The North Ranch Subdivision

Final Drainage Report

PCD File No: SF2622

All Terrain Engineering Project No: 26001

August 2026

Prepared for:

The North Ranch LLC

Attn: Robert Myers

rob@myerscompany.biz

Prepared by:

All Terrain Engineering LLC

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ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

To be provided on final submittal

Nicholas Q. Jokerst, PE Date

State of Colorado No. 59273

For and on behalf of All Terrain Engineering LLC

DEVELOPER'S STATEMENT

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

To be provided on final submittal

Robert Myers Date

The North Ranch LLC

EL PASO COUNTY ONLY

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

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

Conditions:

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I. General Purpose, Location & Description

a. Purpose & Project Description

The purpose of the Final Drainage Report (FDR) for The North Ranch Subdivision is to describe the site's onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate outfalls.

b. Location

The North Ranch Subdivision, referred to as 'the site' herein, is parcel of land being portions of the Southeast Quarter of Section 15 and the East half of the Northwest quarter and the Northeast quarter of the Southwest quarter of Section 22, Township 11 South, Range 66 West of the 6th P.M. The site is bound by Highway 83 to the west, Walden III to the north, east and south. A vicinity map is presented in Appendix A.

c. Description of Property

d. The site is an existing, 48.22 acre parcel. The project will subdivide the site into (15) 2.5 acre lots and (2) tracts that will remain undeveloped. The existing property is occupied with (2) residential homes, (1) barn, and gravel driveways to each structure.

In general, the site slopes north and west towards Highway 83. Onsite elevations range from 7390' – 7470' with approximate slopes ranging 1 – 33%. Per an NRCS soil survey, the site is made up of Type A Ellicott loamy coarse sand, Type B Tomah-Crowfoot loamy sands and Type B Elbeth sandy loam. On-site, existing utilities include gas, fiberoptic, well & septic. An existing drainage map is presented in Appendix F.

The ultimate receiving waters for the site are West Cherry Creek.

e. Floodplain Statement

Based on FEMA Firm map 08041C0285G dated December 7, 2018, the site is Zone X. Zone X are areas determined to be outside the 0.2% annual chance flood hazard.

II. Drainage Basins

a. Major Basin Description

The site is located within the West Cherry Creek Drainage Basin. At the time of this FDR, West Cherry Creek does not have a published Drainage Basin Planning Study.

b. Existing Basin Descriptions

The existing site's drainage patterns are north and west. The site is divided into 10 existing drainage basins.

Basin EX1 is 5.05 acres of existing 5 acre lots, Needles Drive and undeveloped area. Basin EX1 stormwater (Q_5 = 2.0 cfs Q_{100} = 8.3 cfs) is captured in Needles Drive roadside ditch and conveyed to DP1 (Q_5 = 2.0 cfs Q_{100} = 8.3 cfs). DP1 follows historic drainage patterns to an existing 84" CMP culvert that conveys flow under Highway 83.

Basin EX2 is 34.20 acres of existing 5 acre lots, Highway 83 and undeveloped area. Basin EX2 stormwater (Q_5 = 7.0 cfs Q_{100} = 36.3 cfs) flows through multiple existing drainages towards DP2 (Q_5 = 5.7 cfs Q_{100} = 31.9 cfs). DP2 conveys the flow under Highway 83 towards DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs).

does not match summary table and map

Basin EX3 is 38.06 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX3 stormwater (Q_5 = 7.0 cfs Q_{100} = 36.3 cfs) flows through multiple existing drainages and an ex 24" CMP culvert under Pinehurst Circle to a 24" CMP culvert at DP3 (Q_5 = 12.5 cfs Q_{100} = 65.5 cfs). DP3 conveys the flow under Highway 83 towards DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs).

Basin EX4 is 3.15 acres of existing 5 acre lots and Pinehurst Circle. Basin EX4 stormwater (Q_5 = 1.6 cfs Q_{100} = 7.3 cfs) flows to an existing 24" CMP culvert under Pinehurst Circle. Basin EX4 flows continue to DP7 (Q_5 = 4.2 cfs Q_{100} = 21.4 cfs).

label as DP4

Basin EX5 is 3.21 acres of existing 5 acre lots and Pinehurst Circle. Basin EX5 stormwater (Q_5 = 1.5 cfs Q_{100} = 7.1 cfs) flows to an existing low point on the north side of Pinehurst Circle. Based upon field observation, there is no culvert at this low point. Basin EX5 stormwater is assumed to overtop Pinehurst Circle and continue towards DP7 (Q_5 = 4.2 cfs Q_{100} = 21.4 cfs).

include DP5

Basin EX6 is 8.30 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX6 stormwater (Q_5 = 2.5 cfs Q_{100} = 13.5 cfs) flows through multiple drainages to an existing 24" CMP culvert at DP6 (Q_5 = 2.5 cfs Q_{100} = 13.5 cfs). DP6 conveys the flow under Highway 83 towards DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs).

Basin EX6.1 is 14.10 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX6.1 stormwater (Q_5 = 4.4 cfs Q_{100} = 23.4 cfs) flows through multiple drainages to Highway 83 swale and combines with DP4 and DP5 flow at DP7 (Q_5 = 4.2 cfs Q_{100} = 21.4 cfs). DP7 continues north in the Highway 83 swale to DP8 (Q_5 = 8.4 cfs Q_{100} = 44.2 cfs).

Basin EX7 is 22.13 acres of existing 5 acre lots, Pinehurst Circle, Highway 83 and undeveloped area. Basin EX7 stormwater (Q_5 = 6.0 cfs Q_{100} = 32.3 cfs) flows through multiple drainages to DP8 (Q_5 = 8.4 cfs Q_{100} = 44.2 cfs) and combines with DP7 flow. DP8 is conveyed west under Highway 83 in an existing 24" CMP culvert towards DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs).

Basin EX8 is 16.60 acres of existing 5 acre lots, Highway 83, existing structures and undeveloped area. Basin EX8 stormwater (Q_5 = 4.3 cfs Q_{100} = 23.5 cfs) flows through a variety of drainageways to DP9 (Q_5 = 4.3 cfs Q_{100} = 23.5 cfs). DP9 continues north in the Highway 83 swale to DP10 (Q_5 = 7.2 cfs Q_{100} = 40.8 cfs).

Basin EX9 is 15.65 acres of existing 5 acre lots, Highway 83 and undeveloped area. Basin EX9 stormwater (Q_5 = 3.7 cfs Q_{100} = 21.5 cfs) flows in multiple drainages to DP10 (Q_5 = 7.2 cfs Q_{100} = 40.8 cfs). DP10 continues north in the Highway 83 swale and eventually conveyed west under Highway 83 in an offsite culvert to DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs). DP11 represents the site's total stormwater discharge to West Cherry Creek.

c. Proposed Basin Descriptions

please list exemptions for stormwater if the basin is not being treated by the pond

The proposed site's drainage patterns are north and west. The site is divided into 16 proposed drainage basins. All proposed storm sewer infrastructure will be privately owned and maintained by the developments HOA. Refer to Appendix B for a composite impervious analysis for the proposed 2.5 acre lot areas. Refer to Appendix C for culvert and swale hydraulic performance calculations. Refer to Appendix E for site photographs of existing swales, culvert and culvert outfall locations.

Basin 1 is 4.85 acres of existing 5 acre lots, Needles Drive, proposed roadway and undeveloped area. Basin 1 stormwater (Q_5 = 1.8 cfs Q_{100} = 7.7 cfs) is captured in the Needles Drive swale/proposed private road swale and conveyed to DPA (Q_5 = 1.8 cfs Q_{100} = 7.7 cfs). DPA is conveyed under the proposed private road in an 18" CMP culvert towards DPB (Q_5 = 2.5 cfs Q_{100} = 9.7 cfs).

Basin 2 is 1.10 acres of proposed roadway and undeveloped area. Basin 2 stormwater (Q_5 = 1.7 cfs Q_{100} = 4.7 cfs) is captured in the proposed private road swale and conveyed to DPB (Q_5 = 2.5 cfs Q_{100} = 9.7 cfs). At DPB, an existing 84" CMP culvert conveys the flow under Highway 83 to its historic outfall in West Cherry Creek. The proposed flow at DPB (Q_5 = 2.5 cfs Q_{100} = 9.7 cfs) is a slight increase compared to the flow at existing DP1 (Q_5 = 2.0 cfs Q_{100} = 8.3 cfs). Therefore, the existing 84" culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPB continues north in West Cherry Creek towards DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs).

Basin 3 is 29.67 acres of existing 5 acre lots, proposed 2.5 acre lots, Highway 83 and undeveloped area. Basin 3 stormwater (Q_5 = 3.1 cfs Q_{100} = 31.9 cfs) flows through multiple existing drainages, to the proposed roadside swale and towards DPC (Q_5 = 5.7 cfs Q_{100} = 31.3 cfs). At DPC, a proposed 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPE (Q_5 = 6.4 cfs Q_{100} = 33.8 cfs). The proposed flow at DPE (Q_5 = 6.4 cfs Q_{100} = 33.8 cfs) is a slight increase compared to the flow at existing DP2 (Q_5 = 5.7 cfs Q_{100} = 31.9 cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPE continues north in West Cherry Creek towards DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs).

pipe overtops at DPE, please include suggestions for modification to improve the condition.

Basin 4 is 2.56 acres of proposed roadway and swale. Basin 4 stormwater (Q_5 = 5.1 cfs Q_{100} = 10.5 cfs) is captured in the proposed, private road swale and conveyed to DPD (Q_5 = 5.1 cfs Q_{100} = 10.5 cfs). DPD continues north to DPN (Q_5 = 4.8 cfs Q_{100} = 9.9 cfs).

please include the final outfall of Basin 4

Basin 5 is 2.83 acres of Highway 83 and undeveloped/swale area. Basin 5 stormwater (Q_5 = 1.6 cfs Q_{100} =5.8 cfs) is captured in the Highway 83 swale and conveyed to DPE (Q_5 = 6.4 cfs Q_{100} = 33.8 cfs). Refer to Basin 3 for DPE details.

Basin 5.1 is 0.94 acres of Highway 83 and undeveloped/swale area. Basin 5.1 stormwater (Q_5 = 0.6 cfs Q_{100} = 2.2 cfs) is captured in the Highway 83 swale and conveyed to DPG (Q_5 = 8.7 cfs Q_{100} = 42.6 cfs). Refer to Basin 6 for DPG details.

Basin 5.2 is 0.88 acres of Highway 83 and undeveloped/swale area. Basin 5.2 stormwater (Q_5 = 0.5 cfs Q_{100} = 2.0 cfs) is captured in the Highway 83 swale and conveyed to DPI (Q_5 = 8.7 cfs Q_{100} = 42.6 cfs). Refer to Basin 7 for DPI details.

does not match flow in summary table

Basin 6 is 36.64 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 6 stormwater (Q_5 = 8.9 cfs Q_{100} = 43.9 cfs) flows through multiple existing drainages, an existing 24" CMP culvert and to the proposed roadside swale at DPF (Q_5 = 8.9 cfs Q_{100} = 43.9 cfs). At DPF, a dual 24" RCP culverts convey the flow under the private roadway to its historic outfall at DPG (Q_5 = 8.7 cfs Q_{100} = 42.6 cfs). The proposed flow at DPG (Q_5 = 6.4 cfs Q_{100} = 33.8 cfs) is decreased compared to the flow at existing DP3 (Q_5 = 12.5 cfs Q_{100} = 65.5 cfs). Therefore, the existing 24" CMP culvert will continue to perform in its existing condition. Refer to Appendix C for culvert performance calculations. DPG conveys flow under Highway 83 and continues north in West Cherry Creek towards DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs).

pipe overtops at DPG, please include suggestions for modification to improve the condition.

Basin 7 is 7.05 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 7 stormwater (Q_5 = 2.6 cfs Q_{100} = 13.6 cfs) flows through multiple existing drainages to the proposed roadside swale at DPH (Q_5 = 2.6 cfs Q_{100} = 13.6 cfs). At DPH, a 24" CMP culvert conveys the flow under the private roadway to its historic outfall at DPI (Q_5 = 2.9 cfs Q_{100} = 14.6 cfs). The proposed flow at DPI (Q_5 = 2.9 cfs Q_{100} = 14.6 cfs) is a minor increase compared to the flow at existing DP6 (Q_5 = 2.5 cfs Q_{100} = 13.5 cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPI continues north in West Cherry Creek towards DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs).

for the minor increase, state that this flow will not cause any issues to the existing conditions

Basin 7.1 is 12.19 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 7.1 stormwater (Q_5 = 3.5 cfs Q_{100} = 18.6 cfs) flows through multiple existing drainages to the proposed roadside swale and combines with DPJ (Q_5 = 1.6 cfs Q_{100} = 7.3 cfs) and DPK (Q_5 = 1.5 cfs Q_{100} = 7.1 cfs) flow at DPL (Q_5 = 5.5 cfs Q_{100} = 27.5 cfs). At DPL, a 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPO (Q_5 = 10.6 cfs Q_{100} = 53.0 cfs). At DPO, an existing 24" CMP culvert conveys the flow under Highway 83 to West Cherry Creek. The proposed flow at DPO (Q_5 = 10.6 cfs Q_{100} = 53.0 cfs) demonstrates an increase compared to the flow at existing DP8 (Q_5 = 8.4 cfs Q_{100} = 44.2 cfs). Therefore, the existing 24" CMP culvert capacity has been verified with the additional site discharge. Refer to Appendix C for culvert performance calculations. DPO continues north in West Cherry Creek towards DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs).

this increase is too significant to continue, please revise

Basin 8 is 20.47 acres of existing 5 acre lots, proposed 2.5 acre lots, and Pinehurst Circle. Basin 8 stormwater (Q_5 = 5.9 cfs Q_{100} = 31.3 cfs) flows through multiple existing drainages to the proposed roadside swale at DPM (Q_5 = 5.9 cfs Q_{100} = 31.3 cfs). At DPM, a 30" CMP culvert conveys the flow under the private roadway to its historic outfall at DPO (Q_5 = 10.6 cfs Q_{100} = 53.0 cfs). At DPO, an existing 24" CMP culvert conveys the flow under Highway 83 to West Cherry Creek. Refer to Basin 7.1 for DPO details.

Basin 9 is 0.37 acres of proposed roadway and swale. Basin 9 stormwater (Q_5 = 1.1 cfs Q_{100} = 2.3 cfs) is captured in the proposed, private road swale and combines with DPD flow at DPN (Q_5 = 4.8 cfs Q_{100} = 9.9 cfs). DPN is conveyed to Pond 1 in an 18" CMP culvert.

pipe overtops at DPO, please include suggestions for modification to improve the condition.

superelevation will require a deviation to be submitted with full justification and exhibits. keep in mind that the deviation may not be granted.

Basin 10 is 2.40 acres of Highway 83, emergency access road and undeveloped/swale area. Basin 10 stormwater (Q_5 = 1.5 cfs Q_{100} = 5.3 cfs) is captured in the Highway 83 swale and conveyed to DPO (Q_5 = 10.6 cfs Q_{100} = 53.0 cfs). Refer to Basin 7.1 for DPO details.
Basin 11 is 17.97 acres of existing 5 acre lots and proposed 2.5 acre lots. Basin 11 stormwater (Q_5 = 5.0 cfs Q_{100} = 27.4 cfs) flows through multiple existing drainages to the proposed roadside swale at DPP (Q_5 = 5.0 cfs Q_{100} = 27.4 cfs). At DPP, a 24" CMP culvert conveys the flow under the private roadway to Pond 1.

Basin 12 is 1.29 acres of proposed roadway and swale. Basin 12 stormwater (Q_5 = 2.1 cfs Q_{100} = 4.9 cfs) is captured in the proposed, private road swale at DPQ (Q_5 = 4.8 cfs Q_{100} = 9.9 cfs) and discharges to Pond 1.

Basin 13 is 1.63 acres of proposed roadway, undeveloped area and Pond 1. Basin 13 stormwater (Q_5 = 2.6 cfs Q_{100} = 6.6 cfs) discharges to Pond 1. The proposed, private roadway is superelevated towards Pond 1 to direct Basin 13 stormwater directly to Pond 1. Due to the existing AT&T fiber optic line between the proposed, private road and Pond 1, a swale cannot be constructed due to cut limitations over the fiber optic line.

fiber line may need to be relocated deeper

Basin 14 is 0.96 acres of Highway 83, emergency access road and undeveloped/swale area. Basin 14 stormwater (Q_5 = 0.6 cfs Q_{100} = 2.0 cfs) is captured in the Highway 83 swale, combines with Pond 1 discharge and is conveyed to DPS (Q_5 = 0.9 cfs Q_{100} = 23.1 cfs). DPS continues north in the Highway 83 swale to DPT (Q_5 = 3.7 cfs Q_{100} = 31.0 cfs).

Basin 15 is 10.29 acres of existing 5 acre lots, proposed 2.5 acre lots, and Highway 83. Basin 15 stormwater (Q_5 = 2.8 cfs Q_{100} = 14.0 cfs) flows through multiple existing drainages to the Highway 83 swale and combines with DPS (Q_5 = 0.9 cfs Q_{100} = 23.1 cfs) at DPT (Q_5 = 3.7 cfs Q_{100} = 31.0 cfs). At DPT, flow continues north in the Highway 83 swale before eventually discharging under Highway 83 in offsite culverts to the north. The proposed flow at DPT (Q_5 = 3.7 cfs Q_{100} = 31.0 cfs) demonstrates a decrease in flow compared to existing DP10 (Q_5 = 7.2 cfs Q_{100} = 40.8 cfs). Therefore, the offsite culverts to the north will continue to function in their existing condition. DPU (Q_5 = 35.1 cfs Q_{100} = 184.7 cfs) represents the site's total proposed stormwater discharge to West Cherry Creek. DPU total flow is a reduction compared to the site's existing discharge at DP11 (Q_5 = 32.9 cfs Q_{100} = 189.1 cfs).

Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis follows the criteria from the "Drainage Criteria Manual County of El Paso, Colorado" Volumes 1 and 2," as amended.

b. Hydrologic Criteria

Onsite drainage analysis included the 5-year storm (minor event) and 100-year storm (major event). Runoff is calculated per EPCDCM Chapter 5 – Storm Runoff Method of Analysis and Volume 1 Update Chapter 6 – Hydrology.

d. Hydraulic Criteria

Hydraulic criteria for channel analysis are obtained from EPCDCM Chapter 9 – Culvert Design and Chapter 10 - Open Channels and Structures.

III. Drainage Facility Design

a. General Concept

The proposed site will be subdivided into 2.5+ acre lots served by a paved, private roadway. A secondary emergency access to the site is provided from Highway 83 at the location of the existing site's driveway access. A portion of the site and offsite, tributary areas will be passed through the site to their historic outfalls along Highway 83. The remaining portion of the site and tributary, offsite areas will be captured in the proposed, private roadside swales and conveyed to Pond 1. Pond 1 is a full spectrum, water quality and detention pond. Due to the on-site detention provided by Pond 1, the developed site results in a reduction in total stormwater discharged to West Cherry Creek. Existing culverts along Highway 83 will require removal of sediment in conjunction with this project to ensure the long-term functionality and to maintain historic drainage patterns.

please restate that pond 1 is private here

b. Water Quality & Detention

Water quality and detention for Basins 4, 9 and 11-13 is provided in Pond 1. Pond 1 is an onsite, private, full spectrum detention pond located along adjacent to Highway 83. A total of 23.82 acres at 29.2% composite imperviousness will be detained. The WQCV is 0.296 ac-ft, the EURV is 0.417 ac-ft, and the 100-year volume is 0.844 ac-ft. The WQCV, EURV and 100-year storms are released in 40, 61 and 60 hours, respectively. The 100-year pond discharge has been reduced to 60% of predevelopment levels. There are two concentrated flow outfalls into the pond. A concrete forebay is located at the piped outfall into the pond and riprap forebay with concrete bottom is located at the swale discharge location. A 2.0' concrete trickle channel conveys flow towards the private outlet structure. A 10' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance. A 20' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard towards the Highway 83 swale. The spillway and downstream outfall will be lined with Type L riprap. The pond outlet structure discharges into private, 30" RCP storm sewer that discharges to the Highway 83 swale. Pond design calculations are presented in Appendix D.

c. Inspections & Maintenance

An Inspection and Maintenance Manual will be provided in conjunction with construction drawing submittals.

d. Grading & Erosion Control Plan

A Grading & Erosion Control Plan will be provided in conju

Maintenance roadway to be a 15-foot minimum at a max of 12% slope. It may be acceptable to design the access road with a narrower width and greater slope if the anticipated maintenance vehicles can still safely access the pond and reach structures. Properly document this in the Pond O&M manual.

e. Four Step Method

Step 1 – Employ Runoff Reduction Practices: Existing roof drains discharge to undeveloped areas. Stormwater overland flows through landscaping and open space which will help slow runoff and increase infiltration. Additionally, concentrated stormwater is conveyed in grass lined road side swales. Swales help reduce stormwater velocities and allow for infiltration compared to storm sewer.

Step 2 – Stabilize Drainageways: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization with the drainage basin. Refer to Section F for drainage basin fee calculations.

Step 3 – Provide WQCV: Water quality treatment is provided for the site in Pond 1. The water quality volume will be captured and released over a period of 40 hours.

Step 4 – Consider the need for source controls: No industrial uses are proposed within this development and therefore no source controls are proposed.

f. Drainage Basin & Bridge Fees

The site is within the West Cherry Creek Drainage Basin. Based upon the 2026 El Paso County Drainage Basin Fee schedule, West Cherry Creek does not have an associated drainage or bridge fee.

g. Engineer's Opinion of Probable Cost

An El Paso County 2026 Financial Assurance Estimate will be provided in conjunction with construction drawing submittals.

IV. Summary

The North Ranch Subdivision remains consistent with pre-development drainage conditions. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments as the development reduces the peak stormwater discharges from the site. This report is in accordance with the latest El Paso County Drainage criteria.

V. References

1. El Paso County – Drainage Criteria Manual, 2018 as amended.
2. Urban Storm Drainage Criteria Manual, Mile High Flood District, March 2024.
3. Federal Emergency Management Agency, Flood Map Service Center - https://msc.fema.gov/portal/home, September 2024.
4. Web Soil Survey, Natural Resources Conservation Service - https://websoilsurvey.nrcs.usda.gov/app/, September 2024.

Please provide a basic overview map (or modify an existing drainage map) with color shading/hatching that shows the areas tributary to the pond and excluded areas. Alternatively a summary table displaying the same information would help provide clarity.

APPENDIX A – VICINITY MAP, FEMA MAP, NRCS WEB SOIL SURVEY

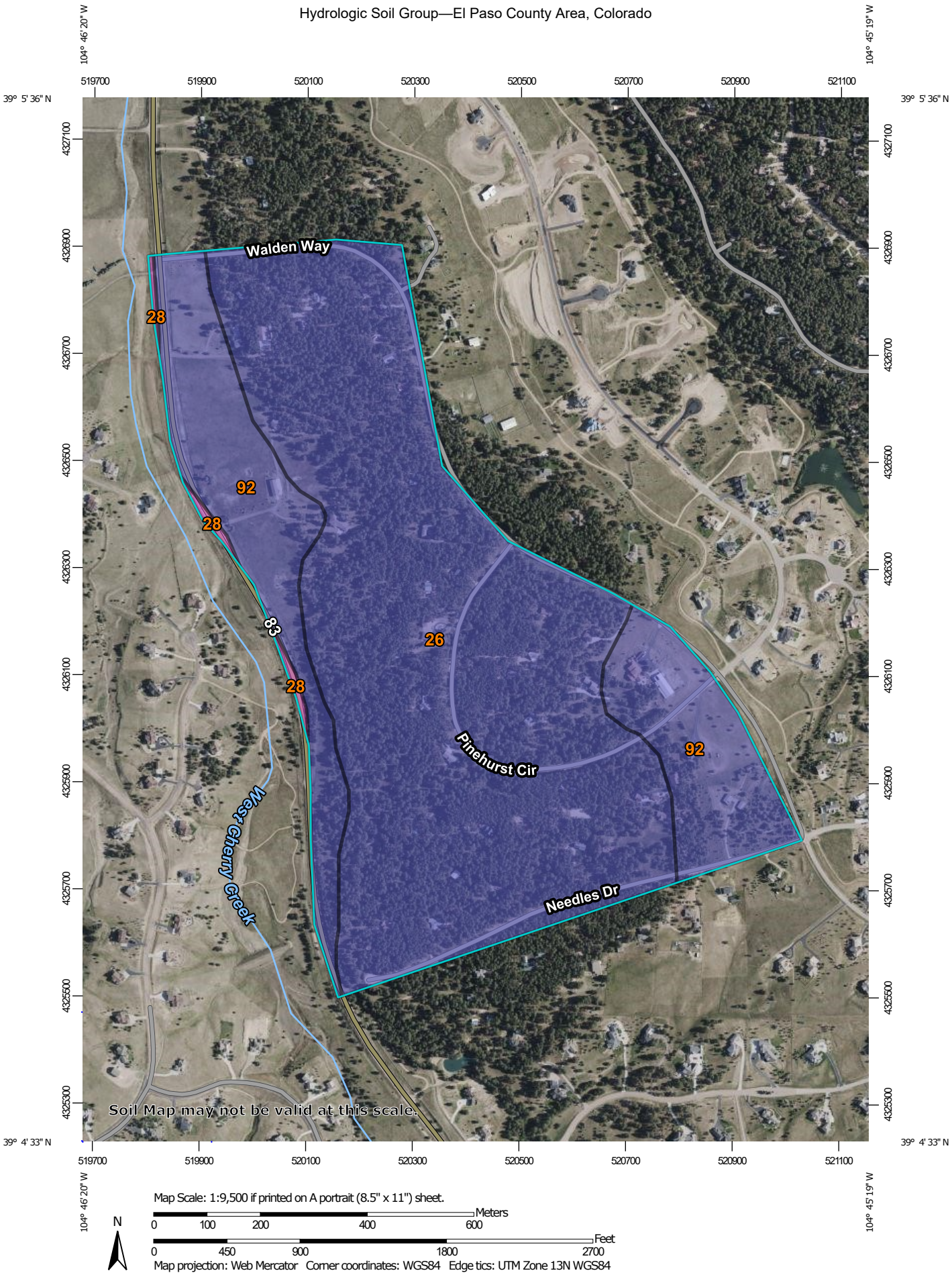
NEEDLES SUBDIVSION

VICINITY MAP



VICINITY MAP	
NEEDLES SUBDIVSION	
JOB NO. 26001	
LOCATION: EPC	SHEET 1
08/26/2062	

ALL TERRAIN ENGINEERING
1004 WEST VAN BUREN STREET
COLORADO SPRINGS, CO 80907



Map Scale: 1:9,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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
26	Elbeth sandy loam, 8 to 15 percent slopes	B	154.4	73.3%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	1.4	0.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	54.9	26.1%
Totals for Area of Interest			**210.7**	**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

National Flood Hazard Layer FIRMette

FEMA

104°46'23"W 39°5'23"N



104°45'46"W 39°4'55"N

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/22/2026 at 7:56 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 39.084°, Longitude: -104.7665°
Elevation: 7442 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.235** (0.194-0.287)	**0.288** (0.237-0.351)	**0.379** (0.311-0.464)	**0.460** (0.375-0.565)	**0.577** (0.456-0.737)	**0.672** (0.517-0.868)	**0.772** (0.573-1.02)	**0.879** (0.623-1.19)	**1.03** (0.698-1.42)	**1.14** (0.755-1.60)
10-min	**0.344** (0.284-0.420)	**0.422** (0.347-0.515)	**0.556** (0.456-0.680)	**0.673** (0.549-0.827)	**0.845** (0.668-1.08)	**0.985** (0.758-1.27)	**1.13** (0.839-1.49)	**1.29** (0.913-1.74)	**1.50** (1.02-2.08)	**1.67** (1.11-2.34)
15-min	**0.420** (0.346-0.512)	**0.514** (0.423-0.628)	**0.678** (0.556-0.829)	**0.821** (0.669-1.01)	**1.03** (0.814-1.32)	**1.20** (0.924-1.55)	**1.38** (1.02-1.82)	**1.57** (1.11-2.12)	**1.83** (1.25-2.54)	**2.04** (1.35-2.85)
30-min	**0.603** (0.497-0.736)	**0.738** (0.607-0.900)	**0.970** (0.796-1.19)	**1.18** (0.958-1.44)	**1.47** (1.16-1.88)	**1.72** (1.32-2.22)	**1.97** (1.46-2.60)	**2.24** (1.59-3.03)	**2.62** (1.78-3.63)	**2.92** (1.93-4.08)
60-min	**0.768** (0.633-0.936)	**0.926** (0.762-1.13)	**1.21** (0.991-1.48)	**1.46** (1.19-1.80)	**1.85** (1.47-2.38)	**2.17** (1.68-2.82)	**2.52** (1.87-3.34)	**2.89** (2.06-3.92)	**3.42** (2.33-4.75)	**3.85** (2.54-5.38)
2-hr	**0.932** (0.772-1.13)	**1.11** (0.922-1.35)	**1.45** (1.19-1.76)	**1.76** (1.44-2.14)	**2.23** (1.78-2.86)	**2.63** (2.04-3.40)	**3.06** (2.30-4.04)	**3.54** (2.54-4.78)	**4.22** (2.90-5.83)	**4.77** (3.17-6.63)
3-hr	**1.02** (0.848-1.23)	**1.20** (1.00-1.45)	**1.55** (1.28-1.88)	**1.88** (1.55-2.29)	**2.40** (1.94-3.08)	**2.86** (2.23-3.68)	**3.35** (2.52-4.42)	**3.90** (2.81-5.26)	**4.69** (3.24-6.48)	**5.34** (3.57-7.40)
6-hr	**1.20** (1.00-1.43)	**1.39** (1.16-1.67)	**1.77** (1.47-2.12)	**2.14** (1.77-2.58)	**2.74** (2.23-3.50)	**3.27** (2.58-4.20)	**3.86** (2.93-5.07)	**4.52** (3.28-6.07)	**5.48** (3.82-7.53)	**6.28** (4.22-8.64)
12-hr	**1.42** (1.19-1.69)	**1.64** (1.38-1.95)	**2.07** (1.73-2.47)	**2.49** (2.07-2.98)	**3.17** (2.59-4.02)	**3.76** (2.98-4.80)	**4.42** (3.38-5.76)	**5.16** (3.77-6.88)	**6.24** (4.37-8.52)	**7.14** (4.83-9.75)
24-hr	**1.68** (1.42-1.98)	**1.96** (1.65-2.32)	**2.48** (2.08-2.94)	**2.97** (2.48-3.53)	**3.72** (3.04-4.66)	**4.37** (3.47-5.51)	**5.08** (3.89-6.54)	**5.86** (4.29-7.72)	**6.97** (4.91-9.42)	**7.89** (5.37-10.7)
2-day	**1.96** (1.67-2.30)	**2.33** (1.97-2.73)	**2.97** (2.51-3.49)	**3.54** (2.97-4.17)	**4.38** (3.58-5.39)	**5.08** (4.04-6.31)	**5.81** (4.46-7.39)	**6.60** (4.86-8.61)	**7.71** (5.45-10.3)	**8.60** (5.89-11.6)
3-day	**2.16** (1.83-2.51)	**2.55** (2.17-2.98)	**3.24** (2.74-3.79)	**3.84** (3.23-4.51)	**4.73** (3.87-5.79)	**5.46** (4.36-6.75)	**6.23** (4.80-7.88)	**7.05** (5.20-9.14)	**8.19** (5.80-10.9)	**9.10** (6.26-12.2)
4-day	**2.31** (1.97-2.69)	**2.72** (2.32-3.17)	**3.43** (2.91-4.00)	**4.05** (3.42-4.75)	**4.97** (4.08-6.07)	**5.73** (4.58-7.06)	**6.52** (5.03-8.23)	**7.37** (5.45-9.53)	**8.55** (6.08-11.3)	**9.49** (6.55-12.7)
7-day	**2.71** (2.32-3.14)	**3.14** (2.69-3.64)	**3.89** (3.32-4.51)	**4.55** (3.86-5.30)	**5.53** (4.56-6.70)	**6.34** (5.09-7.76)	**7.18** (5.57-9.01)	**8.09** (6.02-10.4)	**9.36** (6.69-12.3)	**10.4** (7.19-13.8)
10-day	**3.06** (2.63-3.53)	**3.52** (3.02-4.06)	**4.31** (3.69-4.99)	**5.02** (4.27-5.82)	**6.05** (5.00-7.30)	**6.90** (5.56-8.41)	**7.79** (6.06-9.72)	**8.74** (6.52-11.2)	**10.1** (7.21-13.2)	**11.1** (7.74-14.8)
20-day	**4.04** (3.49-4.62)	**4.63** (3.99-5.29)	**5.61** (4.83-6.44)	**6.46** (5.52-7.45)	**7.68** (6.36-9.15)	**8.65** (7.00-10.4)	**9.66** (7.55-11.9)	**10.7** (8.02-13.6)	**12.1** (8.75-15.8)	**13.3** (9.30-17.5)
30-day	**4.86** (4.21-5.53)	**5.56** (4.81-6.34)	**6.73** (5.80-7.69)	**7.71** (6.61-8.84)	**9.08** (7.53-10.7)	**10.1** (8.22-12.1)	**11.2** (8.79-13.8)	**12.3** (9.26-15.5)	**13.8** (9.98-17.9)	**14.9** (10.5-19.6)
45-day	**5.89** (5.12-6.68)	**6.76** (5.87-7.66)	**8.15** (7.05-9.27)	**9.29** (8.00-10.6)	**10.8** (8.99-12.7)	**12.0** (9.75-14.3)	**13.2** (10.3-16.0)	**14.3** (10.8-17.9)	**15.8** (11.4-20.3)	**16.9** (12.0-22.1)
60-day	**6.78** (5.90-7.66)	**7.78** (6.77-8.80)	**9.37** (8.12-10.6)	**10.6** (9.18-12.1)	**12.3** (10.2-14.4)	**13.6** (11.0-16.0)	**14.8** (11.6-17.9)	**15.9** (12.0-19.8)	**17.4** (12.6-22.2)	**18.5** (13.1-24.1)

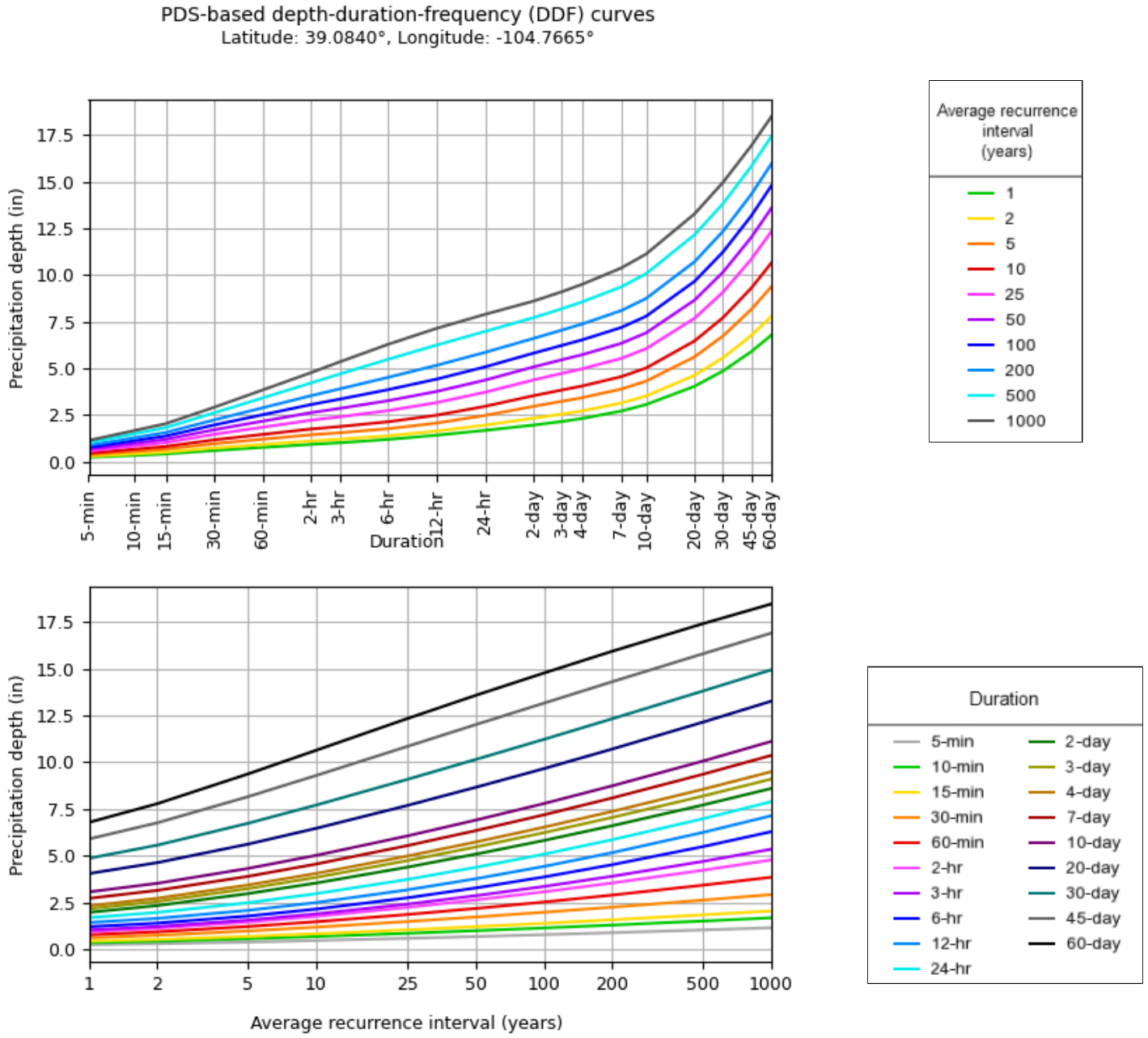
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical



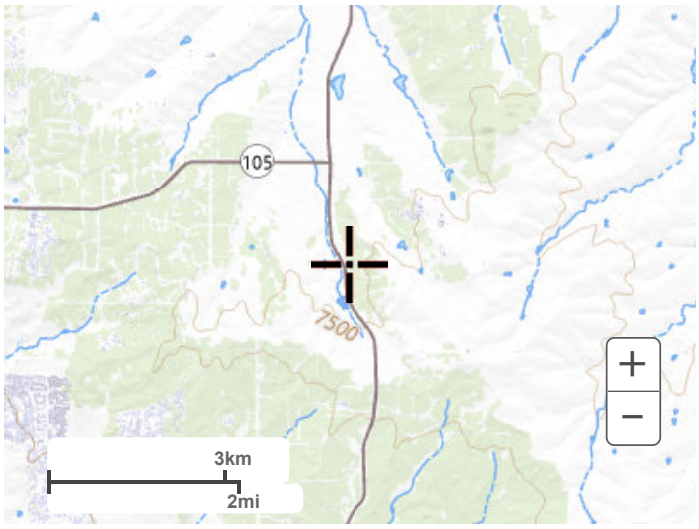
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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B – HYDROLOGIC CALCULATIONS

Subdivision:	The North Ranch
Location:	El Paso County
Project Name:	The North Ranch
Project Number:	26001
Calculated By:	NQJ
Checked By:	REB
Date:	8/26/2026

EXISTING CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
EX1	5.05	14.6%	0.17	0.42	33.4	2.0	8.3
EX2	34.20	7.9%	0.13	0.39	53.8	7.0	36.3
EX3	38.06	9.3%	0.14	0.40	47.2	9.3	45.9
EX4	3.15	11.4%	0.15	0.41	16.3	1.6	7.3
EX5	3.21	10.4%	0.14	0.40	17.6	1.5	7.1
EX6	8.30	6.4%	0.12	0.39	29.3	2.5	13.5
EX6.1	14.10	7.1%	0.12	0.39	28.9	4.4	23.4
EX7	22.13	6.7%	0.12	0.39	35.0	6.0	32.3
EX8	16.60	5.8%	0.12	0.38	35.8	4.3	23.5
EX9	15.65	4.5%	0.11	0.37	36.4	3.7	21.5

EXISTING CONDTIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	2.0	8.3
2	7.0	36.3
3	9.3	45.9
4	1.6	7.3
5	1.5	7.1
6	2.5	13.5
7	4.2	21.4
8	8.4	44.2
9	4.3	23.5
10	7.2	40.8
11	32.9	189.1

COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: The North Ranch
Location: El Paso County

Project Name: The North Ranch
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		Gravel Drives				Paved				5 Acre Lots				Undeveloped				Weighted C_5 & C_{100}		Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
EX1	5.05	0.59	0.70	0.50	80.0%	0.90	0.96	0.05	100.0%	0.12	0.39	3.96	7.0%	0.09	0.36	0.54	2.0%	0.17	0.42	14.6%
EX2	34.20	0.59	0.70	0.39	80.0%	0.90	0.96	0.37	100.0%	0.12	0.39	26.98	7.0%	0.09	0.36	6.46	2.0%	0.13	0.39	7.9%
EX3	38.06	0.59	0.70	1.20	80.0%	0.90	0.96	0.12	100.0%	0.12	0.39	34.24	7.0%	0.09	0.36	2.50	2.0%	0.14	0.40	9.3%
EX4	3.15	0.59	0.70	0.19	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	2.96	7.0%	0.09	0.36	0.00	2.0%	0.15	0.41	11.4%
EX5	3.21	0.59	0.70	0.15	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	3.06	7.0%	0.09	0.36	0.00	2.0%	0.14	0.40	10.4%
EX6	8.30	0.59	0.70	0.03	80.0%	0.90	0.96	0.10	100.0%	0.12	0.39	4.81	7.0%	0.09	0.36	3.36	2.0%	0.12	0.39	6.4%
EX6.1	14.10	0.59	0.70	0.19	80.0%	0.90	0.96	0.22	100.0%	0.12	0.39	7.00	7.0%	0.09	0.36	6.69	2.0%	0.12	0.39	7.1%
EX7	22.13	0.59	0.70	0.23	80.0%	0.90	0.96	0.13	100.0%	0.12	0.39	14.60	7.0%	0.09	0.36	7.17	2.0%	0.12	0.39	6.7%
EX8	16.60	0.59	0.70	0.34	80.0%	0.90	0.96	0.18	100.0%	0.12	0.39	3.78	7.0%	0.09	0.36	12.30	2.0%	0.12	0.38	5.8%
EX9	15.65	0.59	0.70	0.05	80.0%	0.90	0.96	0.19	100.0%	0.12	0.39	3.21	7.0%	0.09	0.36	12.20	2.0%	0.11	0.37	4.5%
Total	**160.45**																			**7.7%**

STANDARD FORM SF-2 - EXISTING CONDITIONS
TIME OF CONCENTRATION

Subdivision: The North Ranch
Location: El Paso County

Project Name: The North Ranch
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Weighted C_{100}	Impervious (%)	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)
EX1	5.05	A	0.17	0.42	14.6%	300	1.0%	29.1	850	1.7%	10.0	1.3	10.9	39.9	1150.0	33.4	33.4
EX2	34.20	A	0.13	0.39	7.9%	300	6.6%	16.3	2500	2.0%	7.0	1.0	42.1	58.4	2800.0	53.8	53.8
EX3	38.06	A	0.14	0.40	9.3%	300	6.0%	16.7	2358	2.8%	7.0	1.2	33.6	50.3	2658.0	47.2	47.2
EX4	3.15	A	0.15	0.41	11.4%	250	7.2%	14.2	134	2.2%	7.0	1.0	2.2	16.3	384.0	25.5	16.3
EX5	3.21	A	0.14	0.40	10.4%	300	8.0%	15.1	227	4.5%	7.0	1.5	2.5	17.6	527.0	25.9	17.6
EX6	8.30	A	0.12	0.39	6.4%	300	5.8%	17.2	870	2.9%	7.0	1.2	12.2	29.3	1170.0	33.5	29.3
EX6.1	14.10	A	0.12	0.39	7.1%	300	10.0%	14.3	1400	5.2%	7.0	1.6	14.6	28.9	1700.0	35.0	28.9
EX7	22.13	A	0.12	0.39	6.7%	300	6.7%	16.4	1285	2.7%	7.0	1.2	18.6	35.0	1585.0	38.0	35.0
EX8	16.60	A	0.12	0.38	5.8%	300	9.3%	14.7	1342	2.3%	7.0	1.1	21.1	35.8	1642.0	40.0	35.8
EX9	15.65	A	0.11	0.37	4.5%	300	8.0%	15.6	1512	3.0%	7.0	1.2	20.8	36.4	1812.0	40.4	36.4

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).

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

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).

Eq

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

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 6-4

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

:

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

Equation 6-5

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

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: The North Ranch
Location: El Paso County
Design Storm: 5-Year

Project Name: The North Ranch
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
DESCRIPTION	Design Point	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)	$Q_{overland}$ (cfs)	C* A (ac)	Slope (%)	Q_{pipe} (cfs)	C* A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX1	5.05	0.17	33.4	0.86	2.32	2.0															BASIN EX1 FLOW @ DP1,C ONVEYED WEST BY EX 84" CMP CULVERT UNDER HWY 83
	2	EX2	34.20	0.13	53.8	4.38	1.60	7.0															BASIN EX2 @ DP2, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	3	EX3	38.06	0.14	47.2	5.15	1.80	9.3															BASIN EX3 @ DP3, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	4	EX4	3.15	0.15	16.3	0.47	3.40	1.6					1.6	0.47	4.8					1031	1.5	11.2	BASIN EX4 @ DP4, CONVEYED UNDER PINEHURST CIR IN EX 24" CMP, SWALE FLOW TO DP7
	5	EX5	3.21	0.14	17.6	0.46	3.28	1.5					1.5	0.46	3					1500	1.2	20.6	BASIN EX5 @ DP5, OVERTOPS PINEHURST CIR, SWALE FLOW TO DP7
	6	EX6	8.30	0.12	29.3	0.99	2.51	2.5															BASIN EX6 @ DP6, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
		EX6.1	14.10	0.12	28.9	1.75	2.54	4.4															BASIN EX6.1 @ DP7
	7								54.6	2.68	1.58	4.2	54.6	2.68	2.4					380	1.1	5.8	COMBINED DP4, DP5 & BASIN EX6.1@ DP7, CONVEYED NORTH IN HWY 83 SWALE TO DP8
		EX7	22.13	0.12	35.0	2.65	2.25	6.0															BASIN EX7 @ DP8
	8								54.6	5.33	1.58	8.4	8.4	5.33	2.1					280	1.0	4.6	COMBINED DP7 & BASIN 7 @ DP8, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	9	EX8	16.60	0.12	35.8	1.92	2.22	4.3					4.3	1.92	5					520	1.6	5.5	BASIN EX8 @ DP9, CONVEYED NORTH IN HWY 83 SWALE TO DP10
		EX9	15.65	0.11	36.4	1.68	2.19	3.7															BASIN EX9 @ DP10
	10								41.3	3.61	2.00	7.2											COMBINED DP9 & BASIN EX9 @ DP10, CONVEYED NORTH IN HWY 83 SWALE
	11											32.9											COMBINED DISCHARGE FROM BASIN AREA

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: The North Ranch
Location: El Paso County
Design Storm: 100-Year

Project Name: The North Ranch
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{OVERLAND}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX1	5.05	0.42	33.4	2.14	3.90	8.3															BASIN EX1 FLOW @ DP1,C ONVEYED WEST BY EX 84" CMP CULVERT UNDER HWY 83
	2	EX2	34.20	0.39	53.8	13.48	2.69	36.3															BASIN EX2 @ DP2, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	3	EX3	38.06	0.40	47.2	15.21	3.02	45.9															BASIN EX3 @ DP3, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	4	EX4	3.15	0.41	16.3	1.29	5.70	7.3					7.3	1.29	4.8					1031	1.5	11.2	BASIN EX4 @ DP4, CONVEYED UNDER PINEHURST CIR IN EX 24" CMP, SWALE FLOW TO DP7
	5	EX5	3.21	0.40	17.6	1.30	5.50	7.1					7.1	1.30	3					1500	1.2	20.6	BASIN EX5 @ DP5, OVERTOPS PINEHURST CIR, SWALE FLOW TO DP7
	6	EX6	8.30	0.39	29.3	3.20	4.22	13.5															BASIN EX6 @ DP6, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
		EX6.1	14.10	0.39	28.9	5.48	4.26	23.4															BASIN EX6.1 @ DP7
	7								54.6	8.07	2.66	21.4	54.6	8.07	2.4					380	1.1	5.8	COMBINED DP4, DP5 & BASIN EX6.1@ DP7, CONVEYED NORTH IN HWY 83 SWALE TO DP8
		EX7	22.13	0.39	35.0	8.56	3.78	32.3															BASIN EX7 @ DP8
	8								54.6	16.63	2.66	44.2	44.2	16.63	2.1					280	1.0	4.6	COMBINED DP7 & BASIN 7 @ DP8, CONVEYED WEST BY EX 24" CMP CULVERT UNDER HWY 83
	9	EX8	16.60	0.38	35.8	6.31	3.72	23.5					23.5	6.31	5					520	1.6	5.5	BASIN EX8 @ DP9, CONVEYED NORTH IN HWY 83 SWALE TO DP10
		EX9	15.65	0.37	36.4	5.86	3.68	21.5															BASIN EX9 @ DP10
	10								41.3	12.17	3.36	40.8											COMBINED DP9 & BASIN EX9 @ DP10, CONVEYED NORTH IN HWY 83 SWALE
												189.1											COMBINED DISCHARGE FROM BASIN AREA

Project: The North Ranch
Project No: 26001
Date: 8/26/2026

2.5 Acre Lot - Composite % Impervious Calculation				
Lot Area (ft^2)	Roof Area (ft^2)	Paved Driveway (ft^2)	Undeveloped (ft^2)	Comp. Impervious
108,900	5,000	1,500	102,400	7.4%

Per BFFPD, driveways to be 15' wide, assumed 100 length

Subdivision:	Needles Sub.
Location:	El Paso County
Project Name:	Needles Sub.
Project Number:	26001
Calculated By:	NQJ
Checked By:	REB
Date:	8/26/2026

PROPOSED CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
1	4.85	12.9%	0.16	0.41	33.9	1.8	7.7
2	1.10	28.7%	0.30	0.52	5.8	1.7	4.7
3	29.67	7.8%	0.13	0.39	52.9	6.1	31.9
4	2.56	64.8%	0.60	0.73	16.8	5.1	10.5
5	2.83	16.1%	0.20	0.44	24.8	1.6	5.8
5.1	0.94	17.2%	0.21	0.45	20.8	0.6	2.2
5.2	0.88	14.0%	0.19	0.43	19.1	0.5	2.0
6	36.64	9.4%	0.14	0.40	47.6	8.9	43.9
7	7.05	8.1%	0.13	0.39	22.5	2.6	13.6
7.1	12.19	8.0%	0.13	0.39	33.6	3.5	18.6
8	20.47	7.8%	0.12	0.39	33.5	5.9	31.3
9	0.37	61.3%	0.57	0.71	5.0	1.1	2.3
10	2.40	18.7%	0.23	0.46	23.5	1.5	5.3
11	17.97	7.2%	0.12	0.39	33.1	5.0	27.4
12	1.29	45.1%	0.44	0.62	13.9	2.1	4.9
13	1.63	40.6%	0.37	0.56	9.0	2.6	6.6
14	0.96	17.9%	0.22	0.45	25.4	0.6	2.0
15	10.29	8.9%	0.13	0.40	39.1	2.8	14.0

PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
A	1.8	7.7
B	2.5	9.7
C	5.7	31.3
D	5.1	10.5
E	6.4	33.8
F	8.9	43.9
G	8.7	42.6
H	2.6	13.6
I	2.9	14.6
J	1.6	7.3
K	1.5	7.1
L	5.5	27.5
M	5.9	31.3
N	4.8	9.9
O	10.6	53.0
P	5.0	27.4
Q	2.1	4.9
R	11.5	41.3
S	0.9	23.1
T	3.7	31.0
U	35.1	184.7

COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: Needles Sub.
Location: El Paso County

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		Gravel Drives				Paved				2.5 Ac Lots - See Comp. Imp. Calc				5 Ac Lots				Undeveloped				Weighted C_5 & C_{100}		Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
EX4	3.15	0.59	0.70	0.19	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	2.96	7.0%	0.09	0.36	0.00	2.0%	0.15	0.41	11.4%
EX5	3.21	0.59	0.70	0.15	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	3.06	7.0%	0.09	0.36	0.00	2.0%	0.14	0.40	10.4%
1	4.85	0.59	0.70	0.43	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	3.85	7.0%	0.09	0.36	0.57	2.0%	0.16	0.41	12.9%
2	1.10	0.59	0.70	0.05	80.0%	0.90	0.96	0.26	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.79	2.0%	0.30	0.52	28.7%
3	29.67	0.59	0.70	0.35	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	2.17	7.4%	0.12	0.39	26.79	7.0%	0.09	0.36	0.36	2.0%	0.13	0.39	7.8%
4	2.56	0.59	0.70	0.24	80.0%	0.90	0.96	1.45	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.87	2.0%	0.60	0.73	64.8%
5	2.83	0.59	0.70	0.06	80.0%	0.90	0.96	0.36	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	2.41	2.0%	0.20	0.44	16.1%
5.1	0.94	0.59	0.70	0.02	80.0%	0.90	0.96	0.13	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.79	2.0%	0.21	0.45	17.2%
5.2	0.88	0.59	0.70	0.01	80.0%	0.90	0.96	0.10	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.77	2.0%	0.19	0.43	14.0%
6	36.64	0.59	0.70	1.19	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	1.10	7.4%	0.12	0.39	34.24	7.0%	0.09	0.36	0.11	2.0%	0.14	0.40	9.4%
7	7.05	0.59	0.70	0.10	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	2.03	7.4%	0.12	0.39	4.82	7.0%	0.09	0.36	0.10	2.0%	0.13	0.39	8.1%
7.1	12.19	0.59	0.70	0.16	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	4.73	7.4%	0.12	0.39	7.12	7.0%	0.09	0.36	0.18	2.0%	0.13	0.39	8.0%
8	20.47	0.59	0.70	0.20	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	5.66	7.4%	0.12	0.39	14.48	7.0%	0.09	0.36	0.13	2.0%	0.12	0.39	7.8%
9	0.37	0.59	0.70	0.03	80.0%	0.90	0.96	0.20	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.14	2.0%	0.57	0.71	61.3%
10	2.40	0.59	0.70	0.05	80.0%	0.90	0.96	0.37	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	1.98	2.0%	0.23	0.46	18.7%
11	17.97	0.59	0.70	0.00	80.0%	0.90	0.96	0.00	100.0%	0.12	0.39	13.52	7.4%	0.12	0.39	3.99	7.0%	0.09	0.36	0.46	2.0%	0.12	0.39	7.2%
12	1.29	0.59	0.70	0.06	80.0%	0.90	0.96	0.52	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.71	2.0%	0.44	0.62	45.1%
13	1.63	0.59	0.70	0.43	80.0%	0.90	0.96	0.30	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.90	2.0%	0.37	0.56	40.6%
14	0.96	0.59	0.70	0.02	80.0%	0.90	0.96	0.14	100.0%	0.12	0.39	0.00	7.4%	0.12	0.39	0.00	7.0%	0.09	0.36	0.80	2.0%	0.22	0.45	17.9%
15	10.29	0.59	0.70	0.03	80.0%	0.90	0.96	0.21	100.0%	0.12	0.39	6.92	7.4%	0.12	0.39	2.23	7.0%	0.09	0.36	0.90	2.0%	0.13	0.40	8.9%
Pond (Basins 4, 9 11-13)	**23.82**																							**29.2%**
Total	**160.45**																							**10.7%**

STANDARD FORM SF-2 - EXISTING CONDITIONS
TIME OF CONCENTRATION

Subdivision: Needles Sub.
Location: El Paso County

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Weighted C_{100}	Impervious (%)	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)
EX4	3.15	A	0.15	0.41	11.4%	250	7.2%	14.2	134	2.2%	7.0	1.0	2.2	16.3	384.0	25.5	16.3
EX5	3.21	A	0.14	0.40	10.4%	300	8.0%	15.1	227	4.5%	7.0	1.5	2.5	17.6	527.0	25.9	17.6
1	4.85	A	0.16	0.41	12.9%	300	1.0%	29.5	850	1.7%	15.0	2.0	7.2	36.7	1150.0	33.9	33.9
2	1.10	A	0.30	0.52	28.7%	26	10.9%	3.3	460	4.3%	15.0	3.1	2.5	5.8	486.0	24.0	5.8
3	29.67	A	0.13	0.39	7.8%	300	6.6%	16.4	2420	2.0%	7.0	1.0	40.7	57.1	2720.0	52.9	52.9
4	2.56	A	0.60	0.73	64.8%	26	10.9%	2.1	2258	2.9%	15.0	2.6	14.7	16.8	2284.0	27.2	16.8
5	2.83	A	0.20	0.44	16.1%	60	6.7%	6.7	1100	2.1%	7.0	1.0	18.1	24.8	1160.0	34.5	24.8
5.1	0.94	A	0.21	0.45	17.2%	60	3.6%	8.1	650	1.5%	7.0	0.9	12.6	20.8	710.0	30.8	20.8
5.2	0.88	A	0.19	0.43	14.0%	60	0.6%	15.1	252	2.2%	7.0	1.0	4.0	19.1	312.0	26.2	19.1
6	36.64	A	0.14	0.40	9.4%	300	6.0%	16.7	2405	2.8%	7.0	1.2	34.2	50.9	2705.0	47.6	47.6
7	7.05	A	0.13	0.39	8.1%	300	9.3%	14.6	716	4.7%	7.0	1.5	7.9	22.5	1016.0	30.1	22.5
7.1	12.19	A	0.13	0.39	8.0%	300	8.5%	15.0	1478	3.6%	7.0	1.3	18.5	33.6	1778.0	37.5	33.6
8	20.47	A	0.12	0.39	7.8%	300	6.7%	16.3	1185	2.7%	7.0	1.2	17.2	33.5	1485.0	36.6	33.5
9	0.37	A	0.57	0.71	61.3%	26	10.9%	2.2	325	1.8%	15.0	2.0	2.7	4.9	351.0	17.9	5.0
10	2.40	A	0.23	0.46	18.7%	60	2.0%	9.7	635	1.2%	7.0	0.8	13.8	23.5	695.0	31.1	23.5
11	17.97	A	0.12	0.39	7.2%	300	9.3%	14.7	1175	2.3%	7.0	1.1	18.4	33.1	1475.0	37.7	33.1
12	1.29	A	0.44	0.62	45.1%	290	7.6%	10.4	740	5.4%	15.0	3.5	3.5	13.9	1030.0	21.8	13.9
13	1.63	A	0.37	0.56	40.6%	65	2.0%	8.4	210	15.0%	15.0	5.8	0.6	9.0	275.0	19.7	9.0
14	0.96	A	0.22	0.45	17.9%	55	2.0%	9.4	475	0.5%	7.0	0.5	16.0	25.4	530.0	32.7	25.4
15	10.29	A	0.13	0.40	8.9%	300	8.0%	15.2	1584	2.5%	7.0	1.1	23.9	39.1	1884.0	40.8	39.1

STANDARD FORM SF-2 - EXISTING CONDITIONS
TIME OF CONCENTRATION

Subdivision: Needles Sub.
Location: El Paso County

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Weighted C_{100}	Impervious (%)	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)

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).

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

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

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

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

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 6-4 ?6 − 17$\bar{i}$) + $\frac{L_t}{60(14\bar{i} + 9)\sqrt{S_t}}$

s:

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)
$\bar{i}$ = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Equation 6-5

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

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.
Location: El Paso County
Design Storm: 5-Year

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
DESCRIPTION	Design Point	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)	$Q_{overland}$ (cfs)	C* A (ac)	Slope (%)	Q_{pipe} (cfs)	C* A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	A	1	4.85	0.16	33.9	0.77	2.30	1.8					1.8	0.77	8.2					171	2.0	1.4	BASIN 1 FLOW @ DPA, 18" CULVERT UNDER PRIVATE ROAD TO DPB
		2	1.10	0.30	5.8	0.33	4.95	1.7															BASIN 2 FLOW, SWALE TO DPB
	B								35.3	1.10	2.24	2.5											COMBINED DPA & BASIN 2 @ DPB, EX 84"' CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	C	3	29.67	0.13	52.9	3.71	1.63	6.1					6.1	3.71	2					150	1.0	2.5	BASIN 3 SWALE FLOW TO DPC, 30" CULVERT UNDER PRIVATE ROAD TO DPE
	D	4	2.56	0.60	16.8	1.52	3.35	5.1					5.1	1.52	0.8					310	0.6	8.3	BASIN 4 SWALE FLOW TO DPD, CONTINUES TOWARDS DPN
		5	2.83	0.20	24.8	0.58	2.77	1.6					1.6	0.58	2.7					630	1.2	9.1	BASIN 5 HIGHWAY 83 SWALE FLOW TO DPE
		5.1	0.94	0.21	20.8	0.20	3.03	0.6															BASIN 5.1 HIGHWAY 83 SWALE TO DPG
		5.2	0.88	0.19	19.1	0.17	3.15	0.5															BASIN 5.2 HIGHWAY 83 SWALE TO DPI
	E								55.4	4.29	1.56	6.7											COMBINED DPC & BASIN 5 @ DPE, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	F	6	36.64	0.14	47.6	4.95	1.79	8.9					8.9	4.95	2					205	1.0	3.5	BASIN 6 SWALE FLOW TO DPF, PR DUAL 24" CULVERT UNDER PRIVATE ROAD TO DPG
	G								51.1	5.15	1.68	8.7											COMBINED DPF & BASIN 5.1 @ DPG, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	H	7	7.05	0.13	22.5	0.89	2.92	2.6					2.6	0.89	2					148	1.0	2.5	BASIN 7 SWALE FLOW TO DPH, PR 24" CULVERT UNDER PRIVATE ROAD TO DPI
	I								24.9	1.06	2.76	2.9											COMBINED DPH & BASIN 5.2 @ DPI, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	J	EX4	3.15	0.15	16.3	0.47	3.40	1.6					1.6	0.47	3.8					1050	1.4	12.8	BASIN EX4 @ DPJ, OVERLAND/SWALE FLOW TO DPL
	K	EX5	3.21	0.14	17.6	0.46	3.28	1.5					1.5	0.46	3.9					1500	1.4	18.1	BASIN EX5 @ DPK, OVERLAND/SWALE FLOW TO DPL
		7.1	12.19	0.13	33.6	1.53	2.31	3.5															BASIN 7.1 SWALE FLOW TO DPL
	L								35.7	2.46	2.22	5.5	5.5	2.46	2					485	1.0	8.2	COMBINED BASIN 7.1, DPJ & DPK, 30" CULVERT UNDER PRIVATE ROAD TO DPO
	M	8	20.47	0.12	33.5	2.55	2.32	5.9					5.9	2.55	2					130	1.0	2.2	BASIN 8 FLOW @ DPM, 30" CULVERT UNDER PRIVATE ROAD TO DPO
		9	0.37	0.57	5.0	0.21	5.17	1.1															BASIN 9 FLOW @ DPK
	N								25.1	1.74	2.75	4.8	4.8	1.74	0.5					280	0.5	9.4	COMBINED DPD & BASIN 9 @ DPN, 18" CULVERT TO DPR/POND 1

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.
Location: El Paso County
Design Storm: 5-Year

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
DESCRIPTION	Design Point	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)	$Q_{overland}$ (cfs)	C* A (ac)	Slope (%)	Q_{pipe} (cfs)	C* A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
		10	2.40	0.23	23.5	0.54	2.85	1.5															BASIN 10 FLOW @ DPO
	O								43.9	5.54	1.91	10.6	10.6	5.54	1					400	0.7	9.5	COMBINED DPL, DPM & BASIN 10 @ DPO, EX 24" CULVERT UNDER HWY 83 (FOLLOWS HISTORIC)
	P	11	17.97	0.12	33.1	2.14	2.33	5.0					5.0	2.14	10					120	2.2	0.9	BASIN 11 @ DPP, 24" CULVERT UNDER ROAD TO DPR/POND 1
	Q	12	1.29	0.44	13.9	0.57	3.63	2.1					2.1	0.57	25					80	3.5	0.4	BASIN 12 SWALE TO DPQ, CONTINUES TO DPR/POND 1
		13	1.63	0.37	9.0	0.60	4.28	2.6															BASIN 13 FLOW @ DPR
	R								34.5	5.05	2.27	11.5											COMBINED DPN, P, Q & BASIN 13 @ DPR/POND 1
		14	0.96	0.22	25.4	0.21	2.73	0.6															BASIN 14 FLOW @ DPP
	S								25.4	0.21	2.73	0.9	0.9	0.32	1					650	0.7	15.5	COMBINED BASIN 14 & POND 1 DISCHARGE @ DPS, HWY 83 SWALE TO DPT
		15	10.29	0.13	40.8	1.39	2.02	2.8															BASIN 15 FLOW @ DPT
	T								40.9	1.71	2.02	3.7											COMBINED DPS & BASIN 15 @ DPT
	U											35.1											COMBINED DISCHARGE FROM BASIN AREA

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.
Location: El Paso County
Design Storm: 100-Year

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{OVERLAND}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	A	1	4.85	0.41	33.9	2.01	3.86	7.7					7.7	2.01	8.2					171	2.0	1.4	BASIN 1 FLOW @ DPA, 18" CULVERT UNDER PRIVATE ROAD TO DPB
		2	1.10	0.52	5.8	0.57	8.31	4.7															BASIN 2 FLOW, SWALE TO DPB
	B								35.3	2.58	3.75	9.7											COMBINED DPA & BASIN 2 @ DPB, EX 84"' CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	C	3	29.67	0.39	52.9	11.67	2.73	31.9					31.9	11.67	2					150	1.0	2.5	BASIN 3 SWALE FLOW TO DPC, 30" CULVERT UNDER PRIVATE ROAD TO DPE
	D	4	2.56	0.73	16.8	1.87	5.62	10.5					10.5	1.87	0.8					310	0.6	8.3	BASIN 4 SWALE FLOW TO DPD, CONTINUES TOWARDS DPN
		5	2.83	0.44	24.8	1.26	4.65	5.8					5.8	1.26	2.7					630	1.2	9.1	BASIN 5 HIGHWAY 83 SWALE FLOW TO DPE
		5.1	0.94	0.45	20.8	0.42	5.09	2.2															BASIN 5.1 HIGHWAY 83 SWALE TO DPG
		5.2	0.88	0.43	19.1	0.38	5.30	2.0															BASIN 5.2 HIGHWAY 83 SWALE TO DPI
	E								55.4	12.92	2.62	33.8											COMBINED DPC & BASIN 5 @ DPE, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	F	6	36.64	0.40	47.6	14.66	3.00	43.9					43.9	14.66	2					205	1.0	3.5	BASIN 6 SWALE FLOW TO DPF, PR DUAL 24" CULVERT UNDER PRIVATE ROAD TO DPG
	G								51.1	15.08	2.82	42.6											COMBINED DPF & BASIN 5.1 @ DPG, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	H	7	7.05	0.39	22.5	2.78	4.89	13.6					13.6	2.78	2					148	1.0	2.5	BASIN 7 SWALE FLOW TO DPH, PR 24" CULVERT UNDER PRIVATE ROAD TO DPI
	I								24.9	3.16	4.63	14.6											COMBINED DPH & BASIN 5.2 @ DPI, EX 24" CMP CULVERT UNDER HIGHWAY 83 (FOLLOWS HISTORIC)
	J	EX4	3.15	0.41	16.3	1.29	5.70	7.3					7.3	1.29	3.8					1050	1.4	12.8	BASIN EX4 @ DPJ, OVERLAND/SWALE FLOW TO DPL
	K	EX5	3.21	0.40	17.6	1.30	5.50	7.1					7.1	1.30	3.9					1500	1.4	18.1	BASIN EX5 @ DPK, OVERLAND/SWALE FLOW TO DPL
		7.1	12.19	0.39	33.6	4.80	3.88	18.6															BASIN 7.1 SWALE FLOW TO DPL
	L								35.7	7.38	3.72	27.5	27.5	7.38	2					485	1.0	8.2	COMBINED BASIN 7.1, DPJ & DPK, 30" CULVERT UNDER PRIVATE ROAD TO DPO
	M	8	20.47	0.39	33.5	8.04	3.89	31.3					31.3	8.04	2					130	1.0	2.2	BASIN 8 FLOW @ DPM, 30" CULVERT UNDER PRIVATE ROAD TO DPO
		9	0.37	0.71	5.0	0.26	8.68	2.3															BASIN 9 FLOW @ DPK

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Needles Sub.
Location: El Paso County
Design Storm: 100-Year

Project Name: Needles Sub.
Project No.: 26001.00
Calculated By: NQJ
Checked By: REB
Date: 8/26/26

		DIRECT RUNOFF							TOTAL RUNOFF				OVERLAND			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{OVERLAND}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	N								25.1	2.14	4.61	9.9	9.9	2.14	0.5					280	0.5	9.4	COMBINED DPD & BASIN 9 @ DPN, 18" CULVERT TO DPR/POND 1
		10	2.40	0.46	23.5	1.10	4.78	5.3															BASIN 10 FLOW @ DPO
	O								43.9	16.53	3.21	53.0	53.0	16.53	1					400	0.7	9.5	COMBINED DPL, DPM & BASIN 10 @ DPO, EX 24" CULVERT UNDER HWY 83 (FOLLOWS HISTORIC)
	P	11	17.97	0.39	33.1	6.99	3.91	27.4					27.4	6.99	10					120	2.2	0.9	BASIN 11 @ DPP, 24" CULVERT UNDER ROAD TO DPR/POND 1
	Q	12	1.29	0.62	13.9	0.80	6.10	4.9					4.9	0.80	25					80	3.5	0.4	BASIN 12 SWALE TO DPQ, CONTINUES TO DPR/POND 1
		13	1.63	0.56	9.0	0.91	7.19	6.6															BASIN 13 FLOW @ DPR
	R								34.5	10.84	3.81	41.3											COMBINED DPN, P, Q & BASIN 13 @ DPR/POND 1
		14	0.96	0.45	25.4	0.44	4.59	2.0															BASIN 14 FLOW @ DPP
	S								25.4	0.44	4.59	23.1	23.1	5.05	1					650	0.7	15.5	COMBINED BASIN 14 & POND 1 DISCHARGE @ DPS, HWY 83 SWALE TO DPT
		15	10.29	0.40	40.8	4.12	3.39	14.0															BASIN 15 FLOW @ DPT
	T								40.9	9.16	3.39	31.0											COMBINED DPS & BASIN 15 @ DPT
	U											184.7											COMBINED DISCHARGE FROM BASIN AREA

Swale, forebay, trickle channel, and pond calculations will be fully reviewed when a GEC plan and/or CDs are provided.

APPENDIX C – HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPA (Q100 = 7.7 cfs)

Invert Elev Dn (ft)	=	7453.18
Pipe Length (ft)	=	61.53
Slope (%)	=	6.21
Invert Elev Up (ft)	=	7457.00
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

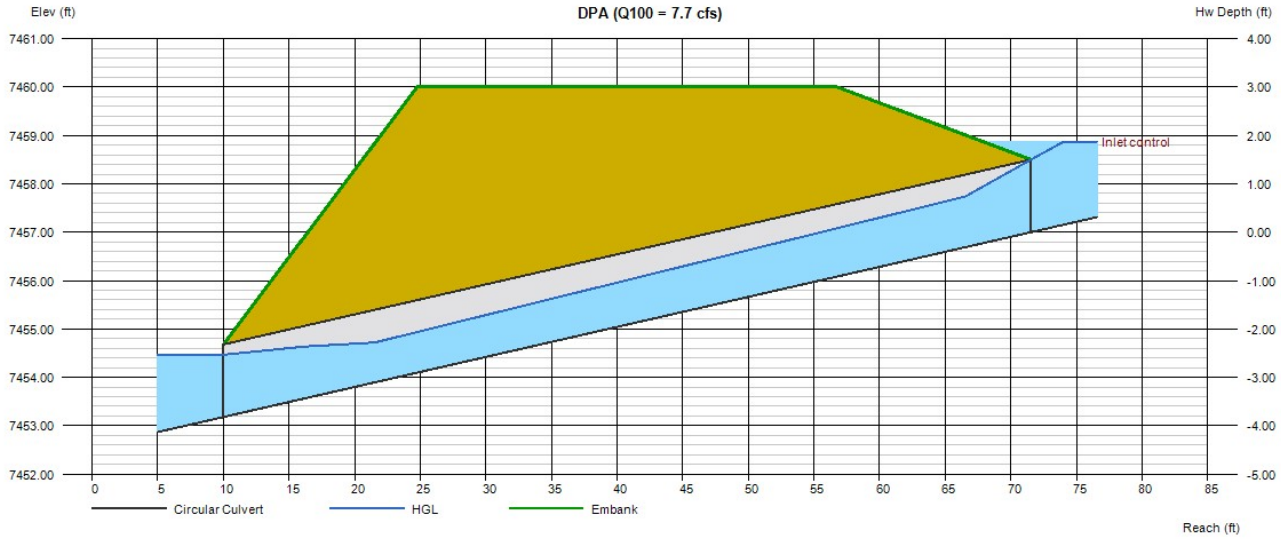
Top Elevation (ft)	=	7460.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	7.70
Qmax (cfs)	=	7.70
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	7.70
Qpipe (cfs)	=	7.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.77
Veloc Up (ft/s)	=	5.69
HGL Dn (ft)	=	7454.47
HGL Up (ft)	=	7458.07
Hw Elev (ft)	=	7458.87
Hw/D (ft)	=	1.25
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPB (Q100 = Cherry Creek Crossing FDR Q100 (368 cfs) + Site Increase (1.4 cfs) = 369.4

Invert Elev Dn (ft)	=	7441.00
Pipe Length (ft)	=	158.00
Slope (%)	=	0.82
Invert Elev Up (ft)	=	7442.30
Rise (in)	=	84.0
Shape	=	Circular
Span (in)	=	84.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

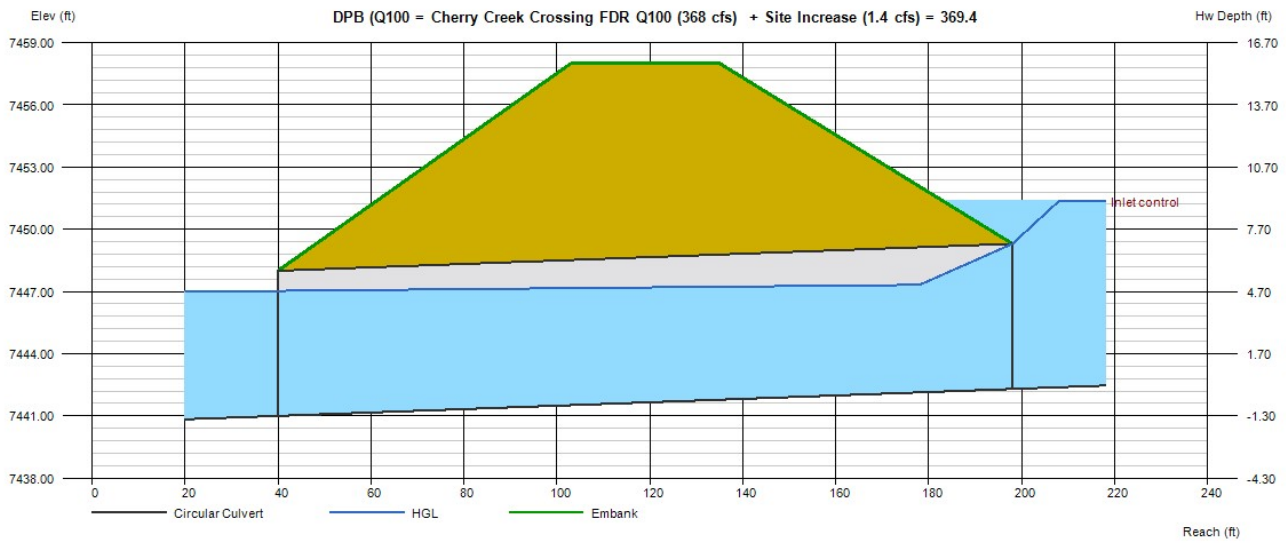
Top Elevation (ft)	=	7458.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	369.40
Qmax (cfs)	=	369.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	369.40
Qpipe (cfs)	=	369.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.48
Veloc Up (ft/s)	=	12.39
HGL Dn (ft)	=	7447.03
HGL Up (ft)	=	7447.36
Hw Elev (ft)	=	7451.37
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPC (Q100 = 31.3 cfs)

Invert Elev Dn (ft)	=	7430.66
Pipe Length (ft)	=	94.00
Slope (%)	=	1.50
Invert Elev Up (ft)	=	7432.07
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

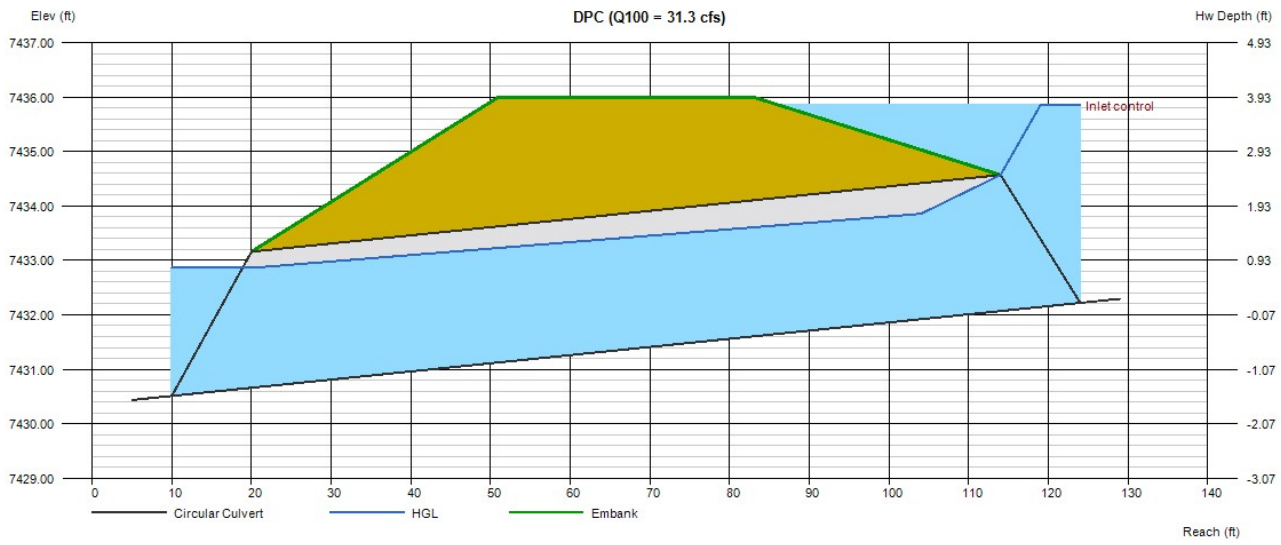
Top Elevation (ft)	=	7436.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	31.30
Qmax (cfs)	=	31.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.30
Qpipe (cfs)	=	31.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.84
Veloc Up (ft/s)	=	7.80
HGL Dn (ft)	=	7432.86
HGL Up (ft)	=	7433.98
Hw Elev (ft)	=	7435.85
Hw/D (ft)	=	1.51
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

culvert overtops, please include recommendation for any revisions to culvert

DPE (Q100 = 33.8 cfs)

Invert Elev Dn (ft)	=	7425.00
Pipe Length (ft)	=	51.70
Slope (%)	=	4.84
Invert Elev Up (ft)	=	7427.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

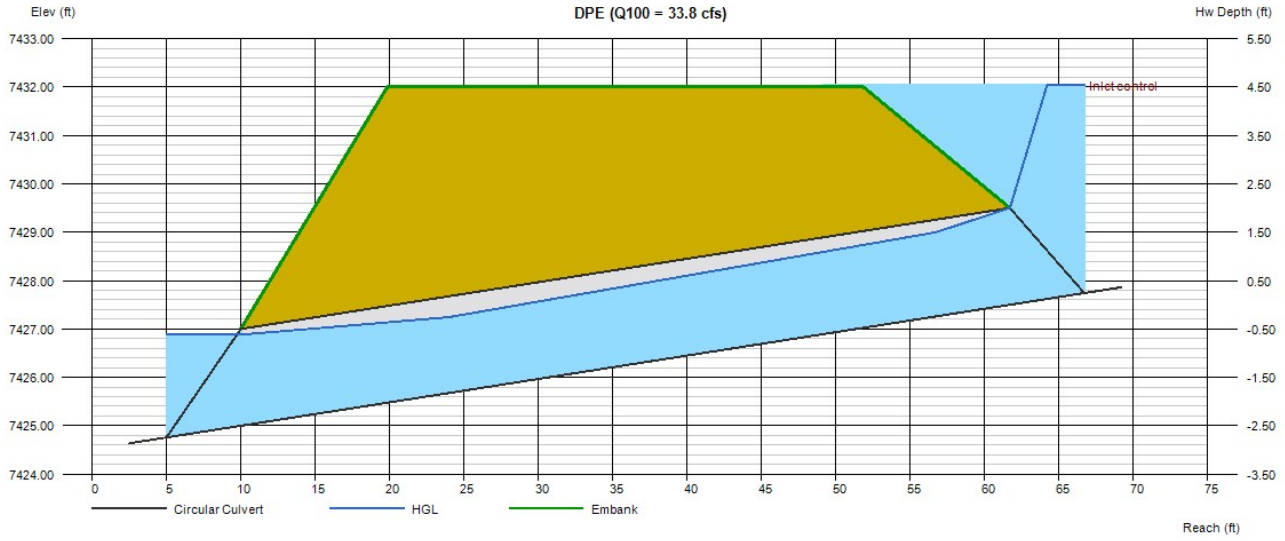
Top Elevation (ft)	=	7432.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	33.80
Qmax (cfs)	=	33.80
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	33.80
Qpipe (cfs)	=	25.18
Qovertop (cfs)	=	8.62
Veloc Dn (ft/s)	=	8.21
Veloc Up (ft/s)	=	8.58
HGL Dn (ft)	=	7426.88
HGL Up (ft)	=	7429.27
Hw Elev (ft)	=	7432.04
Hw/D (ft)	=	2.27
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPF (Q100 = 43.9 cfs)

Invert Elev Dn (ft)	=	7427.00
Pipe Length (ft)	=	85.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7428.70
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0018, 2, 0.0292, 0.74, 0.2

Embankment

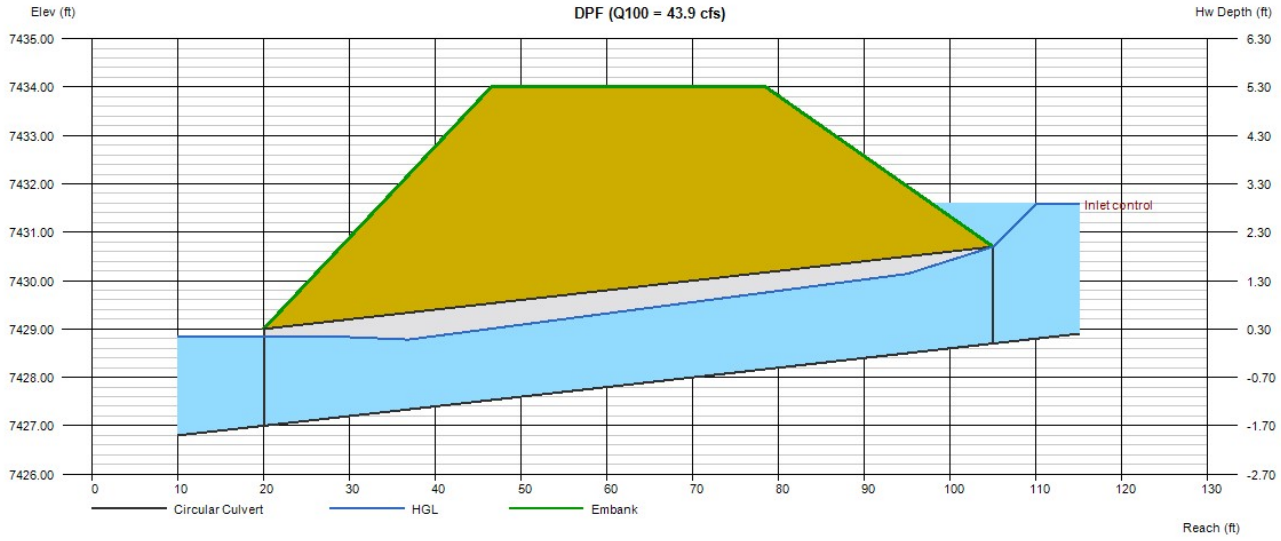
Top Elevation (ft)	=	7434.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	43.90
Qmax (cfs)	=	43.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	43.90
Qpipe (cfs)	=	43.90
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.27
Veloc Up (ft/s)	=	7.82
HGL Dn (ft)	=	7428.84
HGL Up (ft)	=	7430.37
Hw Elev (ft)	=	7431.59
Hw/D (ft)	=	1.44
Flow Regime	=	Inlet Control



Culvert Report

DPG (Q100 = 42.6 cfs)

Invert Elev Dn (ft)	=	7421.00
Pipe Length (ft)	=	52.00
Slope (%)	=	5.65
Invert Elev Up (ft)	=	7423.94
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

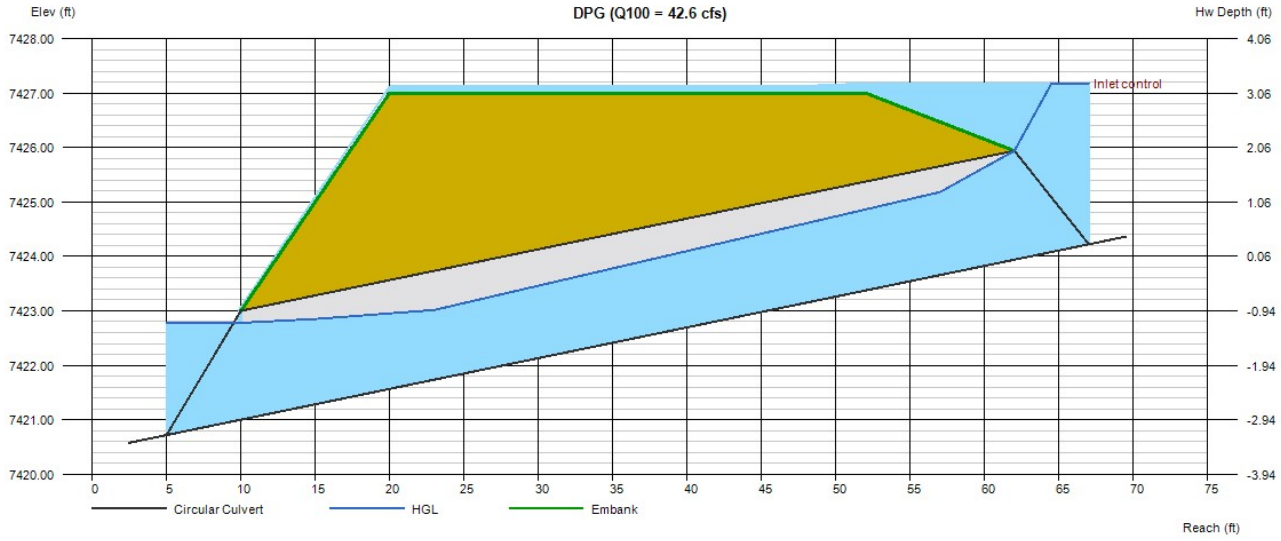
Top Elevation (ft)	=	7427.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	42.60
Qmax (cfs)	=	42.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	42.60
Qpipe (cfs)	=	18.81
Qovertop (cfs)	=	23.79
Veloc Dn (ft/s)	=	6.37
Veloc Up (ft/s)	=	7.16
HGL Dn (ft)	=	7422.78
HGL Up (ft)	=	7425.50
Hw Elev (ft)	=	7427.18
Hw/D (ft)	=	1.62
Flow Regime	=	Inlet Control



Culvert Report

DPH (Q100 = 13.6 cfs)

Invert Elev Dn (ft)	=	7424.00
Pipe Length (ft)	=	94.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7425.88
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

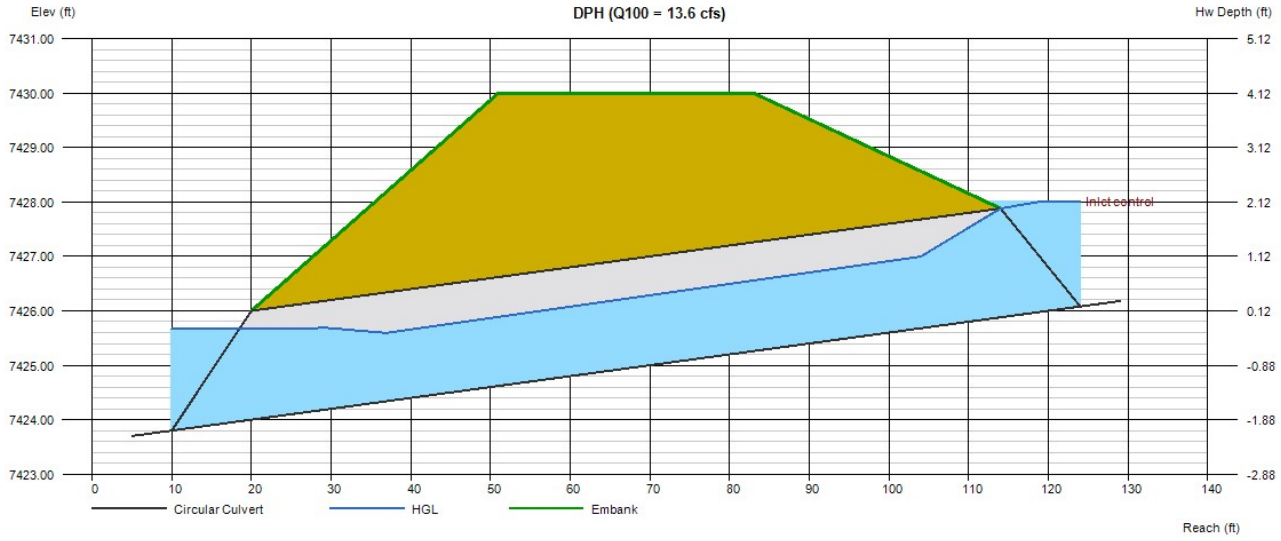
Top Elevation (ft)	=	7430.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	13.60
Qmax (cfs)	=	13.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	13.60
Qpipe (cfs)	=	13.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.87
Veloc Up (ft/s)	=	6.15
HGL Dn (ft)	=	7425.66
HGL Up (ft)	=	7427.21
Hw Elev (ft)	=	7428.01
Hw/D (ft)	=	1.06
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPI (Q100 = 14.6 cfs)

Invert Elev Dn (ft)	=	7413.96
Pipe Length (ft)	=	65.00
Slope (%)	=	6.22
Invert Elev Up (ft)	=	7418.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

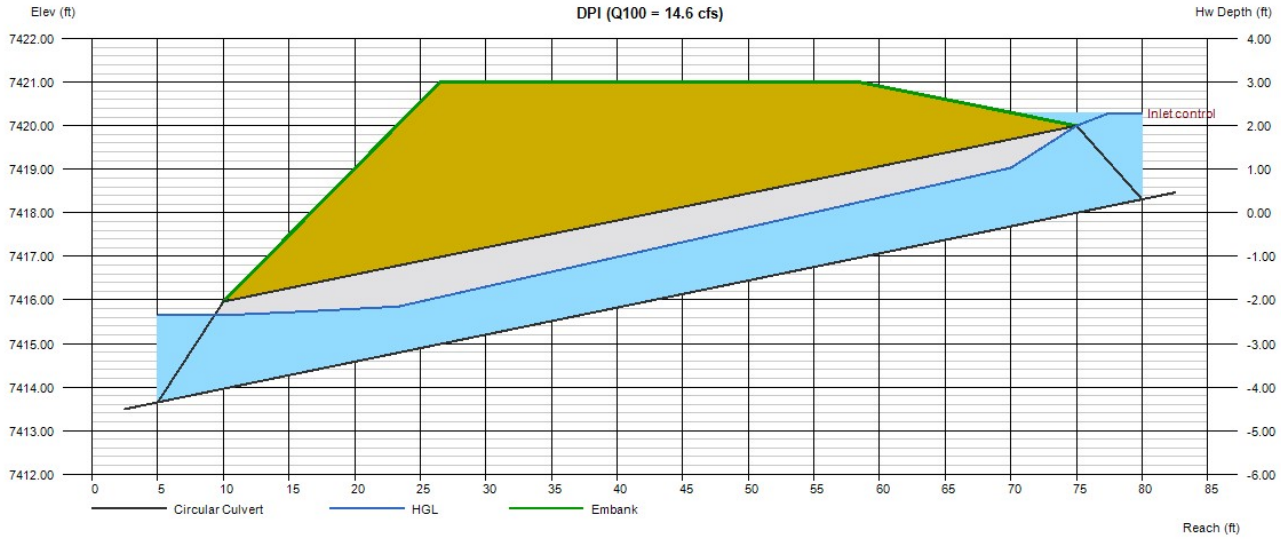
Top Elevation (ft)	=	7421.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	14.60
Qmax (cfs)	=	14.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	14.60
Qpipe (cfs)	=	14.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.16
Veloc Up (ft/s)	=	6.34
HGL Dn (ft)	=	7415.65
HGL Up (ft)	=	7419.38
Hw Elev (ft)	=	7420.29
Hw/D (ft)	=	1.15
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPL (Q100 = 27.5 cfs)

Invert Elev Dn (ft)	=	7424.00
Pipe Length (ft)	=	94.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7425.88
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

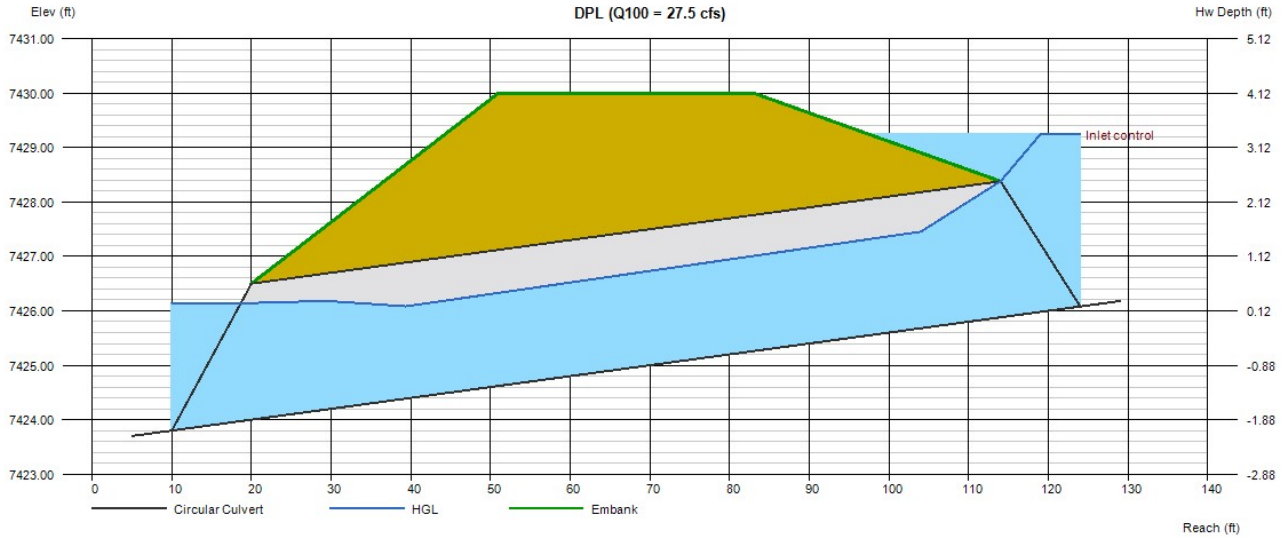
Top Elevation (ft)	=	7430.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	27.50
Qmax (cfs)	=	27.50
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	27.50
Qpipe (cfs)	=	27.50
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.14
Veloc Up (ft/s)	=	7.33
HGL Dn (ft)	=	7426.14
HGL Up (ft)	=	7427.67
Hw Elev (ft)	=	7429.24
Hw/D (ft)	=	1.35
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPM (Q100 = 31.3 cfs)

Invert Elev Dn (ft)	=	7393.86
Pipe Length (ft)	=	115.77
Slope (%)	=	3.14
Invert Elev Up (ft)	=	7397.50
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	7402.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

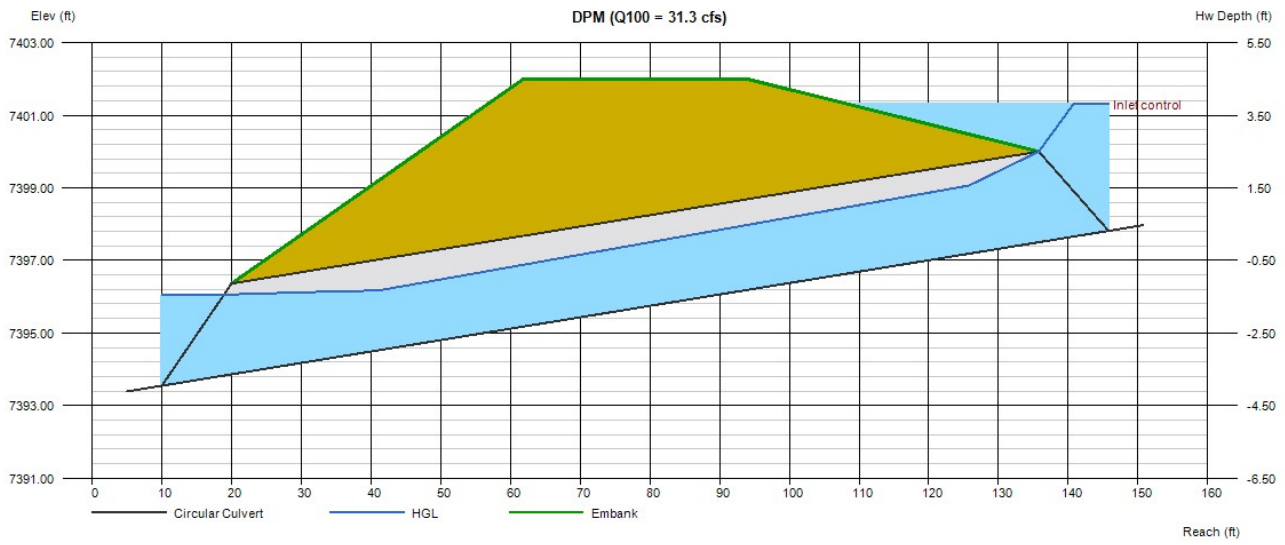
Calculations

Qmin (cfs)	=	31.30
Qmax (cfs)	=	31.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.30
Qpipe (cfs)	=	31.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.84
Veloc Up (ft/s)	=	7.80
HGL Dn (ft)	=	7396.06
HGL Up (ft)	=	7399.41
Hw Elev (ft)	=	7401.31
Hw/D (ft)	=	1.53
Flow Regime	=	Inlet Control

above ECM 1.5



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPO (Q100 = 53.0 cfs)

Invert Elev Dn (ft)	=	7389.93
Pipe Length (ft)	=	67.00
Slope (%)	=	3.09
Invert Elev Up (ft)	=	7392.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

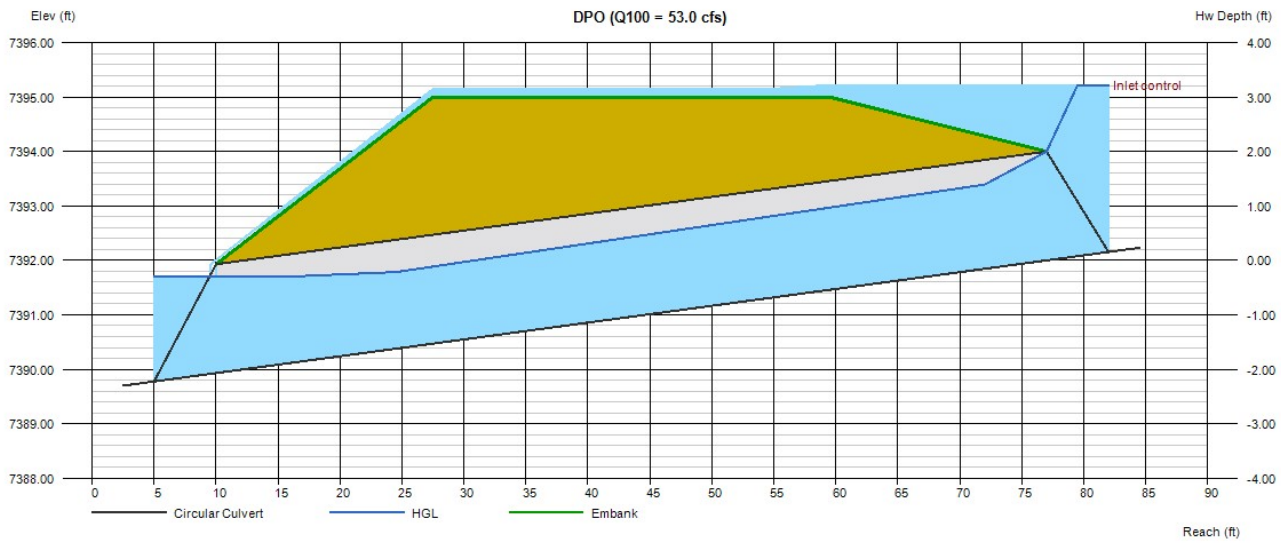
Top Elevation (ft)	=	7395.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	53.00
Qmax (cfs)	=	53.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	53.00
Qpipe (cfs)	=	18.92
Qovertop (cfs)	=	34.08
Veloc Dn (ft/s)	=	6.40
Veloc Up (ft/s)	=	7.18
HGL Dn (ft)	=	7391.71
HGL Up (ft)	=	7393.56
Hw Elev (ft)	=	7395.22
Hw/D (ft)	=	1.61
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

consider up sizing this culvert to eliminate over topping the emergency access.

DPN (Q100 = 9.9 cfs)

Invert Elev Dn (ft)	=	7396.00
Pipe Length (ft)	=	46.00
Slope (%)	=	3.00
Invert Elev Up (ft)	=	7397.38
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

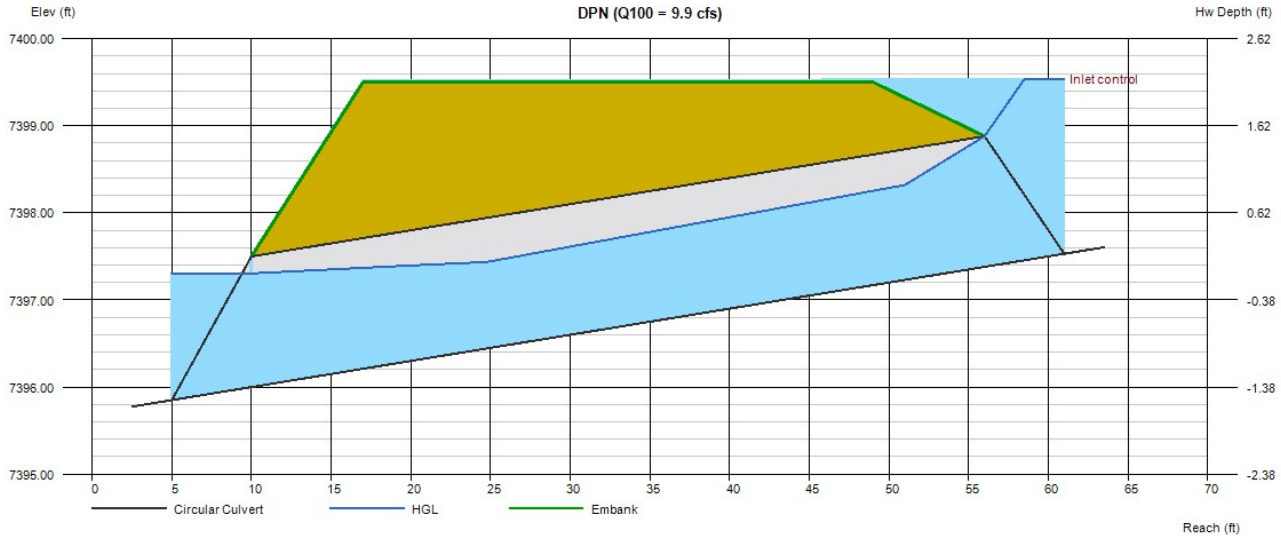
Top Elevation (ft)	=	7399.50
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	9.90
Qmax (cfs)	=	9.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.90
Qpipe (cfs)	=	8.21
Qovertop (cfs)	=	1.69
Veloc Dn (ft/s)	=	5.03
Veloc Up (ft/s)	=	5.86
HGL Dn (ft)	=	7397.31
HGL Up (ft)	=	7398.49
Hw Elev (ft)	=	7399.54
Hw/D (ft)	=	1.44
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

DPP (Q100 = 27.4 cfs)

Invert Elev Dn (ft)	=	7393.00
Pipe Length (ft)	=	40.00
Slope (%)	=	10.00
Invert Elev Up (ft)	=	7397.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	7400.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	27.40
Qmax (cfs)	=	27.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	27.40
Qpipe (cfs)	=	17.63
Qovertop (cfs)	=	9.77
Veloc Dn (ft/s)	=	6.03
Veloc Up (ft/s)	=	6.92
HGL Dn (ft)	=	7394.76
HGL Up (ft)	=	7398.51
Hw Elev (ft)	=	7400.10
Hw/D (ft)	=	1.55
Flow Regime	=	Inlet Control

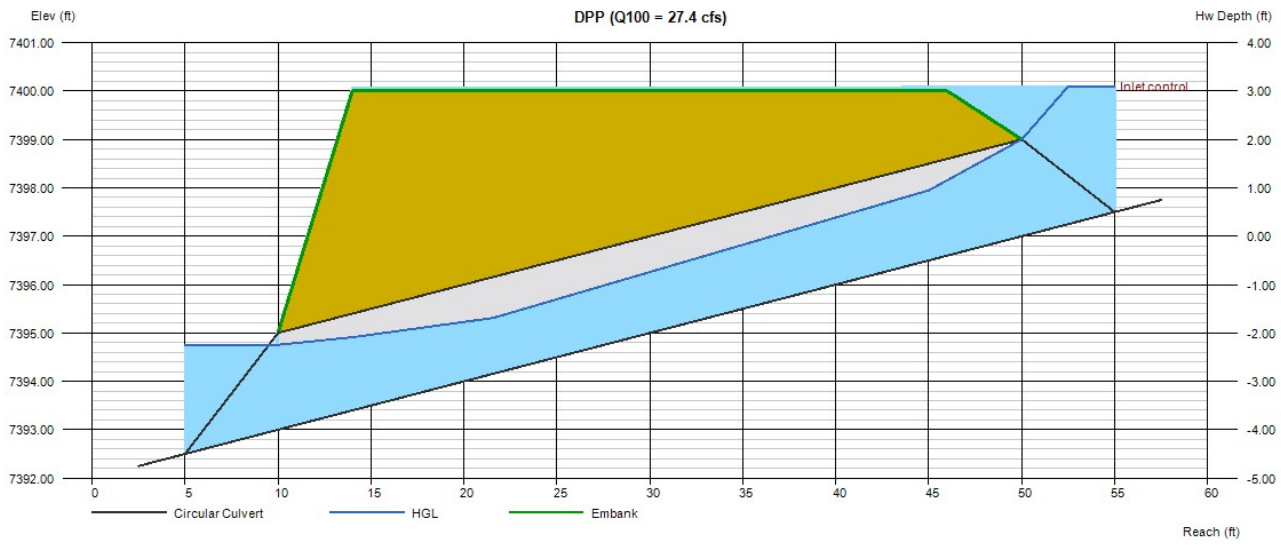


Figure 13-12c. Emergency Spillway Protection

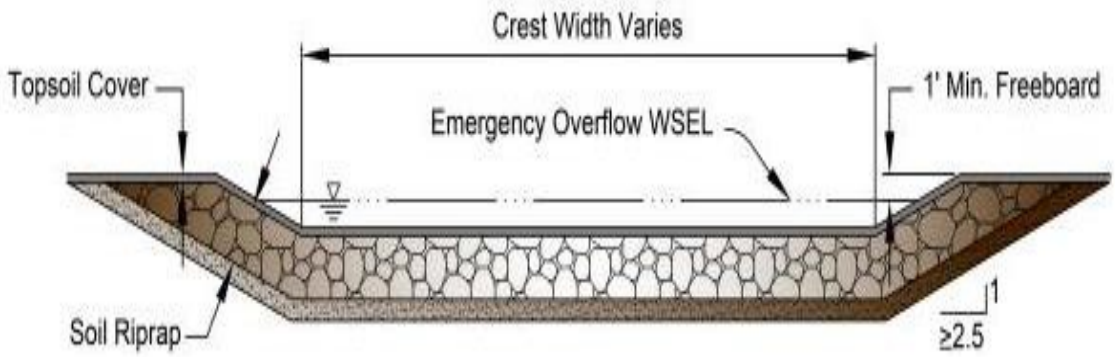
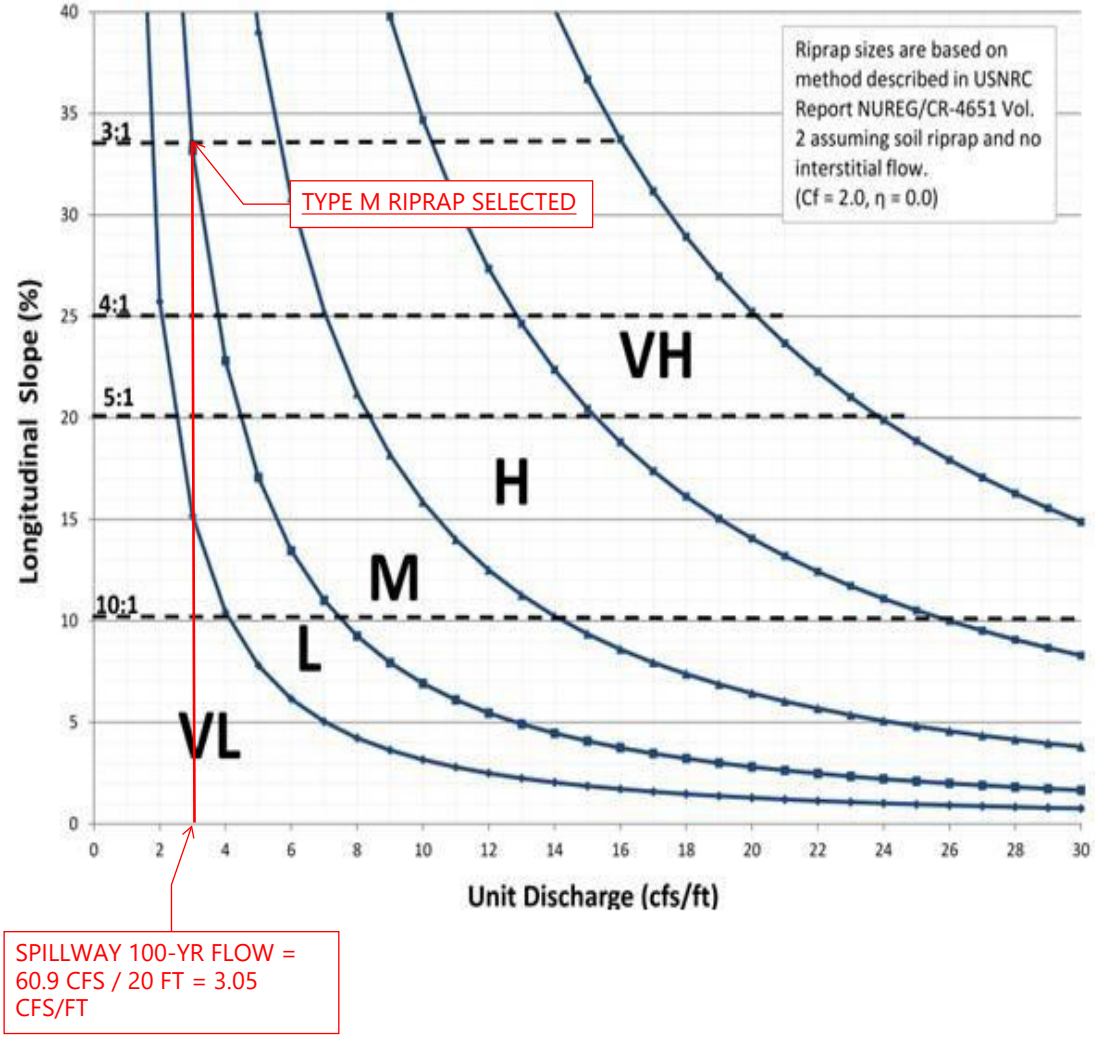


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Project: The North Ranch
Project No: 26001
Date: 8/28/2026

Forebay Sizing (Per USDCM Volume 3, Table 4-12)				
WQCV (ac-ft)	1% WQCV (ft^3)	Forebay Area (ft^2)	Forebay Depth (ft)	Forebay Volume (ft^3)
0.296	129	65	2	130

Forebay Notch Sizing (Per USDCM Volume 3 Equation 4-1)			
$w=9.23(A_{FB}/t)(1/sqrt(h_{max}))$			
A_{FB} (ft^2)	t (s)	h_{max} (ft)	w_{min} (in)
65	240	2	1.77

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Pond 1 Trickle Channel Sizing (1% of Peak 100 Year Inflow = 0.41 cfs)

Rectangular

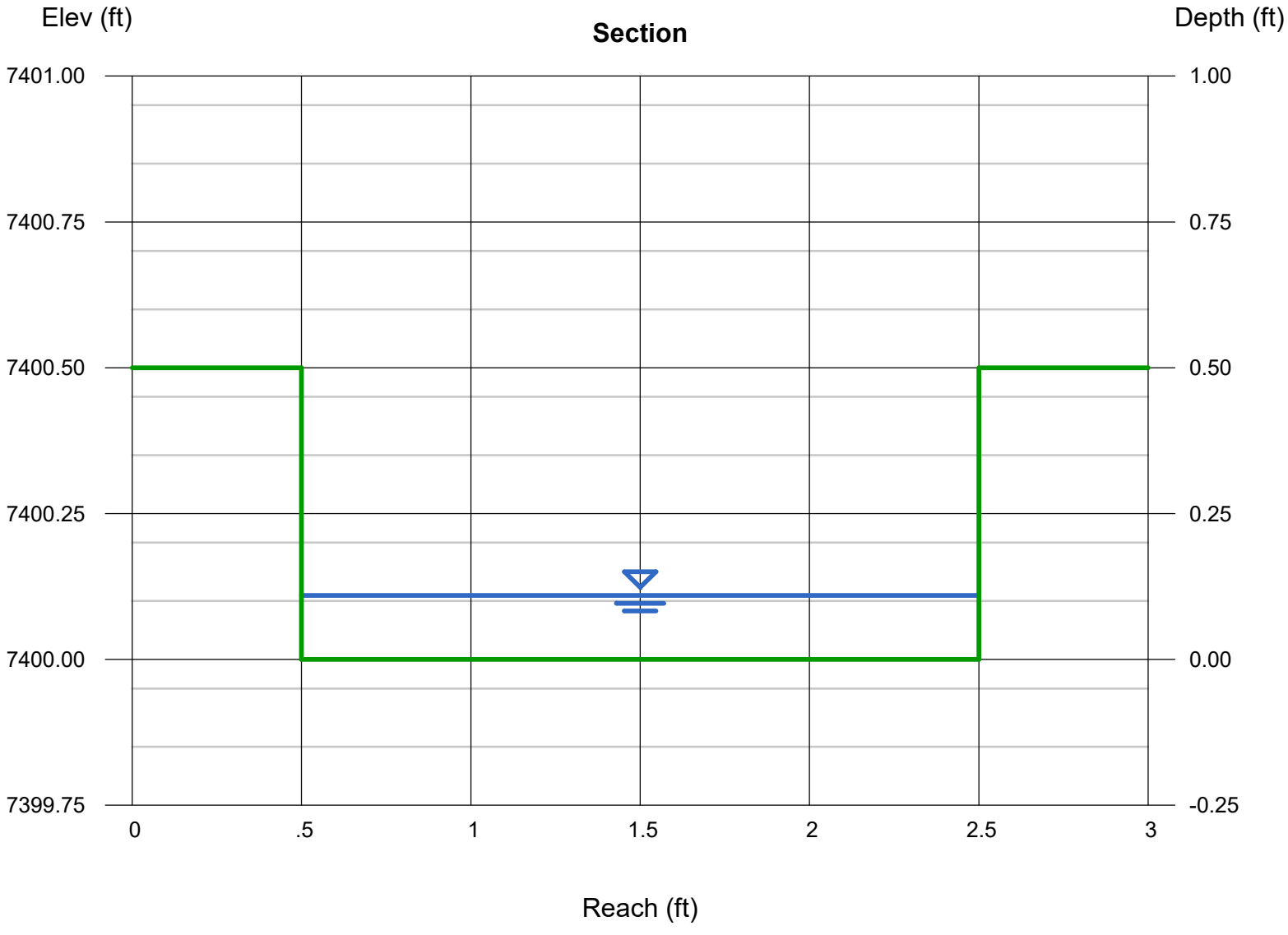
Bottom Width (ft)	= 2.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 7400.00
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.41

Highlighted

Depth (ft)	= 0.11
Q (cfs)	= 0.410
Area (sqft)	= 0.22
Velocity (ft/s)	= 1.86
Wetted Perim (ft)	= 2.22
Crit Depth, Yc (ft)	= 0.11
Top Width (ft)	= 2.00
EGL (ft)	= 0.16



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 4 Swale - Max. Slope Q100 = 10.5 cfs

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 6.00
N-Value	= 0.030

Calculations

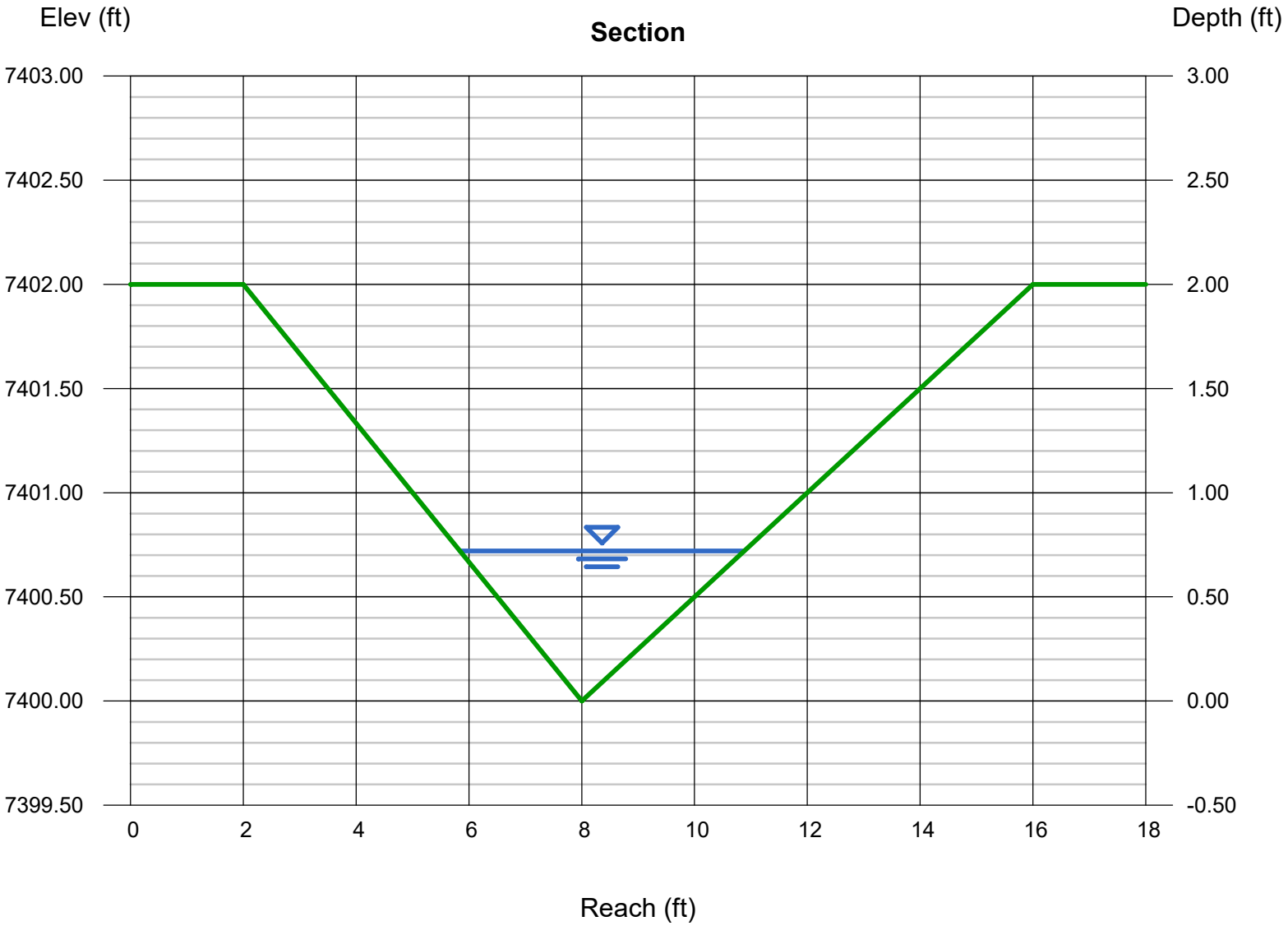
Compute by:	Known Q
Known Q (cfs)	= 10.50

Highlighted

Depth (ft)	= 0.72
Q (cfs)	= 10.50
Area (sqft)	= 1.81
Velocity (ft/s)	= 5.79
Wetted Perim (ft)	= 5.25
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 5.04
EGL (ft)	= 1.24
Froude #	= 1.20

ARMORING REQUIRED

consider check dams to reduce velocity here as well.



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 4 Swale - Min. Slope Q100 = 10.5 cfs

Triangular

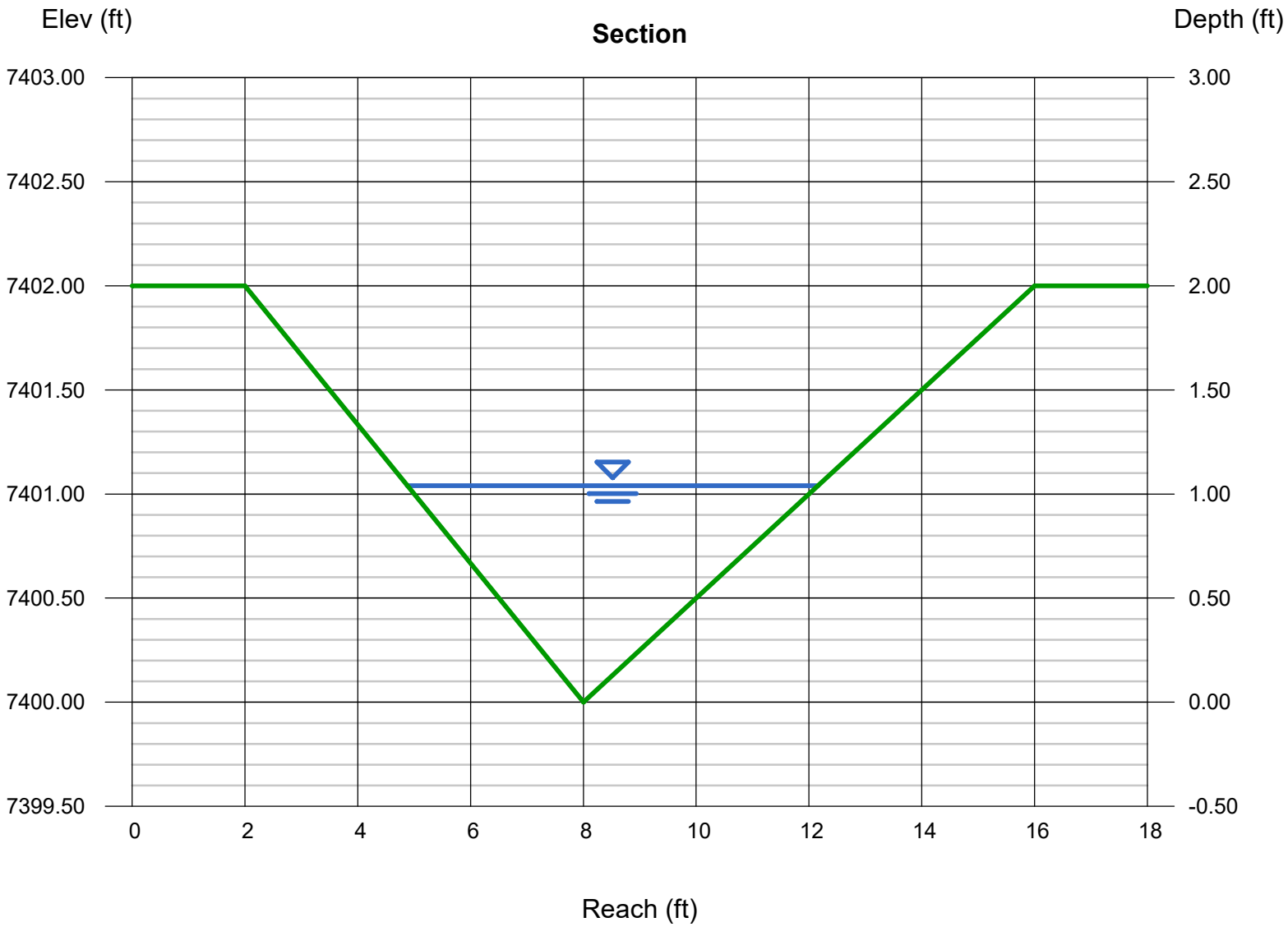
Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 0.80
N-Value	= 0.030

Calculations

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

Highlighted

Depth (ft)	= 1.04
Q (cfs)	= 10.50
Area (sqft)	= 3.79
Velocity (ft/s)	= 2.77
Wetted Perim (ft)	= 7.58
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 7.28
EGL (ft)	= 1.16
Froude #	= 0.47



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 12 Swale - Max. Slope Q100 = 4.9 cfs

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 12.00
N-Value	= 0.030

Calculations

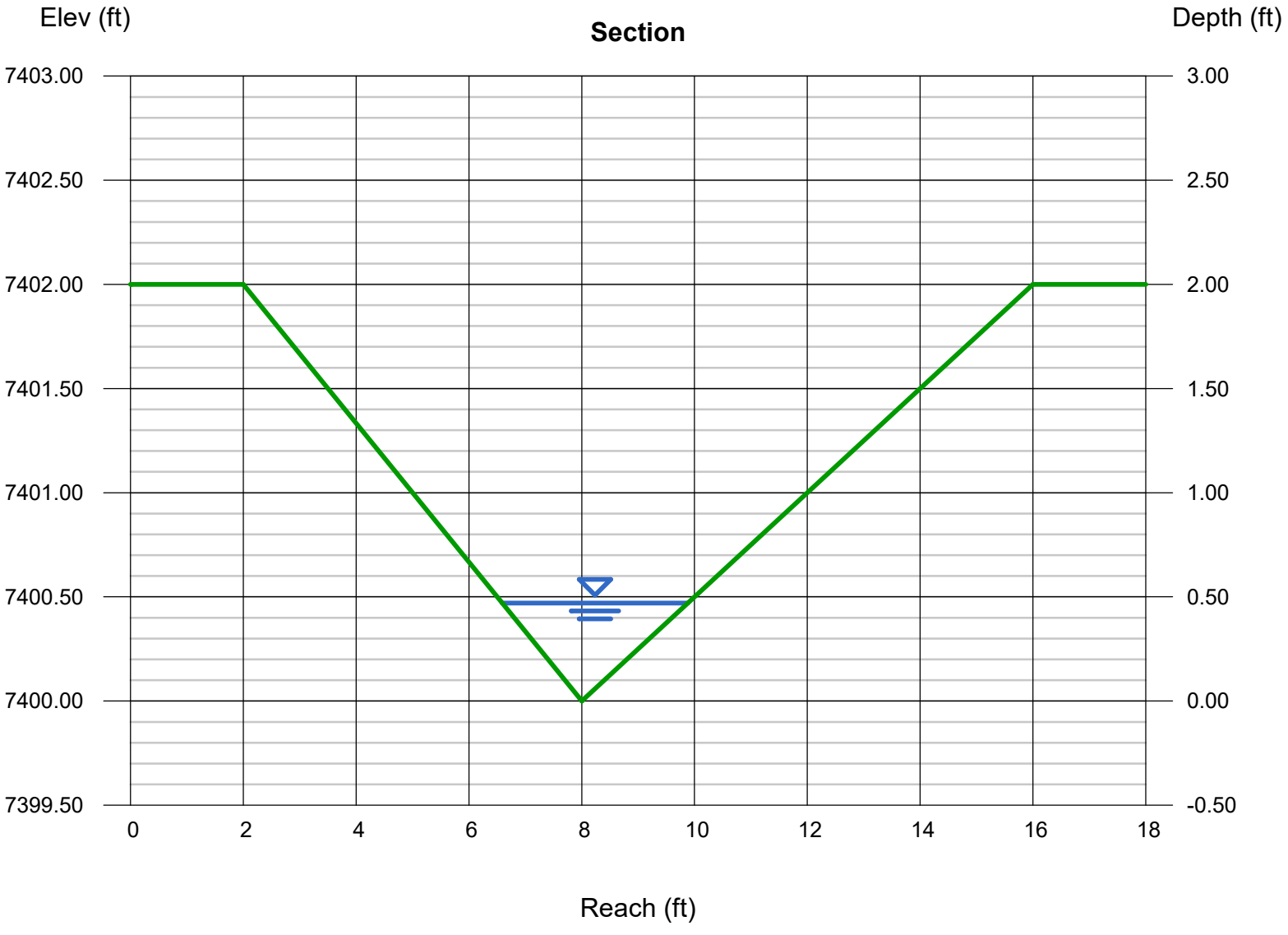
Compute by:	Known Q
Known Q (cfs)	= 4.90

Highlighted

Depth (ft)	= 0.47
Q (cfs)	= 4.900
Area (sqft)	= 0.77
Velocity (ft/s)	= 6.34
Wetted Perim (ft)	= 3.42
Crit Depth, Yc (ft)	= 0.66
Top Width (ft)	= 3.29
EGL (ft)	= 1.09
Froude #	= 1.62

ARMORNING REQUIRED

consider check dams



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 12 Swale - Min. Slope Q100 = 4.9 cfs

Triangular

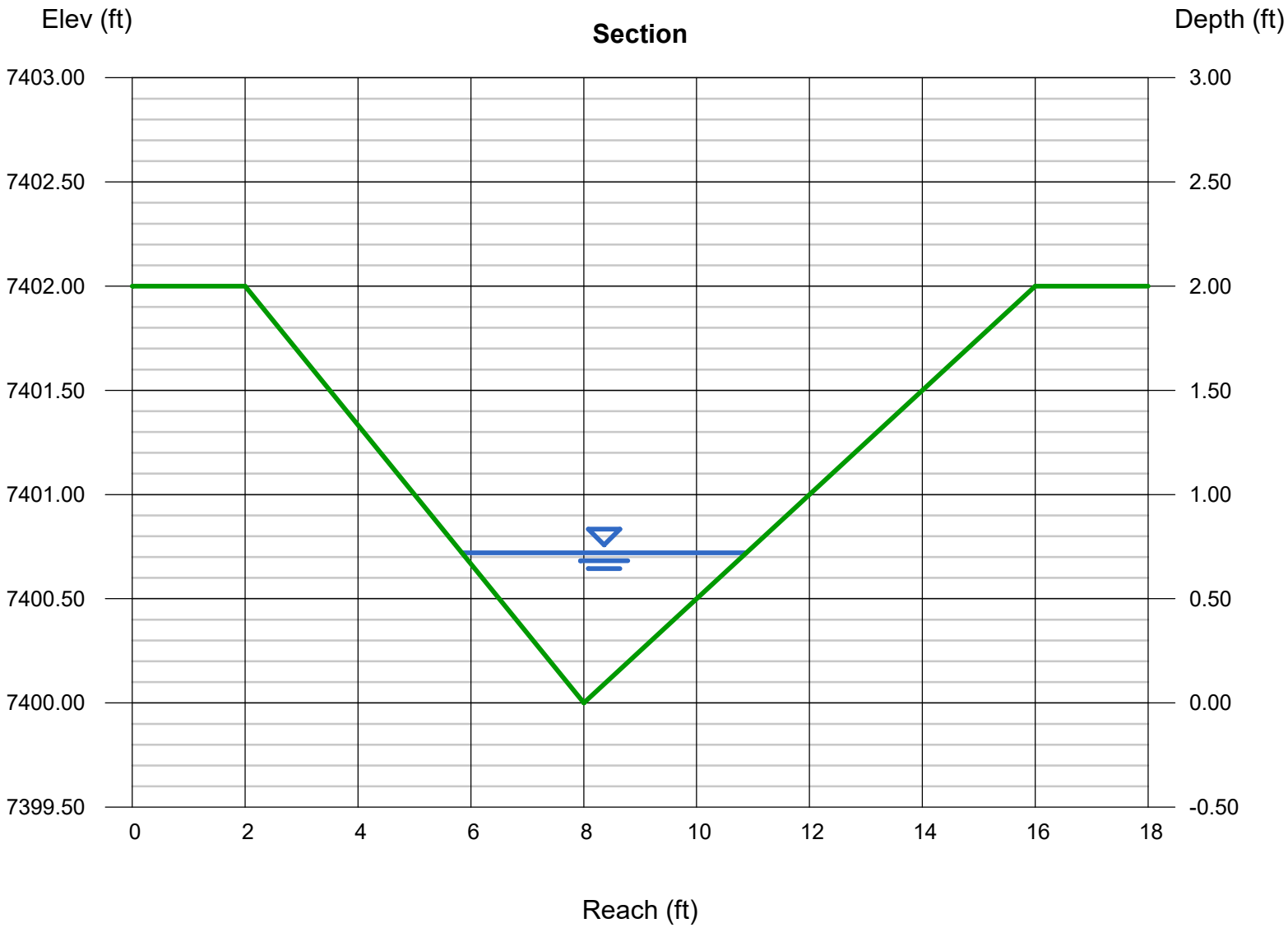
Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 1.23
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.90

Highlighted

Depth (ft)	= 0.72
Q (cfs)	= 4.900
Area (sqft)	= 1.81
Velocity (ft/s)	= 2.70
Wetted Perim (ft)	= 5.25
Crit Depth, Yc (ft)	= 0.66
Top Width (ft)	= 5.04
EGL (ft)	= 0.83
Froude #	= 0.56



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 5 Swale - Avg. Slope Q100 = 5.8 cfs

Triangular

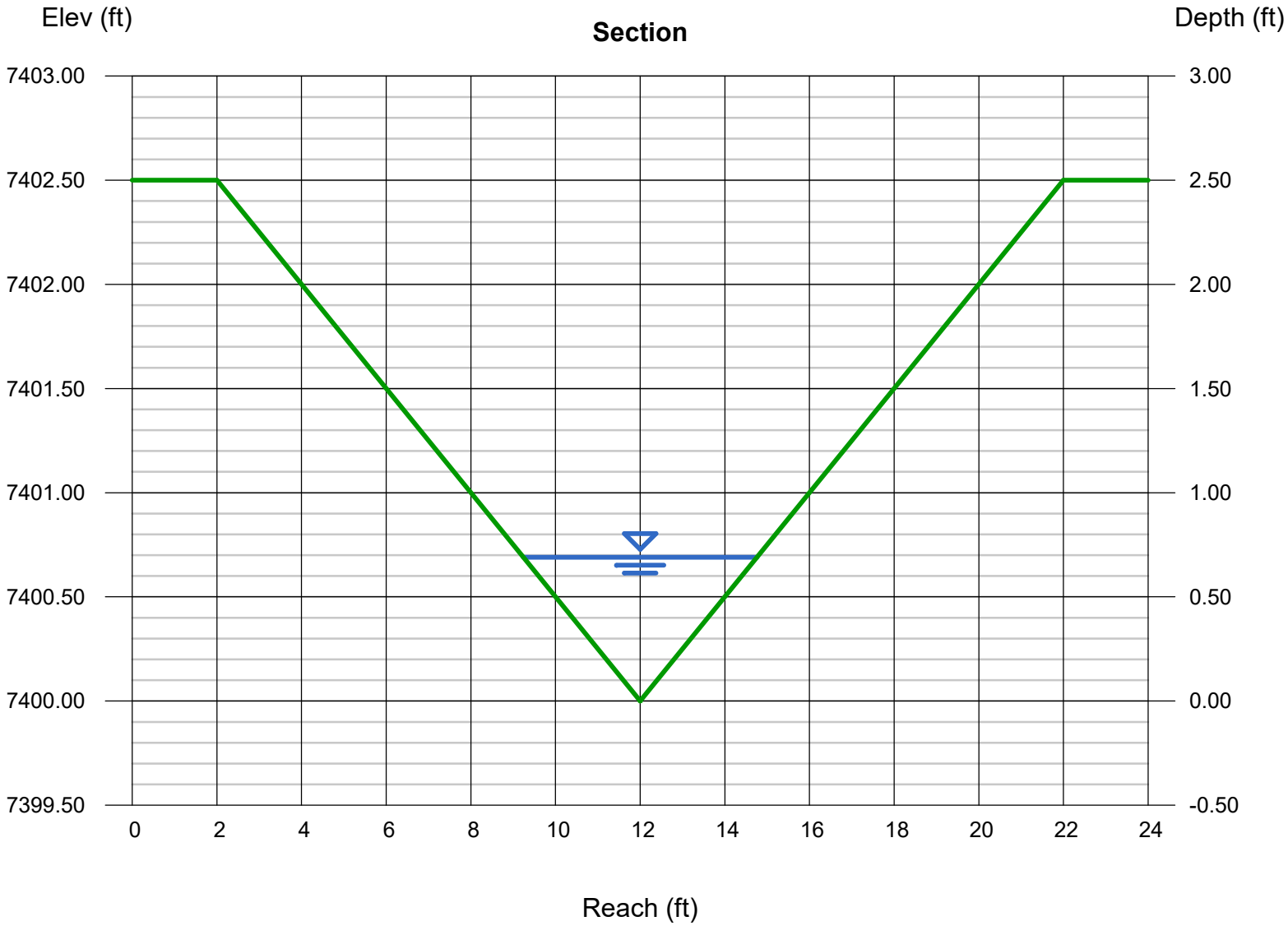
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 7400.00
Slope (%)	= 2.30
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.80

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 5.800
Area (sqft)	= 1.90
Velocity (ft/s)	= 3.05
Wetted Perim (ft)	= 5.69
Crit Depth, Yc (ft)	= 0.67
Top Width (ft)	= 5.52
EGL (ft)	= 0.83
Froude #	= 0.74



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 5.1 Swale - Avg. Slope Q100 = 2.2 cfs

Triangular

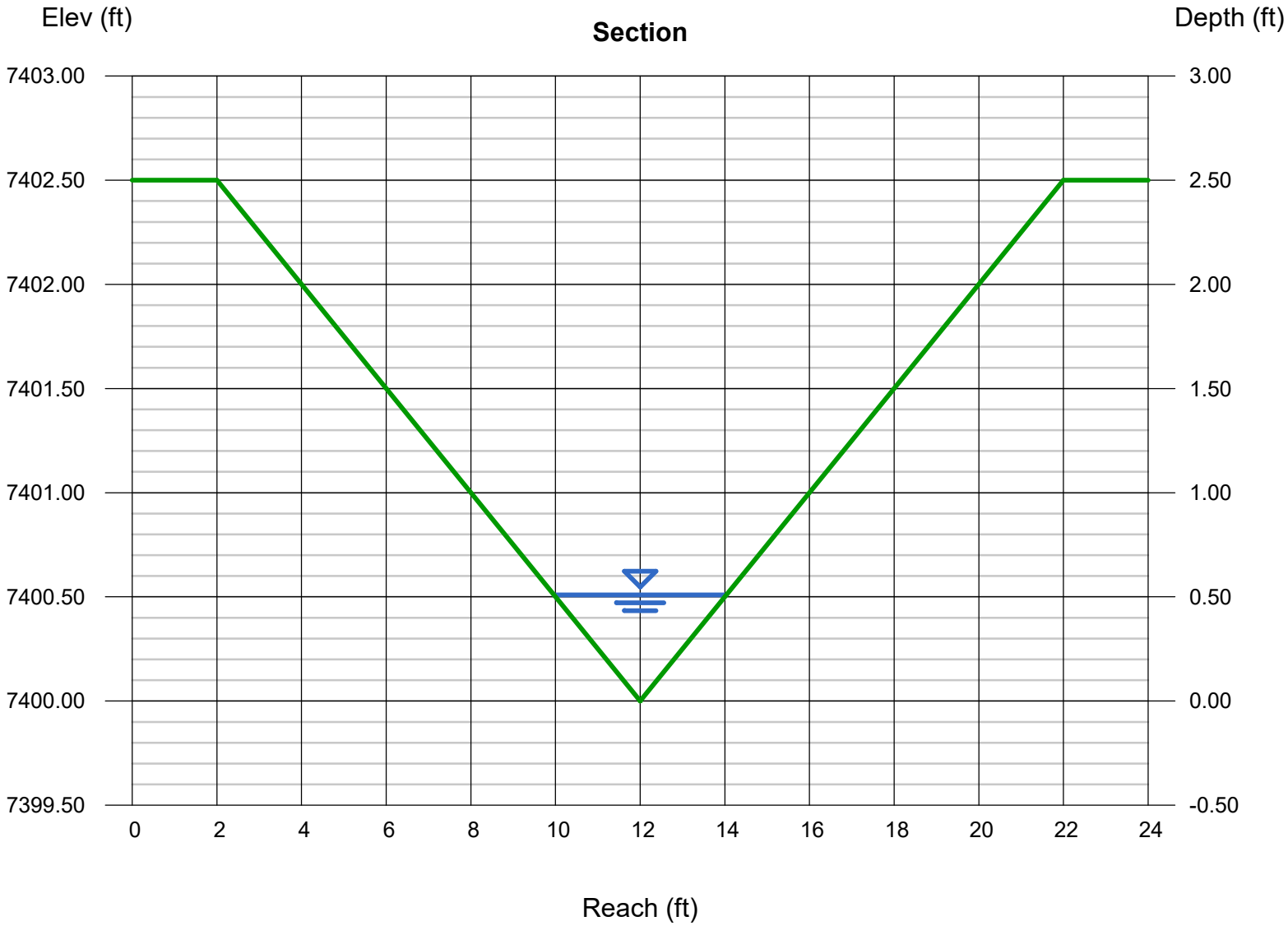
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 7400.00
Slope (%)	= 1.65
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.20

Highlighted

Depth (ft)	= 0.51
Q (cfs)	= 2.200
Area (sqft)	= 1.04
Velocity (ft/s)	= 2.11
Wetted Perim (ft)	= 4.21
Crit Depth, Yc (ft)	= 0.46
Top Width (ft)	= 4.08
EGL (ft)	= 0.58
Froude #	= 0.52



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 5.2 Swale - Avg. Slope Q100 = 2.0 cfs

Triangular

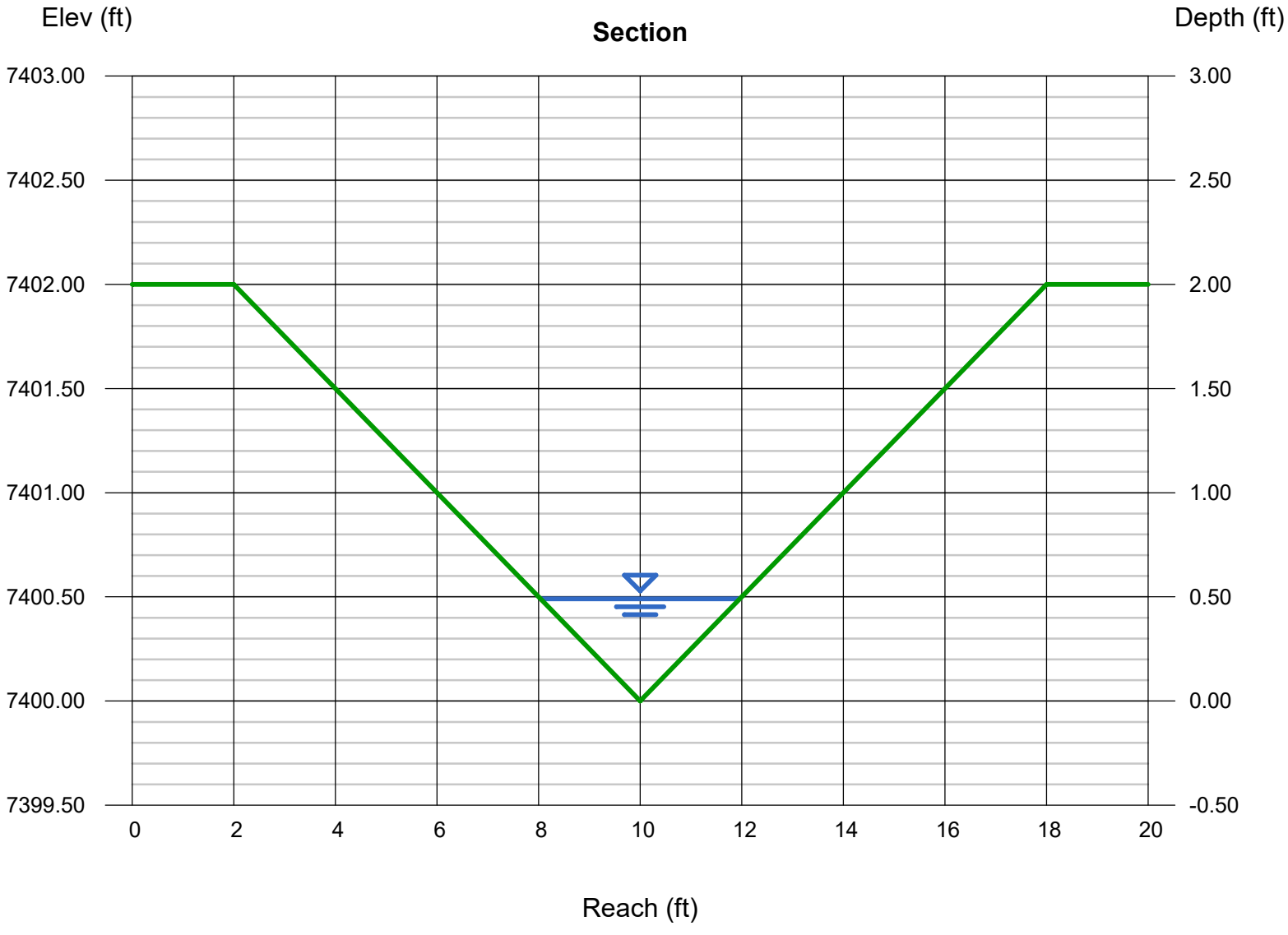
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 1.65
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.00

Highlighted

Depth (ft)	= 0.49
Q (cfs)	= 2.000
Area (sqft)	= 0.96
Velocity (ft/s)	= 2.08
Wetted Perim (ft)	= 4.04
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 3.92
EGL (ft)	= 0.56
Froude #	= 0.52



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 10 Swale - Avg. Slope Q100 = 32.7 cfs (DPL + Basin 10)

Triangular

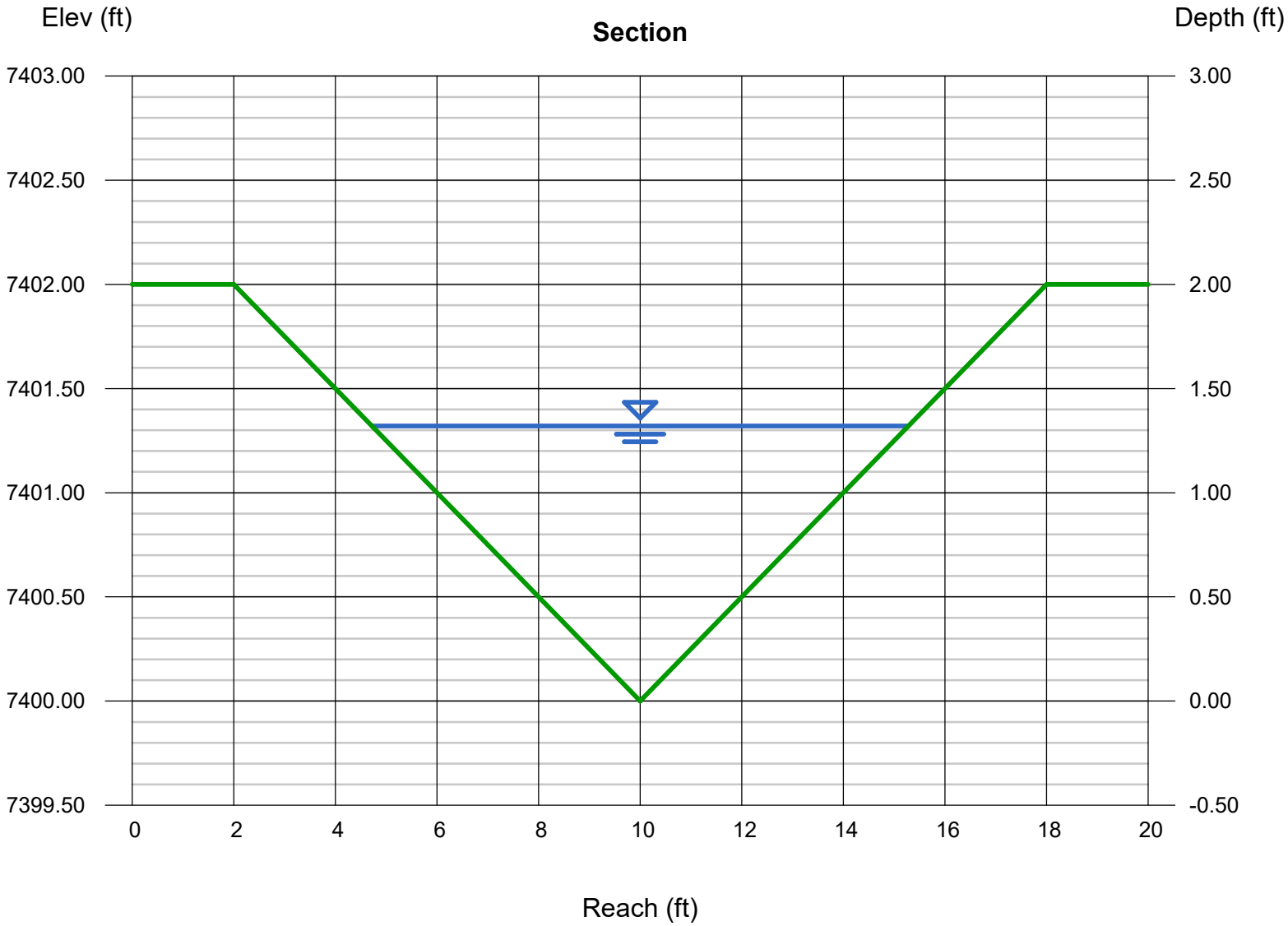
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 2.26
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 32.70

Highlighted

Depth (ft)	= 1.32
Q (cfs)	= 32.70
Area (sqft)	= 6.97
Velocity (ft/s)	= 4.69
Wetted Perim (ft)	= 10.88
Crit Depth, Yc (ft)	= 1.33
Top Width (ft)	= 10.56
EGL (ft)	= 1.66
Froude #	= 0.72



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 14 Swale - Avg. Slope Q100 = 2.0

Triangular

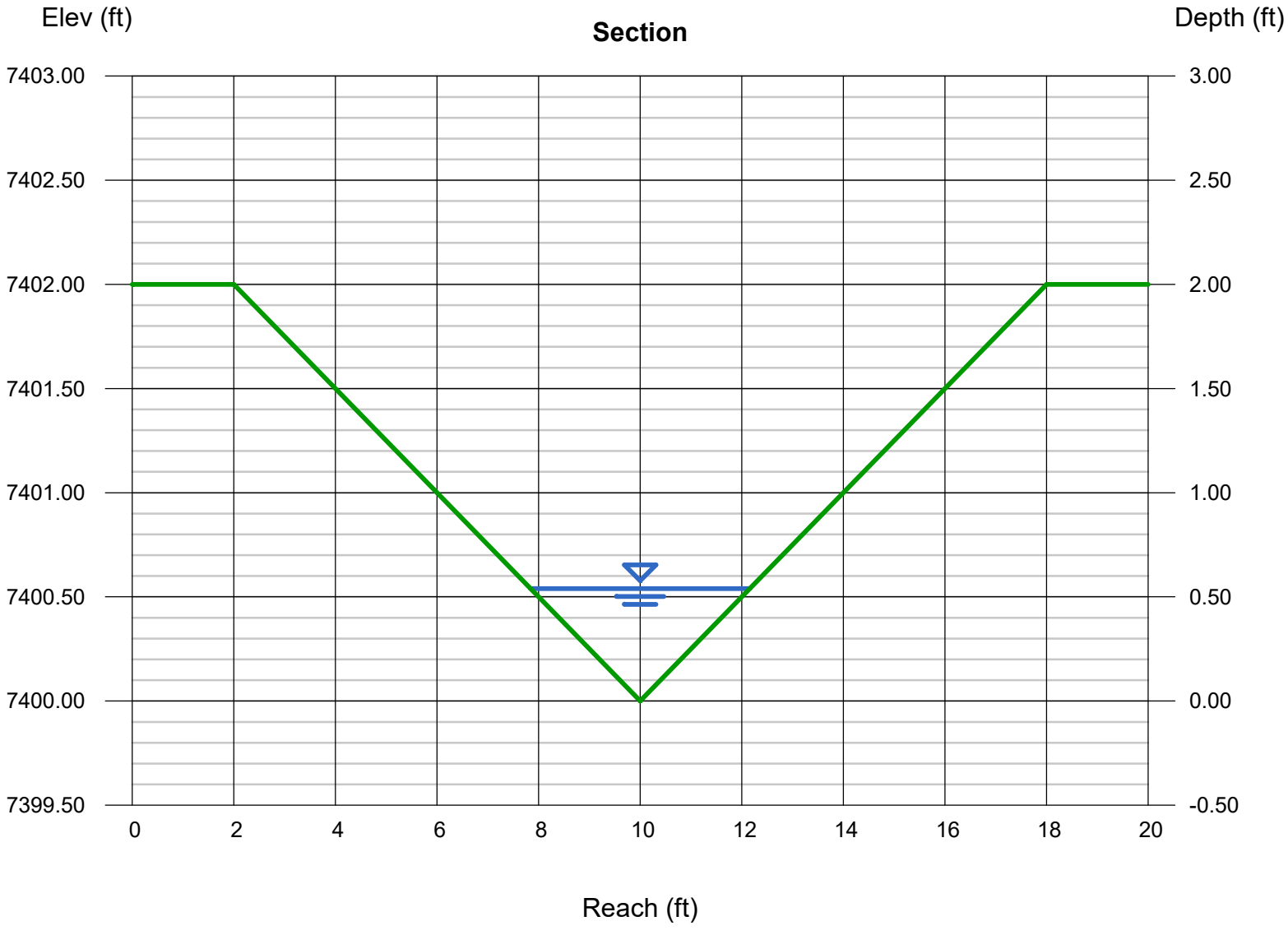
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 1.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.00

Highlighted

Depth (ft)	= 0.54
Q (cfs)	= 2.000
Area (sqft)	= 1.17
Velocity (ft/s)	= 1.71
Wetted Perim (ft)	= 4.45
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 4.32
EGL (ft)	= 0.59
Froude #	= 0.41



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 28 2026

Basin 15 Swale - Avg. Slope Q100 = 31.0 cfs (DPT)

Triangular

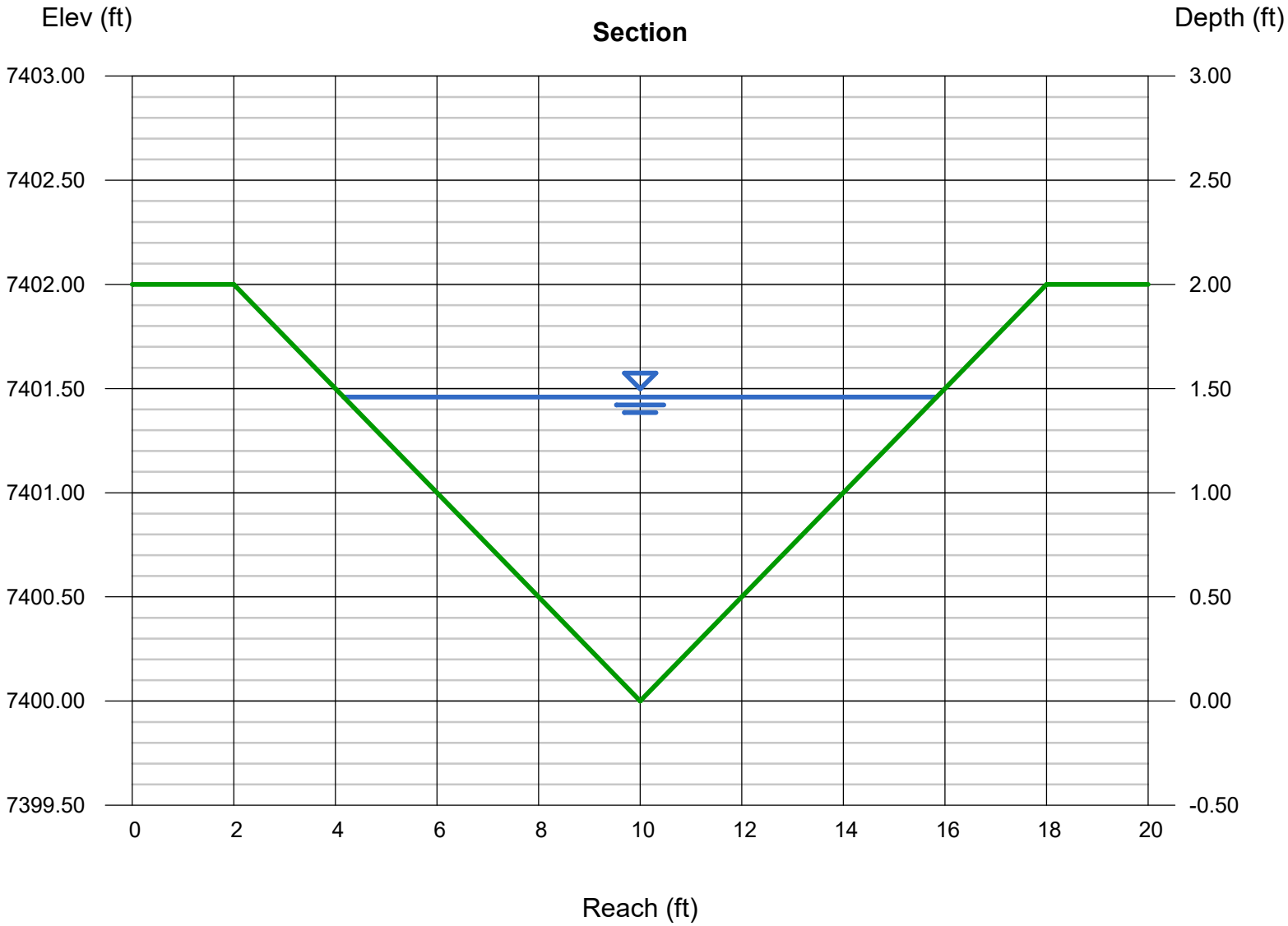
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7400.00
Slope (%)	= 1.20
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 31.00

Highlighted

Depth (ft)	= 1.46
Q (cfs)	= 31.00
Area (sqft)	= 8.53
Velocity (ft/s)	= 3.64
Wetted Perim (ft)	= 12.04
Crit Depth, Yc (ft)	= 1.31
Top Width (ft)	= 11.68
EGL (ft)	= 1.67
Froude #	= 0.53



ALL TERRAIN ENGINEERING

The North Ranch - Culvert Outfall Riprap Sizing

Location	Ss	Velocity (ft/s)	Slope (ft/ft)	d_{50} (calc) (in)	d_{50} (selected) (in)	Designation	Depth
DPA Outfall	2.5	4.77	0.25	2.9	6"	TYPE VL	12"
DPC Outfall	2.5	6.84	0.039	3.0	6"	TYPE VL	12"
DPF Outfall	2.5	7.27	0.057	3.4	6"	TYPE VL	12"
DPH Outfall	2.5	4.87	0.093	2.5	6"	TYPE VL	12"
DPL Outfall	2.5	6.14	0.029	2.6	6"	TYPE VL	12"
DPM Outfall	2.5	6.84	0.005	2.1	6"	TYPE VL	12"

$$\frac{VS^{0.17}}{(S_s-1)^{0.66}} = 1.0$$

Where:

V = mean channel flow velocity, in fps;

S = longitudinal channel slope, in feet per foot (ft/ft); and

S_s = specific gravity of stone (minimum S_s = 2.50)

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18
*D_{50} = MEAN ROCK SIZE			

Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)

MHFD USDCM Figure 8-34

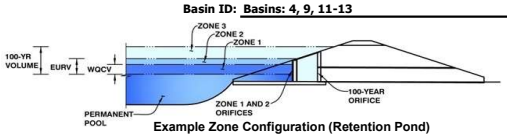
APPENDIX D – WATER QUALITY & DETENTION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Needles Subdivision

Basin ID: Basins: 4, 9, 11-13



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	23.82	acres
Watershed Length =	1,337	ft
Watershed Length to Centroid =	410	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	29.20%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.296	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.712	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.93 in.) =	0.421	acre-feet	0.93	inches
5-yr Runoff Volume (P1 = 1.21 in.) =	0.702	acre-feet	1.21	inches
10-yr Runoff Volume (P1 = 1.46 in.) =	1.059	acre-feet	1.46	inches
25-yr Runoff Volume (P1 = 1.85 in.) =	1.916	acre-feet	1.85	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	2.514	acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.298	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.42 in.) =	5.071	acre-feet	3.42	inches
Approximate 2-yr Detention Volume =	0.395	acre-feet		
Approximate 5-yr Detention Volume =	0.588	acre-feet		
Approximate 10-yr Detention Volume =	0.892	acre-feet		
Approximate 25-yr Detention Volume =	1.152	acre-feet		
Approximate 50-yr Detention Volume =	1.266	acre-feet		
Approximate 100-yr Detention Volume =	1.556	acre-feet		

Define Zones and Basin Geometry

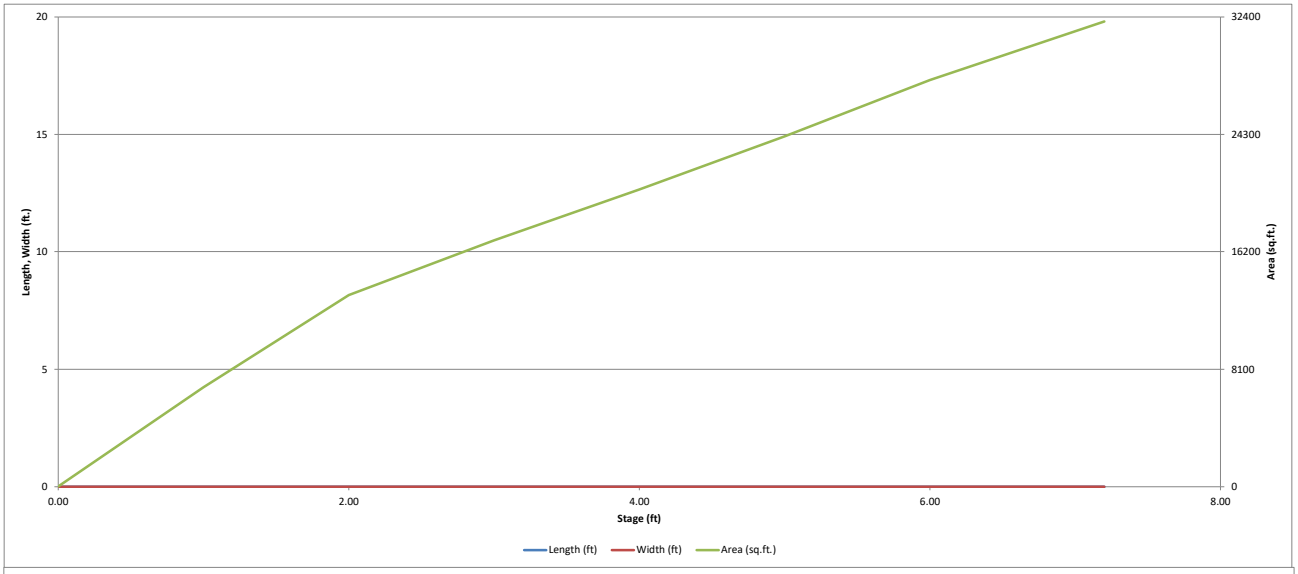
Zone 1 Volume (WQCV) =	0.296	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.417	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.844	acre-feet
Total Detention Basin Volume =	1.556	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

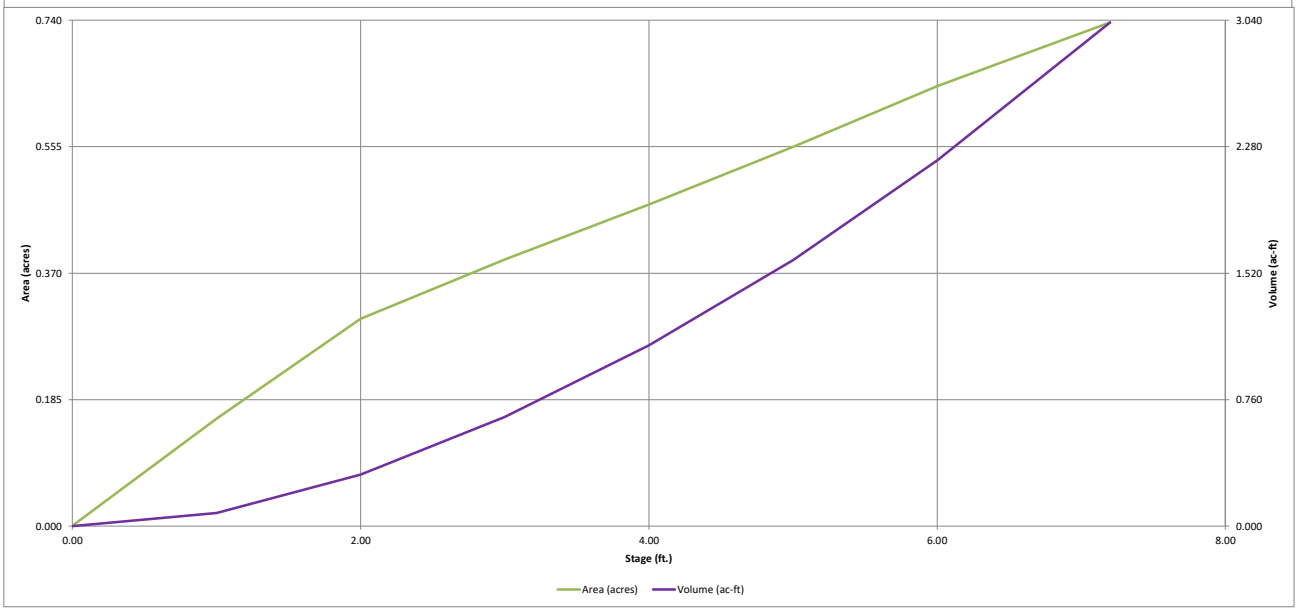
Depth Increment = ft

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	--	--	--	20	0.000		
	--	1.00	--	--	--	6,854	0.157	3,437	0.079
	--	2.00	--	--	--	13,211	0.303	13,469	0.309
	--	3.00	--	--	--	16,984	0.390	28,567	0.656
	--	4.00	--	--	--	20,484	0.470	47,301	1.086
	--	5.00	--	--	--	24,168	0.555	69,627	1.598
	--	6.00	--	--	--	28,036	0.644	95,729	2.198
	--	7.20	--	--	--	32,088	0.737	131,803	3.026

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



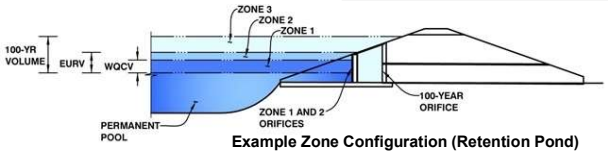


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Needles Subdivision**

Basin ID: **Basins: 4, 9, 11-13**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.96	0.296	Orifice Plate
Zone 2 (EURV)	3.15	0.417	Orifice Plate
Zone 3 (100-year)	4.93	0.844	Weir&Pipe (Restrict)
Total (all zones)		1.556	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.375E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.15	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.98	sq. inches (diameter = 1-9/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.08	2.10					
Orifice Area (sq. inches)	1.98	1.98	1.98					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.25	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	11.15	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	25.06	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	12.53	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	2.25	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.67	N/A	feet
Restrictor Plate Height Above Pipe Invert =	14.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.50	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.91	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	7.16	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.73	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.00	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	0.93	1.21	1.46	1.85	2.17	2.52	3.42
CUHP Runoff Volume (acre-ft) =	0.296	0.712	0.421	0.702	1.059	1.916	2.514	3.298	5.071
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.421	0.702	1.059	1.916	2.514	3.298	5.071
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	3.5	9.2	24.9	34.2	45.7	72.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.15	0.39	1.05	1.43	1.92	3.03
Peak Inflow Q (cfs) =	N/A	N/A	7.4	12.8	19.9	35.9	47.0	60.9	91.5
Peak Outflow Q (cfs) =	0.2	0.3	0.2	0.3	3.8	19.8	26.5	28.2	58.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.4	0.8	0.8	0.6	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.8	1.0	1.1	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	57	46	58	60	54	51	47	41
Time to Drain 99% of Inflow Volume (hours) =	**40**	61	49	62	65	63	62	60	56
Maximum Ponding Depth (ft) =	1.96	3.15	2.26	3.01	3.45	3.88	4.18	4.95	5.83
Area at Maximum Ponding Depth (acres) =	0.30	0.40	0.33	0.39	0.43	0.46	0.49	0.55	0.63
Maximum Volume Stored (acre-ft) =	0.297	0.715	0.391	0.660	0.839	1.030	1.172	1.571	2.083

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	0.05	0.01	0.42
	0:15:00	0.00	0.00	0.34	0.79	1.11	0.89	1.24	1.30	2.12
	0:20:00	0.00	0.00	1.83	2.63	3.80	2.36	2.94	3.64	6.96
	0:25:00	0.00	0.00	5.58	9.04	14.19	7.70	10.25	12.83	28.06
	0:30:00	0.00	0.00	7.36	12.78	19.88	29.67	40.28	49.79	77.87
	0:35:00	0.00	0.00	6.84	11.82	18.11	35.91	47.04	60.91	91.48
	0:40:00	0.00	0.00	6.05	10.03	15.34	34.93	45.13	57.79	86.07
	0:45:00	0.00	0.00	5.03	8.47	12.94	30.44	39.30	52.13	77.46
	0:50:00	0.00	0.00	4.17	7.21	10.65	27.04	34.87	45.89	67.96
	0:55:00	0.00	0.00	3.46	5.96	8.78	21.92	28.39	38.72	57.53
	1:00:00	0.00	0.00	3.00	5.12	7.56	17.90	23.45	33.39	50.08
	1:05:00	0.00	0.00	2.68	4.55	6.71	15.24	20.19	29.93	45.06
	1:10:00	0.00	0.00	2.27	4.04	5.92	12.45	16.46	23.75	36.21
	1:15:00	0.00	0.00	1.89	3.38	5.15	10.04	13.23	18.43	28.55
	1:20:00	0.00	0.00	1.54	2.67	4.16	7.62	9.96	13.38	20.53
	1:25:00	0.00	0.00	1.24	2.09	3.14	5.52	7.15	9.11	14.05
	1:30:00	0.00	0.00	1.04	1.76	2.53	3.84	5.06	6.29	9.98
	1:35:00	0.00	0.00	0.95	1.60	2.19	2.85	3.83	4.63	7.53
	1:40:00	0.00	0.00	0.91	1.39	1.96	2.25	3.07	3.58	5.88
	1:45:00	0.00	0.00	0.88	1.23	1.80	1.86	2.56	2.85	4.75
	1:50:00	0.00	0.00	0.87	1.11	1.68	1.62	2.24	2.35	3.97
	1:55:00	0.00	0.00	0.76	1.03	1.53	1.46	2.02	2.00	3.41
	2:00:00	0.00	0.00	0.67	0.93	1.34	1.35	1.88	1.79	3.07
	2:05:00	0.00	0.00	0.51	0.69	0.99	0.99	1.37	1.30	2.22
	2:10:00	0.00	0.00	0.38	0.51	0.71	0.71	0.98	0.94	1.58
	2:15:00	0.00	0.00	0.28	0.37	0.51	0.51	0.71	0.68	1.14
	2:20:00	0.00	0.00	0.20	0.27	0.36	0.36	0.50	0.49	0.82
	2:25:00	0.00	0.00	0.15	0.18	0.26	0.25	0.35	0.34	0.57
	2:30:00	0.00	0.00	0.10	0.13	0.18	0.18	0.25	0.24	0.39
	2:35:00	0.00	0.00	0.07	0.09	0.12	0.12	0.17	0.16	0.26
	2:40:00	0.00	0.00	0.05	0.06	0.08	0.08	0.11	0.10	0.16
	2:45:00	0.00	0.00	0.03	0.03	0.04	0.04	0.06	0.05	0.08
	2:50:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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

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

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Email: Stormwater@elpasoco.com
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EL PASO COUNTY
PCM APPLICABILITY FORM

EPC Project Number: _____

This form is to be used by the Engineer of Record to determine if the proposed construction activities are eligible for an exclusion to stormwater quality permanent control measure (PCM) requirements. All "applicable construction activity" within El Paso County (EPC) must comply with the post-construction stormwater management criteria. Reference ECM Appendix I for information about PCMs.

Note that this form only addresses stormwater quality for the site. Even if the site is fully excluded from needing a stormwater quality PCM, the site may still need to address stormwater detention (per DCMv1 Chap 1.5 and ECM Chap 3.2.8.B). However, if the site requires stormwater detention, then it must also address stormwater quality (per DCMv2 Chap 4.1 and ECM Appendix I.7.3). Refer to the Reference Information pages below for more guidance.

Part I. Project Summary			
Project Name:	The North Ranch Subdivision		
Is Stormwater Detention Required?	☒ Yes ☐ No	**Is Water Quality Treatment Required? (i.e.: non-excluded disturbance >1ac)**	☒ Yes ☐ No
Is an ESQCP Required? If "No," Check Applicable Reason	☒ Yes ☐ No	☐ Not an Applicable Construction Activity ☐ Oil & Gas ☐ R-Factor	
Engineer of Record Email Address:	NJOKERST@ALLTERRAINENG.COM		

Part II. PCM Exclusions

Note: Questions A through K directly correlate to Part I.E.4.a.i (A) to (K) on page 27 of the 2016 CDPS Statewide Standard MS4 General Permit COR090000 (i.e.: the MS4 Permit), as amended. Document exclusions that apply to the whole project or parts of it.

Questions	Excluded Acreage	Yes	No	Notes
A. Is this project a "Pavement Management Site?"			X	This exclusion applies to the maintenance, rehabilitation, and reconstruction of pavement on existing roads, bridges, bike lanes, and parking along roads. Areas used primarily for parking (i.e.: separate lots not along roadway) or access to parking are not included. No increase in impervious area is allowable.
B. Review two options below to see if project is an "Excluded Roadway Development."				Does not include sidewalks. Does include curb & gutter.
• Does the project include improvements to an existing roadway that adds < 1 acre of paved or gravel area per mile of roadway?			X	If selected, list the proposed additional acreage per mile in Part IV Notes below.
• Does the project include improvements to an existing roadway that adds ≤ 8.25 ft of paved width at any location?			X	If selected, list the proposed additional width in Part IV Notes below.

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EL PASO COUNTY
PCM APPLICABILITY FORM

EPC Project Number: _____

Part II. PCM Exclusions (continued)				
Questions	**Excluded Acreage**	**Yes**	**No**	**Notes**
C. Does the project include "Excluded Existing Roadway Areas?"			X	For redevelopment of existing roadways. This exclusion only excludes the original roadway area, it does NOT apply to the entire project. This exclusion applies only when the proposed project will expand the existing roadway width by <2x on average. If selected, list the proposed expanded width in Part IV Notes below.
D. Is the project considered an Aboveground or Underground Utilities activity?			X	Activity can not permanently alter the terrain, ground cover, or drainage patterns from existing conditions.
E. Is the project considered a "Large Lot Single-Family Site"? *This exclusion only pertains to the lots and does not include roadways.*	46.16 ac	X		Must be a single-family residential lot or agricultural zoned land with ≥ 2.5 acres per dwelling and total lot impervious area < 10%. If "Yes," notate the percent impervious below in Part IV: Notes.
F. Do Non-Residential or Non-Commercial Infiltration Conditions exist? *Post-development surface conditions do not result in concentrated stormwater flow or surface water discharge during an 80th percentile stormwater runoff event, and the 80th percentile event must be infiltrated.*			X	Exclusion does not apply to residential or commercial sites for buildings. A site-specific study is required and must show rainfall and soil conditions, allowable slopes, surface conditions, and ratios of imperviousness area to pervious area.
G. Is the project land disturbance to Undeveloped Land where undeveloped land remains undeveloped following the activity?		X		Project must be on land with no human made structures such as buildings or pavement. The proposed development must return the disturbed area to its historical condition. See CDPHE's "Standard MS4 Permit FAQ" for more detail on how this exclusion applies.
H. Is the project a Stream Stabilization Site?			X	
I. Is the project a Bike or Pedestrian Trail?			X	Bike lanes for roadways are not included in this exclusion but may qualify if attached to a larger roadway activity that is excluded in A, B or C above. Pedestrian trails (e.g. sidewalks) that are attached to a roadway do not apply.
J. Is the project Oil and Gas Exploration?			X	Activities and facilities associated with oil and gas exploration are excluded.
K. Is the project in a County Growth Area?				El Paso County does not apply this exclusion.

If any exclusions above apply (via a "Yes" for any row), runoff from those areas is excluded from stormwater quality treatment requirements. All runoff from remaining non-excluded disturbed areas will need to be treated by a stormwater quality PCM, unless remaining area is <1ac. If remaining area is >1ac, select at least one Design Standard on the next page.

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EL PASO COUNTY
PCM APPLICABILITY FORM

EPC Project Number: _____

Part III: PCM Information		
Questions	**Yes**	**No**
1. Which of the following Design Standard(s) will the project utilize? *(If a PCM is required, you must select at least one. See Control Measure Requirements identified in MS4 Permit Part I.E.4.a.iv on page 29.)*		
A. Water Quality Capture Volume (WQCV) Standard	X	
B. Pollutant Removal Standard - 80% Total Suspended Solids Removal (TSS) *(must treat runoff to <30mg/L of TSS)*		
C. Runoff Reduction Standard		
D. Applicable Development Site Draining to a Regional WQCV Control Measure *(no conveyance via "Waters of the State")*		
E. Applicable Development Site Draining to a Regional WQCV Facility *(conveyance allowable via "Waters of the State," if the 8 conditions in the MS4 permit are met and documented in the drainage report)*		
F. Constrained Redevelopment Sites Standard *(must be pre-approved by ECM Administrator)*		
G. Previous Permit Term Standard		
2. Will any of the PCMs be located within any other jurisdiction besides EPC?		X

Part IV: Notes

Provide info regarding all applicable PCM(s) and PCM Exclusion(s) including location, PCM name(s)/number(s), and additional relevant filings or reports or maintenance agreements, etc. Attach an additional sheet if you need more space. Attaching a detailed summary table would replace the need for any notes here.

The site area is 48.23 acres. The site will be subdivided into (15) 2.5+ acre lots, (1) drainage tract (where a FSD WQ & detention pond will be located) and (1) private road & drainage tract.

The total lot area is 46.16 ac. 2.5+ acre lots are excluded from water quality per Part 2, Section E above.

The private roadway is located within the lot area. The total area of paved roadway is 2.91 acres with 0.39 acres of gravel shoulder. Of the total paved area & gravel shoulder, 2.52 acres and 0.34 acres, respectively, will be detained in Pond 1. The remaining 0.39 acres of paved area & 0.05 acres of gravel shoulder are topographically constrained from being captured by Pond 1. However, the total 0.44 acres is less than the 1 acre allowable threshold per EPC ECM Appendix I Section I.6.3.A.1.a and will be excluded from water quality treatment.

The remaining site area will remain undeveloped and not require water quality treatment.

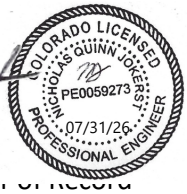
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Colorado Springs, CO 80910
Phone: 719-520-6300
Email: Stormwater@elpasoco.com
publicworks.elpasoco.com/stormwater/

EL PASO COUNTY
PCM APPLICABILITY FORM

EPC Project Number: _____

Part V: Signatures

Applicant: This PCM Applicability Form was prepared under my direction and supervision and is correct to the best of my knowledge and belief. It was prepared along with the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required. And it has been reviewed for compliance with the Post Construction Stormwater Management criteria and MS4 Permit requirements.



_____ _____ 08/26/2026

Signature and Stamp of Engineer of Record — Date

(If the project is not an Applicable Construction Activity, this line can be signed by the Applicant or their rep, they do not have to be an engineer)

El Paso County: This PCM Applicability Form has been reviewed and the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required, have been reviewed for compliance with the Post Construction Stormwater Management process and MS4 Permit requirements.

_____ _____

Signature of El Paso County Project Engineer — Date

APPENDIX E – REFENCE MATERIAL

Drainage Basins

El Paso County
Colorado

Legend

- Drainage Basins Source: Muller Engineering Company (1988)
- US Interstate Highways
- US Highways
- Colorado State Highways
- Major Roadways
- Local Streets & Roads

Creeks

- Perennial
- Intermittent
- Lakes & Reservoirs
- Summits
- Unincorporated Urban Areas
- Incorporated Cities
- Military
- Forest
- County Lines

N W E S

Miles

0 0.5 1 2 3 4 5

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Douglas County
Elbert County
Teller County
Lincoln County
Fremont County
Pueblo County

SITE

Upper Monument Creek FOMO5800
Monument Rock FOMO5000
Dirty Woman Creek FOMO5200
Jackson Creek FOMO4400
Black Forest FOMO4200
Monument Branch FOMO3800
Black Squirrel Creek FOMO3600
West Cherry Creek CYCY0400
East Cherry Creek CYCY0200
West Kiowa Creek KIKI0200
East Kiowa Creek KIKI0400
Bijou Creek BIBI0200
Upper Big Sandy Creek BGBG1400
Lenard BGBG1200
Antelope Creek BGBG0800
Ramah BGBG0600
Simla BGBG0400
Calhan BGBG1000
Mustang Creek BGBG0200
Beaver Creek FOMO4600
Pike National Forest
Air Force Academy FOMO3200
USAF Academy
Kettle Creek FOMO3000
Pine Creek FOMO2800
Upper Black Squirrel CHBS2000
Upper Bracket Creek CHBR0600
North Fork HOHO0400
Peyton
Bennett Ranch CHWS1200
Geick Ranch CHMS0400
La Vega Ranch CHBR0400
Horse Creek HOHO0600
Hook And Line Ranch CHBS1800
Falcon CHWS1400
Falcon
Baggett CHBR0200
Little Horse Creek HOHO0200
Steels Fork HOPO1000
Cottonwood Creek FOMO2200
Cheyenne Mountain Zoo
Cheyenne Mountain Acres
Upper Fountain FOFO7600
Cheyenne Mountain
Colorado City
Dry Creek FOMO2400
South Pine Creek FOMO2600
Douglas Creek FOMO1000
Templeton Gap FOMO1200
Sand Creek FOFO5800
Williams Canyon FOFO7200
Cascade
Manitou Springs
Manitou Reservoir FOFO7400
Solbers Ranch CHWS0800
Haegler Ranch CHMS0200
Curtis Ranch CHWS1000
West Big Springs Creek CHBG0200
Upper Big Springs Creek CHBG0400
Rush HOPO0800
COLORADO SPRINGS
Shooks Run FOFO4400
Sand Creek FOFO4000
Livestock Company CHWS0400
West Squirrel CHWS0600
Ellicott
Yoder
Rush
Ruxton Creek FOFO7000
Upper Beaver Creek BEBE0400
Sutherland Creek FOFO6400
Bear Creek FOFO4800
Spring Creek FOFO4200
Peterson AFB
Peterson Field FOFO3400
Municipal Airport
Jimmy Camp Creek FOFO2000
Upper East Chico CHEC0400
Schriever AFB
Ellicott CHBS1600
Lower Big Springs Creek CHBS1400
Telephone Exchange CHWS0200
Ellicott Consolidated CHBS1200
Upper Pond Creek HOPO0600
Lower Pond Creek HOPO0400
Windmill Gulch FOFO3000
Fishers Canyon FOFO3600
Southwest Area FOFO4600
Pike National Forest
Big Johnson Reservoir
Big Johnson FOFO2600
Crows Roost CHBS1000
AFA Aux Field
Drennan CHDS0400
Middle East Chico CHEC0200
Truckton
Upper Williams Creek FOWI0600
Upper Chico Creek CHCH1600
Upper Dry Squirrel CHDS0200
Upper Williams Tributary FOWI0400
West Chico Tributary CHCH1200
Haynes Creek HAHA0600
St.lukes HOPO0200
Lower Black Squirrel CHBS0600
Squirrel Creek CHBS0200
Fort Carson FOFO2200
Little Fountain Creek FOFO1800
Calhan Reservoir FOFO1400
Chico Creek CHCH1400
FOUNTAIN
Fort Carson
Lower Williams Creek FOFO1000
Lower Williams Tributary FOWI0200
Lower Dry Squirrel CHBS0400
East Kramer KRKR0600
Kramer Creek KRKR0400
Sand Canyon FOFO1600
Turkey Creek TUTU0200
Lower East Chico CHCH0800
East Haynes HAHA0400
Hammer Ranch CHCH0600
Finch Ranch CHCH0400
Windmill CHCH0200
West Haynes HAHA0200
West Kramer KRKR0200
Sand Creek FOFO0600
Williams Ranch FOFO0400
Midway Ranch FOFO0800
West Chico Creek CHCH0600
Red Creek BEBE0200
Young Hollow FOFO0200

100-YEAR DISCHARGE SUMMARY WITHOUT STORAGE

STREAM	REACH	Q_{100} (cfs)
CHERRY CREEK (MAIN)	SECTION 1.00 TO SECTION 3.50	1020
	SECTION 3.50 TO SECTION 15.10	920
	SECTION 15.10 TO SECTION 43.85	530
	SECTION 43.85 TO SECTION 51.90	440
	SECTION 51.90 TO SECTION 77.40	90
TRIBUTARY 1	SECTION 100.00 TO SECTION 122.90	100
TRIBUTARY 2	SECTION 200.00 TO SECTION 203.90	215
	SECTION 203.90 TO SECTION 220.70	210
	SECTION 220.70 TO SECTION 243.20	160
SUB-TRIB. OF TRIBUTARY 2	SECTION 244.40 TO SECTION 252.40	53
TRIBUTARY 3	SECTION 300.00 TO SECTION 307.90	90
	SECTION 307.90 TO SECTION 323.50	60
SUB-TRIB. OF TRIBUTARY 3	SECTION 326.60 TO SECTION 340.50	30

NOTES:

*.) MANNING'S N ASSUMED 0.040 FOR ALL STREAMS AND REACHES.

2.) TOPOGRAPHIC MAPPING PREPARED BY CARREÑA AERIAL SURVEYING, DATED MARCH, 1996.

NORTH

SCALE

200' 100' 0 100' 200' 400'

150' 50'

1" = 200' 1:2400

SITE

VICINITY MAP

N.T.S.

LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- PROPERTY BOUNDARY LINE
- EXISTING CULVERT
- EXISTING 100-YEAR FLOOD PLAIN BOUNDARY
- 230.90 HEC2 CROSS SECTION LOCATION AND NUMBER
- TRIBUTARY 2 STREAM BRANCH OFF OF MAIN CREEK CHANNEL

SITE

Q_{10}=89 cfs
Q_{100}=368 cfs

EX 84" CMP ARCH CULVERT

STATE HIGHWAY 83

EX 24" CMP CULVERTS

EXISTING 24" CMP CULVERTS TO REMAIN

WEST CHERRY CREEK

SCS EMBANKMENT #1

SCS EMBANKMENT #2

TRIBUTARY 3

TRIBUTARY 2

TRIBUTARY

FILING #1

FILING #2

FILING 1

FILING 2

HODGEN ROAD

CHERRY CREEK CROSSING DRIVE

FILING NO. 1 BOUNDARY

PROPERTY LINE

EX 48" CMP CULVERT
Q_{10}=75 cfs
Q_{100}=163 cfs

EX 42" CMP
Q_{10}=10 cfs
Q_{100}=30.7 cfs

Q_{10}=14cfs
Q_{100}=37cfs

Q_{10}=8cfs
Q_{100}=21cfs

Q_{10}=7cfs
Q_{100}=19cfs

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904-4208
(719) 630-7342

CHERRY CREEK CROSSING SUBDIVISION
EL PASO COUNTY, COLORADO
FINAL DRAINAGE PLAN FILING NO. 2
EXISTING CONDITION FLOODPLAIN MAP

Project No.:	04046
Date:	10/01/04
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

SHEET

FIG 5

Image 1: Existing 18” CMP culvert at Highway 83 driveway



Image 2: Existing 24” CMP culvert at Highway 83 driveway (Ex DP8, Pr DPO)



Image 3: Highway 83 swale, north of Ex DP8, Pr DPO



Image 4: Highway 83 swale, typical condition



Image 5: Highway 83 existing 24" CMP culvert (Ex DP6, Pr DPI)



Image 6: Highway 83 swale north of Image 5



Image 7: Highway 83 existing 24" CMP culvert (Ex DP3, Pr DPG)



Image 8: Highway 83 swale north of Image 7



Image 9: Highway 83 existing 24” CMP culvert (Ex DP2, Pr DPE)



Image 10: Highway 83 existing 84” CMP culvert (Ex DP1, Pr DPB)



Image 11: Outfall Location - Highway 83 existing 24” CMP culvert (Ex DP2, Pr DPE)



Image 12: Outfall Location - Highway 83 existing 24” CMP culvert (Ex DP3, Pr DPG)



Image 13: Outfall Location - Highway 83 existing 24” CMP culvert (Ex DP8, Pr DPO)



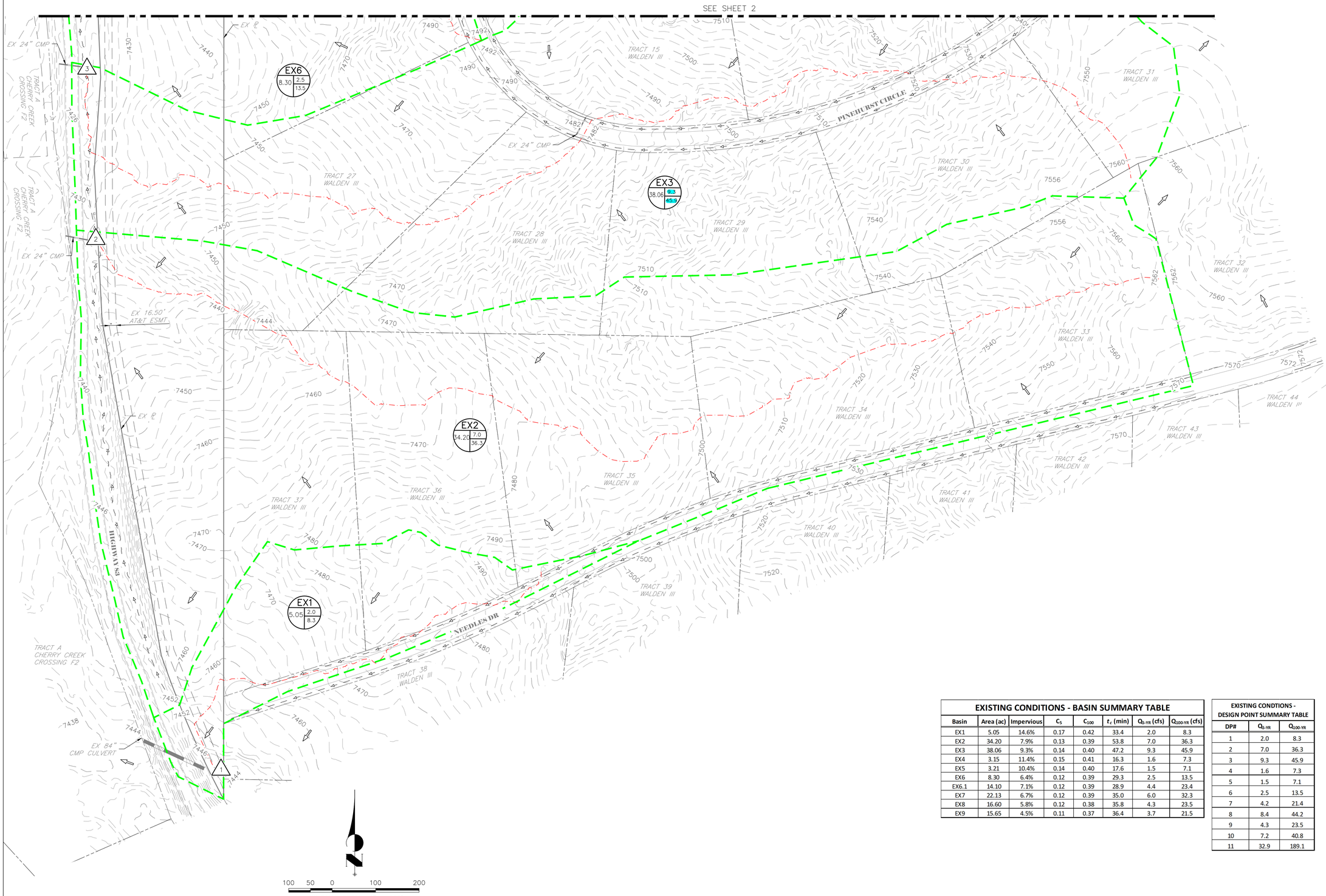
Image 14: Outfall Location - Highway 83 existing 24” CMP culvert (Ex DP6, Pr DPI)



APPENDIX F – DRAINAGE MAPS

THE NORTH RANCH SUBDIVISION

EXISTING DRAINAGE MAP



EXISTING CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
EX1	5.05	14.6%	0.17	0.42	33.4	2.0	8.3
EX2	34.20	7.9%	0.13	0.39	53.8	7.0	36.3
EX3	38.06	9.3%	0.14	0.40	47.2	9.3	45.9
EX4	3.15	11.4%	0.15	0.41	16.3	1.6	7.3
EX5	3.21	10.4%	0.14	0.40	17.6	1.5	7.1
EX6	8.30	6.4%	0.12	0.39	29.3	2.5	13.5
EX6.1	14.10	7.1%	0.12	0.39	28.9	4.4	23.4
EX7	22.13	6.7%	0.12	0.39	35.0	6.0	32.3
EX8	16.60	5.8%	0.12	0.38	35.8	4.3	23.5
EX9	15.65	4.5%	0.11	0.37	36.4	3.7	21.5

EXISTING CONDTIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	2.0	8.3
2	7.0	36.3
3	9.3	45.9
4	1.6	7.3
5	1.5	7.1
6	2.5	13.5
7	4.2	21.4
8	8.4	44.2
9	4.3	23.5
10	7.2	40.8
11	32.9	189.1

EXISTING DRAINAGE MAP

THE NORTH RANCH SUBDIVISION

JOB NO. 26001 | SHEET 1

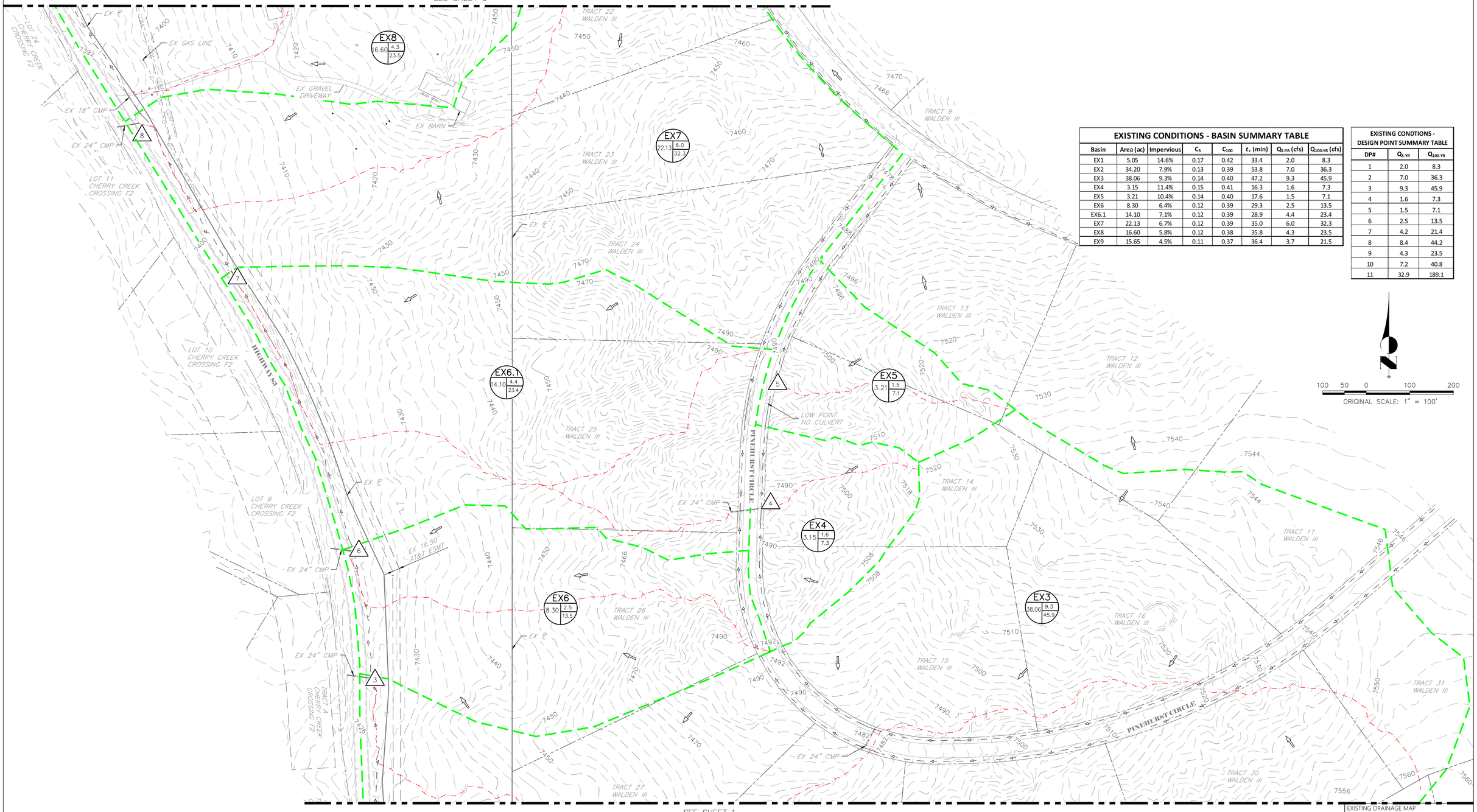
LOCATION: EPC

08/26/2026

ALL TERRAIN ENGINEERING

THE NORTH RANCH SUBDIVISION

EXISTING DRAINAGE MAP



EXISTING CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
EX1	5.05	14.6%	0.17	0.42	33.4	2.0	8.3
EX2	34.20	7.9%	0.13	0.39	53.8	7.0	36.3
EX3	38.06	9.3%	0.14	0.40	47.2	9.3	45.9
EX4	3.15	11.4%	0.15	0.41	16.3	1.6	7.3
EX5	3.21	10.4%	0.14	0.40	17.6	1.5	7.1
EX6	8.30	6.4%	0.12	0.39	29.3	2.5	13.5
EX6.1	14.10	7.1%	0.12	0.39	28.9	4.4	23.4
EX7	22.13	6.7%	0.12	0.39	35.0	6.0	32.3
EX8	16.60	5.8%	0.12	0.38	35.8	4.3	23.5
EX9	15.65	4.5%	0.11	0.37	36.4	3.7	21.5

EXISTING CONDTIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	2.0	8.3
2	7.0	36.3
3	9.3	45.9
4	1.6	7.3
5	1.5	7.1
6	2.5	13.5
7	4.2	21.4
8	8.4	44.2
9	4.3	23.5
10	7.2	40.8
11	32.9	189.1

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

EXISTING DRAINAGE MAP

THE NORTH RANCH SUBDIVISION

JOB NO. 26001 | SHEET 2

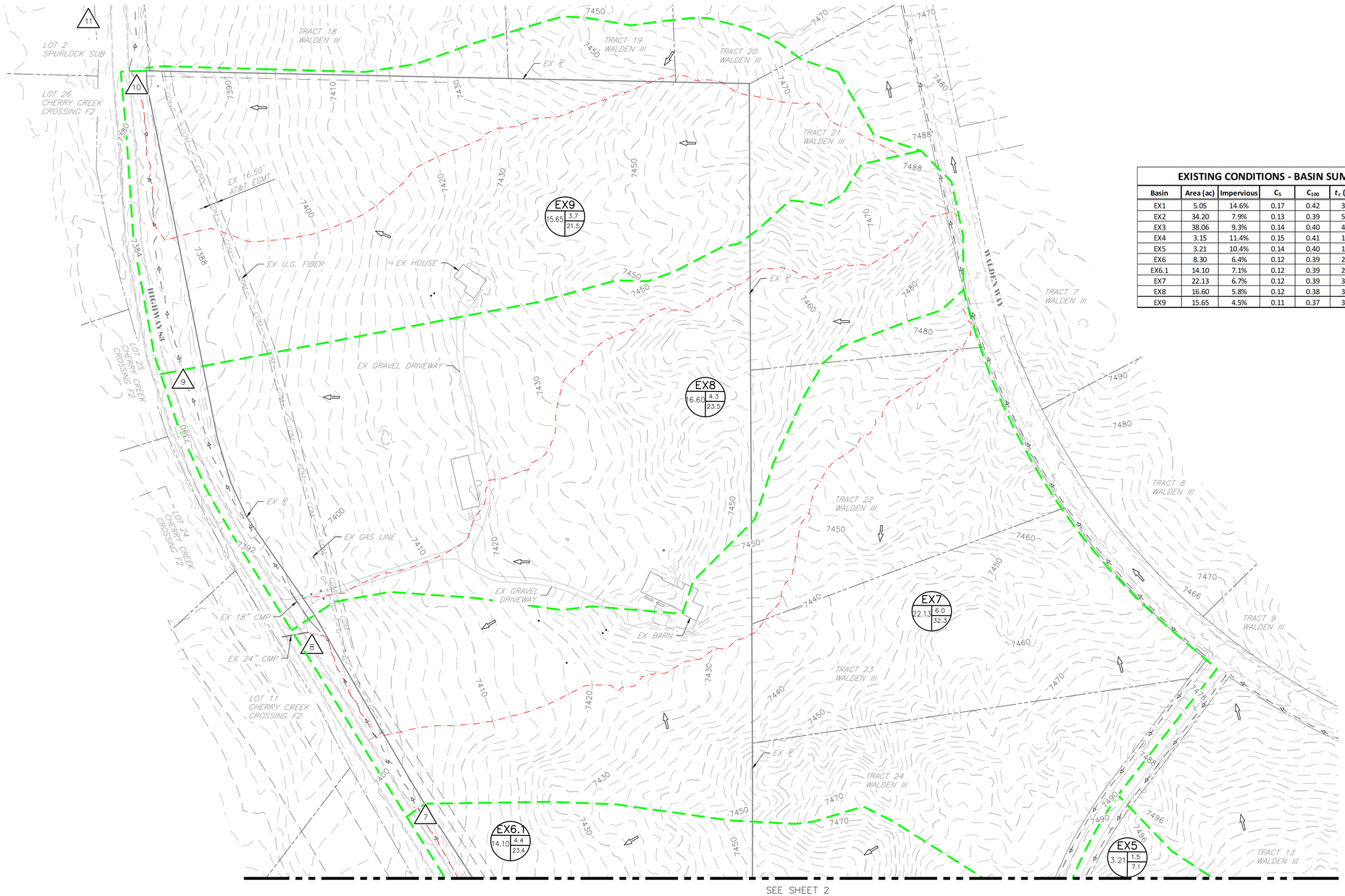
LOCATION: EPC

08/20/2026

ALL TERRAIN ENGINEERING

THE NORTH RANCH SUBDIVISION

EXISTING DRAINAGE MAP



EXISTING CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
EX1	5.05	14.6%	0.17	0.42	33.4	2.0	8.3
EX2	34.20	7.9%	0.13	0.39	53.8	7.0	36.3
EX3	38.06	9.3%	0.14	0.40	47.2	9.3	45.9
EX4	3.15	11.4%	0.15	0.41	16.3	1.6	7.3
EX5	3.21	10.4%	0.14	0.40	17.6	1.5	7.1
EX6	8.30	6.4%	0.12	0.39	29.3	2.5	13.5
EX6.1	14.10	7.1%	0.12	0.39	28.9	4.4	23.4
EX7	22.13	6.7%	0.12	0.39	35.0	6.0	32.3
EX8	16.60	5.8%	0.12	0.38	35.8	4.3	23.5
EX9	15.65	4.5%	0.11	0.37	36.4	3.7	21.5

EXISTING CONDTIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	2.0	8.3
2	7.0	36.3
3	9.3	45.9
4	1.6	7.3
5	1.5	7.1
6	2.5	13.5
7	4.2	21.4
8	8.4	44.2
9	4.3	23.5
10	7.2	40.8
11	32.9	189.1

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

EXISTING DRAINAGE MAP

THE NORTH RANCH SUBDIVISION

JOB NO. 26001 | SHEET 3

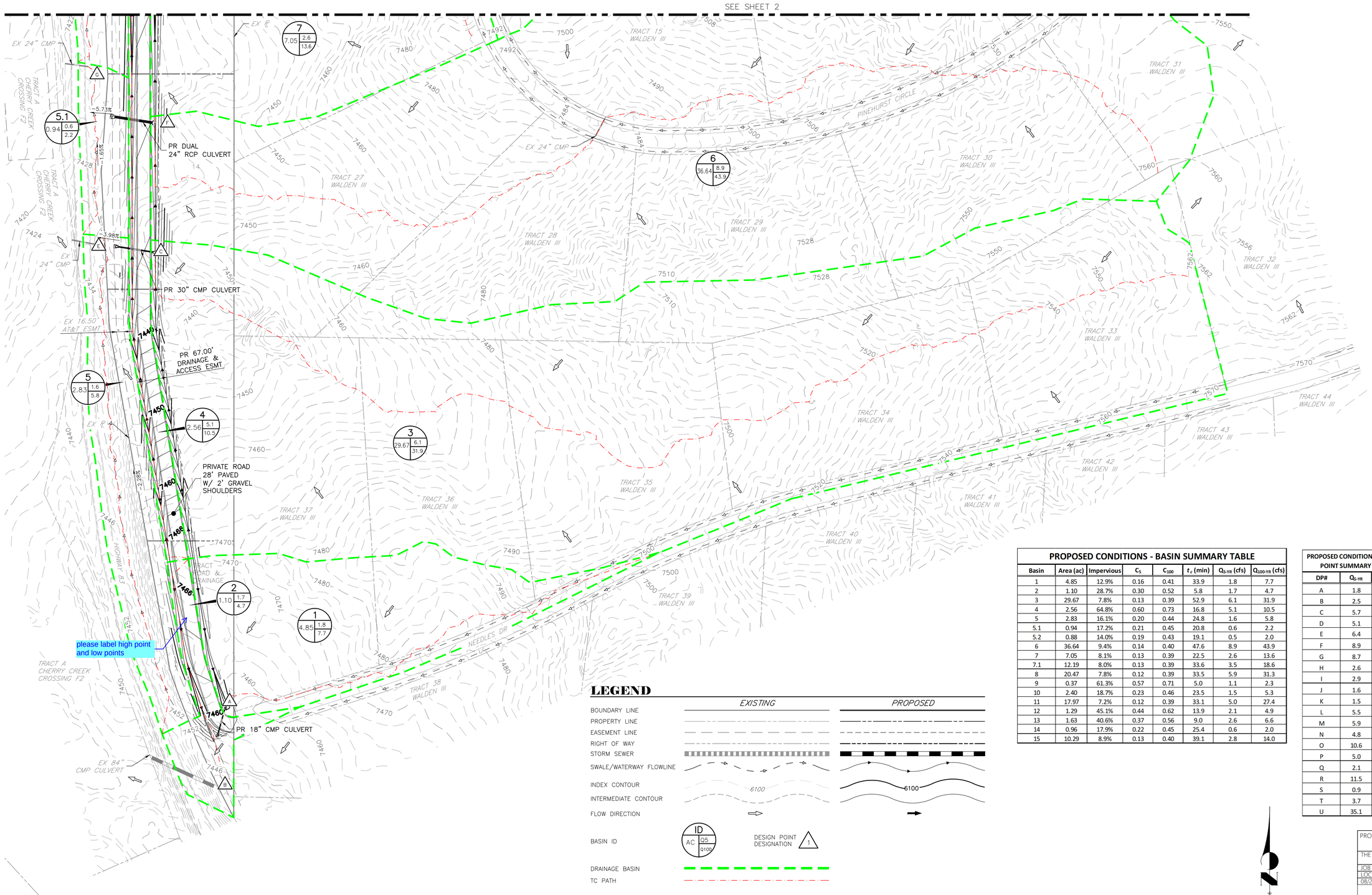
LOCATION: EPC

08/26/2026

ALL TERRAIN ENGINEERING

THE NORTH RANCH SUBDIVISION

PROPOSED DRAINAGE MAP



LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		
BASIN ID	ID / AC / Q5 / Q100	
DESIGN POINT DESIGNATION		1
DRAINAGE BASIN		
TC PATH		

PROPOSED CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
1	4.85	12.9%	0.16	0.41	33.9	1.8	7.7
2	1.10	28.7%	0.30	0.52	5.8	1.7	4.7
3	29.67	7.8%	0.13	0.39	52.9	6.1	31.9
4	2.56	64.8%	0.60	0.73	16.8	5.1	10.5
5	2.83	16.1%	0.20	0.44	24.8	1.6	5.8
5.1	0.94	17.2%	0.21	0.45	20.8	0.6	2.2
5.2	0.88	14.0%	0.19	0.43	19.1	0.5	2.0
6	36.64	9.4%	0.14	0.40	47.6	8.9	43.9
7	7.05	8.1%	0.13	0.39	22.5	2.6	13.6
7.1	12.19	8.0%	0.13	0.39	33.6	3.5	18.6
8	20.47	7.8%	0.12	0.39	33.5	5.9	31.3
9	0.37	61.3%	0.57	0.71	5.0	1.1	2.3
10	2.40	18.7%	0.23	0.46	23.5	1.5	5.3
11	17.97	7.2%	0.12	0.39	33.1	5.0	27.4
12	1.29	45.1%	0.44	0.62	13.9	2.1	4.9
13	1.63	40.6%	0.37	0.56	9.0	2.6	6.6
14	0.96	17.9%	0.22	0.45	25.4	0.6	2.0
15	10.29	8.9%	0.13	0.40	39.1	2.8	14.0

PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
A	1.8	7.7
B	2.5	9.7
C	5.7	31.3
D	5.1	10.5
E	6.4	33.8
F	8.9	43.9
G	8.7	42.6
H	2.6	13.6
I	2.9	14.6
J	1.6	7.3
K	1.5	7.1
L	5.5	27.5
M	5.9	31.3
N	4.8	9.9
O	10.6	53.0
P	5.0	27.4
Q	2.1	4.9
R	11.5	41.3
S	0.9	23.1
T	3.7	31.0
U	35.1	184.7

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP

THE NORTH RANCH SUBDIVISION

JOB NO. 26001 | SHEET 1

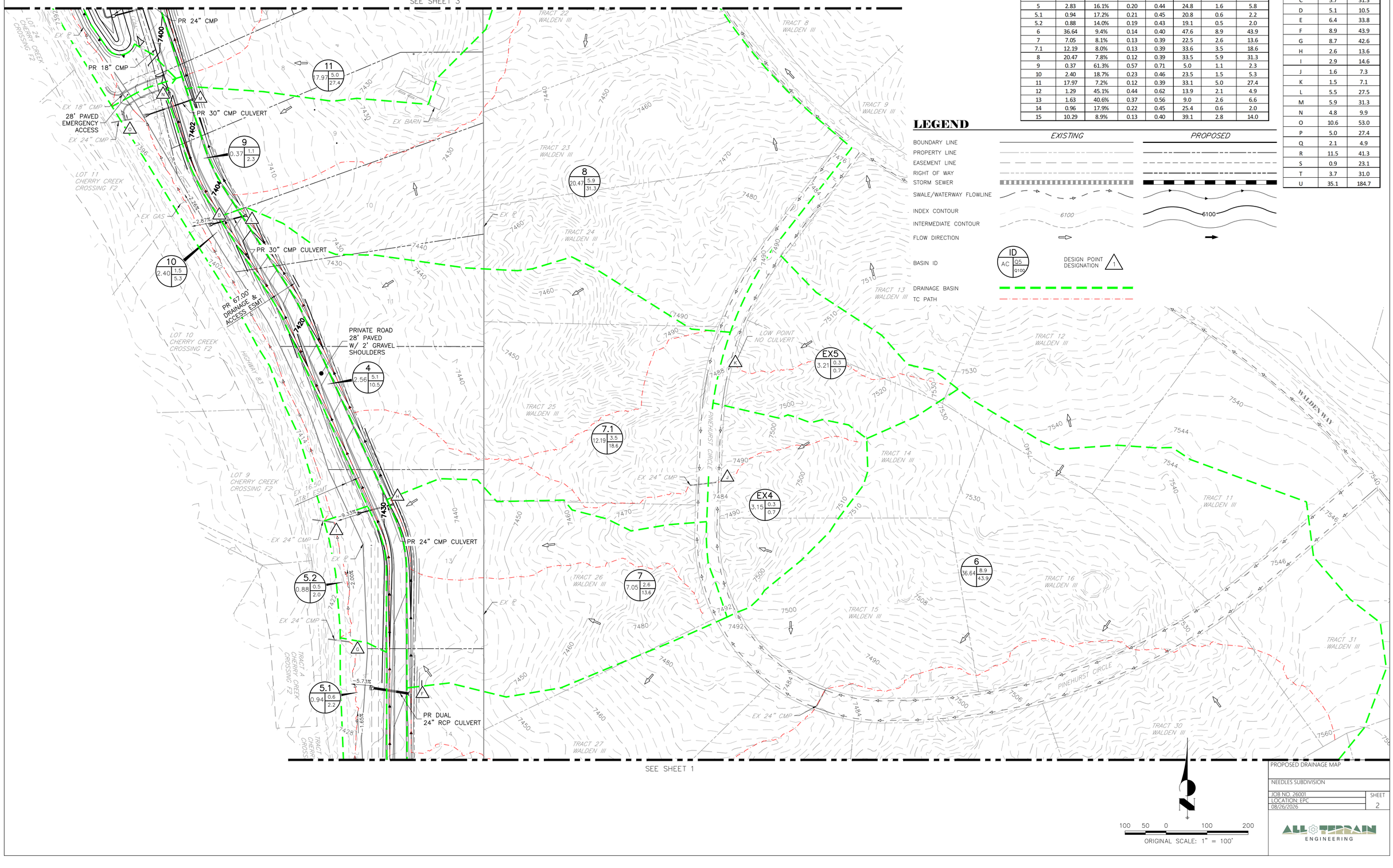
LOCATION: EPC

08/26/2026

ALL TERRAIN ENGINEERING

NEEDLES SUBDIVISION

PROPOSED DRAINAGE MAP



PROPOSED CONDITIONS - BASIN SUMMARY TABLE

Basin	Area (ac)	Impervious	C_5	C_{100}	t_c (min)	$Q_{5\text{-YR}}$ (cfs)	$Q_{100\text{-YR}}$ (cfs)
1	4.85	12.9%	0.16	0.41	33.9	1.8	7.7
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PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
A	1.8	7.7
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C	5.7	31.3
D	5.1	10.5
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F	8.9	43.9
G	8.7	42.6
H	2.6	13.6
I	2.9	14.6
J	1.6	7.3
K	1.5	7.1
L	5.5	27.5
M	5.9	31.3
N	4.8	9.9
O	10.6	53.0
P	5.0	27.4
Q	2.1	4.9
R	11.5	41.3
S	0.9	23.1
T	3.7	31.0
U	35.1	184.7

LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		
BASIN ID	ID / AC / Q5 / Q100	
DESIGN POINT DESIGNATION	1	
DRAINAGE BASIN		
TC PATH		

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP

NEEDLES SUBDIVISION

JOB NO. 26001 | SHEET 2

LOCATION: EPC

08/26/2026

ALL TERRAIN ENGINEERING

North Ranch

NEEDLES SUBDIVISION

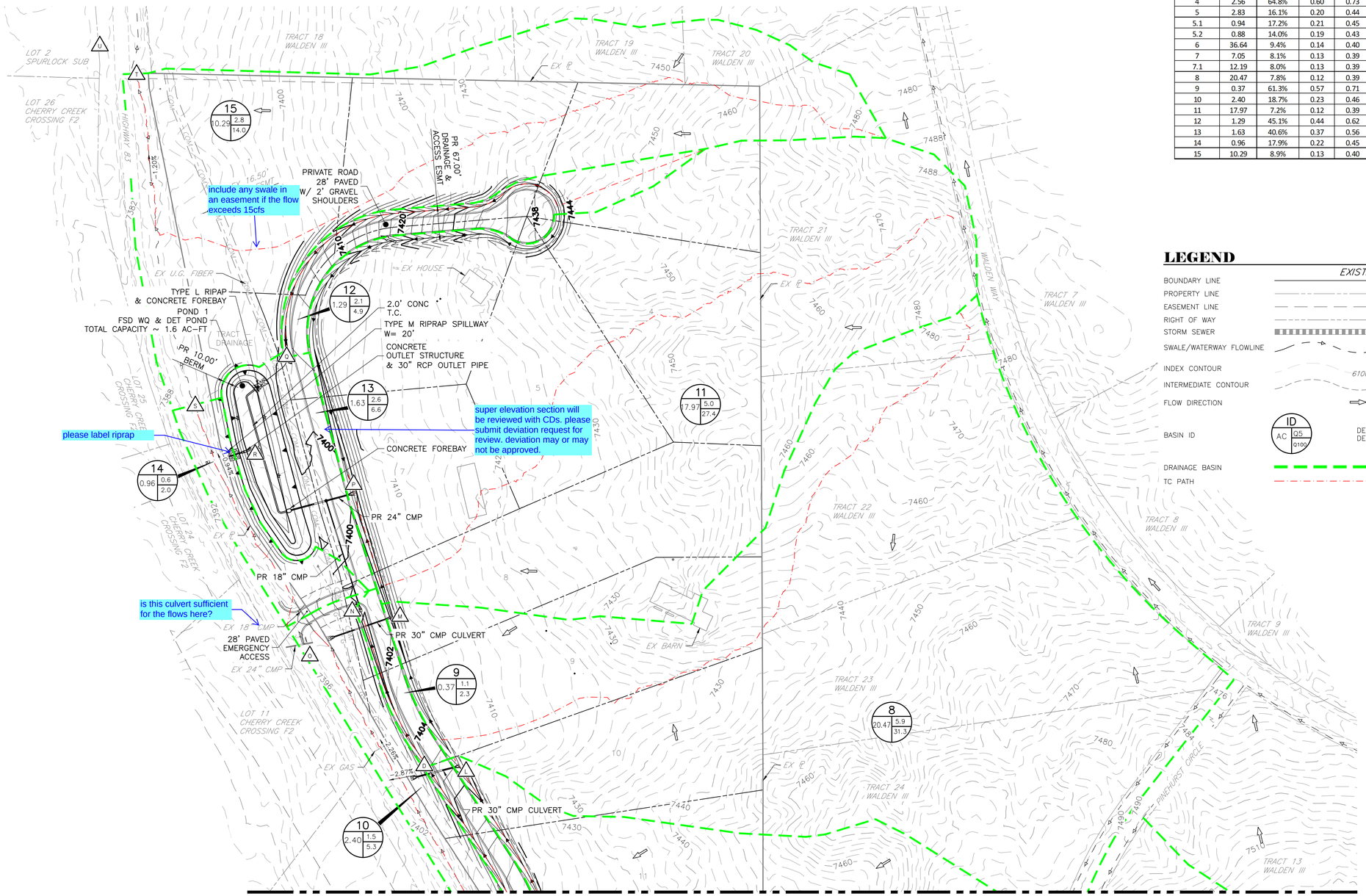
PROPOSED DRAINAGE MAP

PROPOSED CONDITIONS - BASIN SUMMARY TABLE

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15	10.29	8.9%	0.13	0.40	39.1	2.8	14.0

PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE

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B	2.5	9.7
C	5.7	31.3
D	5.1	10.5
E	6.4	33.8
F	8.9	43.9
G	8.7	42.6
H	2.6	13.6
I	2.9	14.6
J	1.6	7.3
K	1.5	7.1
L	5.5	27.5
M	5.9	31.3
N	4.8	9.9
O	10.6	53.0
P	5.0	27.4
Q	2.1	4.9
R	11.5	41.3
S	0.9	23.1
T	3.7	31.0
U	35.1	184.7



LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		
BASIN ID	ID / AC / Q5 / Q100	
DESIGN POINT DESIGNATION	1	
DRAINAGE BASIN		
TC PATH		

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP

NEEDLES SUBDIVISION

JOB NO. 26001 | SHEET 3

LOCATION: EPC

08/20/2026

ALL TERRAIN ENGINEERING