FINAL DRAINAGE REPORT
FOR
SADDLEHORN RANCH – FILING 5 EARLY GRADING

Prepared For:
ROI Property Group, LLC
2495 Rigdon Street
Napa, CA 94558
(707) 365-6891

August 17, 2023
Project No. 25142.07

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

El Paso County PCD File No.:
EGP226

Final Drainage Report
Filing 5 - Saddlehorn Ranch Early Grading

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.

25043

Bryan Law, Colorado P.E. # 25043
For and On Behalf of JR Engineering, LLC

9/8/22
Date

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: ROI Property Group, LLC

By: FOR ROI (BILL GUMAN

Title: REPRESENTATIVE

Address: 2495 Rigdon Street
Napa, CA 94558

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.

Joshua Palmer, P.E.
County Engineer/ ECM Administrator

Date

Conditions:

CONTENTS

Unresolved:
No reference materials included.
Please provide with next submittal
or delete appendix section

PURPOSE

This document is the Final Drainage report for Filing 5 of Saddlehorn Ranch Early Grading. 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 during early grading operations to appropriate 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 proposed Saddlehorn Ranch Filing 5, known as "Filing 5" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 64 West of the 6th Principal Meridian in El Paso County, Colorado. Saddlehorn Ranch is an 824 acre, rural, single family-development. Filing 5 is 126.73 acres and is comprised of 41 lots of the overall Saddlehorn Ranch development. Saddlehorn Ranch is bound by Judge Orr Road to the North and Curtis Road to the West. To the East, Saddlehorn Ranch is bound by undeveloped land owned by Brent Houser Enterprises, LLC. To the south, Saddlehorn Ranch is bound by undeveloped properties owned by Carolyn Gudzunas and Faye Reynolds. Filing 5 is bound by future Filing 4 to the north, Drainageway MS-06 to the west, and unplatted vacant land to the east and to the south. A vicinity map is presented in Appendix A.

Currently, there are two major Drainageway that will receive flows from Filing 5: Gieck Ranch (WF-R7A) and Haegler Ranch Main Stem 6 (MS-06). These Drainageways were analyzed, both hydrologically and hydraulically, in the following reports:

- Haegler Ranch Basin Drainage Basin Planning Study (DBPS), May 2009.
- Santa Fe Springs – Haegler Ranch Drainage Basin Letter of Map Revision, June 2004.
- Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, May 2020.
- Geick Ranch Drainage Basin Planning Study (DBPS), October 2007

The impact of these Drainageways and planning studies on the proposed development will be discussed later in the report.

Description of Property

Filing 5 is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Filing 5 slopes from south to southeast and the existing drainageways follow this topography.

Per a NRCS web soil survey of the area, Filing 5 is made up of Group A soils. Group A soils have a high infiltration rate when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM Map number 08041C0558G, dated December 7, 2018, Filing 5 lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. All proposed residential development within Filing 5 will occur in Zone X. The FIRM Map has been presented in Appendix A.

DRAINAGE BASINS AND SUB-BASINS

Unresolved:
Address CLOMR/LOMR requirements

Existing Major Basin Descriptions

Filing 5 lies within Haegler Ranch Drainage Basin based on the "*Haegler Ranch Drainage Basin Planning Study*" prepared by URS Corporation in May 2009.

The Haegler Ranch Drainage Basin covers approximately 16.6 square miles in unincorporated El Paso County, CO. The Haegler Ranch Drainage Basin is tributary to Black Squirrel Creek. In its existing condition, the basin is comprised of rolling rangeland with poor vegetative cover associated with Colorado's semi-arid climate. The natural Drainageways within the basin are typically shallow and wide with poorly defined flow paths in most areas. Anticipated land use for the basin includes residential and commercial development. Residential developments will range from 0.125 – 5 acre lots with a mix of low, medium and high density developments.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Haegler Ranch Drainage Basin Planning Study prepared by URS Corporation in May 2009
- Santa Fe Springs – Haegler Ranch Drainage Basin Letter of Map Revision prepared by Tri-Core Engineering in June 2004.
- Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, prepared by JR Engineering, May 2020.
- Gieck Ranch Drainage Basin Planning Study (DBPS), October 2007

The "*Haegler Ranch Drainage Basin Planning Study*" was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Haegler Ranch Drainage Basin. Based on provided drainage maps and analysis, in the existing condition Haegler Ranch contributes a total

of 710 cfs onto the site. Of the 710 cfs, 590 cfs crosses Curtis Road in an existing 24" CMP onto the site. Major Drainageway MS-06 conveys the stormwater through the site and to its off-site confluence with Major Drainageway MS-05. The remaining 210 cfs crosses Curtis Road in an existing 36" CMP onto the site. Major Drainageway T-6 conveys the stormwater through the site and to its off-site confluence with Major Drainageway MS-05. Both Curtis Road culverts are undersized for existing and future flows and overtopping occurs locally near the culvert crossings.

Based on flood impacts, stream stability and cost effectiveness, this study recommended a sub-regional detention approach. This allows future development anywhere in the basin with the construction of an associated sub-regional pond. However, based on the *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch,* Filing 5 will utilize one on-site full spectrum water quality and detention ponds instead. This full spectrum detention pond will limit developed discharge into Drainageway MS-06 to less than historic rates.

The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR was executed on Haegler Ranch Tributary 2, 3, and 4. The LOMR revised the onsite effective flood zone from Zone A to Zone AE. See FIRM Map Panel 08041C0558G for limits of LOMR study and revised flood zones, presented in Appendix E.

The Gieck Ranch Drainage Basin covers approximately 22 square miles and begins approximately five miles northeast of the Town of Falcon and travels approximately 15 miles to the southeast. The Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains south to the Arkansas River near the city of Pueblo, Colorado. The majority of the area within the basin is undeveloped and is characterized as rolling range land typically associated with Colorado's semi-arid climates. Anticipated land use for the basin includes residential, industrial, agricultural and commercial development. Residential developments will range from 0.125 – 5 acre lots with a mix of low, medium and high density developments.

See Table 2 for comparison of Drainageway identification and the naming convention used within the context of this report. See Table 3 for a comparison of 100-year flows as calculated in the aforementioned DBPS and LOMR. An existing conditions drainage map is presented in Appendix E.

Table 1: Major Drainageway Naming Convention

Major Drainageway Naming Conventions			
Saddlehorn Ranch MDDP/PDR:	Per Haegler Ranch DBPS:	Per Geick Ranch DBPS:	Per Sante Fe Springs LOMR:
MS-06	Main Stem (MS-06)	N/A*	Haegler Ranch Tributary 3
WF-R7A	N/A*	West Fork (Middle)/WF-R7A	N/A*

Table 2: Major Drainageway – Ex. 100-Year Flow Comparison

Major Drainageways: 100-Year Flow Comparison				
Drainageway Name	Contributing Area (sq. mi.)	Q_{100} Per Haegler Ranch DBPS:	Q_{100} Per Geick Ranch DBPS:	Q_{100} Per Sante Fe Springs LOMR:
MS-06 @ Curtis Road	1.05	590 cfs	N/A*	505 cfs
WF-R7A @ Judge Orr Road	1.50	N/A*	1,017 cfs	N/A*

*N/A: Flow regime outside limits of study.

The *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch* proposed the overall drainage facility design for Saddlehorn Ranch. Within the context of this report, onsite drainage basins the associated full spectrum water quality pond were established. As it pertains to Filing 5, two full spectrum water quality ponds are recommended. Roadside ditches and local street culverts will be utilized to capture and convey Filing 5's runoff to the water quality ponds. Both ponds A and B will discharge into Drainageway MS-06, while a portion of the proposed lots will release directly into Drainageway WF-R7A. All ponds are full spectrum and will release at less than historic rates.

Existing Sub-basin Drainage

On-site, existing sub-basin drainage patterns are generally from northeast to southwest, following the general slope of the existing grade. On-site areas flow directly into these drainageways, which also bypass off-site flows through the site.

On-site, existing drainage basins were established based upon existing topography and the limits of the 100-year floodplain. These existing sub-basins were analyzed in the *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch.* An existing drainage map has been provided in Appendix E.

Sub-basin H2 is comprised of rolling rangeland and runoff flows southwest to Drainageway MS-06 as represented by Design Point 4 (Q100=91.1 cfs). Include 4 offsite basins, basin CH2 & design point 7 in discussion

Proposed Sub-basin Drainage

The proposed Filing 5 basin delineation is as follows;

Basin A consists solely of Basin A1 for a total of 15.08 acres. In its existing condition, Basin A is rolling rangeland and runoff generally flows southeast towards the southern property line where it will flow across adjacent property and ultimately outfall into Drainageway MS-06. In the proposed condition, Basin A will be rural 2.5 acre lots, paved roadway, and will include Pond A. In the early grading phase, runoff from this basin will be collected in roadside ditches and conveyed to Sediment Basin 2 in the southeast corner of the Filing 5 development. The watershed area of Pond A is 15.08 acres, and in the major event, the pond receives 10.4 cfs of flow. In the proposed condition, Sediment Basin 2 will be

59.24 for Basins B1 to B5. Does this include OS1 & OS2? then include them in the discussion that OS1 & OS2 are also diverted to Sed Pond 1

converted to Pond A. Pond A will be a full spectrum water quality and detention pond, and will release at less than historic rates into Drainageway MS-06.

B5

Unresolved:
Address how much acreage and flow is diverted and its effect on the drainageway

Basin B consists of Sub-basins B1-B6 combining for a total of 60.42 acres. In its ex
Basin B is rolling rangeland and runoff generally flows southwest to Drainageway
proposed condition, Basin B will be rural 2.5 acre lots and paved roadway, flowing ultimately to Pond B. In the early grading phase, runoff from this basin will be collected in roadside ditches and conveyed west to Sediment Basin 1 located in the south west corner of the Filing 5 development. In the proposed condition, Sediment Basin 1 will be converted to Pond B. The watershed area of Pond B is 60.42 acres, and in the major event the pond receives 34.3 cfs of flow. Pond B will be a full spectrum water quality and detention pond, and will release at less than historic rates into Drainageway MS-06.

Basin C consists of Sub-basins C1-C2 combining for a total of 5.45 acres. In its existing condition, Basin C is rolling rangeland and runoff generally flows south west towards Drainageway MS-06. In the proposed condition, Basin C will be rural 2.5 acre lots and paved roadway. Runoff from this basin will be collected in road side ditches and conveyed to the existing Pond C located in the southern portion of the Filing 4 development along Del Cambre Trail. Pond C is a full spectrum water quality and detention pond, and will release at less than historic rates into Drainageway MS-06. All calculations pertaining to Pond C can be found in the *Final Drainage Report for Saddlehorn Ranch – Filing 3*, prepared by JR Engineering, February 4, 2022.

46.99

Basin UD consists of Sub-basins UD1-UD4 combining for a total of 45.81 acres. In their existing condition, these basins are rolling rangeland. Runoff from Basins UD2, UD3, & UD 4 generally flows south and west to Drainageway MS-06. Basin UD1 flows east to Drainageway WF-R7A. In the proposed condition, these basins will be rural 2.5 acre lots with an Imperviousness = 6.2% and will be excluded from permanent stormwater quality management per Section I.7.1.B.5 of the ECM – Stormwater Quality Policy and Procedures.

less than 10%?

Basin OS consists of Sub-basins OS1-OS4 combining for a total of 10.55 acres. These basins are offsite, and will remain undeveloped rangeland throughout the duration of the project. Runoff from sub-basins OS1-OS4 generally flows from northeast to southwest on to the Saddlehorn site. Runoff from Basin OS will not be treated by on-site water quality treatment per Section I.7.1.B.7 of the ECM – Stormwater Quality Policy and Procedures.

Finish basin name

A summary table of proposed basin parameters and flow rates are presented in Appendix B.

In the ultimate conditions, Basin A runoff will overland flow into Pond A, or be captured by roadside swales and conveyed to the proposed Pond A. In the ultimate conditions, Basin B will be captured in roadside swales and conveyed to the proposed Pond B. Both full spectrum ponds will release treated flows at less than historic rates to minimize adverse downstream impacts, and both will discharge into Drainageway MS-06.

See Table 3 below for proposed Filing 5 pond parameters.

Table 3: Pond Summary

Tributary Sub-Basin	Pond Name	Tributary Acres	WQ Volume (ac-ft)	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum 100-Year Discharge (cfs)
A	Pond A	15.08	0.085	0.199	0.279	7.5
B	Pond B	60.42	0.382	1.144	1.295	21.6

Early Grading Drainage

During early grading operations, runoff will be captured in roadside ditches and conveyed into one of two sediment basins. Basin A runoff will be conveyed to Sediment Basin 2. Basin B runoff will be conveyed to Sediment Basin 1. Sediment Basin 1 is designed to treat a tributary area of 60.42 acre, 20.98 acre of disturbed area, and 39.44 acre of undisturbed area. The required volume of Sediment Basin 1 in order to treat the 60.42 acre is 1.320 Ac-ft. Sediment Basin 1 exceeds this with a provided volume of 2.315 Ac-ft. Sediment Basin 1 was designed to drain its entire volume within 40 hrs via a temporary outlet structure. This temporary outlet structure was designed as a singular column with five 1.25" dia holes allowing for water to drain.

Sediment Basin 2 is designed to treat a tributary area of 15.08 acre, 1.55 acre of disturbed area, and 13.53 acre of undisturbed area. The required volume of Sediment Basin 2 in order to treat the 15.08 acre is 0.219 Ac-ft. Sediment Basin 2 has a provided volume of 0.279 Ac-ft. Sediment Basin 2 was designed to drain its entire volume within 40 hrs via a temporary outlet structure. This temporary outlet structure was designed as a singular column with five 1.25" dia holes allowing for water to drain.

Once the project progresses past this early grading phase, both Sediment Basin 1 and Sediment Basin 2 will be converted to a full spectrum water quality detention ponds. Sediment Basin 1 will be converted to Pond B, and Sediment Basin 2 will be converted to Pond A. Each Pond will be fitted with a concrete forebay along with appropriately sized riprap. The water will then drain through a concrete trickle channel to the proposed permanent outlet structure. Both temporary outlet structures will be replaced with permanent outlet structures, each with appropriately sized riprap spreaders. Both ponds will release treated flows at less than historic rates to minimize adverse impacts downstream. Both ponds will discharge into Major Drainageway MS-06. The final design for both Pond A and Pond B will be included in the Final drainage Report.

See Table 4 below for proposed Filing 5 Early Grading sediment basin parameters

Table 4: Sediment Basin Summary

Tributary Sub-Basin	Sediment Basin Name	Tributary Acres	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum Discharge (cfs)
A	Sediment Basin 2	15.08	0.219	0.279	0.0331
B	Sediment Basin 1	60.42	1.320	2.315	0.1997

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "*City of Colorado Spring/El Paso County Drainage Criteria Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual"* Volumes 1 - 3 (USDCM) 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, 2, and 3. Onsite 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 Appendix B.

Urban Drainage and Flood Control District's UD-Detention, Version 4.06 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix D.

Hydraulic Criteria

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for roadside ditch design. Ditches were checked for velocity and capacity per the CCS/EPCDCM Section 12.3.2.2. In order to check both capacity and velocity, a cross section analysis was performed on the roadside swales using the basin's

maximum runoff Q and the proposed uniform slope of the swale. Swale cross sections have been presented in Appendix C.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for local road crossing culvert design. Culvert size was determined based on 100-year flows and hydraulic criteria from EPCDCM Chapter 9 –Culvert Design. All local road crossing culvert design reports are presented in Appendix C.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Filing 5 runoff during interim early grading to one of two Sediment Basins via roadside ditches and local street culverts. These Sediment Basins were designed to release at less than historic rates to minimize adverse impacts downstream during early grading.

The proposed early grading improvements are over designed for the current state of the project site. The roadside swales along with the proposed culverts are designed to treat runoff for the completed development. During early grading operations, the site will have minimal composite impervious surfaces without the proposed roads and vacant lots. This will allow more runoff to infiltrate the ground, reducing the amount of runoff that needs to be caught by the roadside swales and sediment basins.

Once the project progresses past early grading operations, Sediment Basin 1 and Sediment Basin 2 will each be converted into Pond B and Pond A respectively. The temporary outlet structures will be replaced with permanent outlet structures. Each Pond will have a concrete forebay and trickle channel. Both ponds will release treated flows at less than historic rates to minimize adverse impacts downstream. Both ponds will discharge into Major Drainageway MS-06. The final design for Ponds A and B will be included in the Final Drainage report.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed single family residential lots (2.5 ac. min.) with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways utilize soil riprap lined roadside ditches further disconnecting impervious areas. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: Filing 5 utilizes roadside ditches with culvert crossings throughout. These roadside ditches direct the on-site development flows to the proposed detention ponds within the project that releases at or below historic rates into Drainageway MS-06. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impacts to downstream Drainageway MS-06 or Drainageway WF-R7A are anticipated.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in a full spectrum water quality and detention pond that is designed per current El Paso County drainage criteria.

Step 4 Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative are prepared in conjunction with this report. Site specific temporary source control BMPs as well as permanent BMP's are detailed in this plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. Outlet structure release rates are limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities. Complete pond and outlet structure designs are presented in Appendix D for information.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted since this project is disturbing more than 1 acre. The Early Erosion Control Plans for Filing 5 have been 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 within the any platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts will be owned and maintained by the Saddlehorn Ranch Metropolitan District. Vegetation in the natural and improved portions of Drainageway MS-06 with the Filing 5 improvements is the responsibility of the Saddlehorn Ranch Metropolitan District. This includes all mowing, seeding and weed control activities. An Inspection & Maintenance Plan is submitted concurrently with this drainage report that details the required maintenance activities and intervals to ensure proper function of all stormwater infrastructure in the future.

Drainage and Bridge Fees

Drainage and Bridge Fees are not due with the early grading permit application. An estimate of basin fees for the proposed development within Haegler Ranch drainage basin will be calculated and provided with the Filing 5 Final Drainage Report.

SUMMARY

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including ditches, culverts and detention ponds. 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 PDR/MDDP for Saddlehorn Ranch.

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. Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, JR Engineering, May 2020.

4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.

5. The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR, Federal Emergency Management Agency, October 20, 2004.

6. Final Drainage Report for Saddlehorn Ranch – Filing 3, JR Engineering, February 4, 2022

APPENDIX A

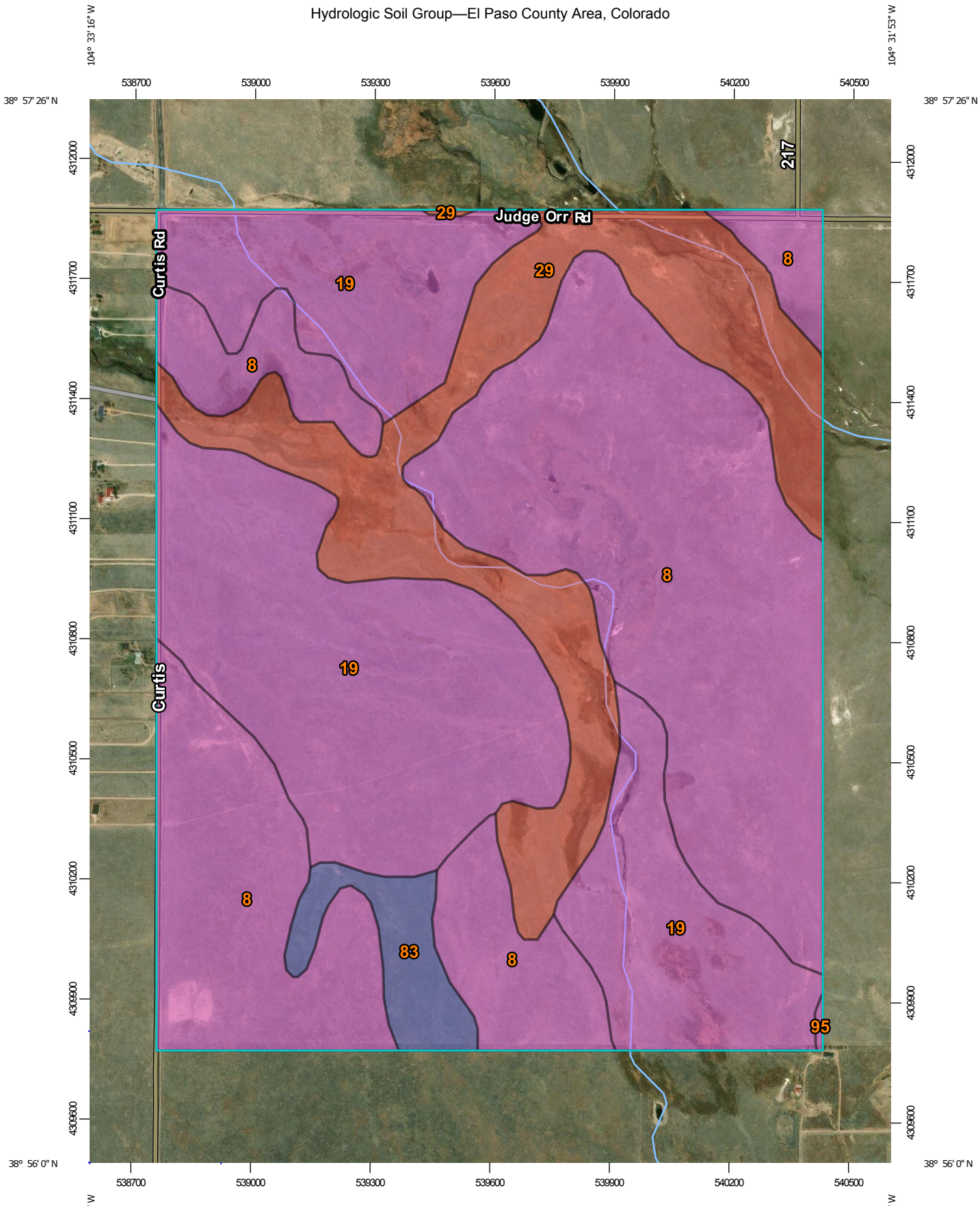
FIGURES AND EXHIBITS

5000 2500 0 5000 10000

ORIGINAL SCALE: 1" = 5000'

VICINITY MAP
SADDLEHORN RANCH
25142.07
08/29/21
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



Map Scale: 1:13,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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.

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

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

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

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

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

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

Date(s) aerial images were photographed: May 22, 2016—Aug 17, 2017

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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	388.3	44.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	307.3	35.3%
29	Fluvaquentic Haplaquolls, nearly level	D	150.0	17.2%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	24.6	2.8%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.6	0.1%
Totals for Area of Interest			**870.8**	**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.

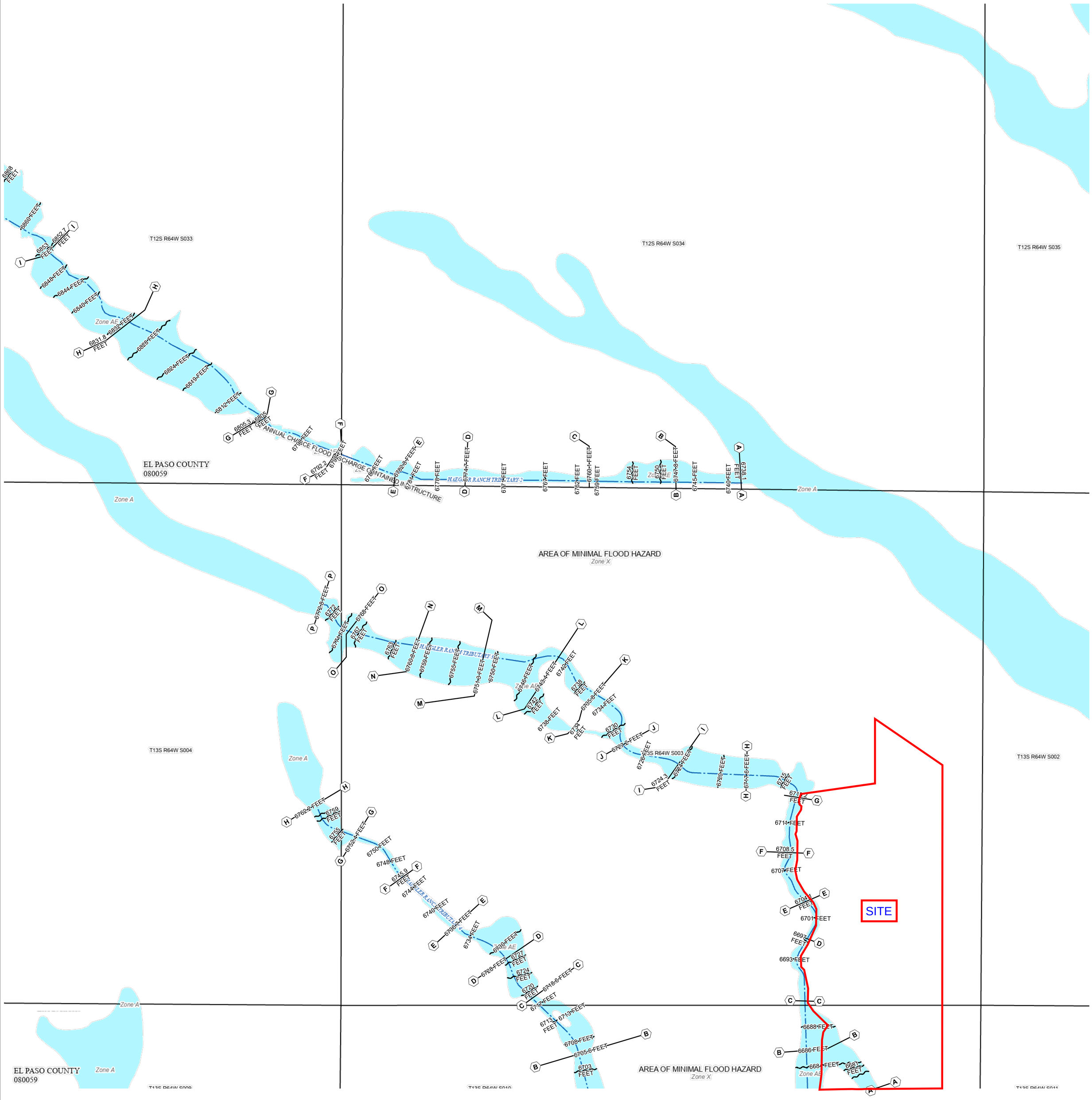
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

104°33'45.46"W 38°58'14.11"N



104°31'52.11"W 38°56'8.43"N

FLOOD HAZARD INFORMATION

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery. Last refreshed October, 2020.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **8/21/2023 7:15 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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. 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.

SCALE

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map, please see the Flood Insurance Study (FIS) Report for your community at https://msc.fema.gov

N

1 inch = 500 feet 1:6,000

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

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

PANEL **558** OF **1275**

Panel Contains:

COMMUNITY	NUMBER	PANEL
EL PASO COUNTY	080059	0558

MAP NUMBER
08041C0558G
EFFECTIVE DATE
December 07, 2018

APPENDIX B

HYDROLOGIC CALCULATIONS

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Saddlehorn Ranch Filing 5 Early Grading
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.07
Calculated By: WKN
Checked By: TBD
Date: 8/22/23

Basin ID	Total Area (ac)	Paved Roads			2.5 Acre Rural Lots			Lawns			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
A1	15.08	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	15.08	2.0%	2.0%
B1	12.57	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	12.57	2.0%	2.0%
B2	12.64	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	12.64	2.0%	2.0%
B3	10.83	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	10.83	2.0%	2.0%
B4	9.16	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	9.16	2.0%	2.0%
B5	14.04	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	14.04	2.0%	2.0%
C1	1.26	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	1.26	2.0%	2.0%
C2	4.19	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	4.19	2.0%	2.0%
UD1	8.14	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	8.14	2.0%	2.0%
UD2	25.14	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	25.14	2.0%	2.0%
UD3	11.03	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	11.03	2.0%	2.0%
UD4	2.68	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	2.68	2.0%	2.0%
OS1	0.59	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	0.59	2.0%	2.0%
OS2	0.68	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	0.68	2.0%	2.0%
OS3	3.56	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	3.56	2.0%	2.0%
OS4	5.72	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	5.72	2.0%	2.0%
TOTAL	**137.31**										**2.0%**

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

2.5 Acre Rural Lots - Comp. % Impervious Calculation

Total Area (ac)	Area (ac) - Roofs (90%)	Area (ac)- Drives (100%)	Area (ac) - Lawns (2%)
2.50	0.068	0.046	2.39
Comp % Imperviousness	**6.20%**		

Roads w/ Roadside Ditches - Comp. % Impervious Calculation

Area* (ac)	Area - Ditch (5%)	Area - Roads (100%)
0.2124	0.1320	0.0804
Comp % Imperviousness	**0.41**	

*Area based on 250 LF roadway from CL to outside edge of roadside ditch

The above conservatively rounded to 45%.

Unresolved:
Add note about plat restriction to 10% imperviousness

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

bdivision: Saddlehorn Ranch Filing 5 Early Grading
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.07
Calculated By: WKN
Checked By: TBD
Date: 8/22/23

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
A1	15.08	2.0%	15.08	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
B1	12.57	2.0%	12.57	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
B2	12.64	2.0%	12.64	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
B3	10.83	2.0%	10.83	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
B4	9.16	2.0%	9.16	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
B5	14.04	2.0%	14.04	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
C1	1.26	2.0%	1.26	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
C2	4.19	2.0%	4.19	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
UD1	8.14	2.0%	8.14	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
UD2	25.14	2.0%	25.14	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
UD3	11.03	2.0%	11.03	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
UD4	2.68	2.0%	2.68	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
OS1	0.59	2.0%	0.59	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
OS2	0.68	2.0%	0.68	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
OS3	3.56	2.0%	3.56	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
OS4	5.72	2.0%	5.72	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
TOTAL	**137.31**	**2.0%**	**137.31**	**0.00**	**0.00**	**100%**	**0%**	**0%**	**---**	**---**	**---**	**---**	**---**	**---**	**0.01**	**0.13**

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Saddlehorn Ranch Filing 5 Early Grading
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.07
Calculated By: WKN
Checked By: TBD
Date: 8/22/23

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)
A1	15.08	A	2%	0.01	0.13	300	4.8%	20.4	1330	2.9%	7.0	1.2	18.6	39.0	1630.0	39.7	39.0
B1	12.57	A	2%	0.01	0.13	282	4.9%	19.6	1160	1.3%	15.0	1.7	11.5	31.2	1442.0	44.3	31.2
B2	12.64	A	2%	0.01	0.13	20	20.0%	3.3	1561	4.6%	15.0	3.2	8.1	11.4	1581.0	38.7	11.4
B3	10.83	A	2%	0.01	0.13	300	2.0%	27.2	1117	3.1%	15.0	2.6	7.0	34.3	1417.0	37.1	34.3
B4	9.16	A	2%	0.01	0.13	300	3.3%	23.1	997	1.5%	15.0	1.8	9.0	32.1	1297.0	40.3	32.1
B5	14.04	A	2%	0.01	0.13	41	9.0%	6.1	3242	1.6%	15.0	1.9	28.9	35.1	3283.0	72.4	35.1
C1	1.26	A	2%	0.01	0.13	143	2.4%	17.7	184	1.0%	15.0	1.5	2.0	19.7	327.0	29.0	19.7
C2	4.19	A	2%	0.01	0.13	154	3.0%	17.1	455	1.0%	15.0	1.5	5.1	22.1	609.0	33.8	22.1
UD1	8.14	A	2%	0.01	0.13	300	3.6%	22.4	267	5.5%	7.0	1.6	2.7	25.1	567.0	27.7	25.1
UD2	25.14	A	2%	0.01	0.13	300	1.7%	28.7	367	4.1%	7.0	1.4	4.3	33.0	667.0	28.9	28.9
UD3	11.03	A	2%	0.01	0.13	300	1.8%	28.2	810	1.3%	7.0	0.8	16.7	44.8	1110.0	38.2	38.2
UD4	2.68	A	2%	0.01	0.13	300	5.1%	19.9	360	2.1%	7.0	1.0	5.9	25.8	660.0	30.1	25.8
OS1	0.59	A	2%	0.01	0.13	50	5.1%	8.1	670	7.1%	7.0	1.9	6.0	14.1	720.0	30.2	14.1
OS2	0.68	A	2%	0.01	0.13	50	1.1%	13.5	345	7.4%	7.0	1.9	3.0	16.6	395.0	27.9	16.6
OS3	3.56	A	2%	0.01	0.13	50	4.0%	8.8	180	3.4%	7.0	1.3	2.3	11.2	230.0	27.4	11.2
OS4	5.72	A	2%	0.01	0.13	50	2.1%	10.9	180	3.2%	7.0	1.3	2.4	13.3	230.0	27.5	13.3

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ 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).

Equation 6-2 $$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$

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).

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

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).

Equation 6-3

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Saddlehorn Ranch Filing 5 Early Grading
Location: El Paso County
Design Storm: 5-Year

Project Name: Saddlehorn Ranch
Project No.: 25142.07
Calculated By: WKN
Checked By: TBD
Date: 8/22/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			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	B1	12.57	0.01	31.2	0.08	2.42	0.2					0.2	0.08	1.1					791	2.1	6.3	Roadside Swale Swale conveyance to DP 1.0
	2	B2	12.64	0.01	11.4	0.08	3.94	0.3					0.3	0.08	1.1					0	2.1	0.0	Roadside Swale Swale conveyance to DP 1.0
	1.0								37.4	0.16	2.15	0.3	0.3	0.16	2.99					804	3.5	3.9	Sum of DP 1 and DP 2 Swale conveyance to DP 1.1
	3	B3	10.83	0.01	34.3	0.06	2.28	0.1					0.1	0.06	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
	1.1								41.3	0.22	2.00	0.4	0.4	0.22	1.0					513	2.0	4.3	Sum of DP 1.0 & DP 3 Swale conveyance to DP 1.2
	4	B4	9.16	0.01	32.1	0.05	2.38	0.1					0.1	0.05	1.9					0	2.7	0.0	Roadside Swale Swale conveyance to DP 1.2
	1.2								45.6	0.27	1.85	0.5	0.5	0.27	0.6					488	1.5	5.3	Sum of DP 1.1 & DP 4 Swale conveyance to DP 1.3
	5	B5	14.04	0.01	35.1	0.08	2.25	0.2					0.2	0.08	1.1					0	2.1	0.0	Swale Overland conveyance to DP 1.3
	1.3								50.8	0.35	1.69	0.6	0.6	0.35	0.5					466	1.4	5.5	Sum of DP 1.3 and DP 5 Sheet flow into Sediment Basin 1
	C1	C1	1.26	0.01	19.7	0.01	3.11	0.03					0.03	0.01	1.9						2.7		Roadside Swale Swale conveyance to Pond C. See Filing 4 for calculations
	C2	C2	4.19	0.01	22.1	0.03	2.94	0.1					0.1	0.03	1.9						2.7		Roadside Swale Swale conveyance to Pond C. See Filing 4 for calculations
	11	A1	15.08	0.01	39.0	0.15	2.09	0.3															Overland Flow Sheet flow into Sediment Basin 2
	UD1	UD1	8.14	0.01	25.1	0.05	2.75	0.1															Overland Flow Sheet flow into Drainageway WF-R7A
	UD2	UD2	25.14	0.01	28.9	0.15	2.54	0.4															Overland Flow Sheet flow into Drainageway MS-06
	UD3	UD3	11.03	0.01	38.2	0.07	2.12	0.1															Overland Flow Sheet flow into Drainageway MS-06
	UD4	UD4	2.68	0.01	25.8	0.03	2.71	0.1															Overland Flow Sheet flow into Drainageway MS-06
	OS1	OS1	0.59	0.01	14.1	0.00	3.61	0.00															Overland Flow from Off-Site Basin Sheet flows to Basin B2
	OS2	OS2	0.68	0.01	16.6	0.00	3.37	0.00															Overland Flow from Off-Site Basin Sheet flows to Basin B3
	OS3	OS3	3.56	0.01	11.2	0.02	3.96	0.1															Overland Flow from Off-Site Basin Sheet flows to Basin A1
	OS4	OS4	5.72	0.01	13.3	0.03	3.70	0.1															Overland Flow from Off-Site Basin Sheet flows to Basin UD4

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: Saddlehorn Ranch Filing 5 Early Grading
Location: El Paso County
Design Storm: 100-Year

Project Name: Saddlehorn Ranch
Project No.: 25142.07
Calculated By: WKN
Checked By: TBD
Date: 8/22/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			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	B1	12.57	0.13	31.2	1.58	4.07	6.4					6.4	1.58	1.1					791	2.1	6.3	Roadside Swale Swale conveyance to DP 1.0
	2	B2	12.64	0.13	11.4	1.59	6.61	10.5					10.5	1.59	1.1					0	2.1	0.0	Roadside Swale Swale conveyance to DP 1.0
	1.0								37.4	3.17	3.61	11.4	11.4	3.17	2.99					804	3.5	3.9	Sum of DP 1 and DP 2 Swale conveyance to DP 1.1
	3	B3	10.83	0.13	34.3	1.36	3.83	5.2					5.2	1.36	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
	1.1								41.3	4.53	3.36	15.2	15.2	4.53	1.0					513	2.0	4.3	Sum of DP 1.0 & DP 3 Swale conveyance to DP 1.2
	4	B4	9.16	0.13	32.1	1.15	3.99	4.6					4.6	1.15	1.9					0	2.7	0.0	Roadside Swale Swale conveyance to DP 1.2
	1.2								45.6	5.68	3.11	17.7	17.7	5.68	0.6					488	1.5	5.3	Sum of DP 1.1 & DP 4 Swale conveyance to DP 1.3
	5	B5	14.04	0.13	35.1	1.77	3.77	6.7					6.7	1.77	1.1					0	2.1	0.0	Swale Overland conveyance to DP 1.3
	1.3								50.8	7.45	2.83	21.1	21.1	7.45	0.5					466	1.4	5.5	Sum of DP 1.3 and DP 5 Sheet flow into Sediment Basin 1
	C1	C1	1.26	0.13	19.7	0.16	5.22	0.8					0.8	0.16	1.9						2.7		Roadside Swale Swale conveyance to Pond C. See Filing 4 for calculations
	C2	C2	4.19	0.13	22.1	0.53	4.93	2.6					2.6	0.53	1.9						2.7		Roadside Swale Swale conveyance to Pond C. See Filing 4 for calculations
	11	A1	15.08	0.13	39.0	1.96	3.50	6.9															Overland Flow Sheet flow into Sediment Basin 2
	UD1	UD1	8.14	0.13	25.1	1.03	4.61	4.7															Overland Flow Sheet flow into Drainageway WF-R7A
	UD2	UD2	25.14	0.13	28.9	3.17	4.26	13.5															Overland Flow Sheet flow into Drainageway MS-06
	UD3	UD3	11.03	0.13	38.2	1.39	3.55	4.9															Overland Flow Sheet flow into Drainageway MS-06
	UD4	UD4	2.68	0.13	25.8	0.35	4.54	1.6															Overland Flow Sheet flow into Drainageway MS-06
	OS1	OS1	0.59	0.13	14.1	0.07	6.06	0.4															Overland Flow from Off-Site Basin Sheet flows to Basin B2
	OS2	OS2	0.68	0.13	16.6	0.09	5.66	0.5															Overland Flow from Off-Site Basin Sheet flows to Basin B3
	OS3	OS3	3.56	0.13	11.2	0.45	6.66	3.0															Overland Flow from Off-Site Basin Sheet flows to Basin A1
	OS4	OS4	5.72	0.13	13.3	0.72	6.21	4.5															Overland Flow from Off-Site Basin Sheet flows to Basin UD4

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

APPENDIX C

HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

DP1 Design Point 1 (Q5=0.2 cfs Q100=6.4 cfs)

Invert Elev Dn (ft)	=	6719.70
Pipe Length (ft)	=	53.00
Slope (%)	=	0.94
Invert Elev Up (ft)	=	6720.20
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

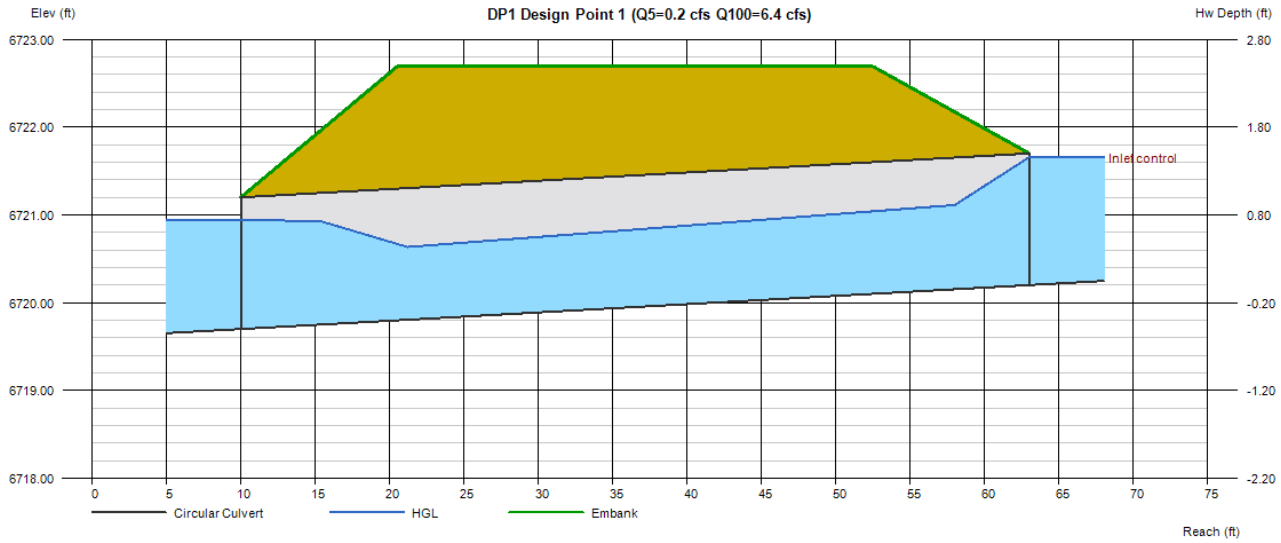
Top Elevation (ft)	=	6722.69
Top Width (ft)	=	32.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.20
Qmax (cfs)	=	6.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	6.40
Qpipe (cfs)	=	6.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.10
Veloc Up (ft/s)	=	5.25
HGL Dn (ft)	=	6720.94
HGL Up (ft)	=	6721.18
Hw Elev (ft)	=	6721.66
Hw/D (ft)	=	0.97
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

DP1.0 Design Point 1.0 (Q5=0.3 cfs Q100=11.4 cfs)

Invert Elev Dn (ft)	=	6708.83
Pipe Length (ft)	=	58.00
Slope (%)	=	1.83
Invert Elev Up (ft)	=	6709.89
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

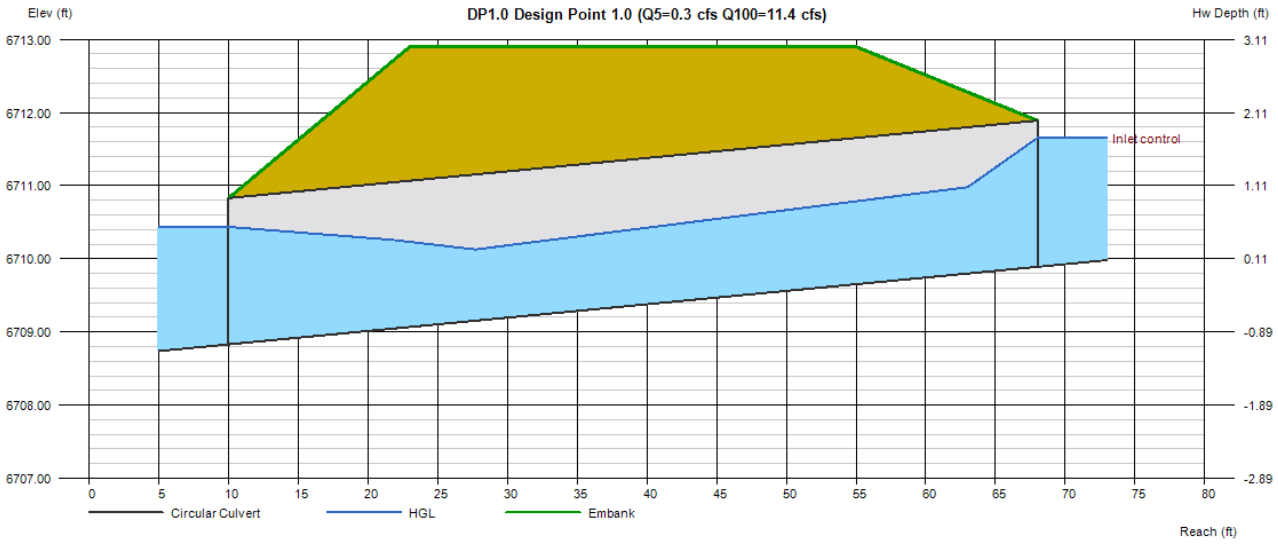
Top Elevation (ft)	=	6712.90
Top Width (ft)	=	32.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.30
Qmax (cfs)	=	11.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	11.40
Qpipe (cfs)	=	11.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.22
Veloc Up (ft/s)	=	5.73
HGL Dn (ft)	=	6710.44
HGL Up (ft)	=	6711.10
Hw Elev (ft)	=	6711.65
Hw/D (ft)	=	0.88
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

DP1.1 Design Point 1.1 (Q5=0.4 cfs Q100=15.2 cfs)

Invert Elev Dn (ft)	=	6680.37
Pipe Length (ft)	=	53.00
Slope (%)	=	1.02
Invert Elev Up (ft)	=	6680.91
Rise (in)	=	24.0
Shape	=	Elliptical
Span (in)	=	38.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Square edge w/headwall (H)
Coeff. K,M,c,Y,k	=	0.01, 2, 0.0398, 0.67, 0.5

Embankment

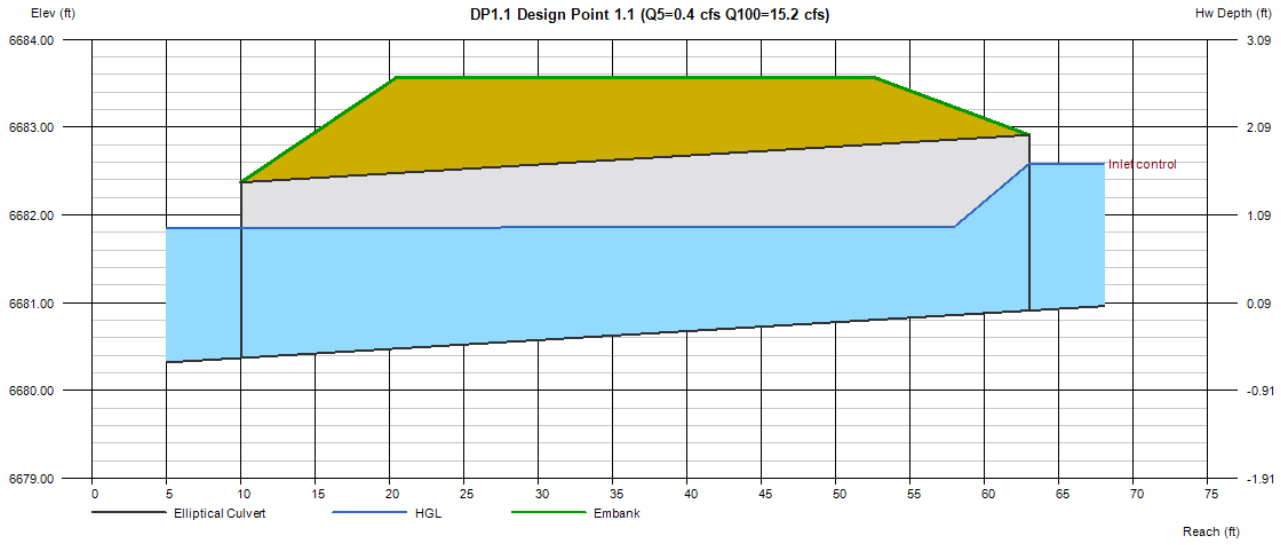
Top Elevation (ft)	=	6683.57
Top Width (ft)	=	32.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.40
Qmax (cfs)	=	15.20
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.20
Qpipe (cfs)	=	15.20
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.66
Veloc Up (ft/s)	=	6.37
HGL Dn (ft)	=	6681.85
HGL Up (ft)	=	6681.87
Hw Elev (ft)	=	6682.58
Hw/D (ft)	=	0.84
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

DP1.2 Design Point 1.2 (Q5=0.5 cfs Q100=17.7 cfs)

Invert Elev Dn (ft)	=	6680.37
Pipe Length (ft)	=	56.00
Slope (%)	=	0.54
Invert Elev Up (ft)	=	6680.67
Rise (in)	=	19.0
Shape	=	Elliptical
Span (in)	=	30.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Square edge w/headwall (H)
Coeff. K,M,c,Y,k	=	0.01, 2, 0.0398, 0.67, 0.5

Embankment

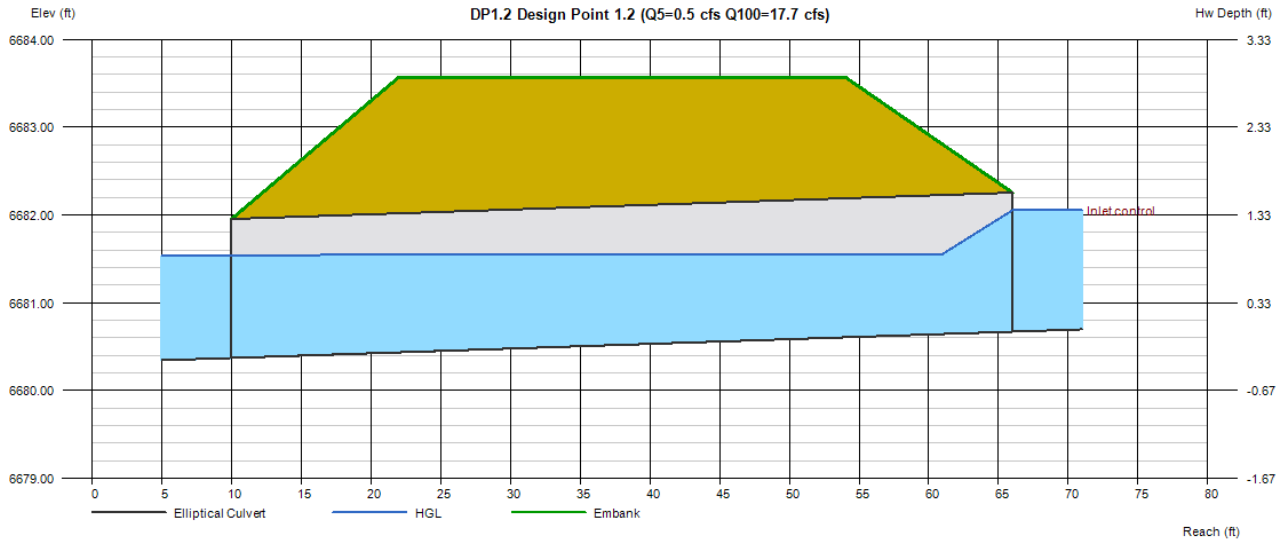
Top Elevation (ft)	=	6683.57
Top Width (ft)	=	32.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.50
Qmax (cfs)	=	17.70
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	17.70
Qpipe (cfs)	=	17.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.41
Veloc Up (ft/s)	=	4.87
HGL Dn (ft)	=	6681.54
HGL Up (ft)	=	6681.56
Hw Elev (ft)	=	6682.05
Hw/D (ft)	=	0.87
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 21 2023

DP 1 Swale (5-Year)(FR:0.48)

Triangular

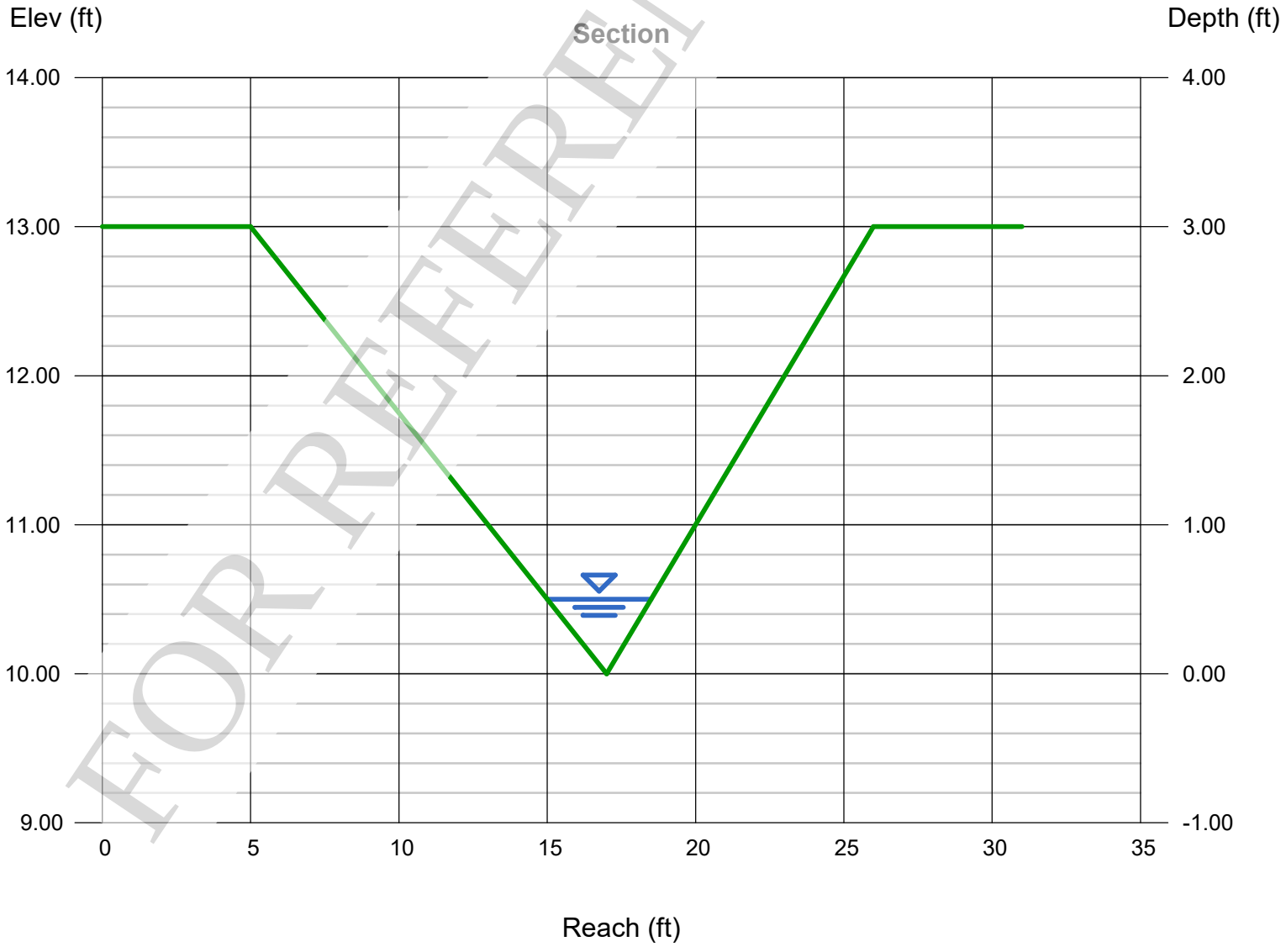
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.09
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.70

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 1.700
Area (sqft)	= 0.87
Velocity (ft/s)	= 1.94
Wetted Perim (ft)	= 3.64
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 3.50
EGL (ft)	= 0.56



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 21 2023

DP 1 Swale (100-Year)(FR:0.56)

Triangular

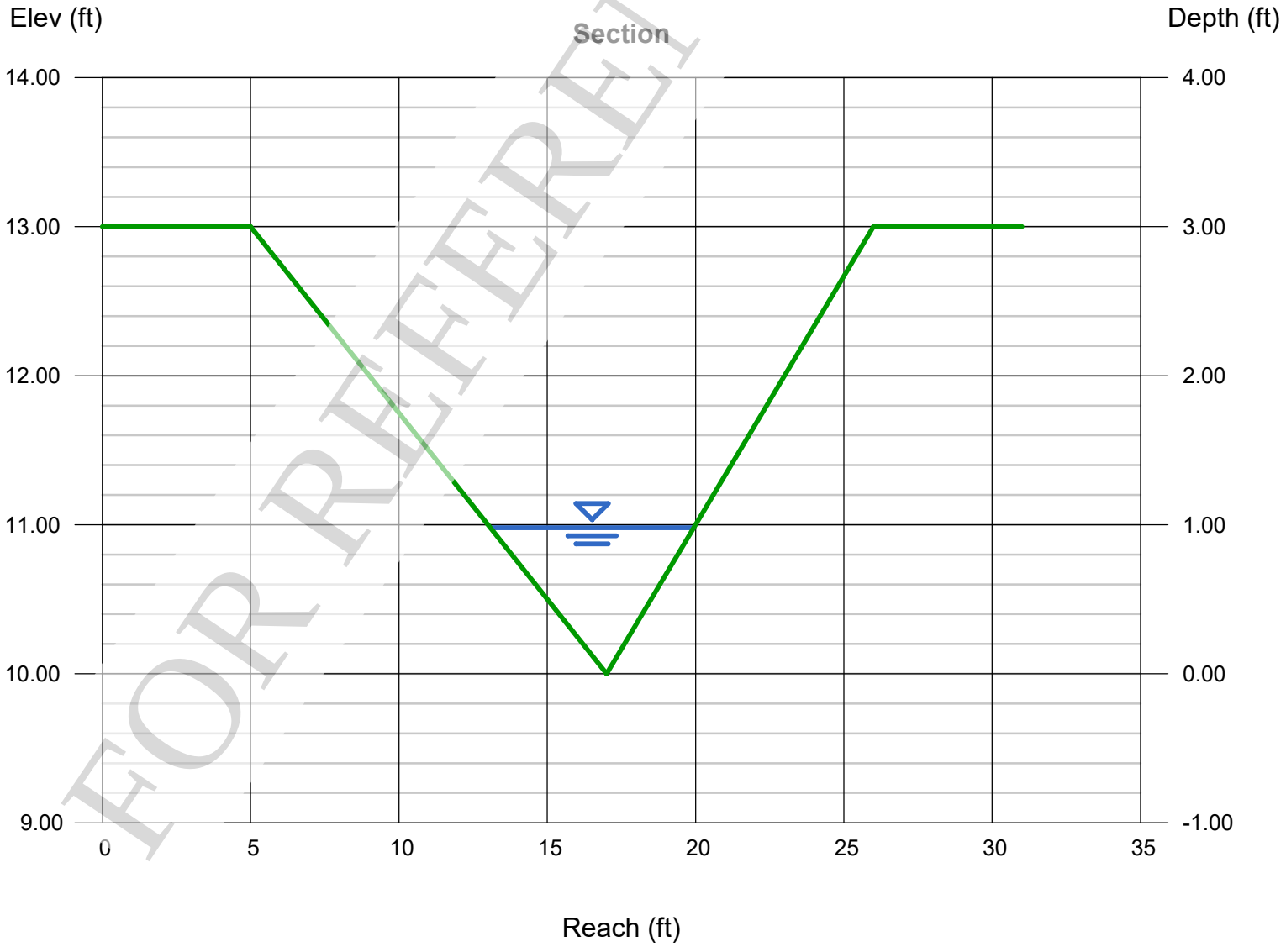
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.09
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.50

Highlighted

Depth (ft)	= 0.98
Q (cfs)	= 10.50
Area (sqft)	= 3.36
Velocity (ft/s)	= 3.12
Wetted Perim (ft)	= 7.14
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 6.86
EGL (ft)	= 1.13



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.0 Swale (5-Year)(FR:0.66)

Triangular

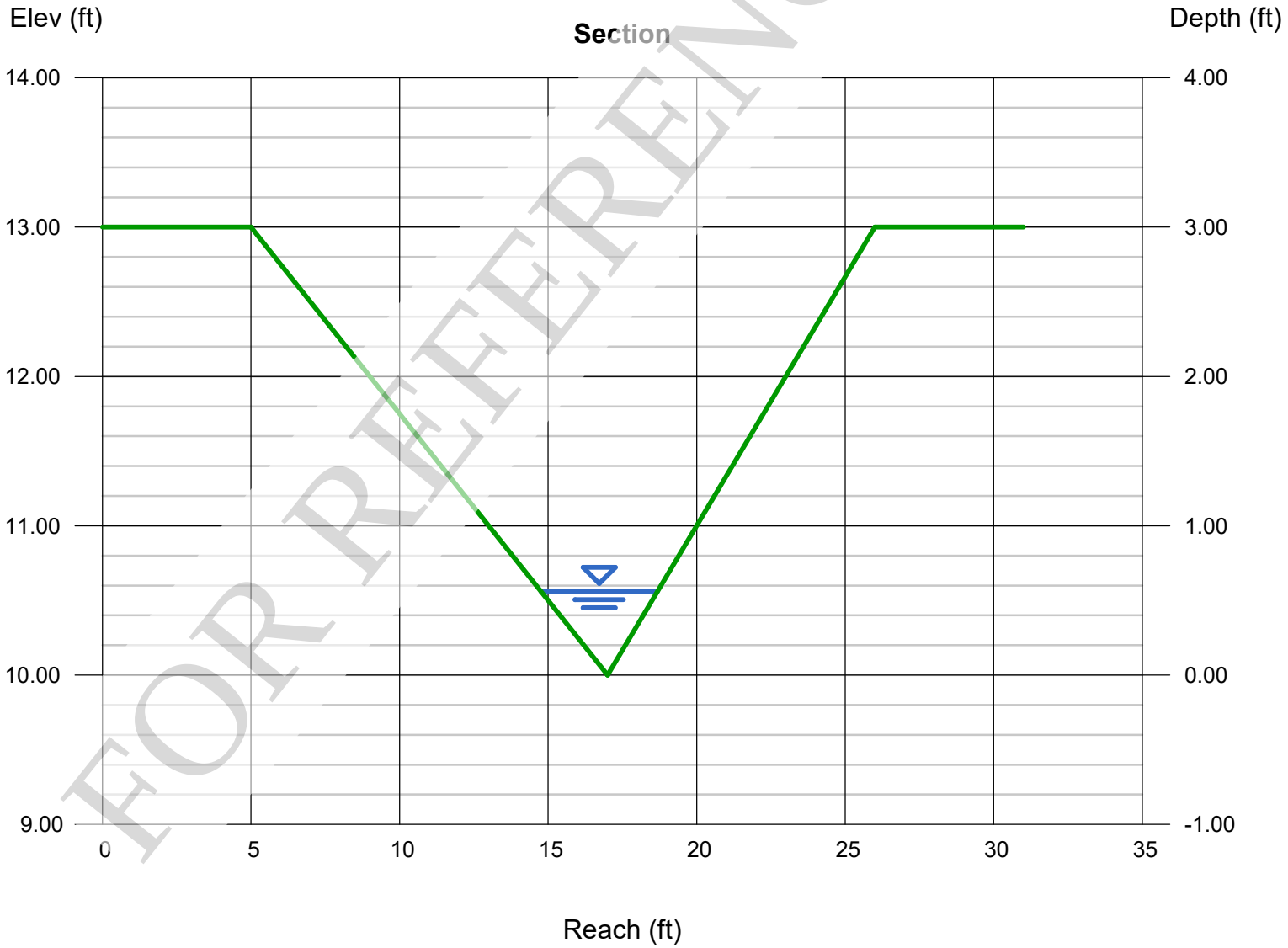
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.01
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.10

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 3.100
Area (sqft)	= 1.10
Velocity (ft/s)	= 2.82
Wetted Perim (ft)	= 4.08
Crit Depth, Yc (ft)	= 0.55
Top Width (ft)	= 3.92
EGL (ft)	= 0.68



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.0 Swale (100-Year)(FR:0.76)

Triangular

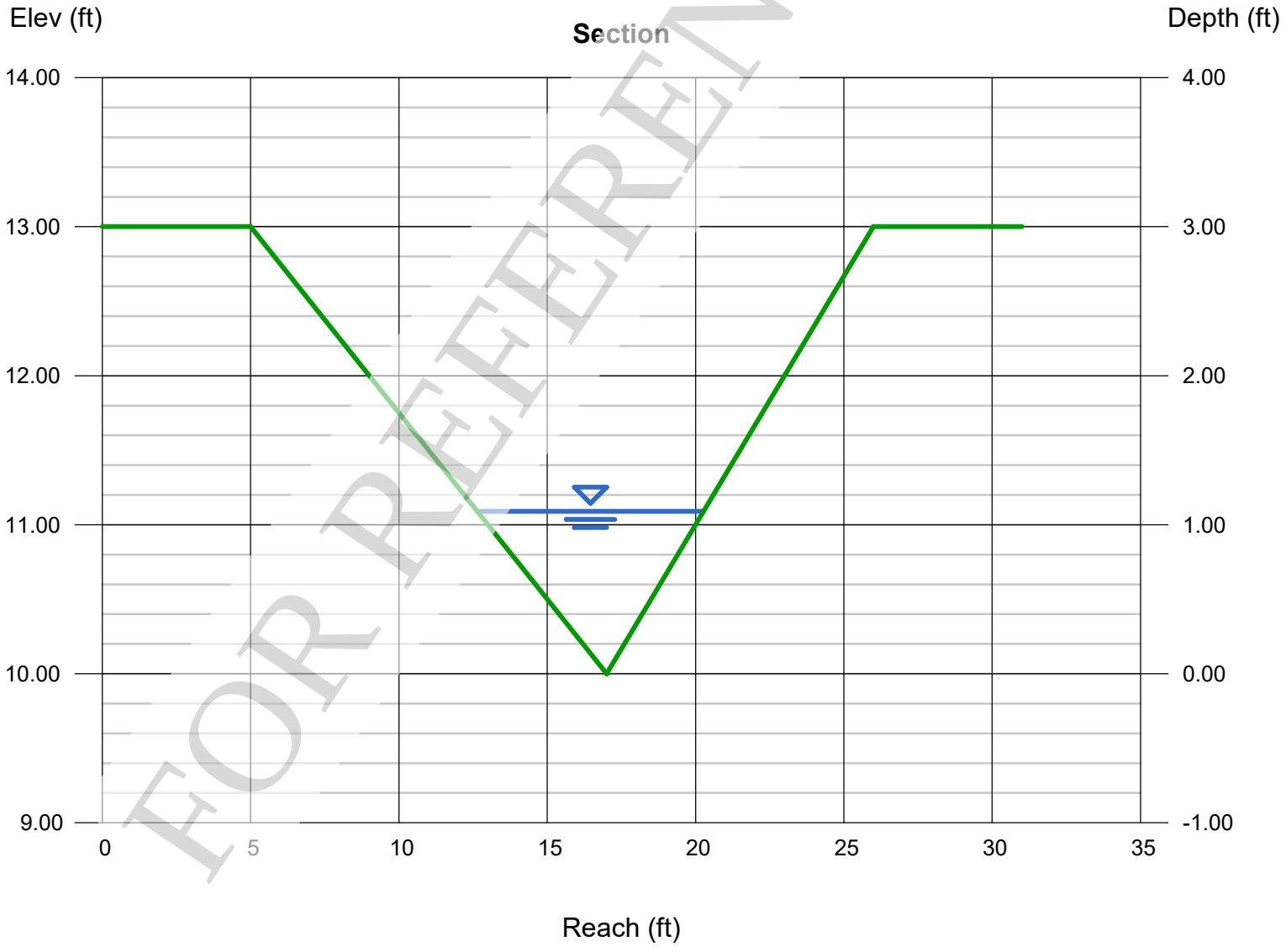
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.01
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 18.70

Highlighted

Depth (ft)	= 1.09
Q (cfs)	= 18.70
Area (sqft)	= 4.16
Velocity (ft/s)	= 4.50
Wetted Perim (ft)	= 7.94
Crit Depth, Yc (ft)	= 1.13
Top Width (ft)	= 7.63
EGL (ft)	= 1.40



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.1 Swale (5-Year)(FR:0.50)

Triangular

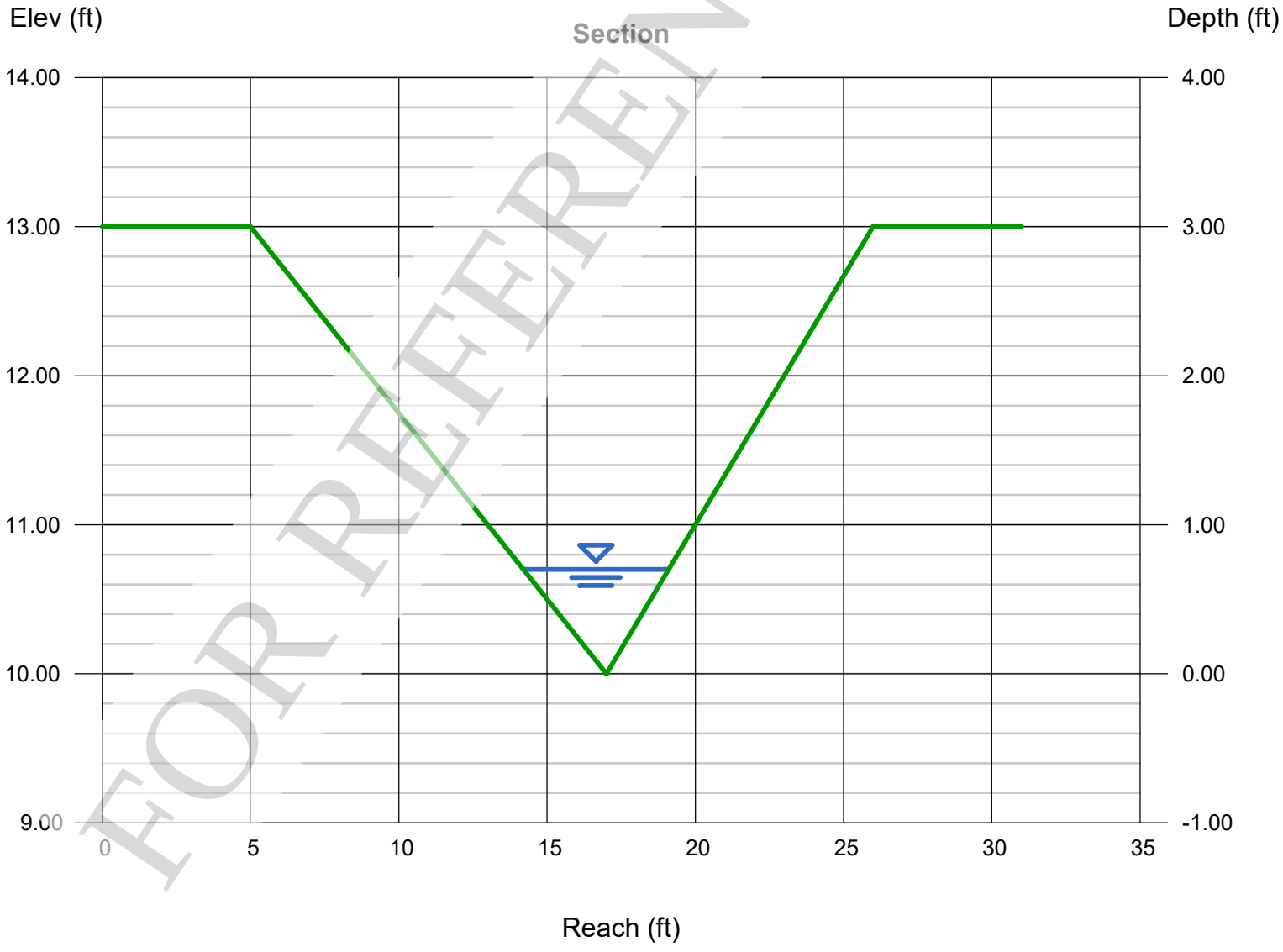
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.10

Highlighted

Depth (ft)	= 0.70
Q (cfs)	= 4.100
Area (sqft)	= 1.71
Velocity (ft/s)	= 2.39
Wetted Perim (ft)	= 5.10
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 4.90
EGL (ft)	= 0.79



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.1 Swale (100-Year)(FR:0.56)

Triangular

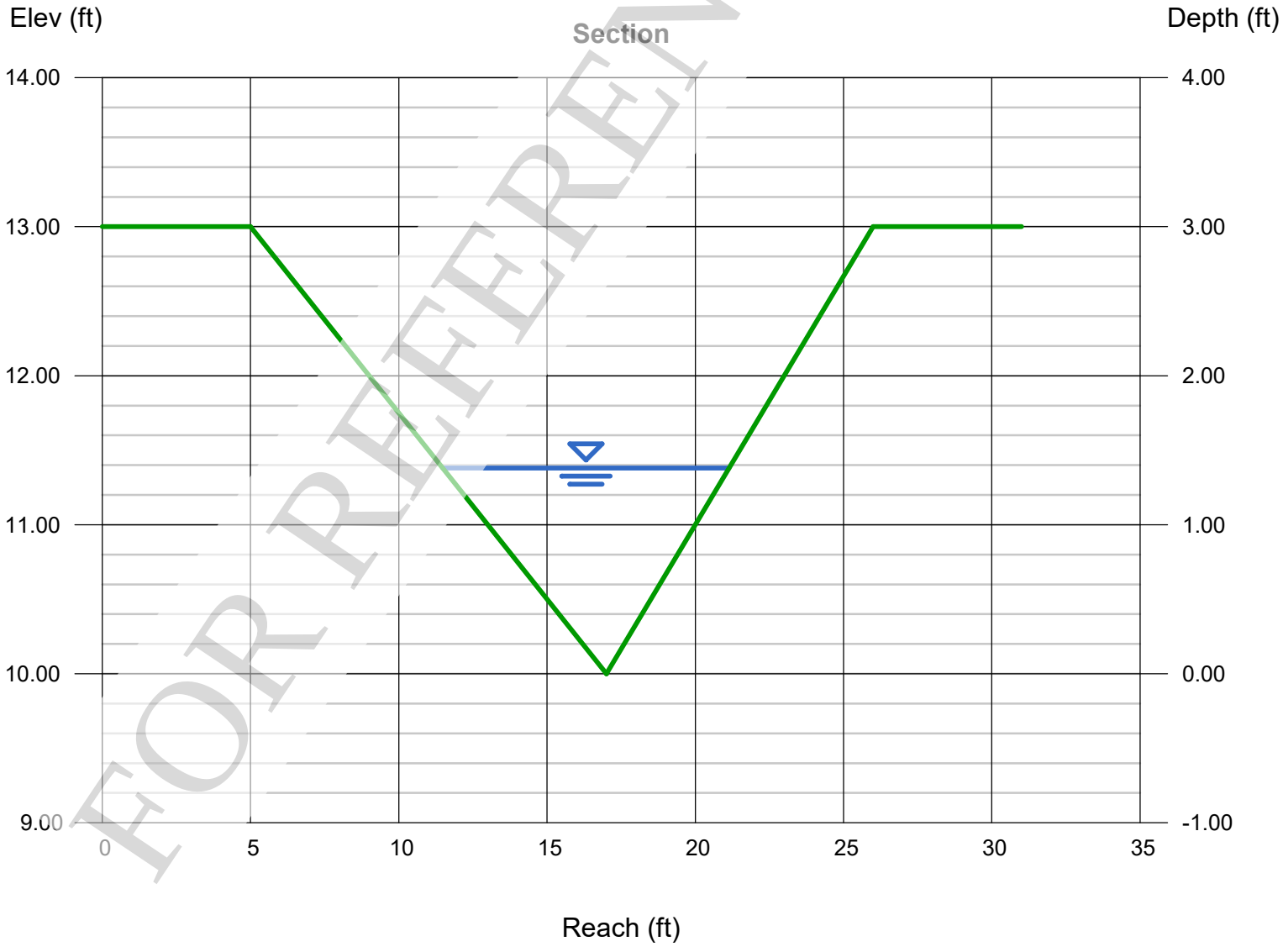
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 24.90

Highlighted

Depth (ft)	= 1.38
Q (cfs)	= 24.90
Area (sqft)	= 6.67
Velocity (ft/s)	= 3.74
Wetted Perim (ft)	= 10.05
Crit Depth, Yc (ft)	= 1.26
Top Width (ft)	= 9.66
EGL (ft)	= 1.60



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.2 Swale (5-Year)(FR:0.50)

Triangular

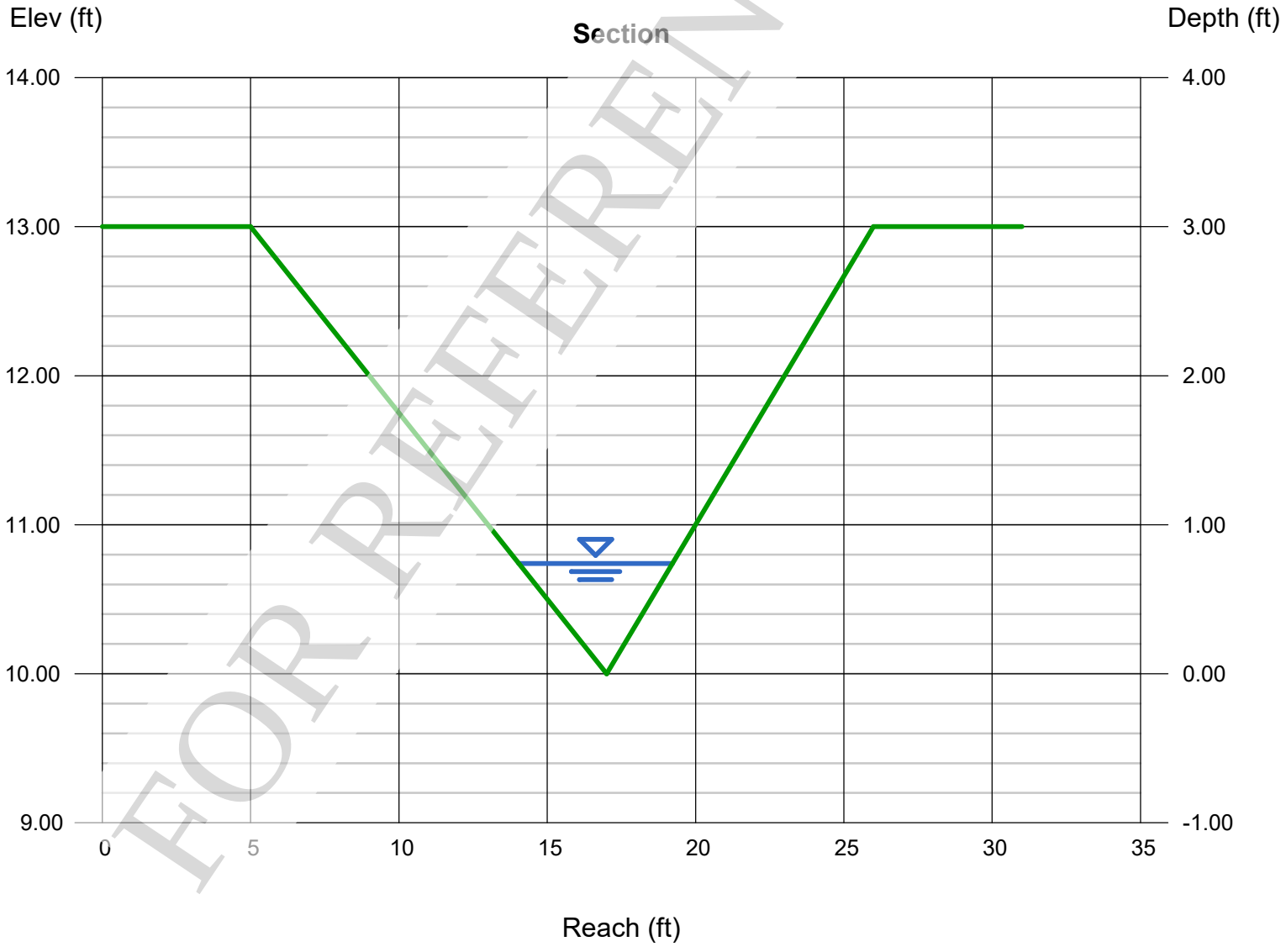
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.60

Highlighted

Depth (ft)	= 0.74
Q (cfs)	= 4.600
Area (sqft)	= 1.92
Velocity (ft/s)	= 2.40
Wetted Perim (ft)	= 5.39
Crit Depth, Yc (ft)	= 0.65
Top Width (ft)	= 5.18
EGL (ft)	= 0.83



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.2 Swale (100-Year)(FR:0.56)

Triangular

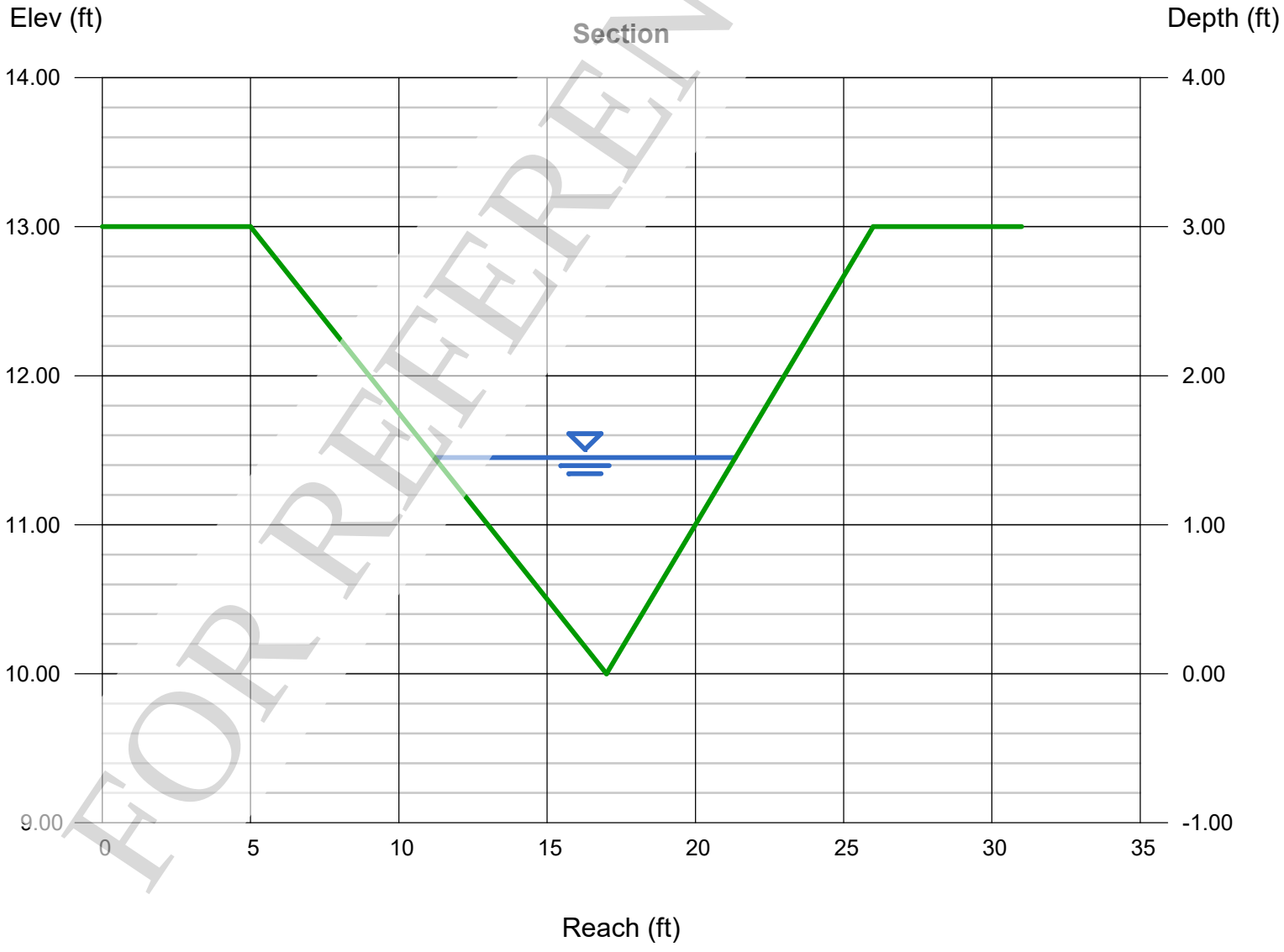
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 28.40

Highlighted

Depth (ft)	= 1.45
Q (cfs)	= 28.40
Area (sqft)	= 7.36
Velocity (ft/s)	= 3.86
Wetted Perim (ft)	= 10.56
Crit Depth, Yc (ft)	= 1.33
Top Width (ft)	= 10.15
EGL (ft)	= 1.68



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.3 Swale (5-Year)(FR:0.44)

Trapezoidal

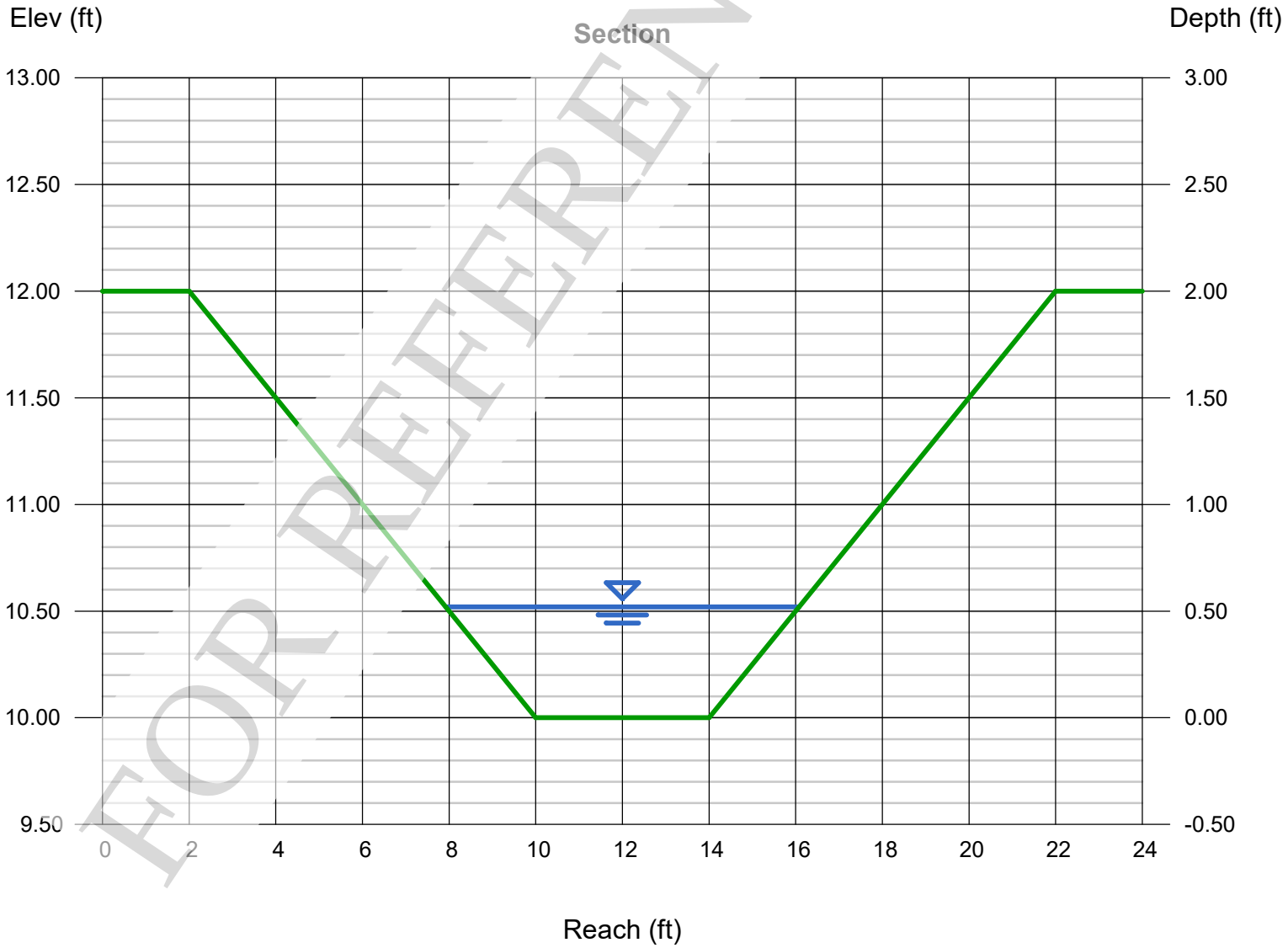
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.70

Highlighted

Depth (ft)	= 0.52
Q (cfs)	= 5.700
Area (sqft)	= 3.16
Velocity (ft/s)	= 1.80
Wetted Perim (ft)	= 8.29
Crit Depth, Yc (ft)	= 0.36
Top Width (ft)	= 8.16
EGL (ft)	= 0.57



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 1.3 Swale (100-Year)(FR:0.46)

Trapezoidal

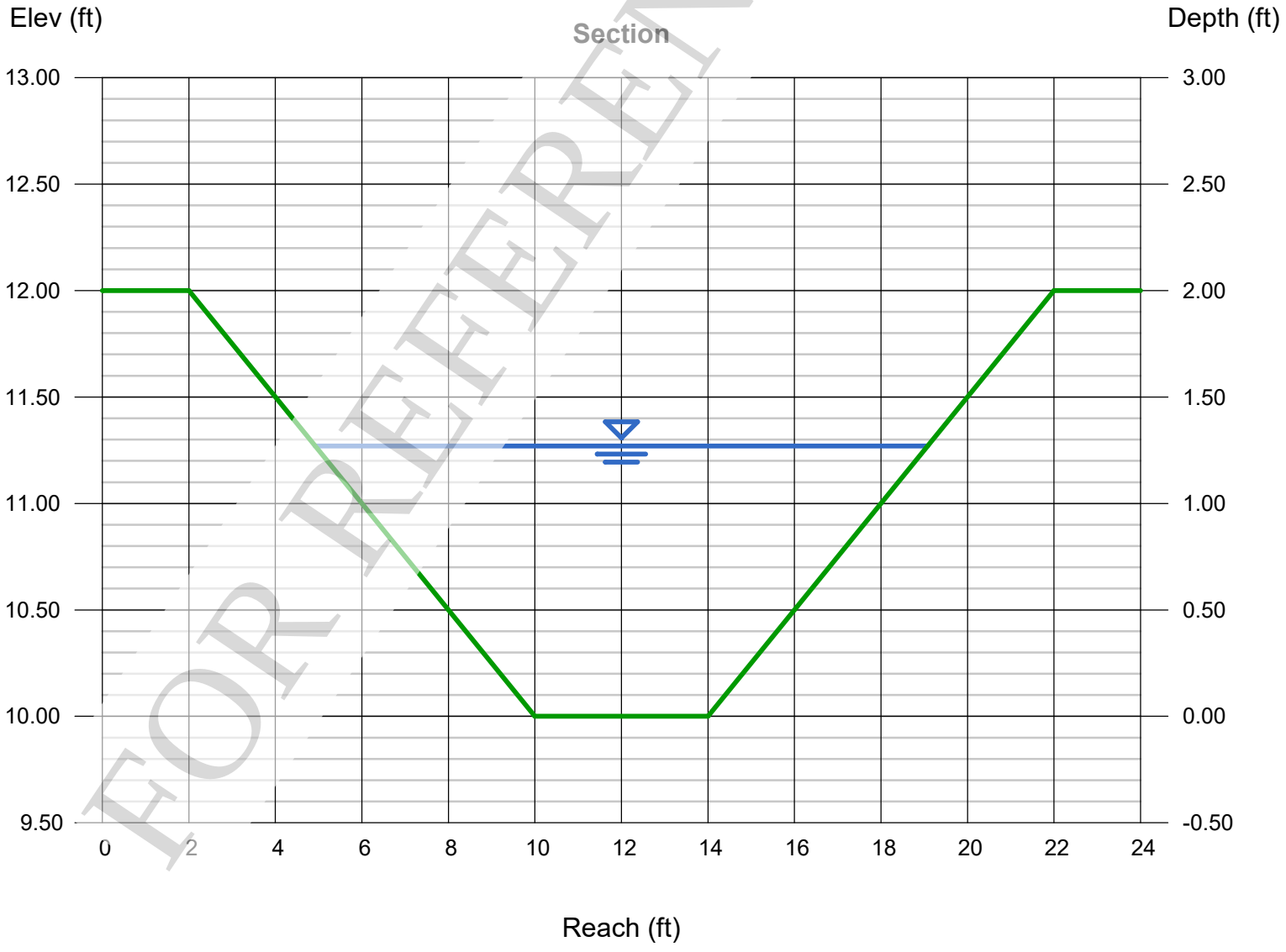
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 34.30

Highlighted

Depth (ft)	= 1.27
Q (cfs)	= 34.30
Area (sqft)	= 11.53
Velocity (ft/s)	= 2.97
Wetted Perim (ft)	= 14.47
Crit Depth, Yc (ft)	= 0.97
Top Width (ft)	= 14.16
EGL (ft)	= 1.41



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 11 Swale (5-Year)(FR:0.70)

Triangular

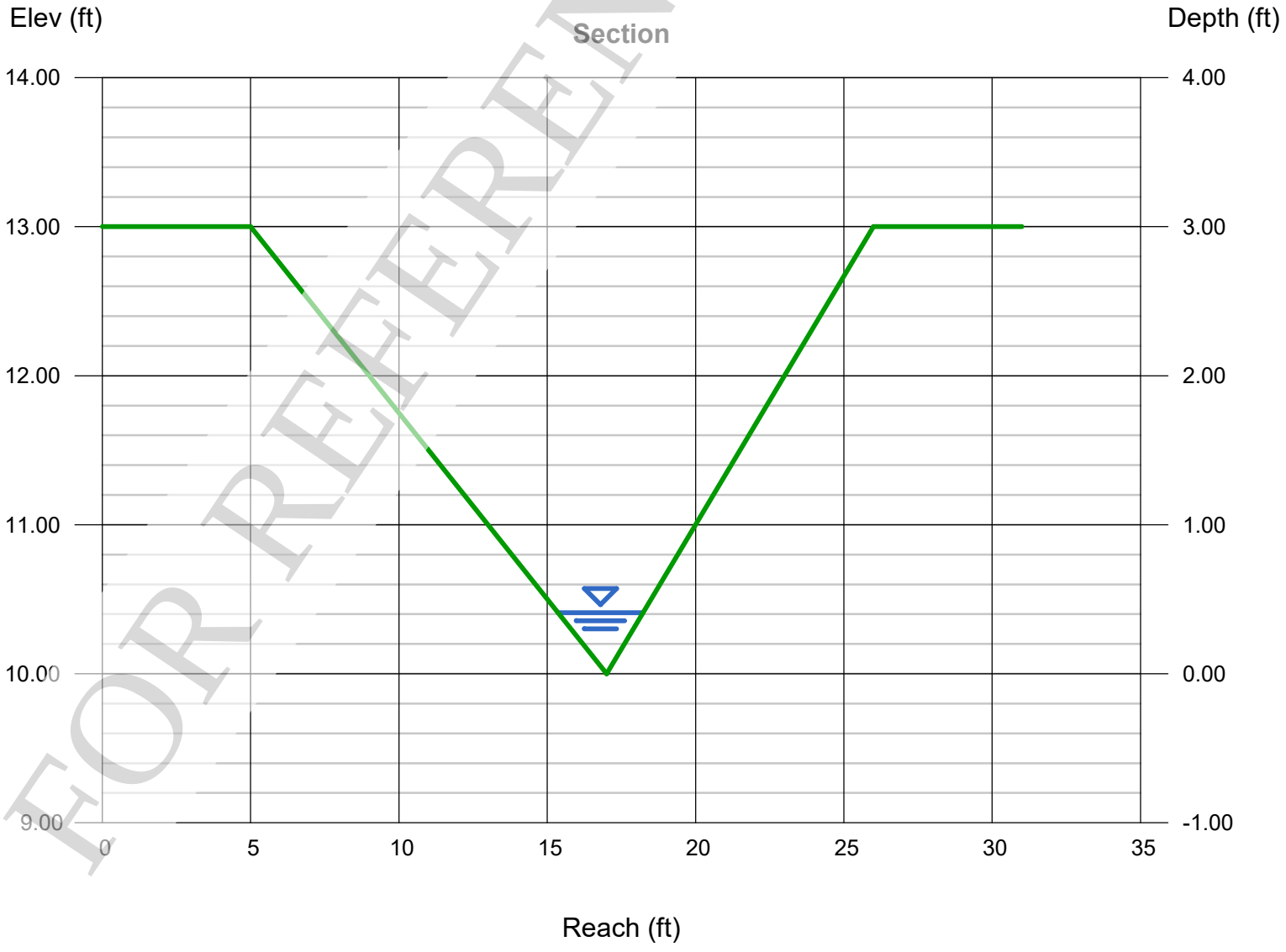
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.39
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.50

Highlighted

Depth (ft)	= 0.41
Q (cfs)	= 1.500
Area (sqft)	= 0.59
Velocity (ft/s)	= 2.55
Wetted Perim (ft)	= 2.99
Crit Depth, Yc (ft)	= 0.41
Top Width (ft)	= 2.87
EGL (ft)	= 0.51



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, May 8 2023

DP 11 Swale (100-Year)(FR:0.79)

Triangular

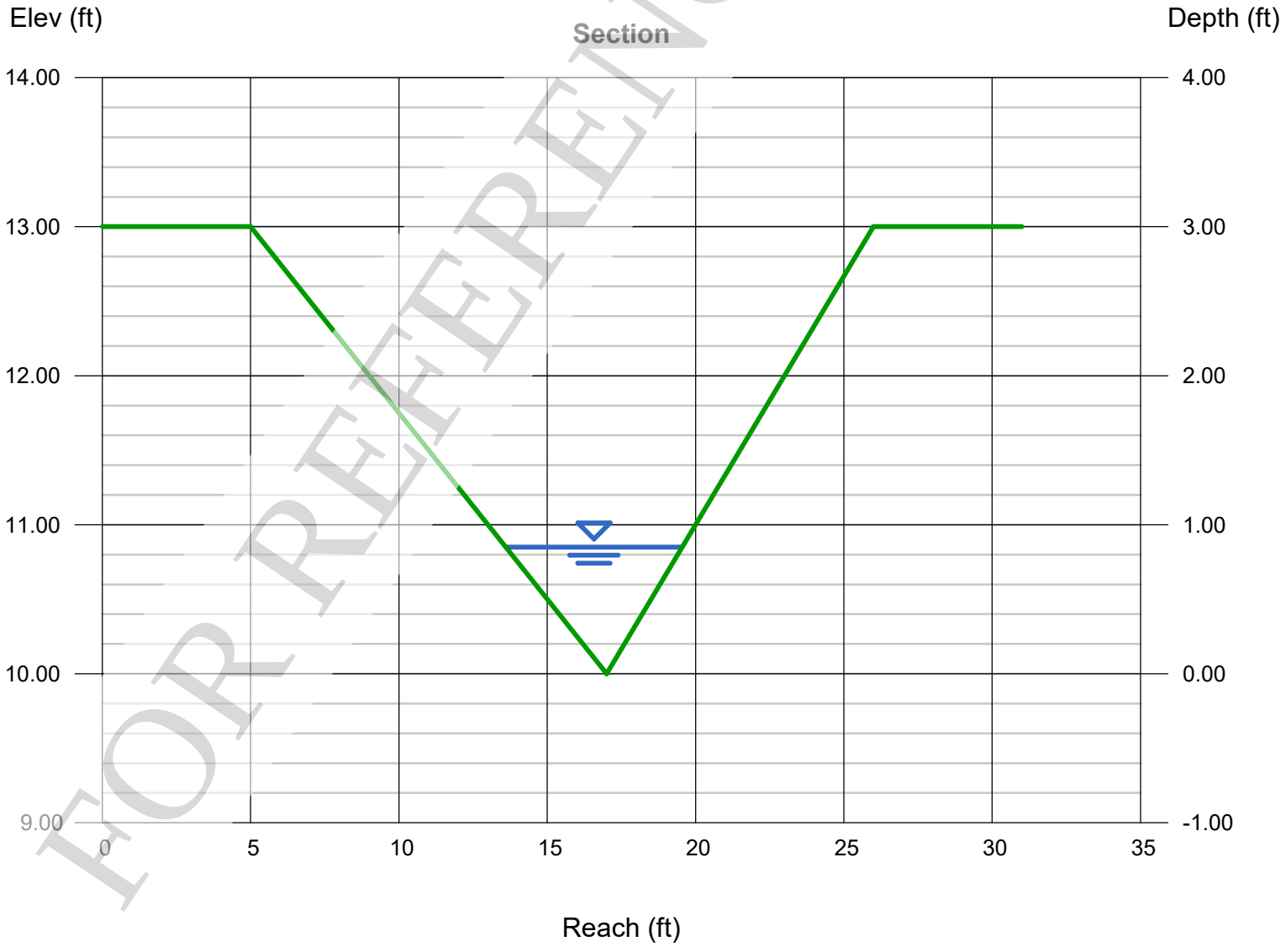
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.39
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.40

Highlighted

Depth (ft)	= 0.85
Q (cfs)	= 10.40
Area (sqft)	= 2.53
Velocity (ft/s)	= 4.11
Wetted Perim (ft)	= 6.19
Crit Depth, Yc (ft)	= 0.89
Top Width (ft)	= 5.95
EGL (ft)	= 1.11



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 21 2023

DP C2 Swale (5-Year)(FR:0.63)

Triangular

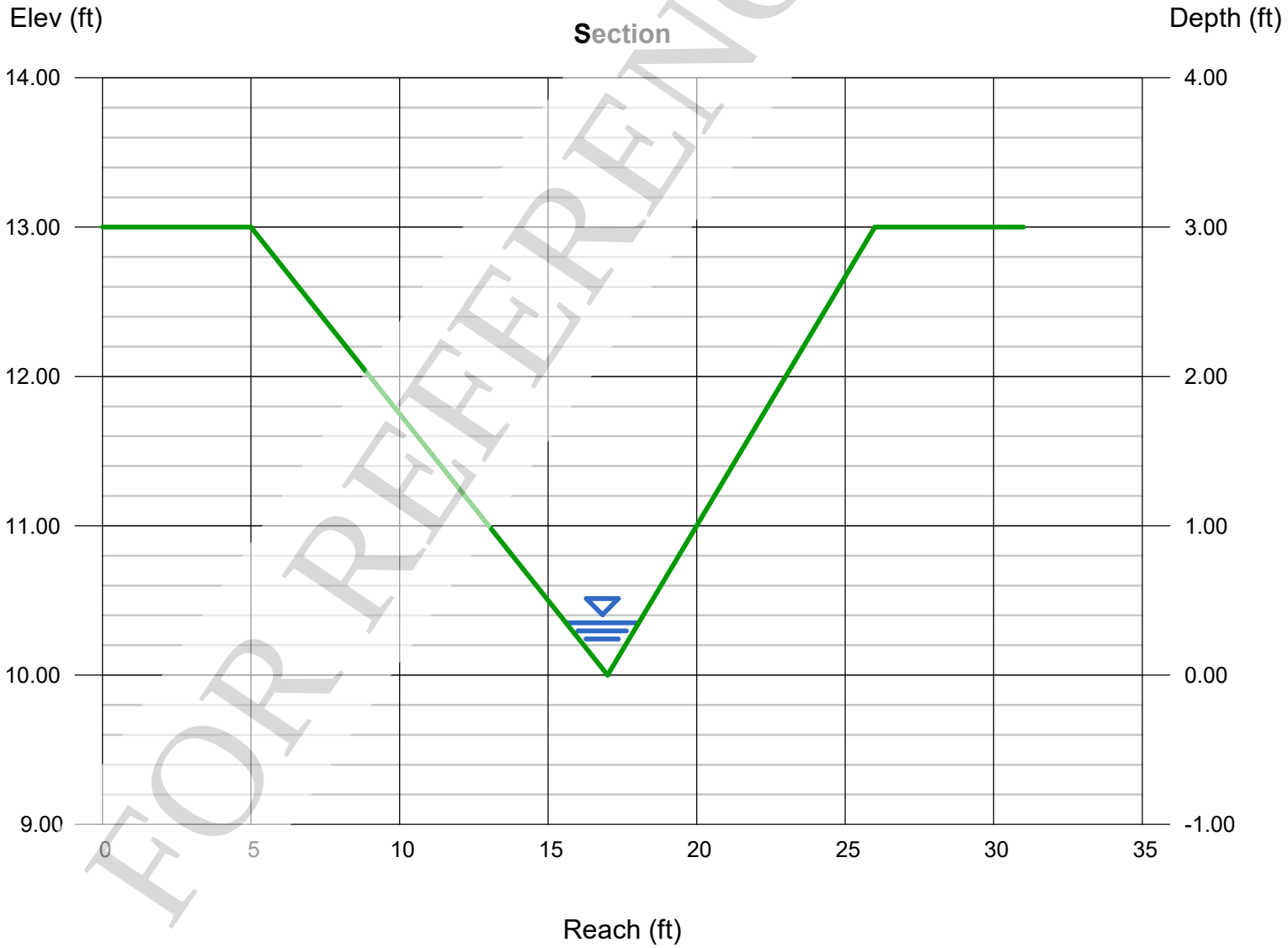
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.90

Highlighted

Depth (ft)	= 0.35
Q (cfs)	= 0.900
Area (sqft)	= 0.43
Velocity (ft/s)	= 2.10
Wetted Perim (ft)	= 2.55
Crit Depth, Yc (ft)	= 0.34
Top Width (ft)	= 2.45
EGL (ft)	= 0.42



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 21 2023

DP C2 Swale (100-Year)(FR:0.68)

Triangular

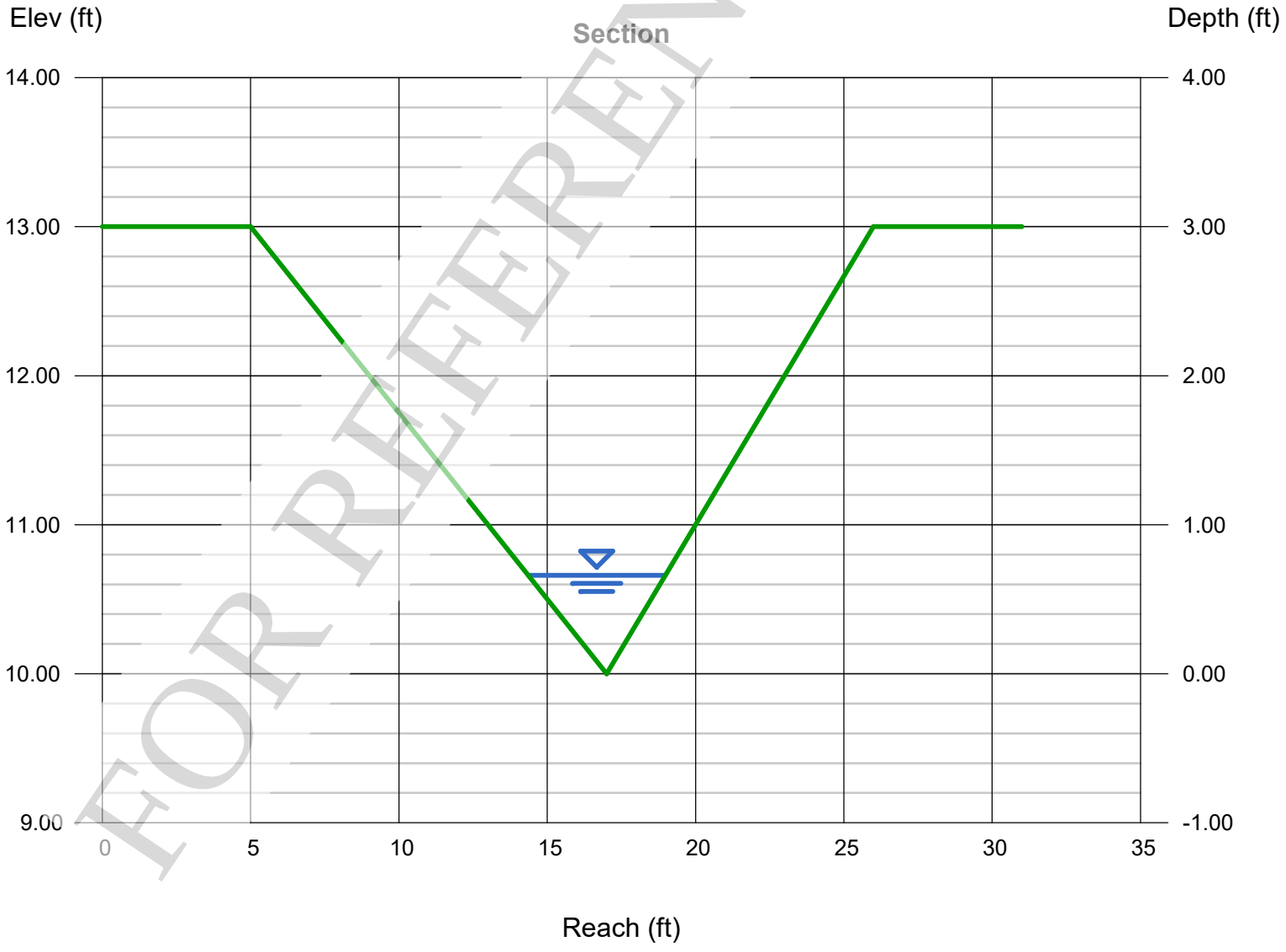
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 2.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.80

Highlighted

Depth (ft)	= 0.66
Q (cfs)	= 4.800
Area (sqft)	= 1.52
Velocity (ft/s)	= 3.15
Wetted Perim (ft)	= 4.81
Crit Depth, Yc (ft)	= 0.66
Top Width (ft)	= 4.62
EGL (ft)	= 0.81



APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

Saddlehorn-2514207
Required Sediment Pond Volumes
8/29/2022

	Sediment Basin #1	(north)	
Total Area =	60.42	acres	
Developed Area =	20.98	acres	
Undeveloped Area =	39.44	acres	
Required Volume =	(Dev. Area * 1800 ft^3/ac) + (Undev. Area * 500 ft^3/ac)		
=	57,484	ft^3	
	1.320	AC-FT	
	0.660	1/2 VOLUME	
L=2xW	196	L	76645.33 ft3
	98	W	
	19,161	pond bottom min (3' depth assumed)	

	Sediment Basin #2	(South)	
Total Area =	15.08	acres	
Developed Area =	1.55	acres	
Undeveloped Area =	13.53	acres	
Required Volume =	(Dev. Area * 1800 ft^3/ac) + (Undev. Area * 500 ft^3/ac)		
=	9,555	ft^3	
	0.219	AC-FT	
	0.110	1/2 VOLUME	
L=2xW	170	L	57800 ft3
	85	W	
	3,185	pond bottom min (3' depth assumed)	

Tributary Sub-Basin	Sediment Basin Name	Tributary Acres	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum Discharge (cfs)
A	Sediment Basin 2	15.08	0.219	0.279	0.0331
B	Sediment Basin 1	60.42	1.320	2.315	0.1997

Saddlehorn (25142.07)
Orifice Sizing

Sediment Basin #1			
Basin Total Volume:	1.320	ac-ft	
Top 1/2	0.660	ac-ft	
	28750	cf	
Drain Time 40 hrs	0.1997	cfs	over 40 hrs
	Assuming	5	holes
	0.0399	cfs	per hole
Equates to a	1.25	diam. hole (in)	
Equates to a	1.23	sq. in. hole	

Solution	5	1 Column - 5 holes
	1.25	Inch diameter holes

Saddlehorn (25142.07)
Orifice Sizing

Sediment Basin #2

Basin Total Volume:	0.219	ac-ft	
Top 1/2	0.110	ac-ft	
	4770	cf	
Drain Time 40 hrs	0.0331	cfs	over 40 hrs
	Assuming	5	holes
	0.0066	cfs	per hole
Equates to a	1.25	diam. hole (in)	
Equates to a	1.23	sq. in. hole	

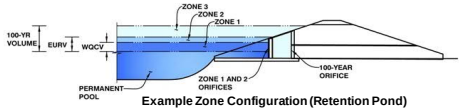
Solution	5	1 Column - 5 holes
	1.25	Inch diameter holes

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Saddlehorn Filing 5

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	15.08	acres
Watershed Length =	1,659	ft
Watershed Length to Centroid =	794	ft
Watershed Slope =	0.048	ft/ft
Watershed Imperviousness =	10.10%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

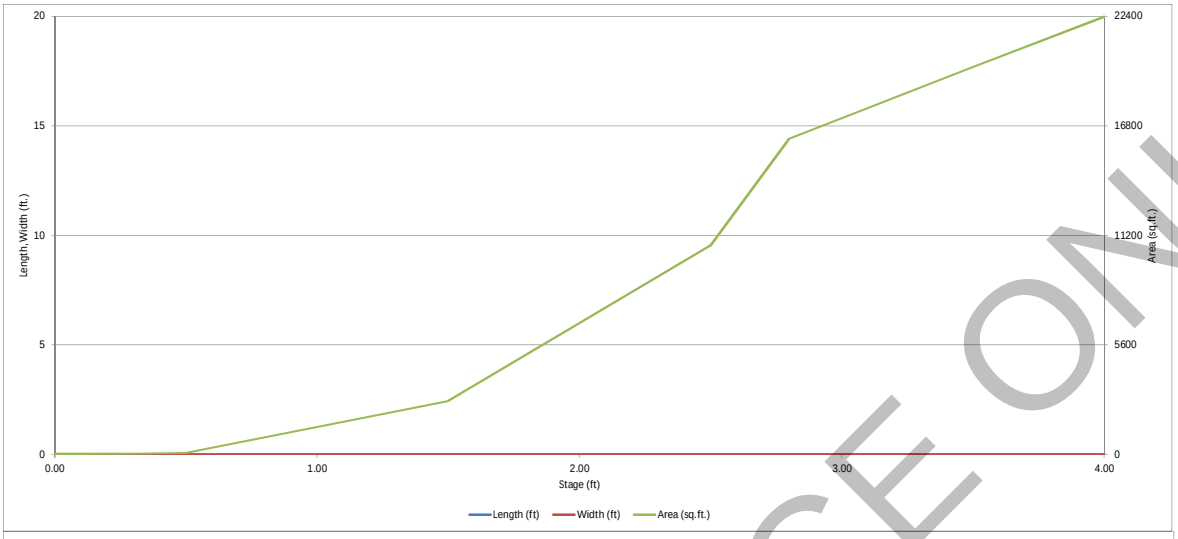
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.085	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.112	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.055	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.094	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.126	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.330	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.534	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.822	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.456	acre-feet		inches
Approximate 2-yr Detention Volume =	0.067	acre-feet		
Approximate 5-yr Detention Volume =	0.092	acre-feet		
Approximate 10-yr Detention Volume =	0.121	acre-feet		
Approximate 25-yr Detention Volume =	0.164	acre-feet		
Approximate 50-yr Detention Volume =	0.221	acre-feet		
Approximate 100-yr Detention Volume =	0.358	acre-feet		

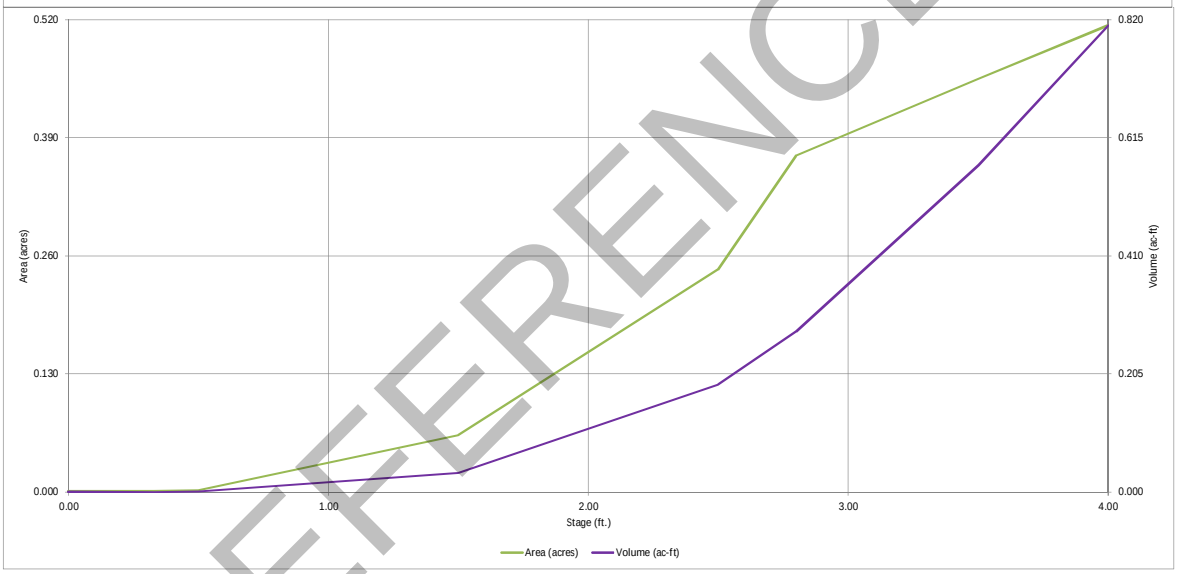
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.085	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.027	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.245	acre-feet
Total Detention Basin Volume =	0.358	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_{LW}) =	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 = 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	--	--	--	36	0.001		
6661.83	--	0.33	--	--	--	50	0.001	14	0.000
6662	--	0.50	--	--	--	75	0.002	25	0.001
6663	--	1.50	--	--	--	2,724	0.063	1,424	0.033
6664	--	2.50	--	--	--	10,676	0.245	8,124	0.187
6664.3	--	2.80	--	--	--	16,135	0.370	12,146	0.279
6665	--	3.50	--	--	--	19,821	0.455	24,730	0.568
6665.5	--	4.00	--	--	--	22,375	0.514	35,279	0.810



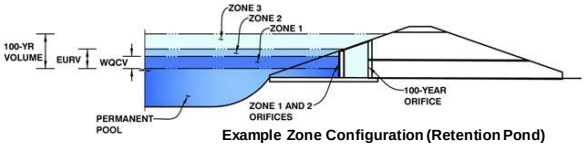


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Saddlehorn Filing 5

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.99	0.085	Orifice Plate
Zone 2 (EURV)	2.16	0.027	Circular Orifice
Zone 3 (100-year)	3.01	0.245	Weir&Pipe (Restrict)
Total (all zones)		0.358	

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	ft²
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.257E-03	ft²
Depth at top of Zone using Orifice Plate =	1.99	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.33	sq. inches (diameter = 5/8 inch)	Elliptical Slot Area =	N/A	ft²

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	0.66	1.33					
Orifice Area (sq. inches)	0.33	0.33	0.33					

	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 =	1.99	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft²
Depth at top of Zone using Vertical Orifice =	2.16	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	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 =	2.17	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.17	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.28	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	8.35	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	8.35	N/A	ft²
Debris Clogging % =	0%	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 =	1.01	N/A	ft²
Outlet Pipe Diameter =	18.00	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 =	1.68	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	35.00	feet	Stage at Top of Freeboard =	4.00	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.51	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.81	acre-ft

Calculated Parameters for Spillway

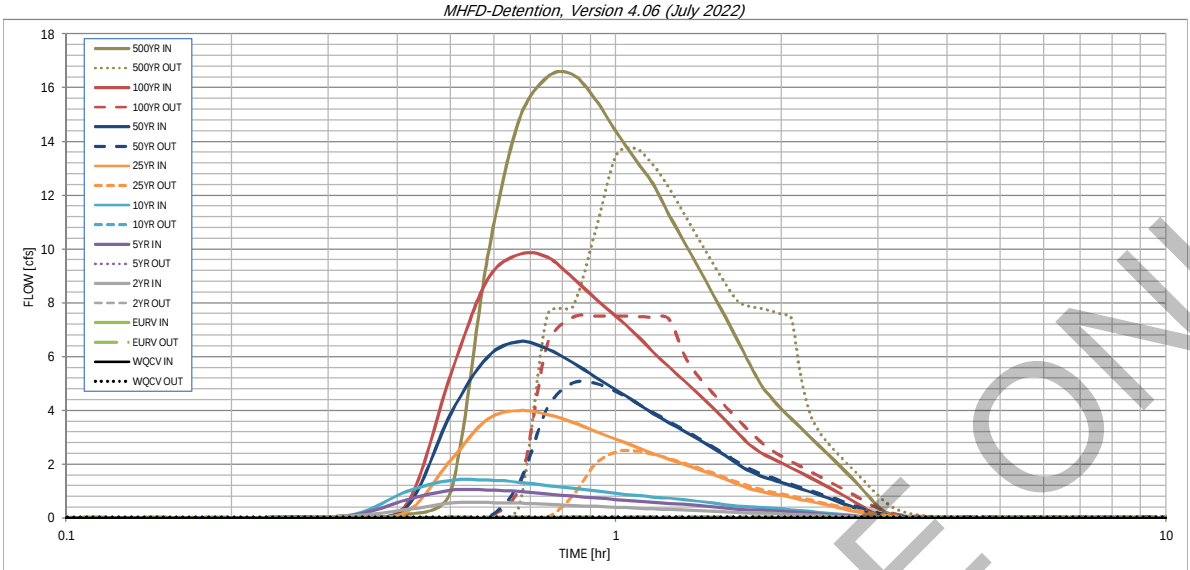
Routed Hydrograph Results

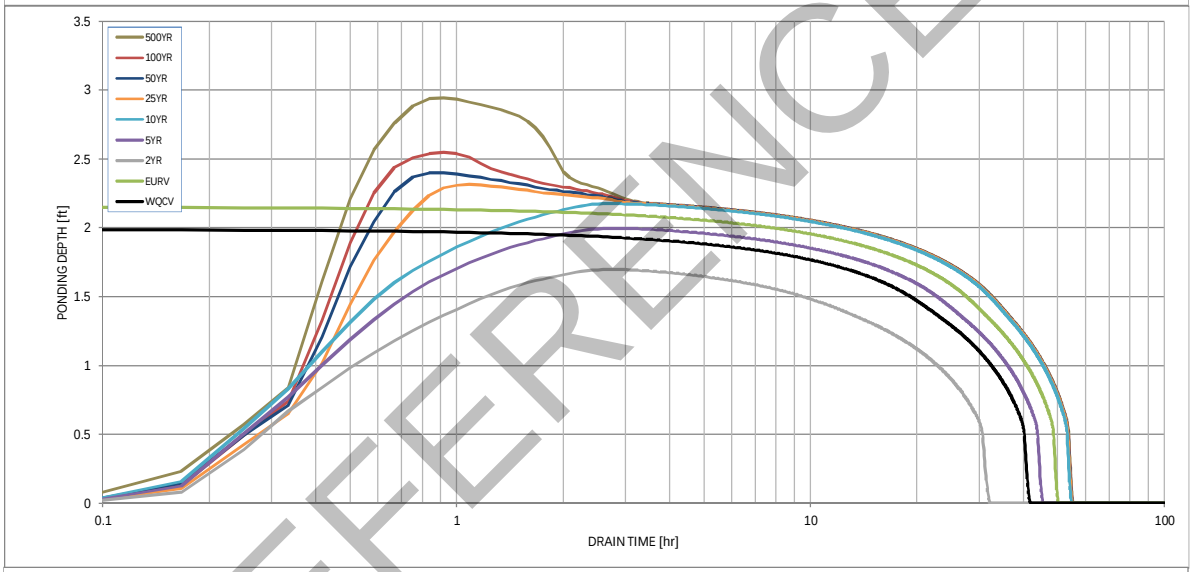
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

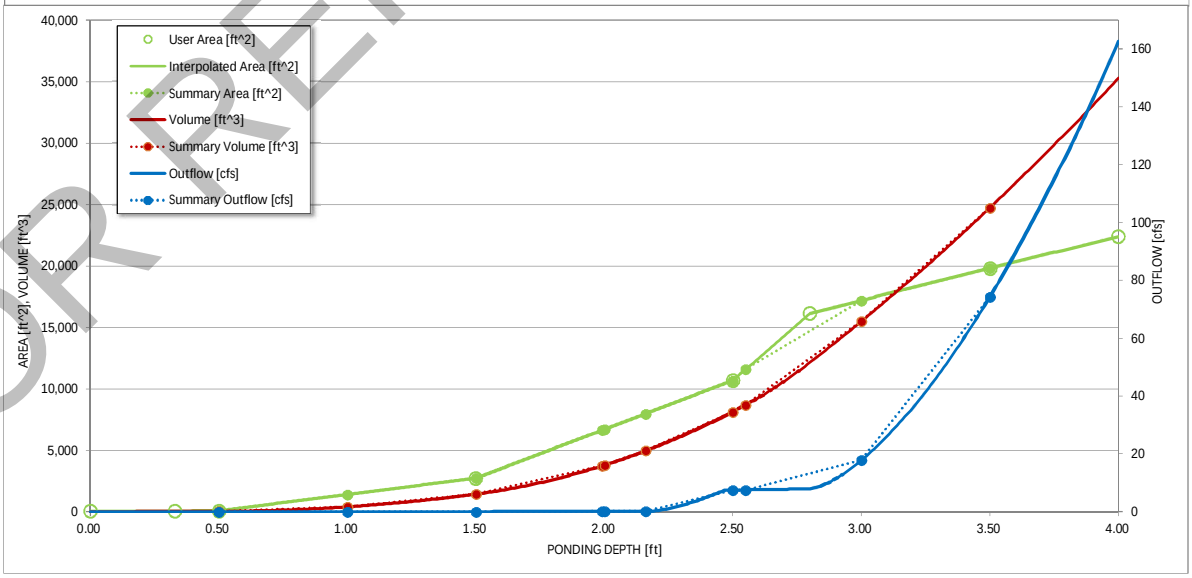
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.085	0.112	0.055	0.094	0.126	0.330	0.534	0.822	1.456
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.055	0.094	0.126	0.330	0.534	0.822	1.456
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.5	5.0	8.1	14.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.16	0.33	0.54	0.98
Peak Inflow Q (cfs) =	N/A	N/A	0.6	1.0	1.4	4.0	6.6	9.8	16.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.1	2.5	5.0	7.5	13.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	1.0	1.0	0.9	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.6	0.9	1.0
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	45	29	41	50	45	41	36	28
Time to Drain 99% of Inflow Volume (hours) =	40	48	31	43	52	50	49	46	42
Maximum Ponding Depth (ft) =	1.99	2.16	1.70	2.00	2.18	2.31	2.40	2.55	2.94
Area at Maximum Ponding Depth (acres) =	0.15	0.18	0.10	0.15	0.18	0.21	0.23	0.26	0.39
Maximum Volume Stored (acre-ft) =	0.085	0.114	0.048	0.085	0.116	0.143	0.163	0.197	0.332

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	0.01
	0:15:00	0.00	0.00	0.02	0.04	0.05	0.03	0.04	0.04	0.06
	0:20:00	0.00	0.00	0.08	0.11	0.13	0.08	0.10	0.10	0.14
	0:25:00	0.00	0.00	0.32	0.69	1.00	0.25	0.43	0.55	0.99
	0:30:00	0.00	0.00	0.56	1.04	1.41	2.14	3.88	5.33	9.66
	0:35:00	0.00	0.00	0.58	1.05	1.42	3.67	5.98	8.87	14.81
	0:40:00	0.00	0.00	0.56	0.99	1.34	4.00	6.57	9.81	16.41
	0:45:00	0.00	0.00	0.51	0.90	1.21	3.85	6.29	9.70	16.50
	0:50:00	0.00	0.00	0.47	0.82	1.10	3.57	5.79	8.95	15.57
	0:55:00	0.00	0.00	0.44	0.76	1.01	3.23	5.24	8.17	14.37
	1:00:00	0.00	0.00	0.40	0.69	0.93	2.94	4.77	7.50	13.34
	1:05:00	0.00	0.00	0.38	0.64	0.85	2.66	4.33	6.87	12.44
	1:10:00	0.00	0.00	0.35	0.60	0.79	2.40	3.90	6.19	11.26
	1:15:00	0.00	0.00	0.33	0.55	0.75	2.19	3.55	5.61	10.24
	1:20:00	0.00	0.00	0.30	0.51	0.69	2.00	3.23	5.09	9.27
	1:25:00	0.00	0.00	0.28	0.47	0.63	1.81	2.92	4.59	8.34
	1:30:00	0.00	0.00	0.25	0.42	0.56	1.63	2.61	4.10	7.45
	1:35:00	0.00	0.00	0.23	0.38	0.50	1.44	2.31	3.63	6.58
	1:40:00	0.00	0.00	0.21	0.34	0.45	1.26	2.01	3.16	5.73
	1:45:00	0.00	0.00	0.20	0.31	0.42	1.10	1.74	2.74	4.98
	1:50:00	0.00	0.00	0.19	0.30	0.39	0.99	1.57	2.44	4.46
	1:55:00	0.00	0.00	0.18	0.28	0.37	0.91	1.44	2.23	4.06
	2:00:00	0.00	0.00	0.16	0.26	0.34	0.84	1.33	2.05	3.70
	2:05:00	0.00	0.00	0.15	0.24	0.31	0.77	1.21	1.87	3.36
	2:10:00	0.00	0.00	0.13	0.21	0.28	0.70	1.10	1.69	3.04
	2:15:00	0.00	0.00	0.12	0.19	0.25	0.63	0.99	1.52	2.72
	2:20:00	0.00	0.00	0.11	0.16	0.22	0.56	0.88	1.35	2.42
	2:25:00	0.00	0.00	0.09	0.14	0.19	0.49	0.77	1.19	2.13
	2:30:00	0.00	0.00	0.08	0.12	0.16	0.42	0.66	1.02	1.84
	2:35:00	0.00	0.00	0.07	0.10	0.13	0.35	0.55	0.86	1.55
	2:40:00	0.00	0.00	0.05	0.08	0.11	0.29	0.45	0.70	1.26
	2:45:00	0.00	0.00	0.04	0.06	0.08	0.22	0.34	0.53	0.98
	2:50:00	0.00	0.00	0.03	0.04	0.05	0.16	0.24	0.37	0.69
	2:55:00	0.00	0.00	0.02	0.03	0.04	0.10	0.14	0.22	0.42
	3:00:00	0.00	0.00	0.02	0.02	0.03	0.05	0.07	0.12	0.24
	3:05:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.07	0.15
	3:10:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.04	0.10
	3:15:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.07
	3:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04
	3:25:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.03
	3:30:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	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	0.01	0.01	0.01	0.01	0.01	0.01
	3:45:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
	0.50	75	0.002	25	0.001	0.01
	1.00	1,400	0.032	393	0.009	0.02
	1.50	2,724	0.063	1,424	0.033	0.03
WQCV	1.99	6,620	0.152	3,714	0.085	0.04
	2.00	6,700	0.154	3,780	0.087	0.04
EURV	2.16	7,972	0.183	4,954	0.114	0.04
	2.50	10,676	0.245	8,124	0.187	7.45
100-YR	2.55	11,586	0.266	8,681	0.199	7.53
	3.00	17,188	0.395	15,478	0.355	17.76
	3.50	19,821	0.455	24,730	0.568	74.32

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).

POND A FOREBAY VOLUME REQUIREMENTS

Equation 3-1 $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$

a=1 (40 hour drain time)

Proposed Forebay I=.101 $WQCV$= 0.067578

Equation 3-3 $V=(WQCV/12)A$

Proposed Forebay A= 15.08 Acres V= 0.085

3% OF WQCV

Forebay Total Volume= .03(V)

Volume Required For Proposed Forebay= 0.003 AC-FT 111 CF

Volume Provided For Proposed Forebay= 0.008 AC-FT 365 CF

Q_{100} Discharges 2% OF Q_{100}

Q_{100} Proposed Forebay = .02*7.5 CFS= .15 CFS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Mar 25 2022

Pond A Spillway

Trapezoidal Weir

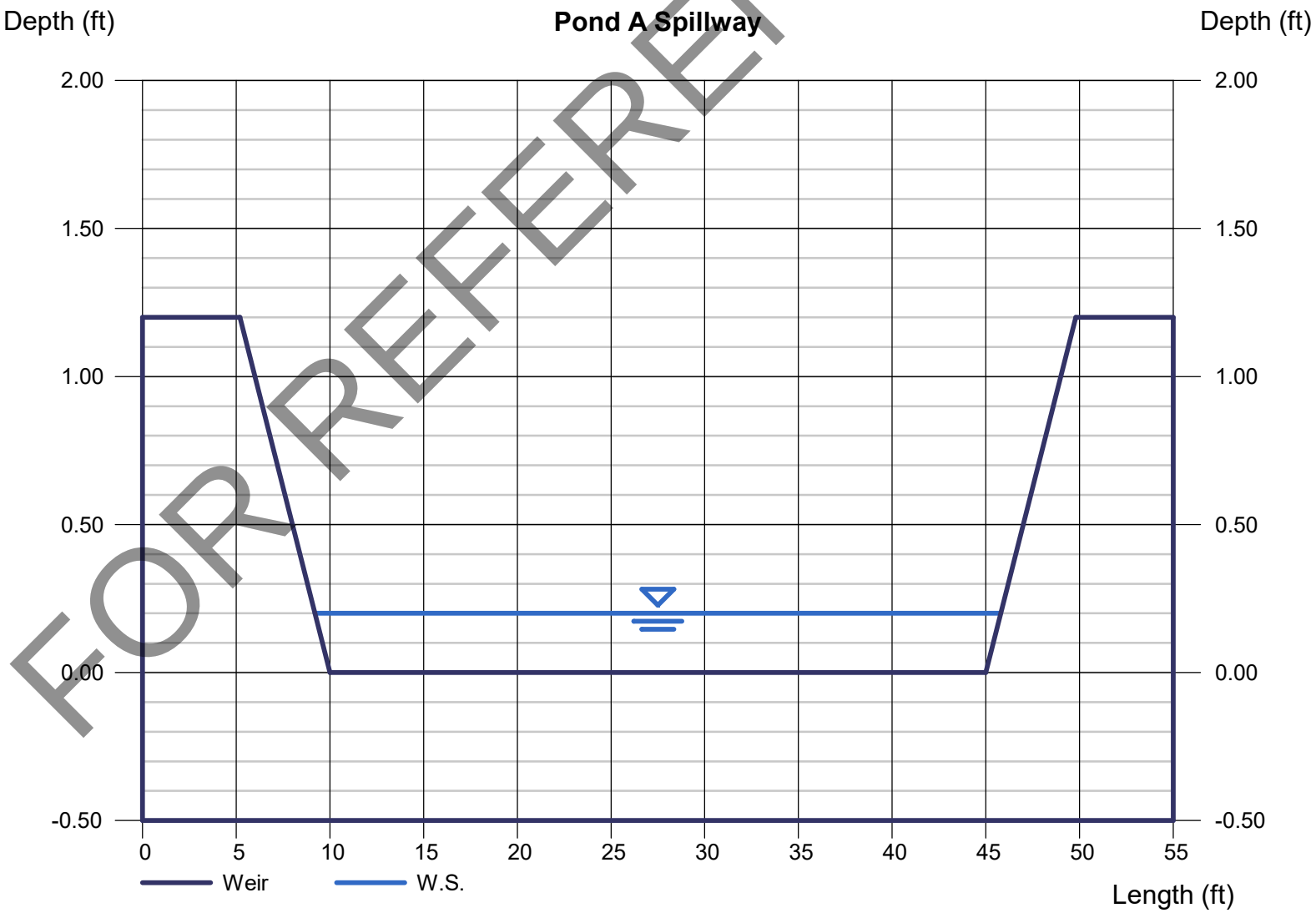
Crest	= Sharp
Bottom Length (ft)	= 35.00
Total Depth (ft)	= 1.20
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 9.30

Highlighted

Depth (ft)	= 0.20
Q (cfs)	= 9.300
Area (sqft)	= 7.16
Velocity (ft/s)	= 1.30
Top Width (ft)	= 36.60



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 24 2022

Pond A Trickle Channel

Rectangular

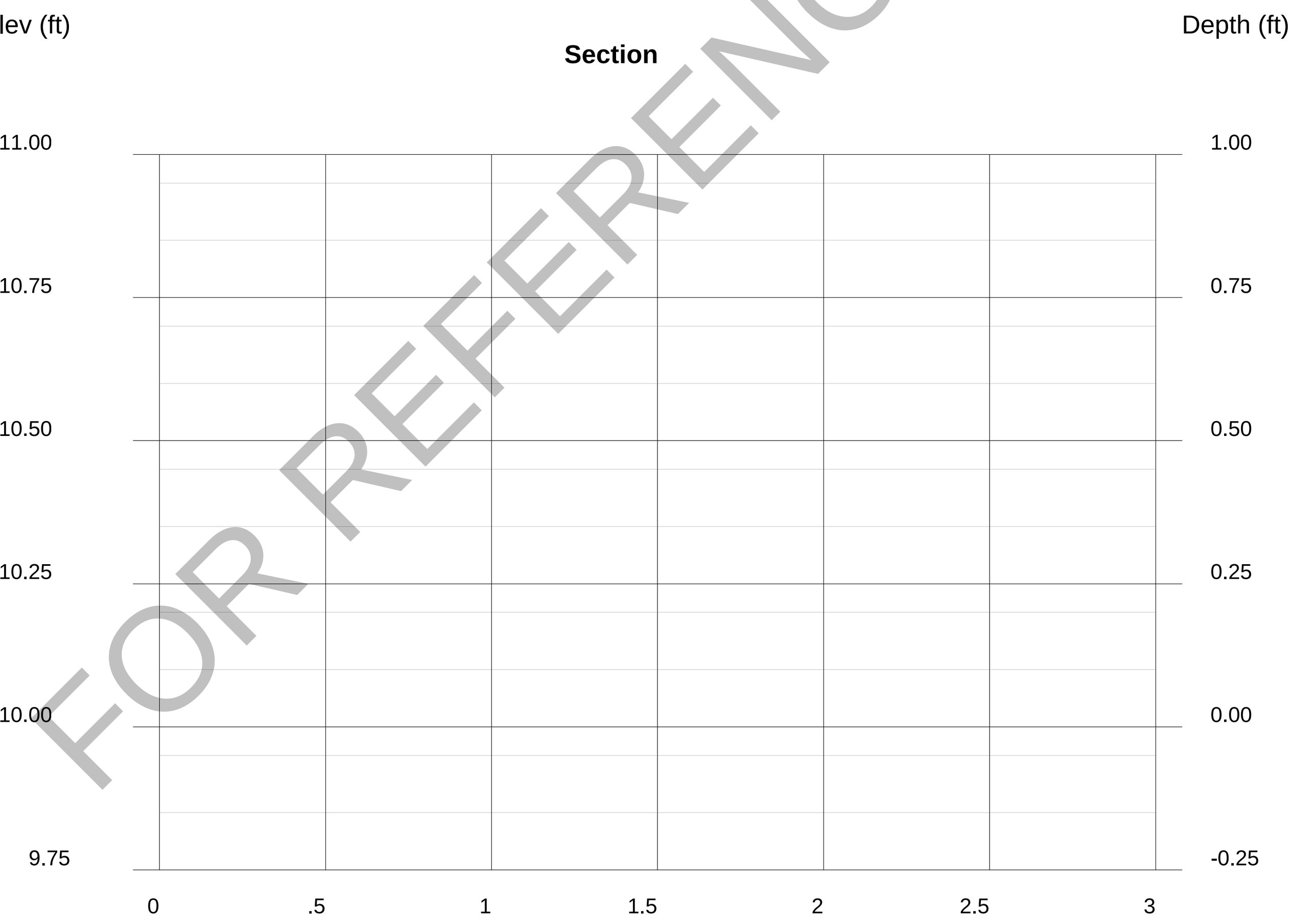
Bottom Width (ft)	= 2.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.013

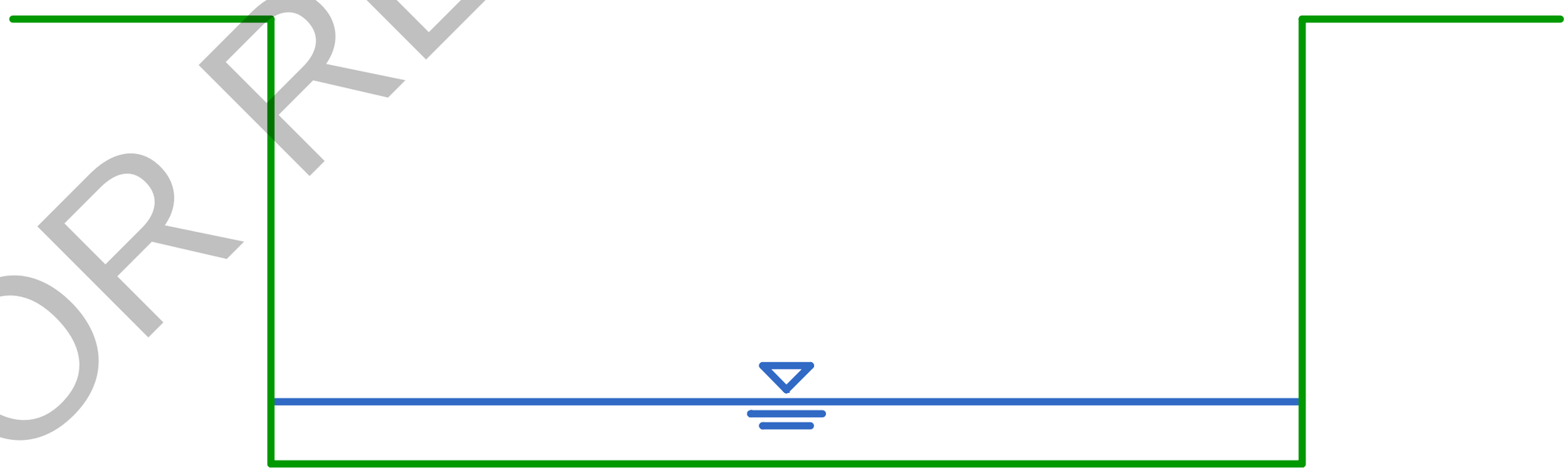
Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.15

Highlighted

Depth (ft)	= 0.07
Q (cfs)	= 0.150
Area (sqft)	= 0.14
Velocity (ft/s)	= 1.07
Wetted Perim (ft)	= 2.14
Crit Depth, Yc (ft)	= 0.06
Top Width (ft)	= 2.00
EGL (ft)	= 0.09



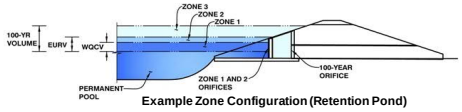


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Saddehorn Filing 5

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	60.42	acres
Watershed Length =	3,478	ft
Watershed Length to Centroid =	1,805	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	11.50%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

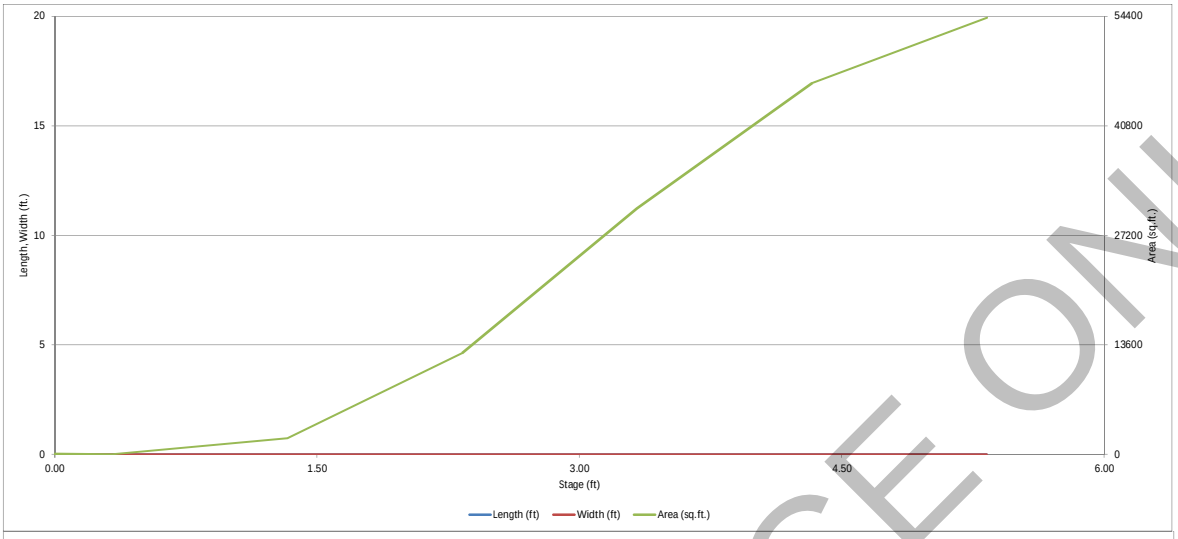
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.379	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.531	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.279	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.454	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.602	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.442	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.273	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.438	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	5.999	acre-feet		inches
Approximate 2-yr Detention Volume =	0.320	acre-feet		
Approximate 5-yr Detention Volume =	0.438	acre-feet		
Approximate 10-yr Detention Volume =	0.572	acre-feet		
Approximate 25-yr Detention Volume =	0.768	acre-feet		
Approximate 50-yr Detention Volume =	1.006	acre-feet		
Approximate 100-yr Detention Volume =	1.563	acre-feet		

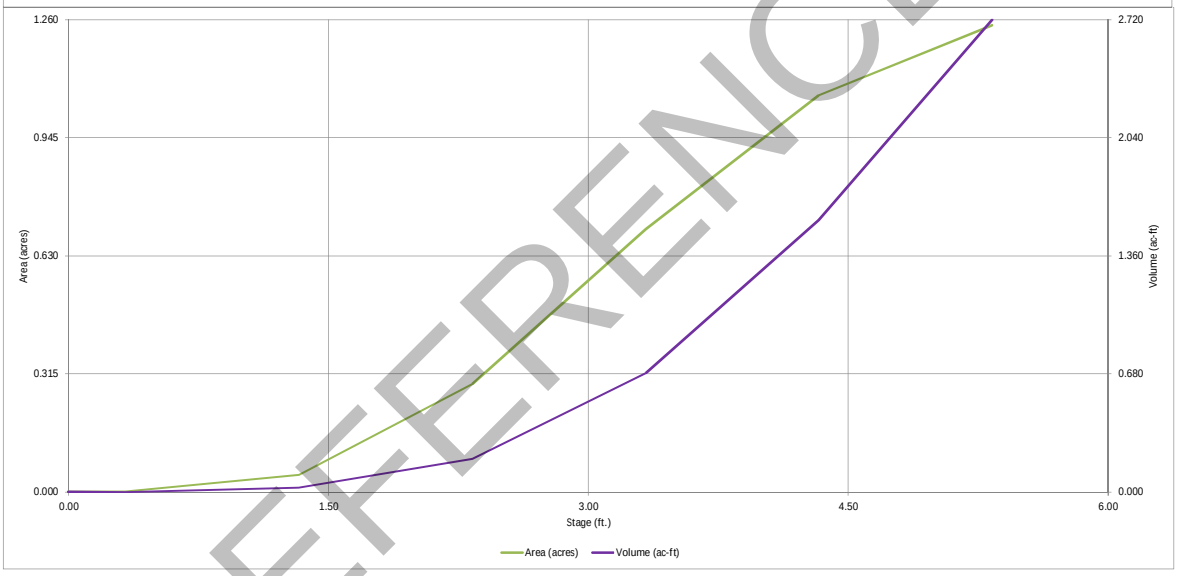
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.379	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.152	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.033	acre-feet
Total Detention Basin Volume =	1.563	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_{LW}) =	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 = 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	--	--	--	36	0.001		
6675	--	0.33	--	--	--	50	0.001	14	0.000
6676	--	1.33	--	--	--	1,986	0.046	1,032	0.024
6677	--	2.33	--	--	--	12,572	0.289	8,311	0.191
6678	--	3.33	--	--	--	30,573	0.702	29,884	0.686
6679	--	4.33	--	--	--	46,107	1.058	68,223	1.566
6680	--	5.33	--	--	--	54,237	1.245	118,395	2.718



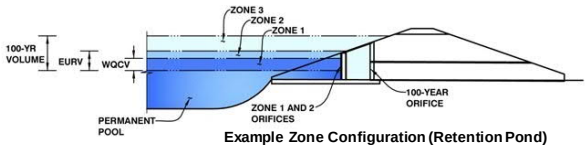


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Saddehorn Filing 5

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.82	0.379	Orifice Plate
Zone 2 (EURV)	3.10	0.152	Circular Orifice
Zone 3 (100-year)	4.33	1.033	Weir&Pipe (Restrict)
Total (all zones)		1.563	

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

			Calculated Parameters for Underdrain		
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

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)

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	8.264E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.82	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	11.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.19	sq. inches (diameter = 1-3/16 inches)	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	0.94	1.88					
Orifice Area (sq. inches)	1.19	1.19	1.19					

	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		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.82	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 =	3.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	N/A	inches				

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		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.11	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.36	N/A	feet
Overflow Weir Front Edge Length =	15.00	N/A	feet	Overflow Weir Slope Length =	5.15	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	17.13	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	53.81	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	53.81	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
Restrictor Plate Height Above Pipe Invert =	24.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway	
Spillway Invert Stage=	4.08	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.24 feet
Spillway Crest Length =	85.00	feet	Stage at Top of Freeboard =	8.32 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.25 acres
Freeboard above Max Water Surface =	4.00	feet	Basin Volume at Top of Freeboard =	2.72 acre-ft

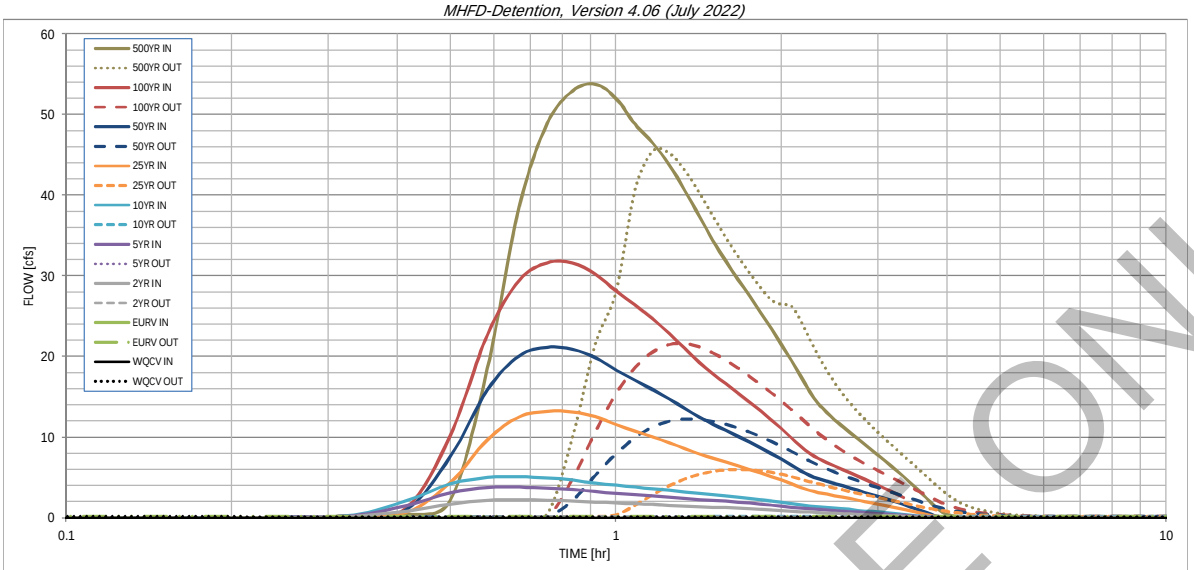
Routed Hydrograph Results

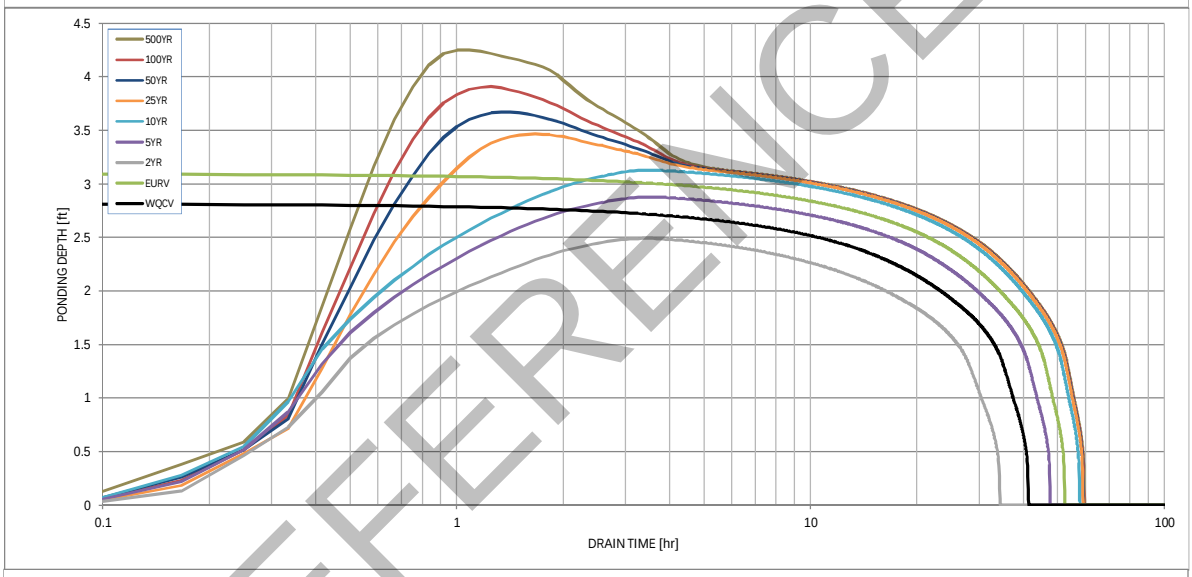
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

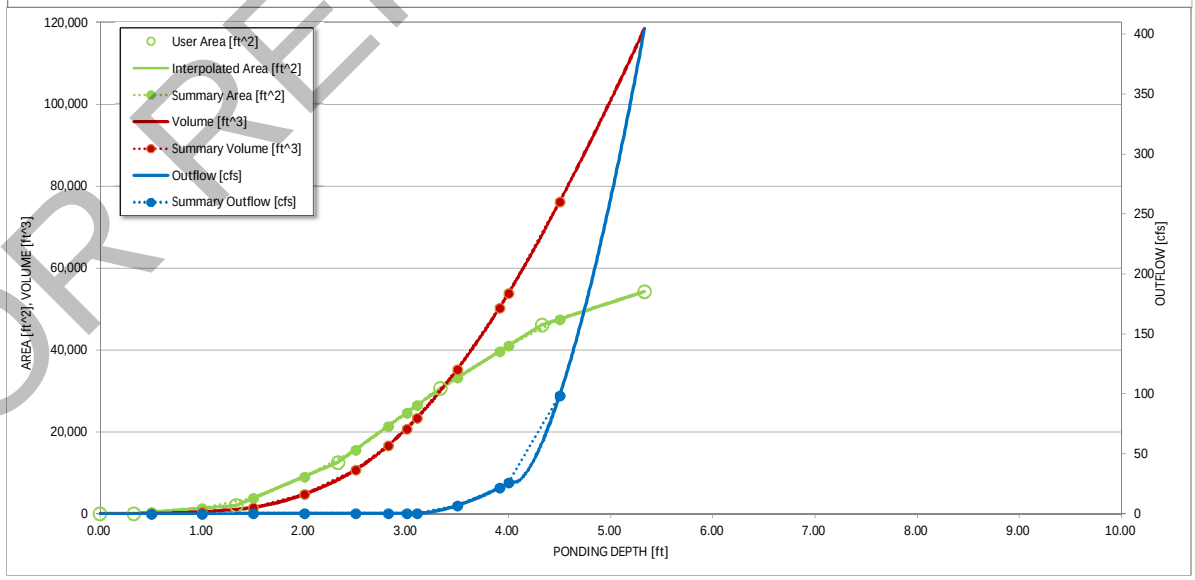
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.379	0.531	0.279	0.454	0.602	1.442	2.273	3.438	5.999
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.279	0.454	0.602	1.442	2.273	3.438	5.999
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.6	0.8	7.5	15.1	25.1	46.6
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	0.01	0.12	0.25	0.42	0.77
Peak Inflow Q (cfs) =	N/A	N/A	2.3	3.8	5.1	13.2	21.2	31.6	53.8
Peak Outflow Q (cfs) =	0.2	0.2	0.1	0.2	0.2	6.0	12.3	21.6	45.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.3	0.8	0.8	0.9	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.4	0.5
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) =	37	47	31	43	52	50	46	42	35
Time to Drain 99% of Inflow Volume (hours) =	40	50	33	46	55	54	53	51	48
Maximum Ponding Depth (ft) =	2.82	3.10	2.49	2.88	3.13	3.46	3.67	3.91	4.25
Area at Maximum Ponding Depth (acres) =	0.49	0.61	0.35	0.51	0.62	0.75	0.82	0.91	1.03
Maximum Volume Stored (acre-ft) =	0.382	0.536	0.242	0.407	0.548	0.780	0.945	1.144	1.483

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	0.01	0.00	0.02
	0:15:00	0.00	0.00	0.05	0.08	0.10	0.07	0.09	0.08	0.14
	0:20:00	0.00	0.00	0.22	0.30	0.36	0.23	0.28	0.29	0.40
	0:25:00	0.00	0.00	0.85	1.57	2.17	0.72	1.10	1.32	2.23
	0:30:00	0.00	0.00	1.73	3.13	4.24	4.42	7.67	10.34	18.52
	0:35:00	0.00	0.00	2.18	3.76	5.02	9.68	15.88	22.71	38.59
	0:40:00	0.00	0.00	2.26	3.82	5.10	12.56	20.11	29.50	48.94
	0:45:00	0.00	0.00	2.22	3.73	4.97	13.23	21.17	31.65	52.96
	0:50:00	0.00	0.00	2.12	3.54	4.70	13.14	20.90	31.61	53.78
	0:55:00	0.00	0.00	1.99	3.28	4.33	12.56	19.89	30.26	52.00
	1:00:00	0.00	0.00	1.87	3.07	4.06	11.59	18.33	28.16	48.82
	1:05:00	0.00	0.00	1.78	2.91	3.83	10.76	17.06	26.39	46.45
	1:10:00	0.00	0.00	1.68	2.75	3.62	10.05	15.90	24.68	43.79
	1:15:00	0.00	0.00	1.58	2.58	3.43	9.33	14.75	22.85	40.63
	1:20:00	0.00	0.00	1.49	2.42	3.24	8.61	13.59	21.01	37.41
	1:25:00	0.00	0.00	1.41	2.29	3.07	7.95	12.51	19.30	34.39
	1:30:00	0.00	0.00	1.35	2.19	2.91	7.40	11.64	17.88	31.84
	1:35:00	0.00	0.00	1.29	2.08	2.75	6.92	10.86	16.65	29.57
	1:40:00	0.00	0.00	1.23	1.96	2.59	6.47	10.13	15.50	27.47
	1:45:00	0.00	0.00	1.16	1.84	2.43	6.02	9.41	14.37	25.44
	1:50:00	0.00	0.00	1.10	1.72	2.27	5.58	8.70	13.26	23.44
	1:55:00	0.00	0.00	1.03	1.59	2.11	5.14	7.99	12.16	21.48
	2:00:00	0.00	0.00	0.95	1.47	1.94	4.70	7.28	11.07	19.54
	2:05:00	0.00	0.00	0.87	1.33	1.76	4.25	6.56	9.97	17.60
	2:10:00	0.00	0.00	0.79	1.21	1.60	3.79	5.84	8.87	15.68
	2:15:00	0.00	0.00	0.73	1.12	1.49	3.42	5.27	8.00	14.19
	2:20:00	0.00	0.00	0.68	1.05	1.39	3.15	4.87	7.38	13.08
	2:25:00	0.00	0.00	0.63	0.98	1.30	2.95	4.55	6.88	12.16
	2:30:00	0.00	0.00	0.59	0.91	1.21	2.75	4.26	6.43	11.34
	2:35:00	0.00	0.00	0.54	0.84	1.12	2.57	3.98	6.01	10.57
	2:40:00	0.00	0.00	0.50	0.78	1.03	2.40	3.71	5.60	9.83
	2:45:00	0.00	0.00	0.46	0.72	0.95	2.23	3.44	5.19	9.12
	2:50:00	0.00	0.00	0.43	0.66	0.87	2.06	3.18	4.81	8.44
	2:55:00	0.00	0.00	0.39	0.60	0.80	1.89	2.92	4.42	7.77
	3:00:00	0.00	0.00	0.36	0.55	0.72	1.73	2.67	4.04	7.11
	3:05:00	0.00	0.00	0.32	0.49	0.65	1.57	2.42	3.66	6.44
	3:10:00	0.00	0.00	0.29	0.44	0.58	1.40	2.16	3.28	5.78
	3:15:00	0.00	0.00	0.25	0.39	0.51	1.24	1.91	2.91	5.12
	3:20:00	0.00	0.00	0.22	0.34	0.44	1.08	1.66	2.53	4.47
	3:25:00	0.00	0.00	0.19	0.28	0.37	0.93	1.41	2.15	3.81
	3:30:00	0.00	0.00	0.16	0.23	0.30	0.77	1.16	1.78	3.15
	3:35:00	0.00	0.00	0.13	0.18	0.24	0.61	0.92	1.40	2.50
	3:40:00	0.00	0.00	0.10	0.14	0.17	0.45	0.67	1.03	1.85
	3:45:00	0.00	0.00	0.07	0.09	0.12	0.30	0.43	0.67	1.21
	3:50:00	0.00	0.00	0.05	0.07	0.09	0.17	0.23	0.37	0.71
	3:55:00	0.00	0.00	0.05	0.06	0.08	0.10	0.14	0.21	0.44
	4:00:00	0.00	0.00	0.04	0.05	0.07	0.08	0.10	0.14	0.29
	4:05:00	0.00	0.00	0.04	0.05	0.06	0.06	0.08	0.10	0.19
	4:10:00	0.00	0.00	0.03	0.04	0.05	0.05	0.06	0.07	0.13
	4:15:00	0.00	0.00	0.03	0.03	0.04	0.04	0.05	0.05	0.09
	4:20:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.05
	4:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	4:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	4:35:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	4:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	4:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	4:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:55:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
	0.50	379	0.009	51	0.001	0.03
	1.00	1,347	0.031	482	0.011	0.05
	1.50	3,786	0.087	1,523	0.035	0.08
	2.00	9,079	0.208	4,739	0.109	0.11
	2.50	15,632	0.359	10,708	0.246	0.14
WQCV	2.82	21,392	0.491	16,632	0.382	0.16
	3.00	24,633	0.565	20,775	0.477	0.17
EURV	3.10	26,433	0.607	23,328	0.536	0.17
	3.50	33,214	0.762	35,305	0.811	6.96
100-YR	3.91	39,583	0.909	50,229	1.153	21.71
	4.00	40,981	0.941	53,854	1.236	25.86
	4.50	47,489	1.090	76,179	1.749	98.81

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).

POND B FOREBAY VOLUME REQUIREMENTS

Equation 3-1 $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$

a=1 (40 hour drain time)

Proposed Forebay *I=.115* *WQCV=* 0.075346

Equation 3-3 V=(WQCV/12)A

Proposed Forebay A= 60.42 Acres V= 0.379

3% OF WQCV

Forebay Total Volume= .03(V)

Volume Required For Proposed Forebay= 0.011 AC-FT 496 CF

Volume Provided For Proposed Forebay= 0.014 AC-FT 620 CF

Q_{100} Discharges 2% OF Q_{100}

Q_{100} Proposed Forebay = .02*31.6 CFS= 0.63 CFS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Mar 29 2022

Pond B Spillway

Trapezoidal Weir

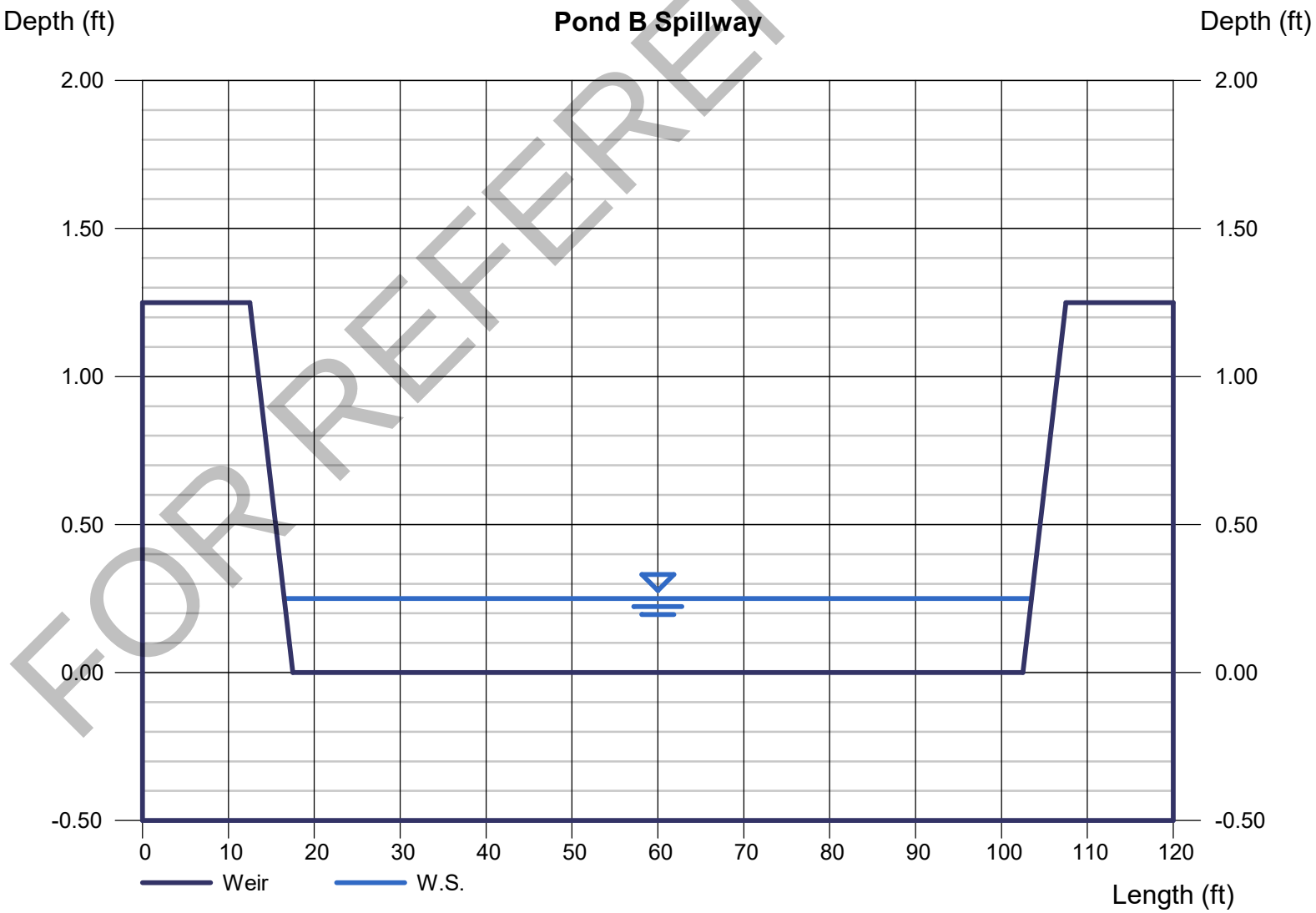
Crest	= Sharp
Bottom Length (ft)	= 85.00
Total Depth (ft)	= 1.25
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 31.60

Highlighted

Depth (ft)	= 0.25
Q (cfs)	= 31.60
Area (sqft)	= 21.50
Velocity (ft/s)	= 1.47
Top Width (ft)	= 87.00



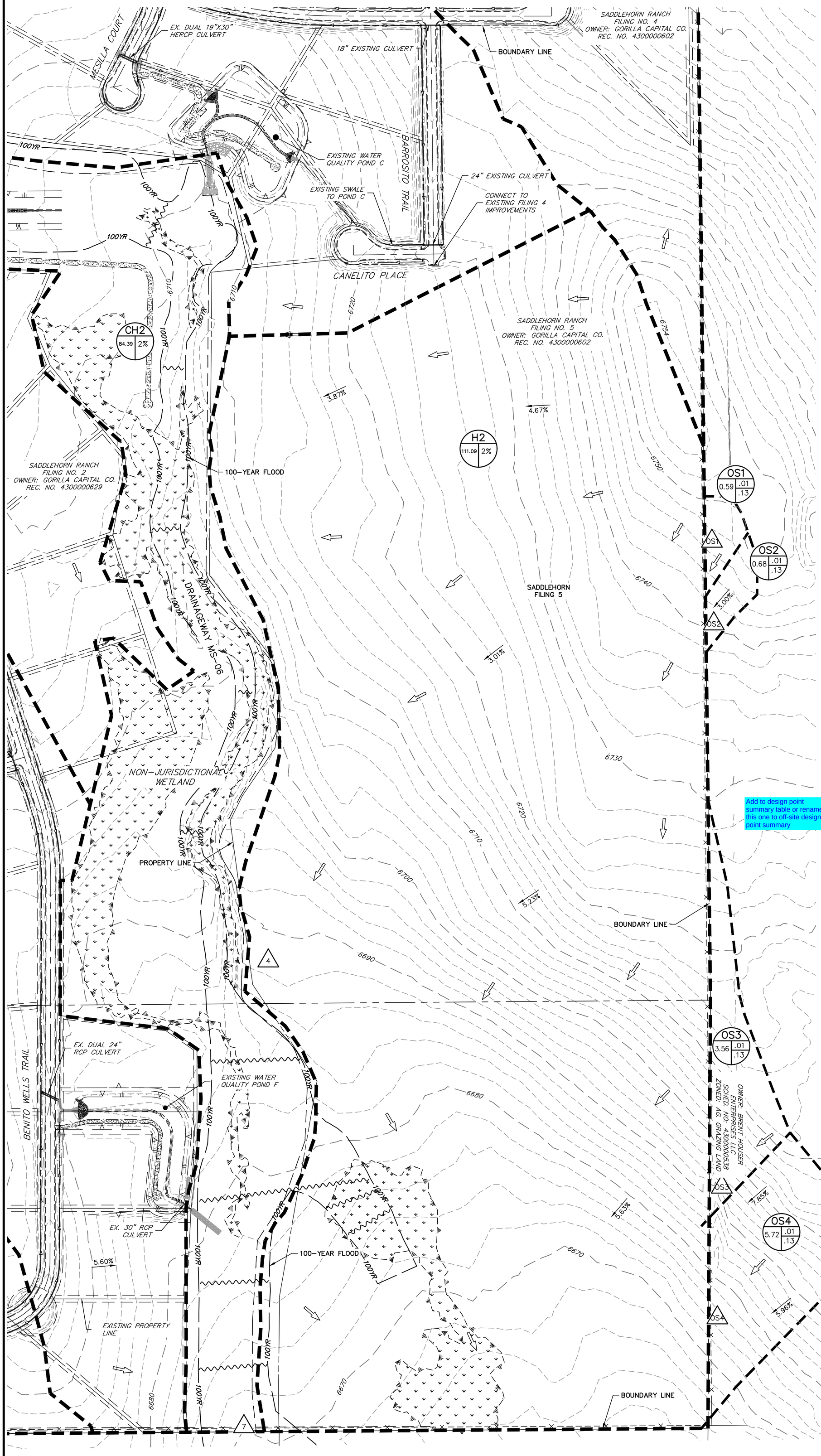
APPENDIX E

REFERENCE MATERIALS

APPENDIX F

DRAINAGE MAPS & PLANS

SADDLEHORN RANCH - FILING 5
EXISTING CONDITIONS MAP



LEGEND

- I.D. (A | B) — BASIN DESIGNATION
  - I.D.: BASIN IDENTIFIER
  - A: BASIN AREA
  - B: % IMPERVIOUS
- X — DESIGN POINT
- MAJOR BASIN DELINEATION
- MINOR BASIN DELINEATION
- 6100 — EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- BASE FLOOD ELEVATION

BASIN SUMMARY TABLE

Tributary Sub-Basin	Area (acres)	Percent Impervious	Q_5 (cfs)	Q_{100} (cfs)
~~G1~~	~~10.1~~	~~2.0%~~	~~0.00~~	~~0.1~~
~~G2~~	~~87.6~~	~~2.0%~~	~~1.5~~	~~76.4~~
~~H1~~	~~166.5~~	~~2.0%~~	~~0.1~~	~~81.0~~
H2	111.1	2.0%	0.2	91.1
~~H3~~	~~118.9~~	~~2.0%~~	~~0.9~~	~~64.1~~
~~H4~~	~~63.3~~	~~2.0%~~	~~1.4~~	~~73.2~~
~~H5~~	~~53.2~~	~~2.0%~~	~~0.3~~	~~28.2~~
~~H6~~	~~87.6~~	~~2.0%~~	~~0.2~~	~~110.1~~
~~CH1~~	~~23.9~~	~~2.0%~~	~~5.4~~	~~21.0~~
CH2	84.2	2.0%	2.6	33.7
~~CH3~~	~~19.1~~	~~2.0%~~	~~0.1~~	~~6.5~~
Total	825.4	N/A	12.7	585.4

OFF-SITE BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	Q_5 (cfs)	Q_{100} (cfs)
OS1	0.59	2%	0.00	0.4
OS2	0.68	2%	0.00	0.5
OS3	3.56	2%	0.1	3.0
OS4	5.72	2%	0.1	4.5

DESIGN POINT SUMMARY TABLE

Tributary Sub-	Q_5 (cfs)	Q_{100} (cfs)
~~0.1~~	~~241.00~~	~~1017.0~~
~~0.2~~	~~-~~	~~451.0~~
~~0.3~~	~~-~~	~~120.0~~
~~1~~	~~6.9~~	~~1114.0~~
~~2~~	~~1.5~~	~~76.4~~
~~3~~	~~0.1~~	~~80.9~~
4	0.1	91.1
~~5~~	~~0.9~~	~~64.1~~
~~6~~	~~1.4~~	~~73.2~~
7	4.1	704.9
~~8~~	~~0.2~~	~~110.1~~
~~9~~	~~0.4~~	~~248.1~~

OFF-SITE BASIN SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
OS1	0.0	0.4
OS2	0.0	0.5
OS3	0.1	3.0
OS4	0.1	4.5

Add to design point summary table or rename this one to off-site design point summary

200 100 0 200 400

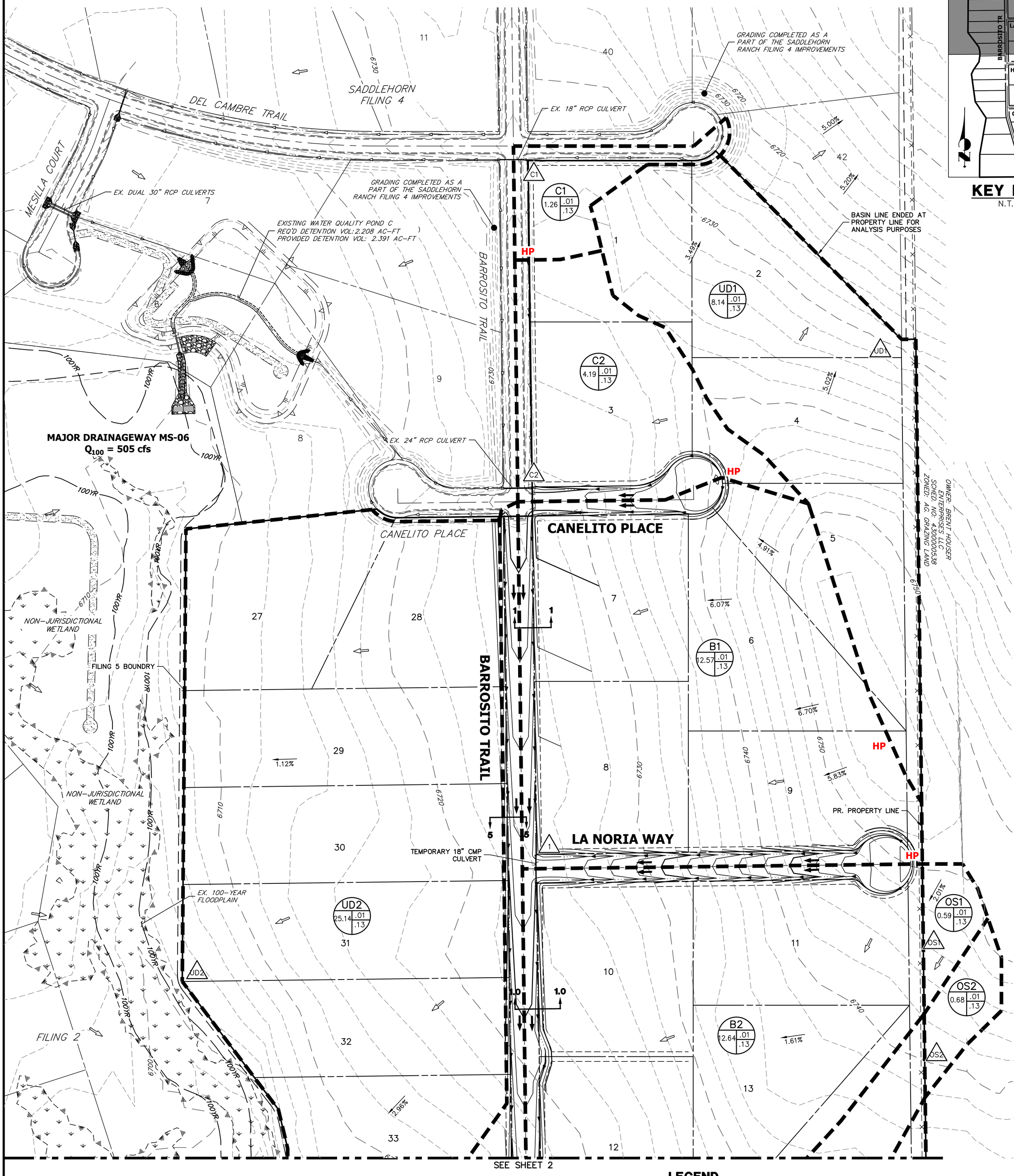
ORIGINAL SCALE: 1" = 200'

EXISTING CONDITIONS MAP
SADDLEHORN RANCH FILING 5
JOB NO. 25142.07
8/24/23
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

SADDLEHORN FILING 5 EARLY GRADING
PROPOSED DRAINAGE MAP



FILING 5 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.2	6.4
2	0.3	10.5
3	0.1	5.2
4	0.1	4.6
5	0.2	6.7
11	0.3	6.9
C1	0.02	0.8
C2	0.1	2.6
UD1	0.1	4.7
UD2	0.4	13.5
UD3	0.1	4.9
UD4	0.1	1.6
1.0	0.3	11.4
1.1	0.4	15.2
1.2	0.5	17.7
1.3	0.6	21.1
OS1	0.00	0.4
OS2	0.00	0.5
OS3	0.1	3.0
OS4	0.1	4.5

FILING 5 - SUB-BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	15.08	2%	0.01	0.13	39.0	0.3	6.9
B1	12.57	2%	0.01	0.13	31.2	0.2	6.4
B2	12.64	2%	0.01	0.13	11.4	0.3	10.5
B3	10.83	2%	0.01	0.13	34.3	0.1	5.2
B4	9.16	2%	0.01	0.13	32.1	0.1	4.6
B5	14.04	2%	0.01	0.13	35.1	0.2	6.7
C1	1.26	2%	0.01	0.13	19.7	0.02	0.8
C2	4.19	2%	0.01	0.13	22.1	0.1	2.6
UD1	8.14	2%	0.01	0.13	25.1	0.1	4.7
UD2	25.14	2%	0.01	0.13	28.9	0.4	13.5
UD3	11.03	2%	0.01	0.13	38.2	0.1	4.9
UD4	2.68	2%	0.01	0.13	25.8	0.1	1.5
OS1	0.59	2%	0.01	0.13	14.1	0.00	0.4
OS2	0.68	2%	0.01	0.13	16.6	0.00	0.5
OS3	3.56	2%	0.01	0.13	11.2	0.1	3.0
OS4	5.72	2%	0.01	0.13	13.3	0.1	4.5

LEGEND

- I.D. (A / B / C): BASIN DESIGNATION
  - I.D.: BASIN IDENTIFIER
  - A: BASIN AREA
  - B: C_5
  - C: C_{100}
- X: DESIGN POINT
- MAJOR BASIN DELINEATION
- SUB-BASIN DELINEATION
- 6700: EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 6700: PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- PROPOSED FLOW DIRECTION
- HP: PROPOSED HIGH POINT
- LP: PROPOSED LOW POINT
- WETLANDS HATCH
- SETBACK LINE

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

EARLY GRADING PROPOSED DRAINAGE MAP
SADDLEHORN RANCH FILING 5
JOB NO. 2514207
8/25/2023
SHEET 1 OF 3

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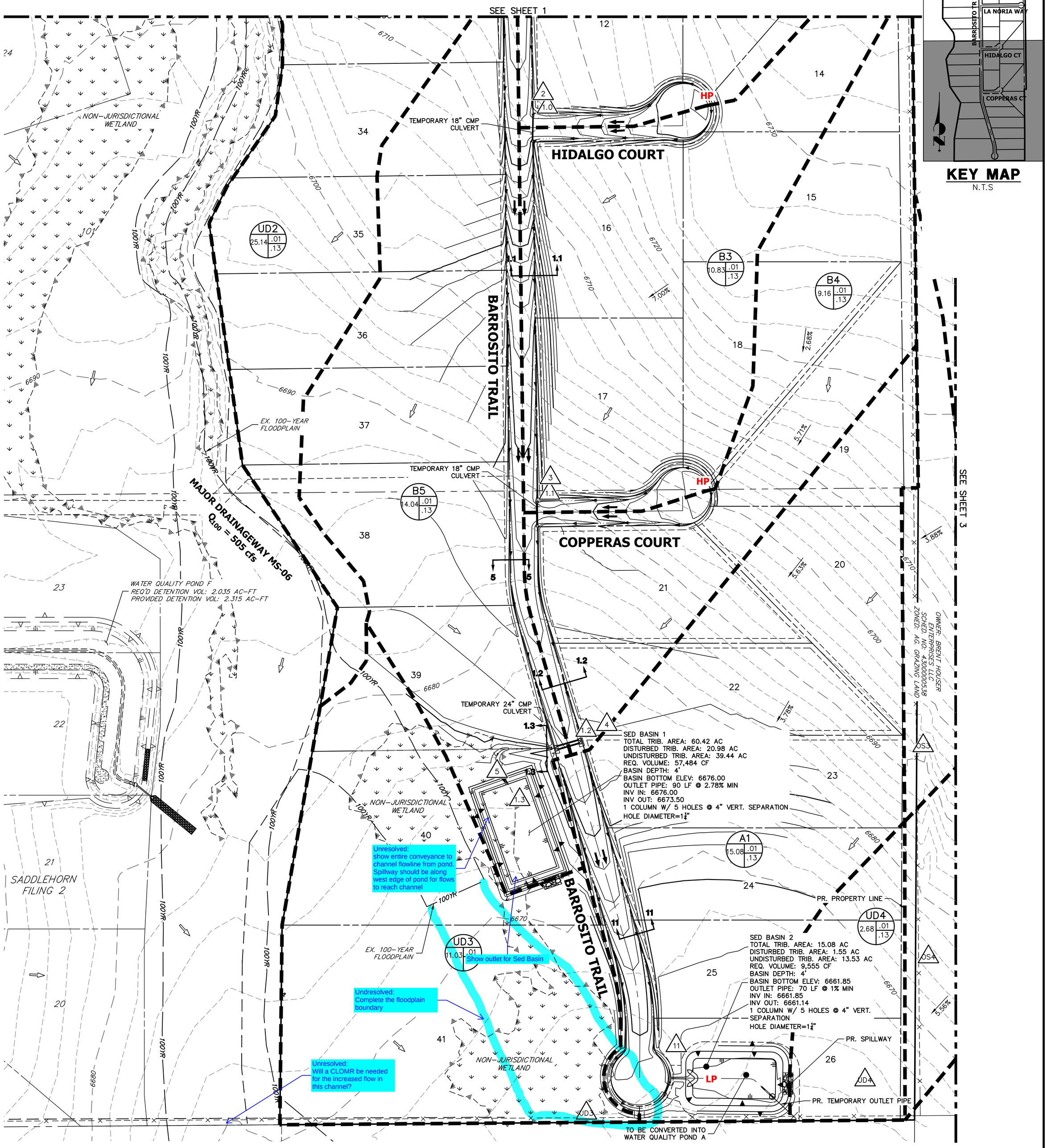
SADDLEHORN FILING 5 EARLY GRADING
PROPOSED DRAINAGE MAP



KEY MAP
N.T.S

FILING 5 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.2	6.4
2	0.3	10.5
3	0.1	5.2
4	0.1	4.6
5	0.2	6.7
11	0.3	6.9
C1	0.02	0.8
C2	0.1	2.6
UD1	0.1	4.7
UD2	0.4	13.5
UD3	0.1	4.9
UD4	0.1	1.6
1.0	0.3	11.4
1.1	0.4	15.2
1.2	0.5	17.7
1.3	0.6	21.1
OS1	0.00	0.4
OS2	0.00	0.5
OS3	0.1	3.0
OS4	0.1	4.5

FILING 5 - SUB-BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	15.08	2%	0.01	0.13	39.0	0.3	6.9
B1	12.57	2%	0.01	0.13	31.2	0.2	6.4
B2	12.64	2%	0.01	0.13	11.4	0.3	10.5
B3	10.83	2%	0.01	0.13	34.3	0.1	5.2
B4	9.16	2%	0.01	0.13	32.1	0.1	4.6
B5	14.04	2%	0.01	0.13	35.1	0.2	6.7
C1	1.26	2%	0.01	0.13	19.7	0.02	0.8
C2	4.19	2%	0.01	0.13	22.1	0.1	2.6
UD1	8.14	2%	0.01	0.13	25.1	0.1	4.7
UD2	25.14	2%	0.01	0.13	28.9	0.4	13.5
UD3	11.03	2%	0.01	0.13	38.2	0.1	4.9
UD4	2.68	2%	0.01	0.13	25.8	0.1	1.5
OS1	0.59	2%	0.01	0.13	14.1	0.00	0.4
OS2	0.68	2%	0.01	0.13	16.6	0.00	0.5
OS3	3.56	2%	0.01	0.13	11.2	0.1	3.0
OS4	5.72	2%	0.01	0.13	13.3	0.1	4.5

LEGEND

- I.D. (A / B / C) — BASIN DESIGNATION
  - I.D.: BASIN IDENTIFIER
  - A: BASIN AREA
  - B: C_5
  - C: C_{100}
- X — DESIGN POINT
- MAJOR BASIN DELINEATION
- SUB-BASIN DELINEATION
- 6700 — EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 6700 — PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- PROPOSED FLOW DIRECTION
- HP — PROPOSED HIGH POINT
- LP — PROPOSED LOW POINT
- WETLANDS HATCH
- SETBACK LINE

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

EARLY GRADING PROPOSED DRAINAGE MAP
SADDLEHORN RANCH FILING 5
JOB NO. 2514207
8/25/2023
SHEET 2 OF 3

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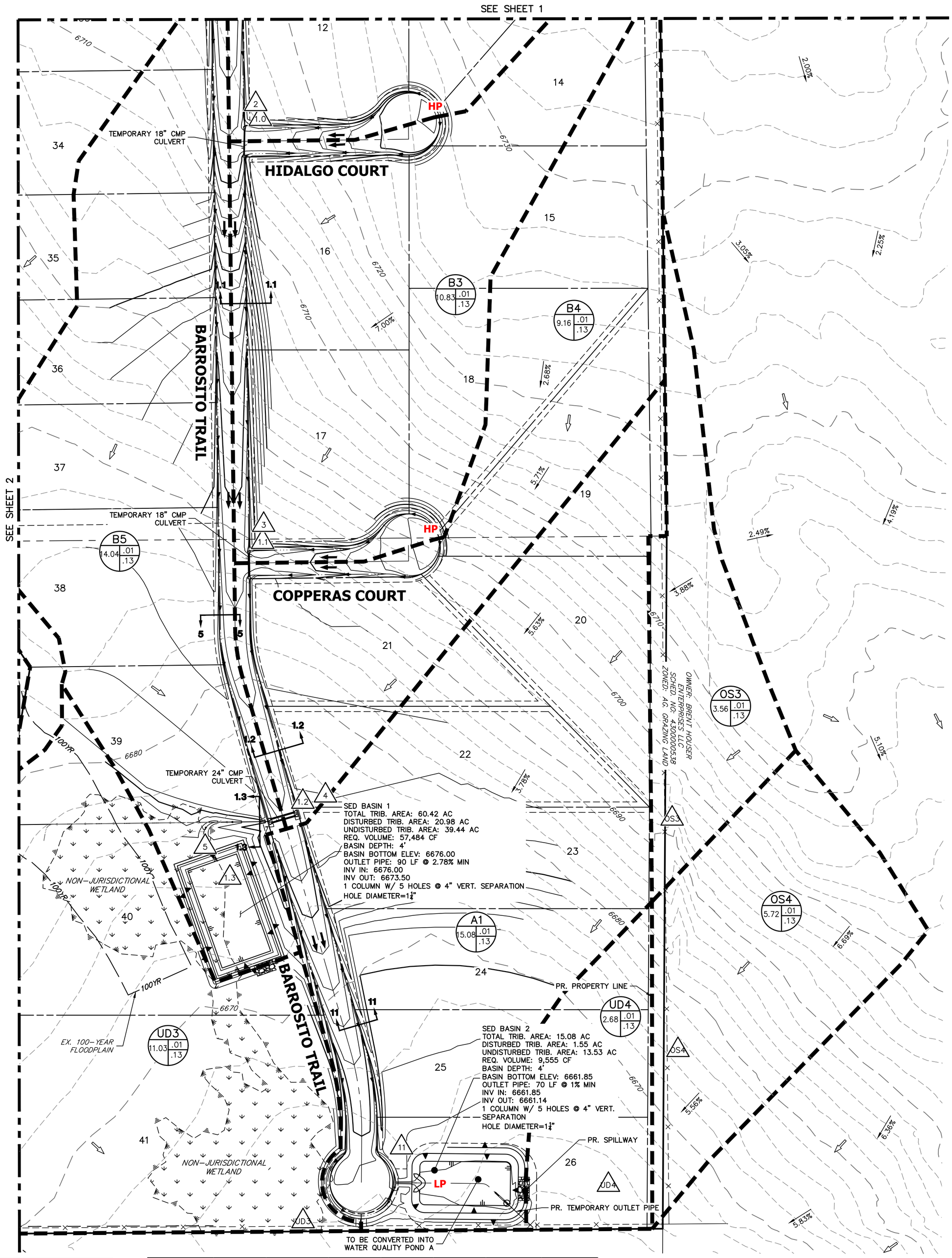
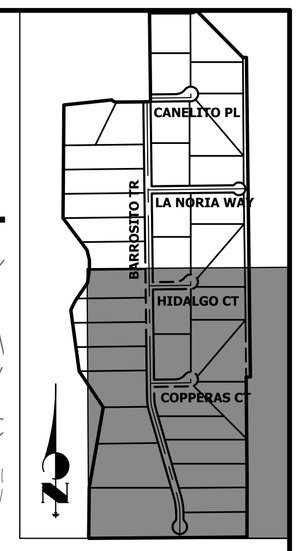
SADDLEHORN FILING 5 EARLY GRADING
PROPOSED DRAINAGE MAP





KEY MAP
N.T.S

FILING 5 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
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2	0.3	10.5
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4	0.1	4.6
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11	0.3	6.9
C1	0.02	0.8
C2	0.1	2.6
UD1	0.1	4.7
UD2	0.4	13.5
UD3	0.1	4.9
UD4	0.1	1.6
1.0	0.3	11.4
1.1	0.4	15.2
1.2	0.5	17.7
1.3	0.6	21.1
OS1	0.00	0.4
OS2	0.00	0.5
OS3	0.1	3.0
OS4	0.1	4.5

FILING 5 - SUB-BASIN SUMMARY TABLE

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B4	9.16	2%	0.01	0.13	32.1	0.1	4.6
B5	14.04	2%	0.01	0.13	35.1	0.2	6.7
C1	1.26	2%	0.01	0.13	19.7	0.02	0.8
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UD1	8.14	2%	0.01	0.13	25.1	0.1	4.7
UD2	25.14	2%	0.01	0.13	28.9	0.4	13.5
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UD4	2.68	2%	0.01	0.13	25.8	0.1	1.5
OS1	0.59	2%	0.01	0.13	14.1	0.00	0.4
OS2	0.68	2%	0.01	0.13	16.6	0.00	0.5
OS3	3.56	2%	0.01	0.13	11.2	0.1	3.0
OS4	5.72	2%	0.01	0.13	13.3	0.1	4.5

LEGEND

- I.D. (A / B / C): BASIN DESIGNATION — I.D.: BASIN IDENTIFIER; A: BASIN AREA; B: C_5; C: C_{100}
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- PROPOSED FLOW DIRECTION
- HP: PROPOSED HIGH POINT
- LP: PROPOSED LOW POINT
- WETLANDS HATCH
- SETBACK LINE

N

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

EARLY GRADING PROPOSED DRAINAGE MAP
SADDLEHORN RANCH FILING 5
JOB NO. 2514207
8/25/2023
SHEET 3 OF 3

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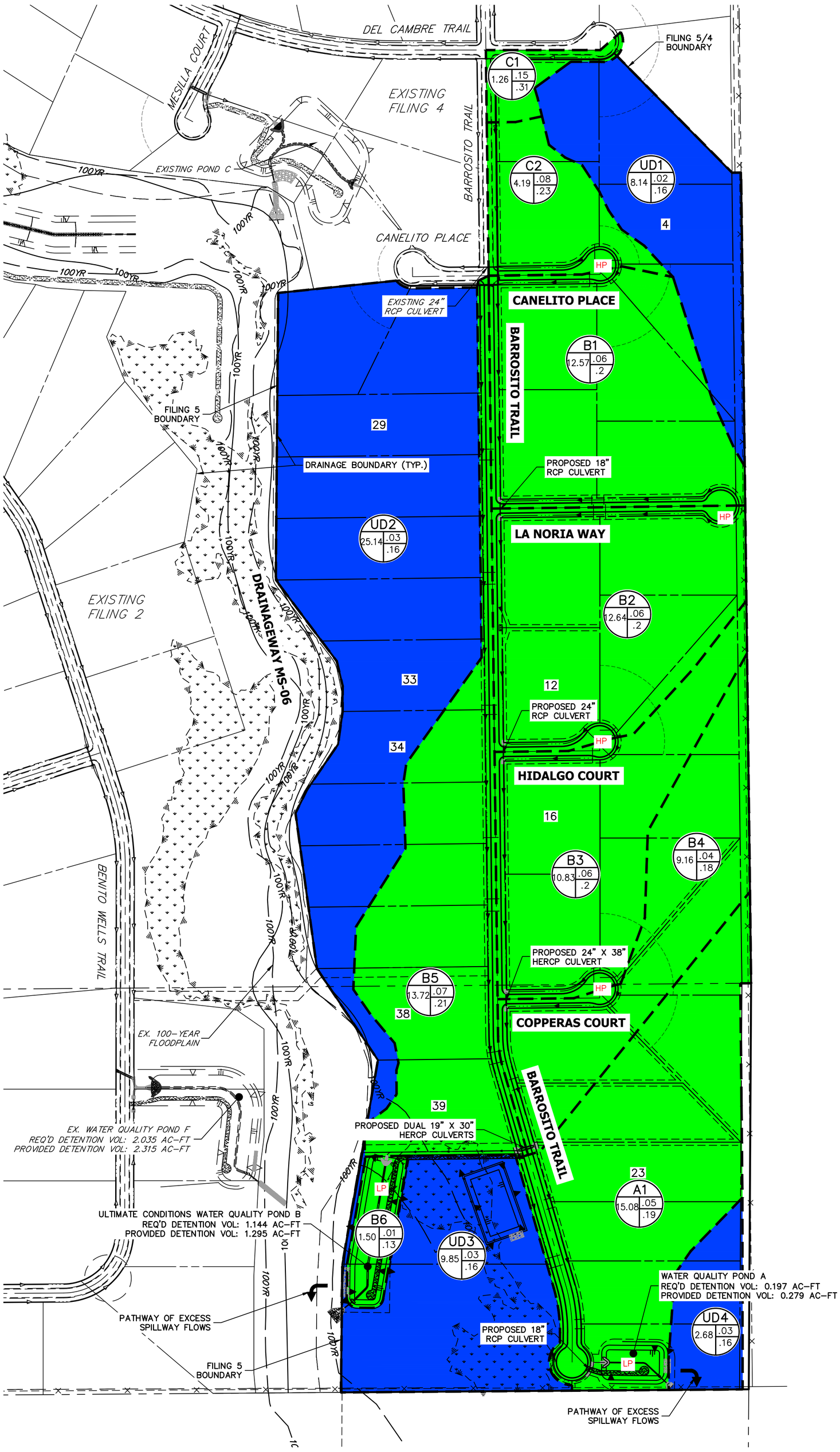
SADDLEHORN RANCH - FILING 5
PERMANENT APPLICABILITY MAP



LEGEND

- BASIN DELINEATION
- 6100 EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 6100 PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- HP PROPOSED HIGH POINT
- LP PROPOSED LOW POINT
- AREA DETAINED IN PBMP
- AREA NOT DETAINED IN PBMP PER SECTION I.7.1.B.5 (RURAL 2.5+ ACRE LOTS W/ IMPERVIOUSNESS < 10%)

N

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

MS4 PERMIT EXCULSION AREAS
SADDLEHORN RANCH FILING 5
JOB NO. 25142.07
5/02/2023
SHEET 1 OF 1

FOR INFORMATION ONLY

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