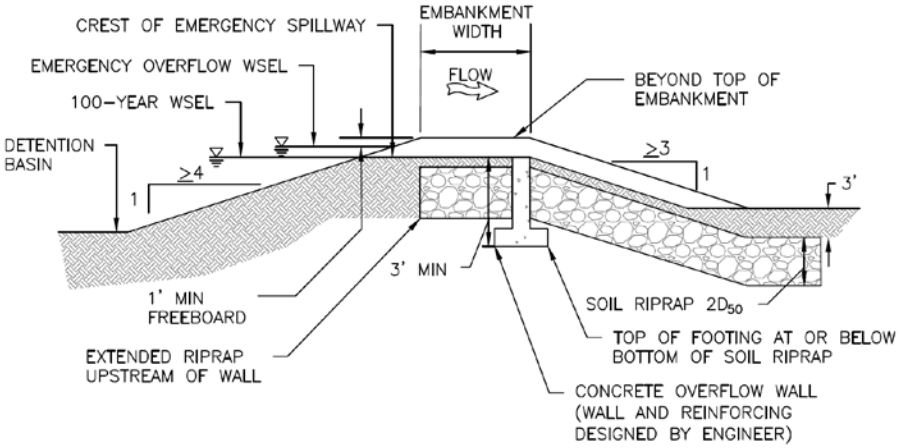


Figure 9-39. Riprap erosion protection at rectangular conduit outlet (valid for Q/WH1.5 ≤ 8.0)

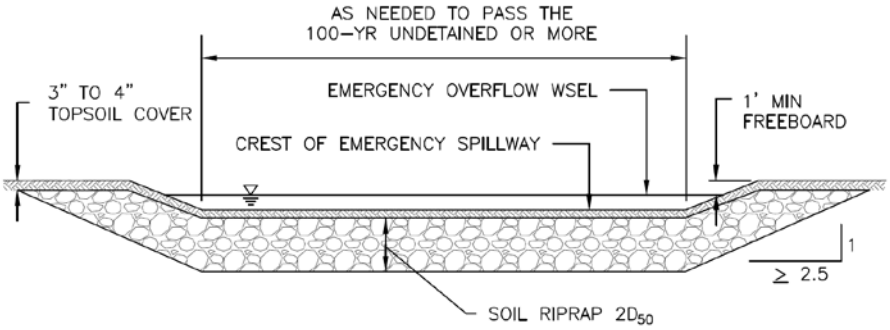
3.2.4 Outfalls and Rundowns

A grouted boulder outfall or "rundown" dissipates energy and provides erosion control protection. Grouted boulder outfalls are most commonly used in large rivers like the South Platte. Figure 9-40 provides a plan view and cross section for a standard grouted boulder rundown. See the grouted boulder drop profiles (A1, A2, and A3) in Figure 9-12 for site specific profile options, (i.e., depressed or free-draining basin for use with a stable downstream channel or with no basin for use in channels subject to degradation). Figure 9-41 provides a plan view of the same structure for use when the structure is in-line with the channel. Evaluate the following when designing a grouted boulder outfall or rundown:

- Minimize disturbance to channel bank
- Determine water surface elevation in receiving channel for base flow and design storm(s)
- Determine flow rate, velocity, depth, etc. of flow exiting the outfall pipe for the design storm(s)
- Evaluate permitting procedures and requirements for construction adjacent to large river system.



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

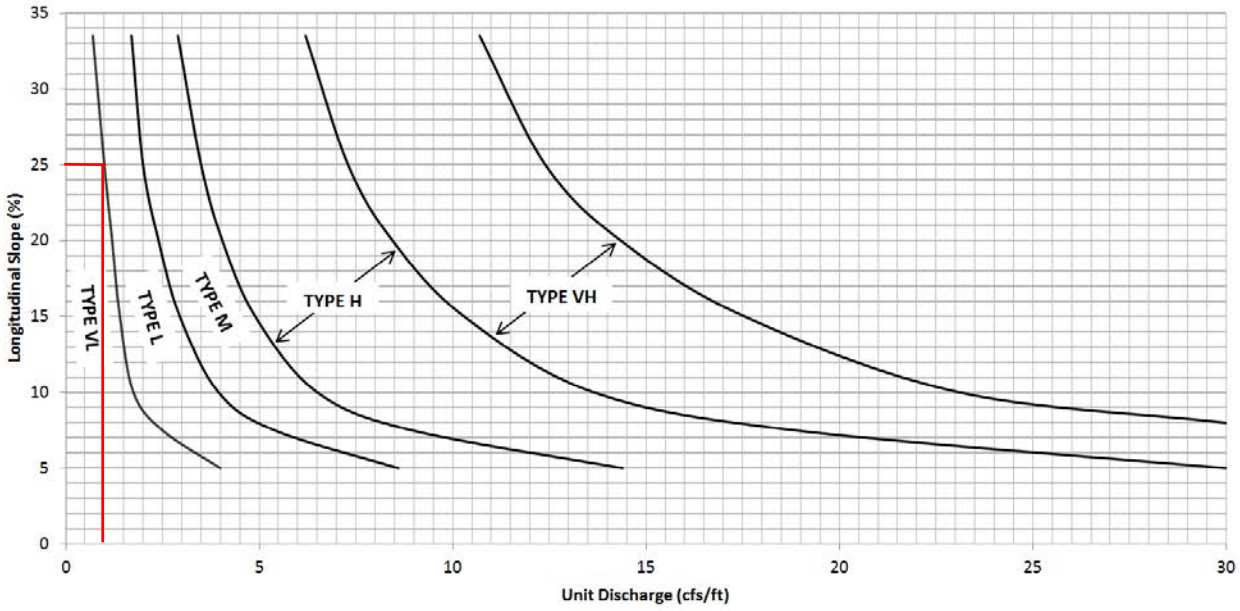


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Existing 30” CMP HY-8 model inputs.

Crossing Data - 55.2

Crossing Properties

Name: 55.2

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	4.300	cfs
Design Flow	25.000	cfs
Maximum Flow	25.000	cfs
TAILWATER DATA		
Channel Type	Trapezoidal Channel	
Bottom Width	26.000	ft
Side Slope (H:V)	20.000	_:1
Channel Slope	0.0001	ft/ft
Manning's n (channel)	0.035	
Channel Invert Elevation	6229.700	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Irregular	
Irregular Shape	Define...	
Roadway Surface	Paved	
Top Width	37.000	ft

Culvert Properties

Ex. 30

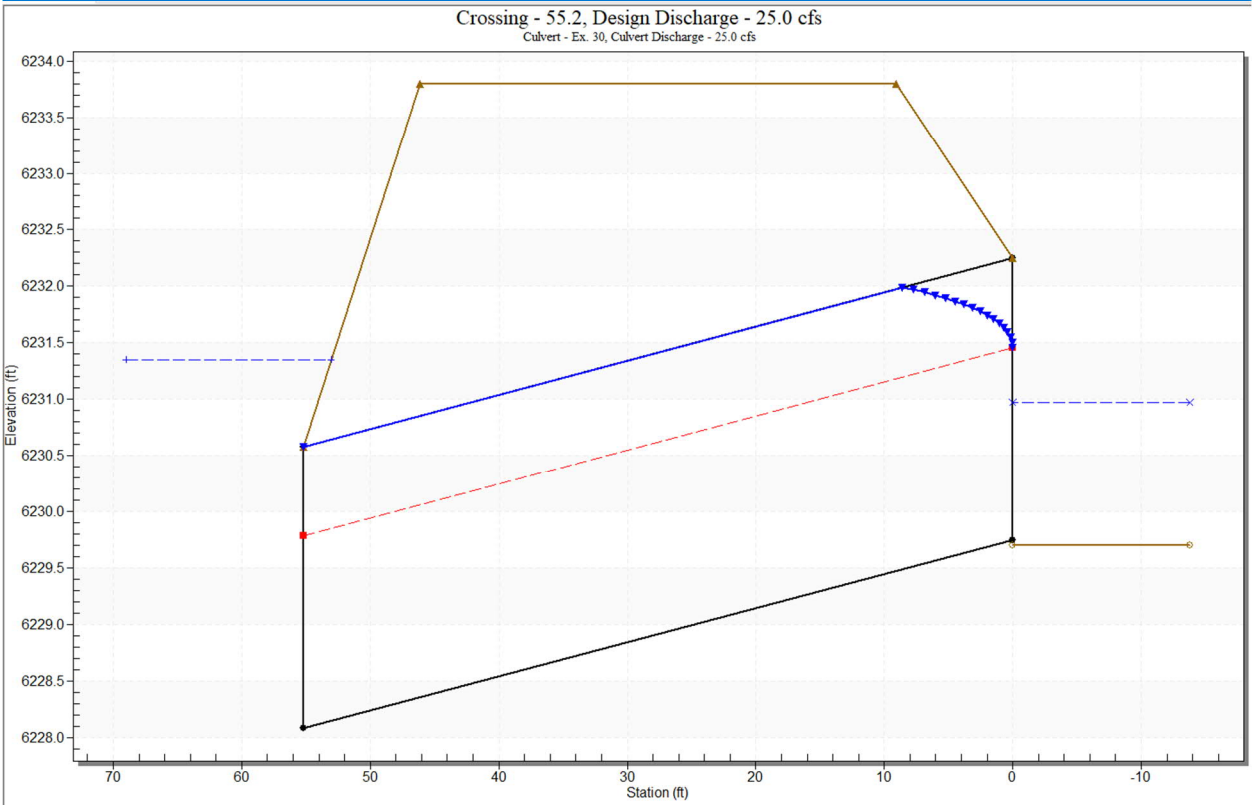
Add Culvert

Duplicate Culvert

Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Ex. 30	
Shape	Circular	
Material	Corrugated Aluminum	
Diameter	2.500	ft
Embedment Depth	0.000	in
Manning's n	0.031	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	55.200	ft
Inlet Elevation	6228.080	ft
Outlet Station	0.000	ft
Outlet Elevation	6229.750	ft
Number of Barrels	1	

Help | Click on any icon for help on a specific topic | Low Flow | AOP | Energy Dissipation | Analyze Crossing | OK | Cancel



HY-8 Culvert Analysis Report

Existing 30” CMP

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 4.3 cfs

Design Flow: 25 cfs

Maximum Flow: 25 cfs

Table 1 - Summary of Culvert Flows at Crossing: 55.2

Headwater Elevation (ft)	Total Discharge (cfs)	Ex. 30 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6230.60	4.30	4.30	0.00	1
6230.63	6.37	6.37	0.00	1
6230.67	8.44	8.44	0.00	1
6230.72	10.51	10.51	0.00	1
6230.77	12.58	12.58	0.00	1
6230.84	14.65	14.65	0.00	1
6230.92	16.72	16.72	0.00	1
6231.01	18.79	18.79	0.00	1
6231.11	20.86	20.86	0.00	1
6231.22	22.93	22.93	0.00	1
6231.35	25.00	25.00	0.00	1
6233.80	42.85	42.85	0.00	Overtopping

Rating Curve Plot for Crossing: 55.2

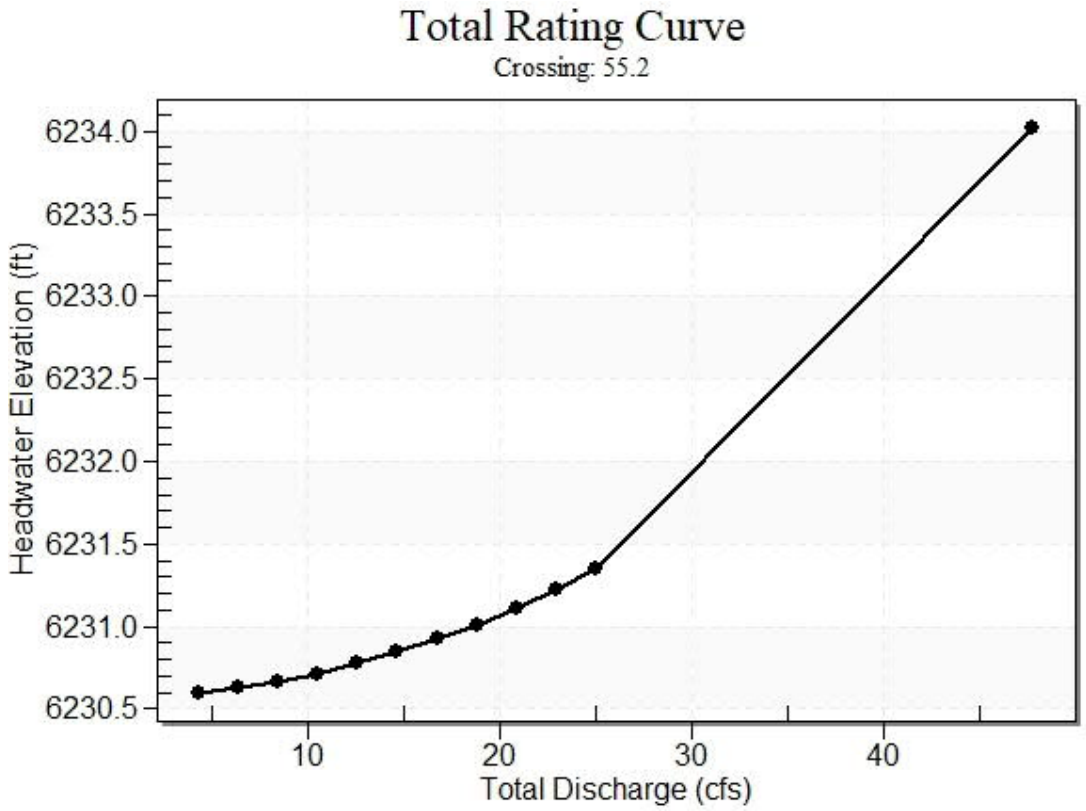


Table 2 - Culvert Summary Table: Ex. 30

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
4.30	4.30	6230.60	1.044	2.523	7-A2c	-1.000	0.682	0.682	0.514	3.962	0.231
6.37	6.37	6230.63	1.287	2.550	7-A2c	-1.000	0.836	0.836	0.635	4.431	0.259
8.44	8.44	6230.67	1.498	2.587	7-A2c	-1.000	0.967	0.967	0.736	4.815	0.282
10.51	10.51	6230.72	1.697	2.635	7-A2c	-1.000	1.084	1.084	0.825	5.150	0.300
12.58	12.58	6230.77	1.887	2.694	7-A2c	-1.000	1.191	1.191	0.904	5.454	0.316
14.65	14.65	6230.84	2.074	2.763	7-A2c	-1.000	1.290	1.290	0.977	5.737	0.329
16.72	16.72	6230.92	2.261	2.843	7-A2c	-1.000	1.382	1.382	1.044	6.005	0.342
18.79	18.79	6231.01	2.451	2.933	7-A2c	-1.000	1.469	1.469	1.107	6.264	0.353
20.86	20.86	6231.11	2.648	3.033	7-A2c	-1.000	1.551	1.551	1.165	6.518	0.363
22.93	22.93	6231.22	2.855	3.144	7-A2c	-1.000	1.629	1.629	1.221	6.768	0.373
25.00	25.00	6231.35	3.073	3.266	7-A2c	-1.000	1.703	1.703	1.274	7.017	0.381

****

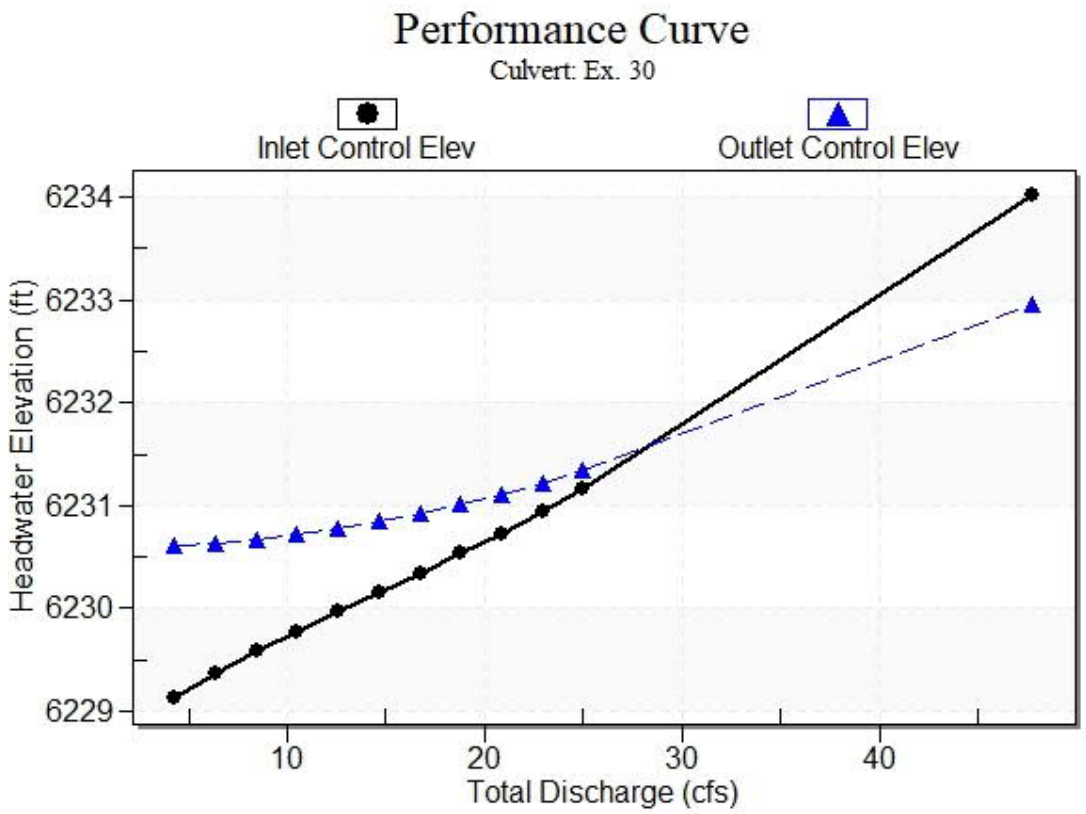
Straight Culvert

Inlet Elevation (invert): 6228.08 ft, Outlet Elevation (invert): 6229.75 ft

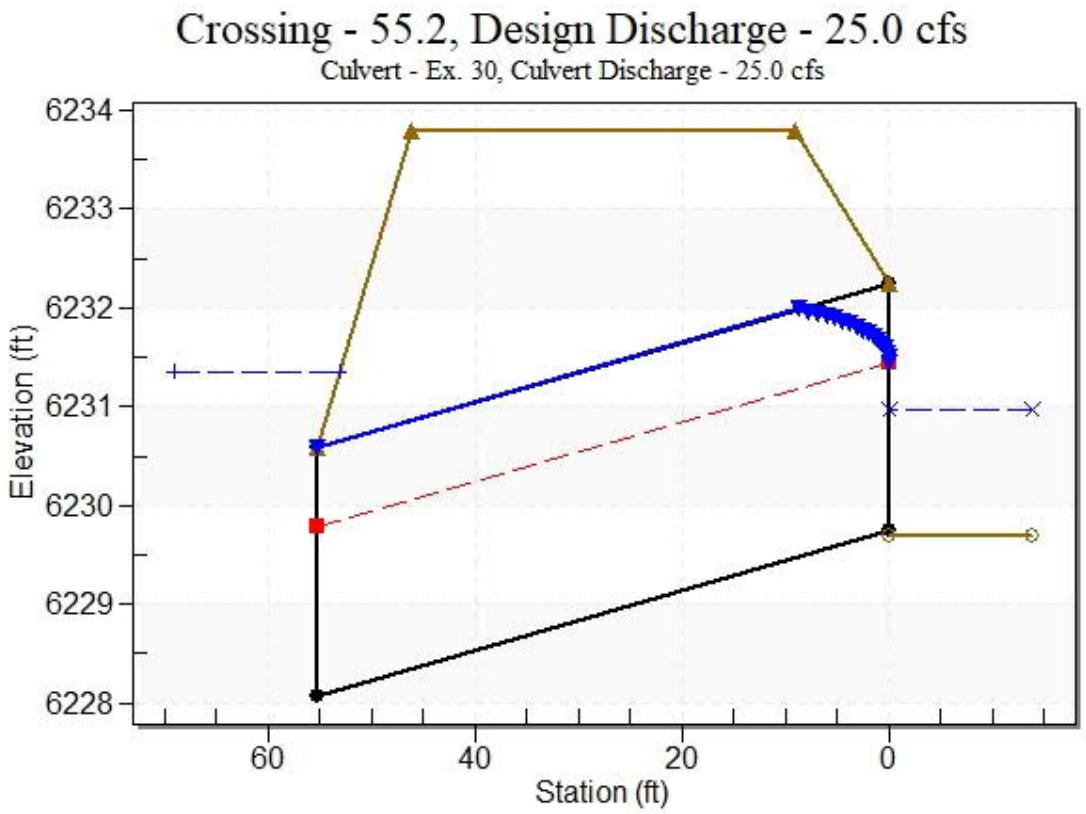
Culvert Length: 55.23 ft, Culvert Slope: -0.0303

****

Culvert Performance Curve Plot: Ex. 30



Water Surface Profile Plot for Culvert: Ex. 30



Site Data - Ex. 30

Site Data Option: Culvert Invert Data

Inlet Station: 55.20 ft

Inlet Elevation: 6228.08 ft

Outlet Station: 0.00 ft

Outlet Elevation: 6229.75 ft

Number of Barrels: 1

Culvert Data Summary - Ex. 30

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Corrugated Aluminum

Embedment: 0.00 in

Barrel Manning's n: 0.0310

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: 55.2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
4.30	6230.21	0.51	0.23	0.00	0.06
6.37	6230.33	0.63	0.26	0.00	0.07
8.44	6230.44	0.74	0.28	0.00	0.07
10.51	6230.52	0.82	0.30	0.01	0.07
12.58	6230.60	0.90	0.32	0.01	0.07
14.65	6230.68	0.98	0.33	0.01	0.07
16.72	6230.74	1.04	0.34	0.01	0.07
18.79	6230.81	1.11	0.35	0.01	0.07
20.86	6230.87	1.17	0.36	0.01	0.07
22.93	6230.92	1.22	0.37	0.01	0.07
25.00	6230.97	1.27	0.38	0.01	0.07

Tailwater Channel Data - 55.2

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 26.00 ft

Side Slope (H:V): 20.00 (_:1)

Channel Slope: 0.0001

Channel Manning's n: 0.0350

Channel Invert Elevation: 6229.70 ft

Roadway Data for Crossing: 55.2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 11.70 ft

Crest Elevation: 6233.80 ft

Roadway Surface: Paved

Roadway Top Width: 37.00 ft

EXISTING ROADWAY/ DRAINAGE CONDITIONS
AT
SOUTH FRANCEVILLE COAL MINE ROAD
FOR
GATEWAY TRUCKING

Gateway Trucking, LLC
11260 West Lane
Colorado Springs, CO 80929
(719) 492-7658
Contact: Perry Hastings

November 3, 2021
Project No. 25215.00

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive
Colorado Springs, CO 80919
719-593-2593

El Paso County PCD File No. PPR-31-033

The pictures attached show the existing conditions of the roadway and drainage at the Gateway Trucking, LLC site. The foreslopes/ditch sections appeared to be well maintained and the roadway appeared to have a satisfactory crown as described in the traffic report. The existing roadway conveys stormwater from the roadway to the roadside.

Figure 1: S. Franceville Coal Mine Rd. in front of site access driveway facing South.

Figure 2: S. Franceville Coal Mine Rd. in front of site access driveway facing North.

Figure 3: S. Franceville Coal Mine Rd. in front of site access driveway facing East toward the site.

Figure 6: S. Franceville Coal Mine Rd. North-most profile showing creek on the right end.

The existing culvert located along S. Franceville Coal Mine Rd. is south of the site access and drains to the West under S. Franceville Coal Mine Rd.

Figure 7: Culvert Entrance, 30” diameter.

Figure 8: Culvert Exit, 30” diameter.

The culvert did not show any signs of damage, however the surrounding vegetation may need to be trimmed back to ensure the existing culvert operates properly.

North of the site is a creek that crosses under S. Franceville Coal Mine Rd. Existing drainage shows that the roadside drainage North of the site access driveway flows North into this creek.

Figure 9: Creek Entrance under S. Franceville Coal Mine Rd, site shown in the distance to the South. Drainage path shown along roadside draining into the creek.

Figure 10: Creek Entrance under S. Franceville Coal Mine Rd.

APPENDIX C

DRAINAGE MAPS

GATEWAY TRUCKING
EXISTING DRAINAGE MAP

PARCEL NUMBER 44000-00-459
OWNER:
PIKES PEAK CHAPTER - IZAAK WALTON LEAGUE
450 SOUTH FRANCEVILLE COAL MINE ROAD
COLORADO SPRINGS, CO 80929
ZONE: A-5
USE: GUN CLUB / SHOOTING RANGE

PARCEL NUMBER 44000-00-529
OWNER:
PERRY HASTINGS
11260 WEST LAKE
COLORADO SPRINGS, CO 80929
ZONE: A-5, RR-5
USE: VACANT

PARCEL NUMBER 44000-00-530
OWNER:
SHIRLEY BOUCHER LIVING TRUST
2440 PALMER PARK BLVD., APT 105
COLORADO SPRINGS, CO 80909
ZONE: RR-5
USE: RESIDENTIAL

PARCEL NUMBER 44000-00-531
OWNER:
PERRY HASTINGS
11260 WEST LAKE
COLORADO SPRINGS, CO 80929
ZONE: RR-5
USE: STORAGE / PARKING

EXISTING METAL SHED

30.00'
ROAD RESERVATION
ROAD BOOK A, PAGE 78

60.00'
ROAD RESERVATION
ROAD BOOK A, PAGE 78

EXISTING GRAVEL ROAD

55.80 LF
EXISTING 30" CMP
S=2.99%

FRANCEVILLE COAL MINE ROAD

EX-A: 6.75 | 0.09 | 0.36
EX-B: 3.76 | 0.16 | 0.41
OS1: 2.29 | 0.09 | 0.36
OS2: 4.68 | 0.09 | 0.36
OS3: 0.60 | 0.22 | 0.45

LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		

BASIN ID (ID / AC / C5 / C100)

DESIGN POINT DESIGNATION (1)

FLOW DIRECTION (PROPOSED)
FLOW DIRECTION (EXISTING)
SUB-BASIN DRAINAGE AREA

EXEMPT BASIN TO FLOW OFF-SITE UNTREATED

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-A	6.75	2.0%	0.09	0.36	19.2	1.3	12.8
EX-B	3.76	12.4%	0.16	0.41	19.3	0.4	8.0
OS1	2.29	2.0%	0.09	0.36	19.0	0.7	4.4
OS2	4.68	2.0%	0.09	0.36	23.1	1.2	8.1
OS3	0.60	21.5%	0.22	0.45	18.0	0.4	1.5

Design Point	Contributing Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
1	2.29	0.7	4.4
2	4.68	1.2	8.1
3	13.72	3.0	23.8
4	0.60	0.4	1.5
5	18.08	3.8	32.4

N

60 30 0 60 120
ORIGINAL SCALE: 1" = 60'

EXISTING DRAINAGE MAP
GATEWAY TRUCKING
JOB NO. 25215.00
11/08/21
SHEET 1 OF 2

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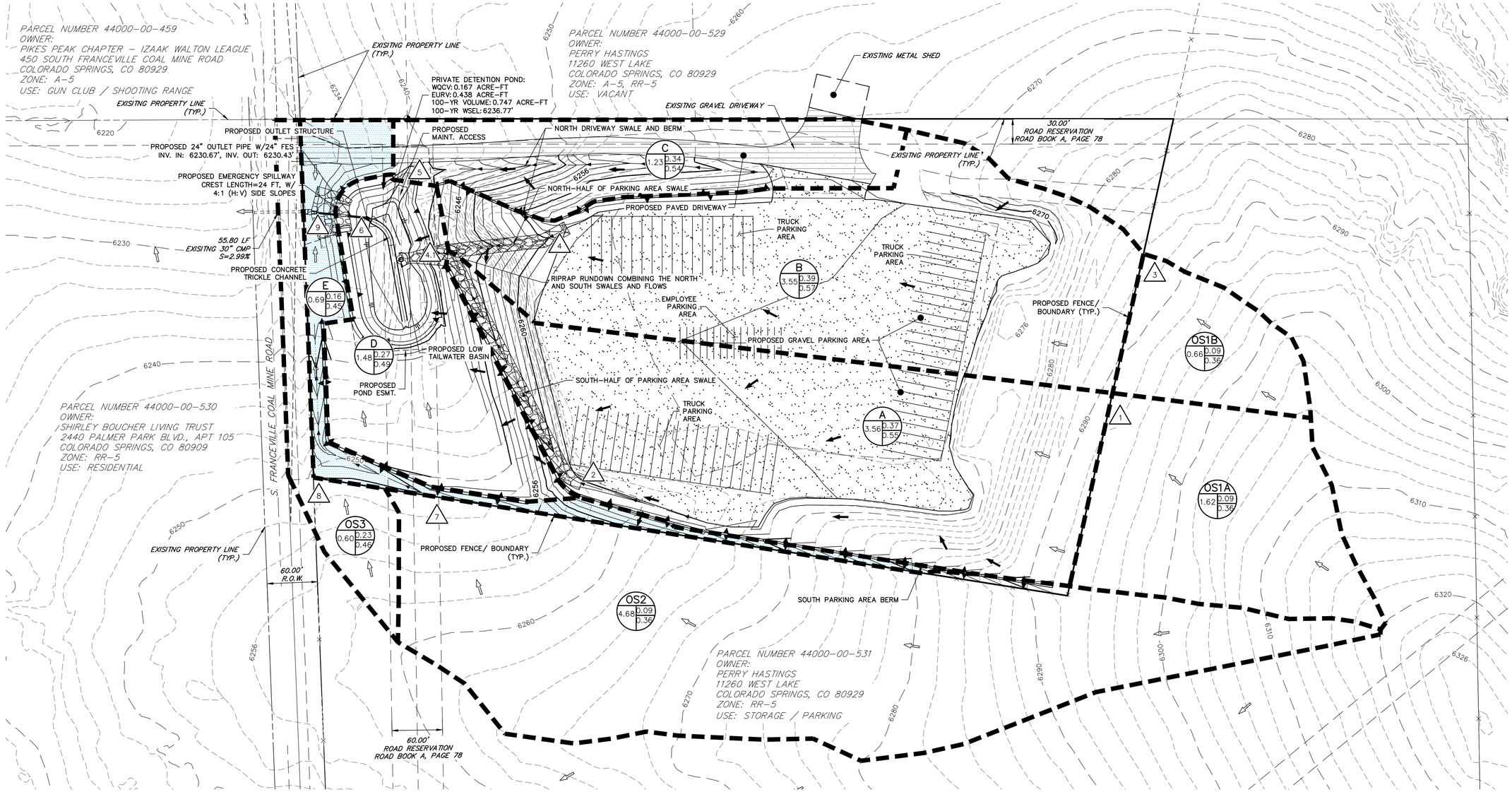
GATEWAY TRUCKING
PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		

BASIN ID (ID / AC / C5 / C100)

DESIGN POINT DESIGNATION (1)

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

SUB-BASIN DRAINAGE AREA

EXEMPT BASIN TO FLOW OFF-SITE UNTREATED

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	3.56	46.3%	0.37	0.55	12.1	5.1	12.7
B	3.55	49.5%	0.39	0.57	11.0	5.6	13.4
C	1.23	33.1%	0.34	0.54	12.6	1.6	4.3
D	1.48	23.2%	0.27	0.49	6.1	1.9	5.9
E	0.69	10.5%	0.16	0.45	7.6	0.5	2.4
OS1A	1.62	2.0%	0.09	0.36	17.6	0.5	3.2
OS1B	0.66	2.0%	0.09	0.36	16.1	0.2	1.4
OS2	4.68	2.0%	0.09	0.36	23.1	1.2	8.1
OS3	0.60	23.1%	0.23	0.46	14.6	0.5	1.6

Design Point	Contributing Area (ac)	Q_5 (cfs)	Q_{100} (cfs)
1	1.62	0.5	3.2
2	5.18	4.9	14.1
3	0.66	0.2	1.4
4	4.21	5.0	12.9
4.1	9.39	9.7	26.5
5	1.23	1.6	4.3
6	12.10	12.3	34.1
7	4.68	1.2	8.1
8	0.60	0.5	1.6
9	5.97	1.9	10.9

N

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

PROPOSED DRAINAGE MAP
GATEWAY TRUCKING
JOB NO. 25215.00
11/08/21
SHEET 2 OF 2

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