Early Grading Permit - Final Drainage Report

Overlook at Homestead Subdivision Filing No. 1
El Paso County, Colorado

Prepared for:
PT Overlook LLC
1864 Woodmoor Drive, Suite 100
Monument, CO 80132

Prepared by:
Kimley-Horn and Associates, Inc.
2 North Nevada Avenue, Suite 900
Colorado Springs, Colorado 80903
(719) 453-0180
Contact: Kevin Kofford, P.E.

Project #: 196239003

PCD Filing No.: EGP241

Prepared: May 7, 2024

Kimley»Horn

CERTIFICATION

DESIGN ENGINEER'S STATEMENT

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

Please sign and stamp for approval.

SIGNATURE (Affix Seal): _____

Kevin Kofford, P.E. Date

OWNER/DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

PT Overlook LLC
Name of Developer

_____
Authorized Signature Date

Joe DesJardin
Printed Name

Director of Entitlements
Title

1864 Woodmoor Drive Suite 100, Monument, CO 80132
Address

EL PASO COUNTY

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

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

Conditions:

TABLE OF CONTENTS

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to document the drainage design in support of early grading improvements for the proposed Overlook at Homestead Subdivision Filing No. 1("the Project") on behalf of PT Overlook LLC. The Project is located within the jurisdictional limits of El Paso County ("the County"). Therefore, the hydrologic and hydraulic design is based on the County's criteria which is described in further detail within the report.

LOCATION

The Project Site located east of Elbert Road within El Paso County, Colorado including parcels 4122000005, 4100000255, 4100000256. More specifically, the site is a Portion of Section 22 and a Portion of Section 27, Township 11 South, Range 64 West of the 6th PM, County of El Paso, State of Colorado. North of the project site is agricultural and rural residential land, to the east is Homestead Ranch Park owned and maintained by El Paso County, and to the south and west is Homestead Ranch subdivisions. Filing No.1 consists of 36, five acre lots and is located just south the Apex Ranch Subdivision and the large butte. A vicinity map has been provided in the **Appendix** of this report.

The Site is currently owned by PT Overlook LLC and will be developed by PT Overlook LLC.

DESCRIPTION OF PROPERTY

The entire Overlook project is approximately 350.8 acres consisting of mostly vacant, undeveloped land with native vegetation and a rural single-family residential home situated in the northwest corner of the Site and is classified as Agricultural Grazing Land to be subdivided into 62 total lots. Filing No. 1 consists of approximately 202.72 acres which will be subdivided into 36 5-acre parcels. Vegetation within the site is characterized primarily by prairie grasses along with some area of scrub brush and trees. The Site does not currently provide water quality or detention for the Project area.

The existing topography consists of slopes ranging from 1% to 33% with an existing butte covering much of the northern portion of the Site. Filing No. 1 includes a roadway and temporary cul-de-sac on the top of the existing butte, but the majority of the site is located south of the butte. Flows in the existing conditions run off site into one of four major drainage basins. Filing No. 1 only discharges into the Upper Black Squirrel Creek and La Vega Ranch drainage basins, to the south. Detailed descriptions of the existing major drainage basins can be found later in the report.

According to NRCS soil mapping data, USCS Type B soils are the primary soil type within the site. Type 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. Soils mapping information has been provided in the **Appendix**.

The Filing No. 1 development of this site will consist of 36, five-acre residential lots with roadway improvements, roadway grading, three full spectrum detention ponds, roadside ditches, culverts, and drainage swales.

FLOODPLAIN STATEMENT

The Site is located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0350G revised on December 7, 2018 (See **Appendix**).

DRAINAGE BASINS

MAJOR BASIN DESCRIPTIONS

The Project Site is tributary to four major drainage basins in the El Paso County Drainage Basin Map. Bijou Creek, East Kiowa Creek, Upper Black Squirrel, and La Vega Ranch Drainage Basins. These drainage basins are located in the north central portion of El Paso County. The northeast portion of the site is tributary to Bijou Creek Drainage Basin, the northwest portion of the site is tributary to East Kiowa Creek Drainage Basin, the southwest portion of the site is tributary to Upper Black Squirrel Drainage Basin, and the southeast portion of the site is tributary to La Vega Ranch Drainage Basin. Filing No. 1 only discharges into the Upper Black Squirrel Creek and La Vega Ranch Drainage Basins, to the south. In an effort to simplify basin nomenclature, the following naming conventions have been used for both existing and proposed drainage sub-basins labeling. Proposed Basins have been designed in effort to keep runoff within the same existing basins, as to not transfer runoff between basins.

A - Upper Black Squirrel Drainage Basin (CHBS2000)
B - La Vega Ranch Drainage Basin (CHBR0400)
C - East Kiowa Creek Drainage Basin (KIKI0400)
D - Bijou Creek Drainage Basin (BIBI0200)

El Paso County Drainage Basin map has been provided in the **Appendix**. A summary of flows in existing and proposed conditions has been added to the **Appendix**.

COMPLIANCE WITH PREVIOUS FINAL DRAINAGE REPORT

A portion of the proposed Project Site falls within the existing approved “Final Drainage Report for Apex Ranch Estates” by Terra Nova Engineering, Inc. approval date September 3, 2008. Flows from these basins will be at or below history values. These flows are not included in the calculation for the existing detention facility for Filing No. 1. Excerpts from the previously approved FDR have been provided in the **Appendix**.

A Preliminary Drainage Report was submitted to the County as part of the SP238 Application for the Preliminary Plat.

EXISTING SUB-BASIN DESCRIPTIONS

Historically the runoff from the Site drains into one of two major drainage basins for Filing No. 1 as described above. Slopes vary from 2-33% throughout the site with various natural features. The Site has been divided into 8 onsite basins A1-A2, B1-B3, and B3A, and 2 offsite basins OS-A1 and OS-A2. The offsite basins are located west of the Site and generally flow west towards to existing stormwater infrastructure. Descriptions of each individual sub-basin can be found below.

In the existing conditions flows within the existing sub-basins are conveyed and collected into

natural drainage channels. These channels can be found on the existing conditions drainage map, and hydraulic analysis of these channels in existing conditions have been completed. Both of these items can be found in the **Appendix**. Flows will generally follow historic drainage patterns with regards to the existing natural drainage channels.

Sub-Basin A1
This on-site sub-basin consists of an area of 19.92 acres, located in the southwest corner of the Site. Drainage flows overland from the northeast to the southwest where it is captured by an existing 36" CMP culvert at DP 1 and outfalls west of Elbert Rd. The weighted imperviousness for this sub-basin is 8%. Runoff during the 5-year and 100-year events are 8.43 cfs and 38.41 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin A2
This on-site sub-basin consists of an area of 61.50 acres, located in the southwest corner of the Site. Drainage flows overland from the northeast to the southwest where it flows offsite at DP 2 into Reata subdivision south of the Site. The weighted imperviousness for this sub-basin is 1%. Runoff during the 5-year and 100-year events are 13.00 cfs and 87.58 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin B1
This on-site sub-basin consists of an area of 45.75 acres, located in the south-central portion of the Site. Drainage flows overland from the north to the south where it flows offsite at DP 3 into Reata subdivision south of the Site. The weighted imperviousness for this sub-basin is 0%. Runoff during the 5-year and 100-year events are 9.87 cfs and 72.48 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin B2
This on-site sub-basin consists of an area of 42.42 acres, located in the south-central portion of the Site. Drainage flows overland from the north to the south where it flows offsite at DP 4 into Reata subdivision south of the Site. The weighted imperviousness for this sub-basin is 0%. Runoff during the 5-year and 100-year events are 9.41 cfs and 69.09 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin B3
This on-site sub-basin consists of an area of 25.42 acres, located in the southeast portion of the Site. Drainage flows overland from the north to the south where it flows offsite at DP 5 into Reata subdivision south of the Site. The weighted imperviousness for this sub-basin is 0%. Runoff during the 5-year and 100-year events are 5.91 cfs and 43.40 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin B3A
This on-site sub-basin consists of an area of 24.23 acres, located in the southeast corner of the Site. Drainage flows overland from the north to the south where it flows offsite at DP 5A into Reata subdivision south of the Site. The weighted imperviousness for this sub-basin is 0%. Runoff during the 5-year and 100-year events are 5.99 cfs and 43.98 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin OS-A1
The off-site sub-basin consists of an area of 4.06 acres, located in the western central portion of the drainage study area. Drainage flows overland from the northeast to southwest where it is captured by an existing drainage culvert at DP 14 and directed west of Elbert Road. The weighted

imperviousness for this sub-basin is 19%. Runoff during the 5-year and 100-year events are 3.76 cfs and 12.49 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

Sub-Basin OS-A2
The off-site sub-basin consists of an area of 4.45 acres, located in the central portion of the drainage study area. Drainage flows overland from the north to south where it enters sub-basin A2 at DP 15 and follows the patterns described in sub-basin A2. The weighted imperviousness for this sub-basin is 19%. Runoff during the 5-year and 100-year events are 3.76 cfs and 12.49 cfs respectively. Refer to the **Appendix** for the Existing Conditions Drainage Map.

PROPOSED SUB-BASIN DESCRIPTIONS

For the proposed condition, stormwater will generally maintain historic flow patterns. The proposed roadways will alter some of the existing flow paths. The roadway ditches will capture runoff from the roadways and direct flows via proposed culverts back to the existing flow paths, which will ultimately follow historic patterns or be capture by one of the three (3) proposed storm water ponds. The proposed Site has been divided into 10 onsite basins A1-A2, B1-B3, B6-B8, and 2 offsite basins OS-A1 and OS-A2. Descriptions of each individual sub-basin can be found below. The off-site basins are fully developed and no changes to the upstream basins are anticipated. Per Final Drainage Report for Apex Ranch Estates by Terra Nova Engineering, dated September 3, 2008, the existing extended detention basin, on the northwest corner of Apex Ranch Road and Fletcherville Lane was designed and sized to provide water quality for the entire basins A-J of the Apex Ranch Estates Final Drainage Report. This area includes all the proposed roadway extensions through the ROW preservation within the Apex Ranch Estates Subdivision. This project does not rely on the water quality or detention volumes provided by the existing detention basin within Apex Ranch Estates.

In the proposed conditions flows within the proposed sub-basins are conveyed and collected into natural drainage channels. These channels can be found on the proposed conditions drainage map, and hydraulic analysis of these channels in proposed conditions have been completed. Both of these items can be found in the **Appendix**. Flows will generally follow historic drainage patterns with regards to the existing natural drainage channels. Due to the increase in site imperviousness some channels will see an increase in flows. All channels that have an increase of flows in proposed conditions currently have capacity to accept the additional flows. Hydraulic analysis was done to determine need for erosion control measures. Any channel with a proposed velocity greater than 6.0 ft/s shall have Turf Reinforcement Mat (TRM) added as an erosion control measure. Details regarding channel velocity and TRM can be found in the **Appendix**.

There are several drainage culverts proposed within Filing 1 of the Site. Locations of the proposed culverts were chosen to ensure historic drainage patterns are maintained. Culvert sizing including outlet protection analysis has been included in the **Appendix** of this report.

The three proposed full spectrum extended detention basins (EDB) will be designed to release developed flows from Filing No. 1 at less than or equal to historic rates for this project before passing the property line. In the early grading condition these three EDBs will be proposed temporary sediment basins (TSB) and will not be fully constructed until final plat and final design. The full design of these full spectrum extended detention basins will be provided at the Final Plat-Final Drainage Report. While the proposed full spectrum extended detention basins will not be constructed as part of this early grading package, the proposed conditions in this report represent final conditions. As erosion control measures are required to be shown for pond outfall and are proposed for the temporary standpipes and temporary spillways. These measures are displayed and discussed in text and drainage maps. More detail regarding the proposed Temporary

See comments on drainage map

As there is no development occuring within this basin, the impervious % should be the same as existing. It appears that each of these basins is taking into account the future development to occur on site but only the rough grading should be accounted for at this stage. Update the drainage plan also. Unresolved V1 comment

n section of this report.

Sub-Basin A1

This on-site sub-basin consists of an area of 19.55 acres, located in the southwest corner of the Site. Drainage flows overland from the northeast to the southwest where it is captured by an existing 36" CMP culvert at DP 1 and outfalls west of Elbert Rd. There are no proposed improvements in sub-basin A1. The weighted imperviousness for this sub-basin is 15%. Runoff during the 5-year and 100-year events are 10.41 cfs and 41.24 cfs respectively. Due to the slight increase in sub-basin imperviousness, the 100-yr runoff increases from 38.41 to 41.24 cfs. The additional runoff will be accepted and mitigated through the nearly 1500 ft long, 50 ft wide existing drainage channel located within the sub-basin. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin A2

This on-site sub-basin consists of an area of 59.51 acres, located in the southwest corner of the Site. Improvements within this sub-basin include proposed roads, roadside ditches, culverts, and proposed private full spectrum detention basin A2. Drainage flows overland from the northeast to the southwest where it flows into proposed roadside ditches, is conveyed through proposed stormwater culverts, and is ultimately captured by propose private full spectrum detention basin A2. Flows will be released at or below historic levels to the existing roadside ditch along Elbert Road located at DP 2. Flows will generally follow historic drainage patterns. The weighted imperviousness for this sub-basin is 11%. Runoff during the 5-year and 100-year events are 20.23 cfs and 93.46 cfs respectively. Due to the increase in sub-basin imperviousness, the 100-yr runoff for DP 2 is anticipated to increases from 87.58 cfs to 93.46 cfs. The additional runoff will be collected and released at less than historic rates via a proposed private full spectrum detention basin. Flows from this basin will not be released into the Reata subdivision south of the Site. The minor increase in flows will be mitigated by the proposed full spectrum detention basin A2 and released a less than historic rates. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B1

This on-site sub-basin consists of an area of 40.74 acres, located in the south-central portion of the Site. Improvements within this sub-basin include proposed roads, roadside ditches, culverts, and proposed private full spectrum detention basin B1. Drainage flows overland from the north to the south where it flows into proposed roadside ditches, is conveyed through proposed stormwater culverts, and is ultimately captured by propose private full spectrum detention basin B1 at DP 3. The weighted imperviousness for this sub-basin is 10%. Runoff during the 5-year and 100-year events are 16.77 cfs and 80.40 cfs respectively. Due to the increase in sub-basin imperviousness, the 100-yr runoff for DP 3 is anticipated to increases from 72.48 cfs to 80.40 cfs. The additional runoff will be collected and released at less than historic rates via a proposed private full spectrum detention basin with a proposed concrete level spreader. Flows from this basin will exit into the Reata subdivision south of the Site via existing, vegetated natural drainage channels and outfall to an existing stock pond within the adjacent property south of the Site. To maintain outfall erosion protection, a level spreader is proposed prior to flows entering the Reata Subdivision. The minor increase in flows will be mitigated by the proposed full spectrum detention basin B1 and released at less than historic rates. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B2

Please discuss the suitability and stability of the natural channels and lot areas within the adjacent property downstream of DP 2 and 3. Address if they require stabilization or improvement.

This on-site sub-basin consists of an area of 16.00 acres, located in the south-central portion of the Site. Drainage flows overland from the north to the south where it flows offsite at DP 4. Improvements within this sub-basin include proposed public roads. This sub-basin includes an approx. 14,351 sq ft improved area of roadway that will not be receiving water quality treatment. A detailed discussion regarding water quality treatment has been included in Step-2 of the Four Step Process. The weighted imperviousness for this sub-basin is 9%. Runoff during the 5-year and 100-year events are 7.82 cfs and 38.64 cfs respectively. It is anticipated in a 100-yr storm event the total runoff for DP 4 will reduce from 69.09 cfs to 38.64 cfs, as the proposed roadway will cut off much of the upstream portion of the existing drainage basin and route those flows to a proposed full spectrum detention basin. As such there are no anticipated downstream impacts. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B3
This on-site sub-basin consists of an area of 19.11 acres, located in the southeastern portion of the Site. Drainage flows overland from the northwest to southeast where it flows off site at DP 5. There are no proposed public improvements within this sub-basin, but single-family homes will be constructed and excluded the large lot exclusion I.7.1.B.5 and discussed in step 2 of the four-step process. The weighted imperviousness for this sub-basin is 7%. Runoff during the 5-year and 100-year events are 7.83 cfs and 42.71 cfs respectively. In the proposed conditions, it is anticipated in a 100-yr storm event the total runoff for DP 5A (DP 5 in proposed conditions) will reduce from 43.98 to 42.71, as such there are no anticipated downstream impacts. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B6
This on-site sub-basin consists of an area of 52.07 acres, located in the central portion of the Site. Improvements within this sub-basin include proposed roads, roadside ditches, and culverts. Drainage flows overland from the northeast to the southwest where it flows into proposed roadside ditches, is conveyed through a proposed stormwater culvert at DP 8, and into sub-basin B8. From there, flows will follow path as described in sub-basin B8 where it will ultimately be captured in proposed full spectrum detention basin B8. The weighted imperviousness for this sub-basin is 10%. Runoff during the 5-year and 100-year events are 22.13 cfs and 104.60 cfs respectively. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B7
This on-site sub-basin consists of an area of 2.46 acres, located in the southern portion of the Site. Drainage flows overland from the north to south where it flows off site at DP 9. There are no proposed improvements within this sub-basin. The weighted imperviousness for this sub-basin is 7%. Runoff during the 5-year and 100-year events are 1.13 cfs and 6.17 cfs respectively. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin B8
This on-site sub-basin consists of an area of 9.52 acres, located in the southern portion of the Site. Drainage flows overland from the north to south where it is captured by proposed private full spectrum extended detention basin B8 at DP 10. It should be noted that sub-basin B8 accepts flows from sub-basin B6 at DP 8. Refer to sub-basin B6 for information regarding the proposed flows from sub-basin B6. Aside from the proposed extended detention basin there are no proposed improvements within this sub-basin. The weighted imperviousness for this sub-basin is 7%. Runoff during the 5-year and 100-year events are 4.22 cfs and 23.05 cfs respectively. In addition to the increase of imperviousness, sub-basin B8 is also accepting flows from sub-basin B6 to the north. The combination of these factors results in a proposed increase of flows at DP 10 (DP 5 in existing conditions) from 43.40 cfs to 130.00 cfs. The additional runoff will be collected and released at less than historic rates via a proposed private full spectrum detention basin. Flows

from this basin will exit into the Reata subdivision south of the Site via existing, vegetated natural drainage channel and outfall to an existing established vegetated area within the adjacent property south of the Site. The increase in flows will be mitigated by the proposed full spectrum detention basin B8 and released a less than historic rates. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin OS-A1
The off-site sub-basin consists of an area of 4.06 acres, located in the western central portion of the drainage study area. Drainage flows overland from the northeast to southwest where it is captured by an existing drainage culvert at DP 18 and directed west of Elbert Road. The weighted imperviousness for this sub-basin is 25%. Runoff during the 5-year and 100-year events are 4.12 cfs and 12.86 cfs respectively. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

Sub-Basin OS-A2
The off-site sub-basin consists of an area of 4.45 acres, located in the central portion of the drainage study area. Drainage flows overland from the north to south where it enters sub-basin A2 at DP 19 and follows the patterns described in sub-basin A2. The weighted imperviousness for this sub-basin is 7%. Runoff during the 5-year and 100-year events are 2.10 cfs and 11.46 cfs respectively. Refer to the **Appendix** for the Proposed Conditions Drainage Map.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities are designed to be in compliance with El Paso County “Drainage Criteria Manual (DCM)” dated October 2018 (”the MANUAL”), El Paso County “Engineering Criteria Manual” (“the Engineering Manual”), Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014 (“the Colorado Springs MANUAL”), and Mile High Flood District (MHFD), Urban Drainage and Flood Control District Drainage Criteria Manuals (UDFCDCM), (Volumes 1, 2 and 3), prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

Site drainage is not significantly impacted by such constraints as utilities or existing development.

A Preliminary Drainage Report was completed for the overall Overlook Subdivision (SP238). This Final Drainage Report uses the Preliminary Drainage Report to assist with the drainage design for Filing No. 1.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per chapter 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin as outlined and shown in the Preliminary Drainage Report.

HYDRAULIC CRITERIA

Applicable design methods were utilized to analyze the proposed ponds, culverts, and existing drainage channels which includes the use of the UD-Detention spreadsheet, rational calculations spreadsheet, and FlowMaster, and UD-Culvert.

Proposed Drainage features on-site have been analyzed and sized for the following design storm events:

- Major Storm: 100-year Storm Event

Three temporary sediment basins are proposed in order to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. The temporary sediment basins will contain perforated outlet pipes with a release time of approximately 72 hours. The table below outlines the sediment basin sizing, which was based on MHFD temporary sediment basin sizing calculations. Detailed design of the temporary sediment basins has been included in the **Appendix**.

Temporary Sediment Basin ID	Tributary Basin Area (Acres)	TSB Volume (Ac-ft)
TSB A2	63.96	4.718
TSB B1	40.70	2.196
TSB B8	61.60	3.954

The existing natural drainage channels and proposed roadside ditches are designed to carry flows to the temporary sediment basins. The natural channels have varying bottom widths, slopes, and side slopes. The Project intends on using existing natural drainage channels to convey flow where appropriate. Natural channels through Filing No. 1 have been labeled and identified on the Proposed Drainage Map. Channel calculations and summary table have been provided in the **Appendix.** It is not anticipated channel upgrades or improvements will be required for this project. Proposed drainage easements have been proposed on the Early Grading Plans in locations where the natural channels convey flow a substantial amount of flow between properties.

Roadside ditches are provided along the proposed roadways to route flows to the proposed culverts. The roadside ditches are sized to convey the major event flow. The roadside ditched have been designed to have an average depth of 3 feet, a v-ditch, a left-side slope of 3:1, and a right-side slope of 4:1. No channels were determined to have velocities above the allowable permissible velocities for grass lines channels. Roadside ditch calculations and summary table has been provided in the **Appendix**.

Culverts were sized to convey flows from the ditches and channels, underneath the sites paved roads. The proposed culverts range from 18” to 36” and have been designed to convey the 100-year storm event. Culvert calculations and summary table has been provided in the **Appendix**.

THE FOUR STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the El Paso County Engineering Manual for BMP selection as noted below:

Step 1. **Employ Runoff Reduction Practices** – The project is proposing a low-density residential development that will be designed to minimize the impact to the current existing terrain. Per Section I.7.1B of Appendix I of the ECM, the single-family residences fall under

the large lot exemption as the total impervious area is less than 10% of the area. Homes are typically placed in the center of the lot and provide long distances for infiltration across natural terrain. The Site's proposed paved roadways will increase the Site's impervious area; however, roadside ditches and channels will be constructed to slow down the runoff velocity and reduce runoff peaks. The three proposed detention ponds will be used to capture stormwater, provide water quality treatment, and maintain flows discharging off site at or below historic levels.

Step 2. Provide a Water Quality Capture Volume – Permanent water quality measures and detention facilities will be necessary for the Project. Temporary water quality and erosion control measures will be provided during construction to prevent sediment laden water from discharging from the Site. Water quality measures are being used for all stormwater that contacts roadways. Three (3) temporary sediment basins will treat the areas not excluded with either the Large Lot or 20% exclusion. Per ECM Appendix I Section I.7.B.5: Large Lot Single Family exclusion, most of the proposed site will be excluded from water quality, lot imperviousness shall be limited to 10 percent or less. Per ECM Appendix I Section 1.7.C.1.a., 20% of the development site or less than 1 acre can be excluded from providing water quality. As mentioned, 0.99 acres (43,197 sq ft) of impervious area will not be able to be treated which is less than 20% of the overall site.

Step 3 Stabilize Drainageways– Stabilizing proposed roadside ditches, and channels by designing them with slopes that control the flow rates. Placement of riprap upstream and downstream of culverts to help reduce erosion of the roadside ditches. Existing drainage ways will be graded to reduce the velocity of the water to minimize erosion. The existing natural channels have been analyzed for width and velocity for the 100-yr storm event. Easements are proposed to accommodate the full width of the major storm event.

Step 4. Implement Site Specific and Other Source Control BMPs – The erosion control construction BMPs of the Project were designed to reduce contamination. Source control BMPs include the use of vehicle tracking control, culvert protection, stockpile management, and stabilized staging areas.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed drainage patterns will match historic patterns. To maintain historic flows, three full spectrum detention ponds are being proposed and will capture and control the flows from the proposed development into a serious of channels and culverts. The Temporary Sediment Basins described in this report TSB A2, B1, B8 will be converted into the extended detention basins as part of the Final Drainage Report to be processed with the Final Plat application.

DRAINAGE FEES

FEES

The project is within the Upper Black Squirrel Drainage Basin (CHBS2000), La Vega Ranch Drainage Basin (CHBR0400), East Kiowa Creek Drainage Basin (KIKI0400), and Bijou Creek

Drainage Basin (BIBI0200) all four of which are not part of the El Paso County Drainage Basin Fee Program. As such, no drainage fees are due with this Project.

SUMMARY

This report has been prepared in accordance with El Paso County stormwater criteria. It outlines the Site design for the 5-year and 100-year storm events drainage system. The drainage design presented within this report conforms to the criteria presented in the MANUAL. Additionally, as the proposed temporary sediment basin release rates are to be designed less than historic rates, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

REFERENCES

1. Final Drainage Report for Apex Ranch Estates by Terra Nova Engineering, Inc. dated September 3, 2008

2. El Paso County “Engineering Criteria Manual” Volumes 1 & 2, dated October 31, 2018

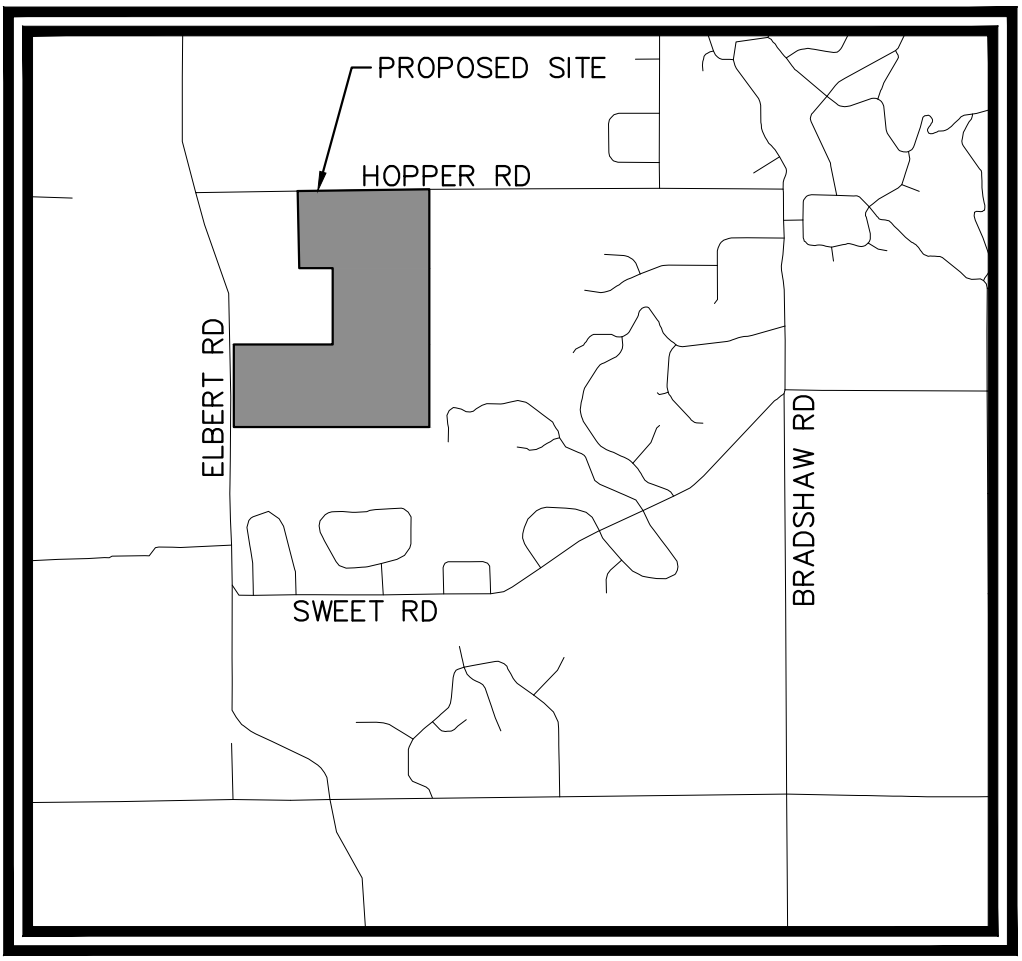
3. Natural Resources Conservation Service, Web Soil Survey, dated June 21, 2023.

4. Urban Drainage and Flood Control District Drainage Criteria Manuals (UDFCDCM), (Volumes 1, 2 and 3), prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

5. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0350G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

APPENDIX A: VICINITY MAP



VICINITY MAP

SCALE: 1":5000'

NORTH

APPENDIX B: FEMA MAP & SOILS REPORT

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

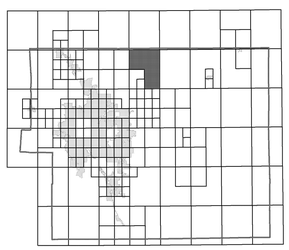
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

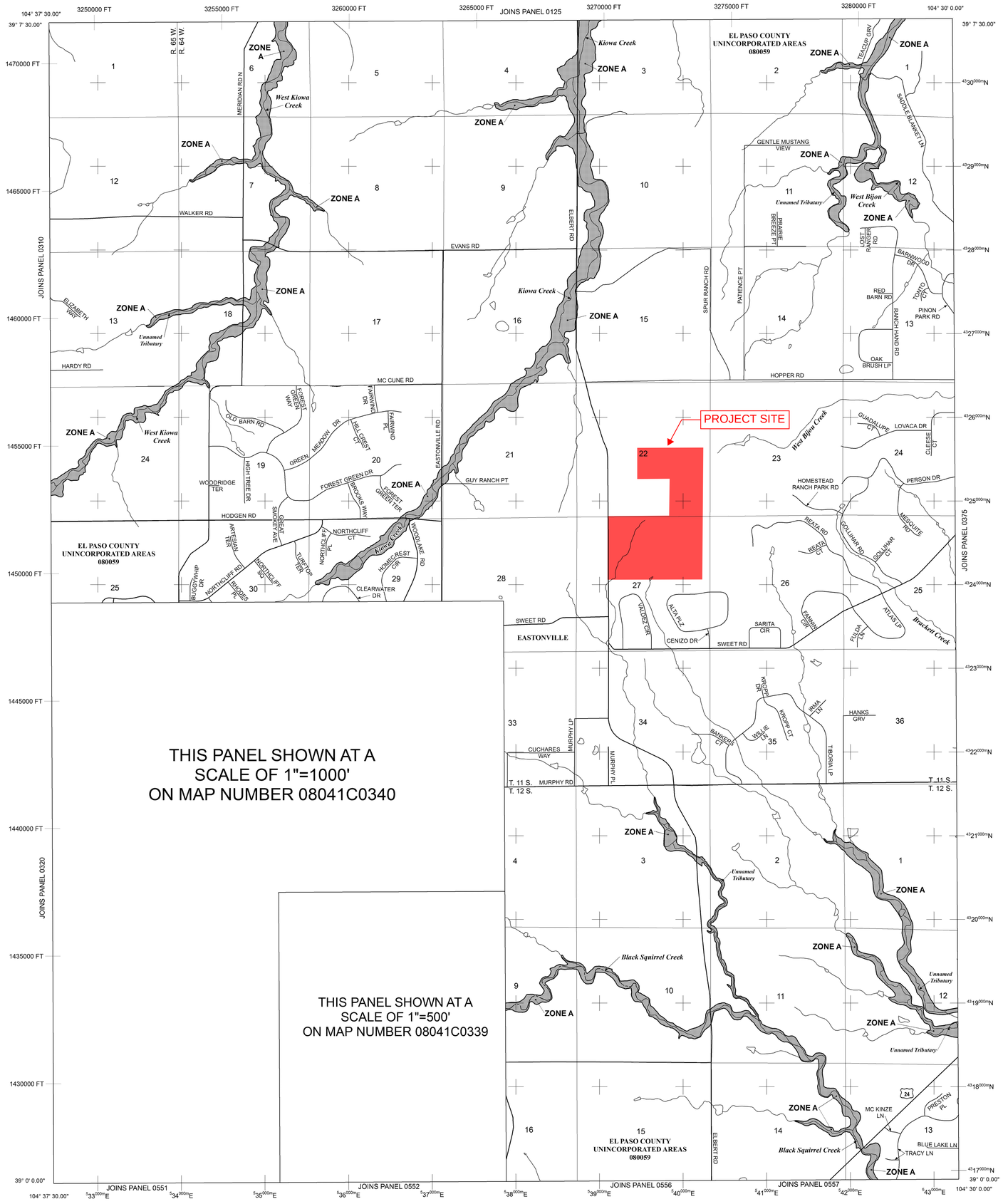
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

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

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP

PANEL 0350G

MAP REVISED DECEMBER 7, 2018

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 350 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

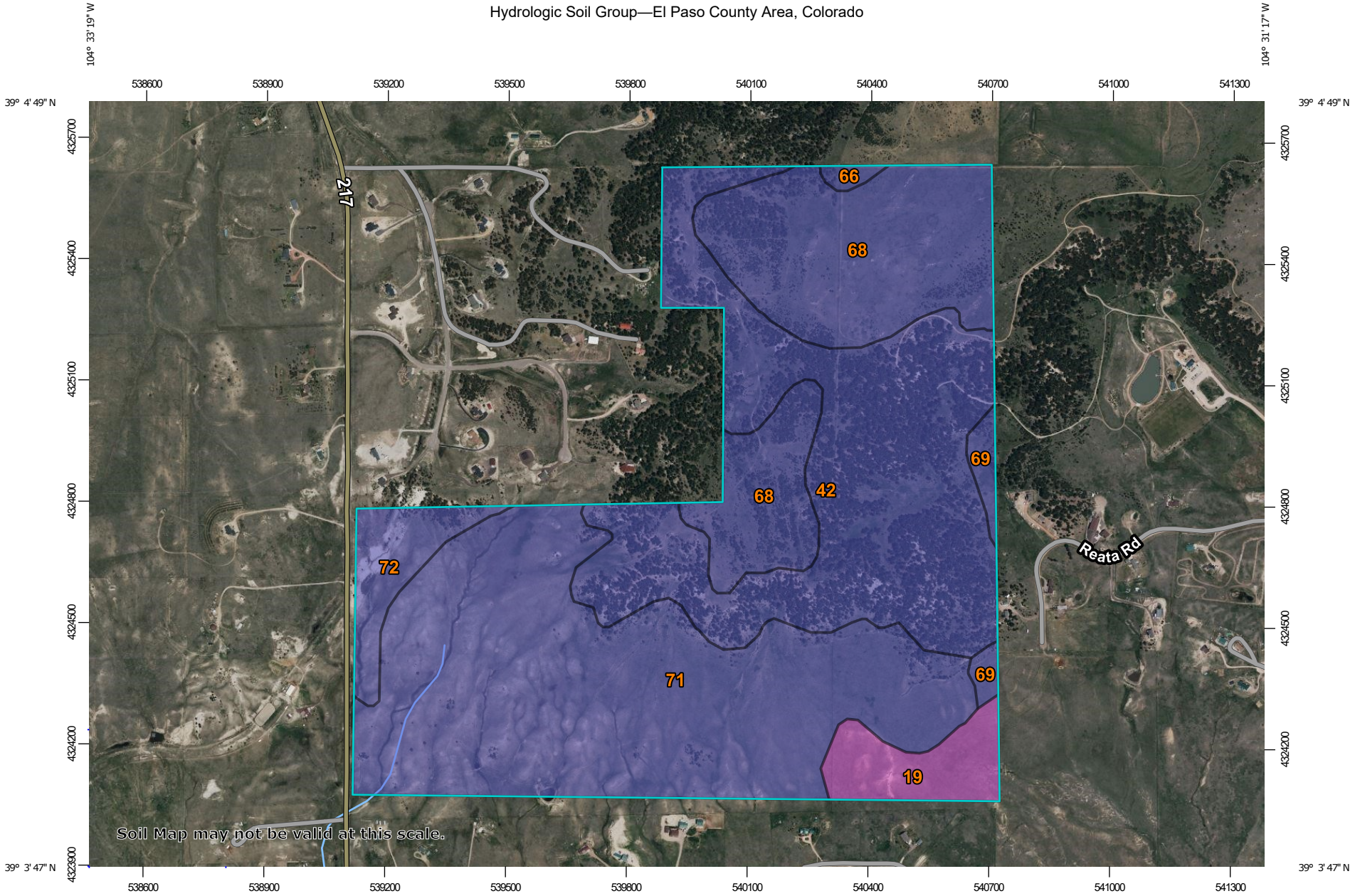
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0350	G

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

MAP NUMBER 08041C0350G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency



Map Scale: 1:13,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	18.1	4.1%
42	Kettle-Rock outcrop complex	B	135.4	30.8%
66	Peyton sandy loam, 1 to 5 percent slopes	B	1.7	0.4%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	91.1	20.7%
69	Peyton-Pring complex, 8 to 15 percent slopes	B	5.6	1.3%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	171.8	39.0%
72	Pring coarse sandy loam, 8 to 15 percent slopes	B	16.2	3.7%
Totals for Area of Interest			**440.0**	**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

APPENDIX C: HYDROLOGY

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION
EXISTING CONDITIONS

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

DATE: 1/24/2024

SOIL: B

LAND USE:	RESIDENTIAL (>5AC) AREA	PASTURE/MEADOW (SOIL GROUP A/B) AREA	PAVEMENT AREA	AREA
2-YEAR COEFF.	0.05	0.02	0.89	
5-YEAR COEFF.	0.12	0.08	0.90	
10-YEAR COEFF.	0.20	0.15	0.92	
100-YEAR COEFF.	0.39	0.35	0.96	
IMPERVIOUS %	7%	0%	100%	

DESIGN BASIN	DESIGN POINT	RESIDENTIAL (>5AC) AREA (AC)	PASTURE/MEADOW (SOIL GROUP A/B) AREA (AC)	PAVEMENT AREA (AC)	AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
FDR Basins											
A1	1		18.28	1.64		**19.92**	0.09	0.15	0.21	0.40	8%
A2	2		60.84	0.66		**61.50**	0.03	0.09	0.16	0.36	1%
B1	3		45.75			**45.75**	0.02	0.08	0.15	0.35	0%
B2	4		42.42			**42.42**	0.02	0.08	0.15	0.35	0%
B3	5		25.42			**25.42**	0.02	0.08	0.15	0.35	0%
B3A	5A		24.23			**24.23**	0.02	0.08	0.15	0.35	0%
OS-A1	14		3.29	0.77		**4.06**	0.19	0.24	0.30	0.47	19%
OS-A2	15	4.45				**4.45**	0.05	0.12	0.20	0.39	7%
TOTAL - OVERALL		**4.45**	**220.23**	**3.07**	**0.00**	**227.75**	0.03	0.09	0.16	0.36	1%
		2%	**97%**	**1%**	**0%**	**100%**					

Note: Land use coefficients sourced from City of Colorado Springs Drainage Criteria Manual, Volume 1, Table 6-6.

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 1/24/2024

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
FDR Basins																
A1	19.92	0.15	300	18.0%	11.5	2,066	5.7%	2.5	0.6	57.7	69.2	2366	7.3%	8%	23.1	23.1
A2	61.50	0.09	300	18.0%	12.3	3,677	5.7%	2.5	0.6	102.7	114.9	3977	6.6%	1%	32.1	32.1
B1	45.75	0.08	300	25.0%	11.1	2,577	6.5%	2.5	0.6	67.4	78.5	2877	8.4%		26.0	26.0
B2	42.42	0.08	300	6.9%	17.0	2,347	10.3%	2.5	0.8	48.8	65.8	2647	9.9%		24.7	24.7
B3	25.42	0.08	300	23.0%	11.4	1,968	9.9%	2.5	0.8	41.7	53.1	2268	11.6%		22.6	22.6
B3A	24.23	0.08	300	20.0%	11.9	1,500	10.0%	2.5	0.8	31.6	43.6	1800	11.7%		20.0	20.0
OS-A1	4.06	0.24	300	5.0%	16.1	161	5.0%	2.5	0.6	4.8	20.9	461	5.0%	19%	12.6	12.6
OS-A2	4.45	0.12	250	10.0%	13.2			2.5			13.2	250	10.0%	7%	11.4	11.4

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_0^{0.33}} \qquad t_c = \frac{L}{180} + 10 \qquad V = C_v S_w^{0.5}$$

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 1/24/2024

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		1	A1	19.92	0.15	23.14	2.94	2.87	8.43													
		2	A2	61.50	0.09	32.09	5.46	2.38	13.00													
		3	B1	45.75	0.08	25.98	3.66	2.70	9.87													
		4	B2	42.42	0.08	24.71	3.39	2.77	9.41													
		5	B3	25.42	0.08	22.60	2.03	2.91	5.91													
		5A	B3A	24.23	0.08	20.00	1.94	3.09	5.99													
		14	OS-A1	4.06	0.24	12.56	0.96	3.79	3.62													
		15	OS-A2	4.45	0.12	11.39	0.53	3.93	2.10													

Note: Rainfall intensity from Figure 6-5 IDF Equations

$$I_5 = -1.5 \ln(t_{c,min}) + 7.583$$

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 1/24/2024

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		1	A1	19.92	0.40	23.14	7.97	4.82	38.41													
		2	A2	61.50	0.36	32.09	21.93	3.99	87.58													
		3	B1	45.75	0.35	25.98	16.01	4.53	72.48													
		4	B2	42.42	0.35	24.71	14.85	4.65	69.09													
		5	B3	25.42	0.35	22.60	8.90	4.88	43.40													
		5A	B3A	24.23	0.35	20.00	8.48	5.19	43.98													
		14	OS-A1	4.06	0.47	12.56	1.89	6.36	12.02													
		15	OS-A2	4.45	0.39	11.39	1.74	6.60	11.46													

Note: Rainfall intensity from Figure 6-5 IDF Equations $I_{100} = -2.52 \ln(t_{c,min}) + 12.735$

Kimley»Horn

PROJECT NAME: Overlook 1/24/2024
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS			% IMPERVIOUS
			Q2	Q5	Q100	
FDR Basins						
1	A1	19.92	4.19	8.43	38.41	8%
2	A2	61.50	3.44	13.00	87.58	1%
3	B1	45.75	1.98	9.87	72.48	0%
4	B2	42.42	1.88	9.41	69.09	0%
5	B3	25.42	1.18	5.91	43.40	0%
5A	B3A	24.23	1.20	5.99	43.98	0%
14	OS-A1	4.06	2.27	3.62	12.02	19%
15	OS-A2	4.45	0.70	2.10	11.46	7%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		81.42	7.63	21.43	125.99	3%
BASIN B TOTAL		137.82	6.24	31.18	228.94	0%
ON-SITE TOTAL		**219.24**	**13.87**	**52.61**	**354.92**	**1%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	2.97	5.72	23.48	13%
OFF-SITE TOTAL		**8.51**	**2.97**	**5.72**	**23.48**	**13%**
SITE TOTAL		**227.75**	**16.84**	**58.33**	**378.41**	**1%**

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION
PROPOSED CONDITIONS

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK
DATE: 5/7/2024

SOIL: B

LAND USE:	RESIDENTIAL (>5AC) AREA	PASTURE/MEADOW (SOIL GROUP A/B) AREA	PAVEMENT AREA	AREA
2-YEAR COEFF.	0.05	0.02	0.89	
5-YEAR COEFF.	0.12	0.08	0.90	
10-YEAR COEFF.	0.20	0.15	0.92	
100-YEAR COEFF.	0.39	0.35	0.96	
IMPERVIOUS %	7%	0%	100%	

DESIGN BASIN	DESIGN POINT	RESIDENTIAL (>5AC) AREA (AC)	PASTURE/MEADOW (SOIL GROUP A/B) AREA (AC)	PAVEMENT AREA (AC)	AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
FDR Basins											
A1	1	17.91		1.64		**19.55**	0.12	0.19	0.26	0.44	15%
A2	2	57.26		2.25		**59.51**	0.08	0.15	0.23	0.41	11%
B1	3	39.58		1.16		**40.74**	0.07	0.14	0.22	0.41	10%
B2	4	15.66		0.34		**16.00**	0.07	0.14	0.22	0.40	9%
B3	5	19.11				**19.11**	0.05	0.12	0.20	0.39	7%
B6	8	50.40		1.67		**52.07**	0.08	0.15	0.22	0.41	10%
B7	9	2.46				**2.46**	0.05	0.12	0.20	0.39	7%
B8	10	9.52				**9.52**	0.05	0.12	0.20	0.39	7%
OS-A1	18	3.29		0.77		**4.06**	0.21	0.27	0.34	0.50	25%
OS-A2	19	4.45				**4.45**	0.05	0.12	0.20	0.39	7%
TOTAL - OVERALL		**219.64**	**0.00**	**7.83**	**0.00**	**227.47**	0.08	0.15	0.22	0.41	10%
		97%	**0%**	**3%**	**0%**	**100%**					

Note: Land use coefficients sourced from City of Colorado Springs Drainage Criteria Manual, Volume 1, Table 6-6.

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

PROPOSED CONDITIONS

DATE: 5/7/2024

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
FDR Basins																
A1	19.55	0.19	300	18.0%	11.1	2,066	5.0%	2.5	0.6	61.6	72.7	2366	6.6%	15%	23.1	23.1
A2	59.51	0.15	300	18.0%	11.5	4,100	4.0%	2.5	0.5	136.7	148.2	4400	5.0%	11%	34.4	34.4
B1	40.74	0.14	300	8.0%	15.2	2,000	4.5%	2.5	0.5	62.9	78.1	2300	5.0%	10%	22.8	22.8
B2	16.00	0.14	300	7.0%	16.0	500	6.0%	2.5	0.6	13.6	29.6	800	6.4%	9%	14.4	14.4
B3	19.11	0.12	300	21.0%	11.3	800	8.0%	2.5	0.7	18.9	30.1	1100	11.5%	7%	16.1	16.1
B6	52.07	0.15	300	22.0%	10.8	1,900	3.0%	2.5	0.4	73.1	84.0	2200	5.6%	10%	22.2	22.2
B7	2.46	0.12	300	6.0%	17.1	100	6.0%	2.2	0.5	3.1	20.2	400	6.0%	7%	12.2	12.2
B8	9.52	0.12	300	6.0%	17.1	300	10.0%	2.5	0.8	6.3	23.5	600	8.0%	7%	13.3	13.3
OS-A1	4.06	0.27	300	5.0%	15.5	161	5.0%	2.5	0.6	4.8	20.3	461	5.0%	25%	12.6	12.6
OS-A2	4.45	0.12	250	10.0%	13.2			2.5			13.2	250	10.0%	7%	11.4	11.4

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_0^{0.33}} \qquad t_c = \frac{L}{180} + 10 \qquad V = C_v S_w^{0.5}$$

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

PROPOSED CONDITIONS

DATE: 5/7/2024

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		1	A1	19.55	0.19	23.14	3.63	2.87	10.41													
		2	A2	59.51	0.15	34.44	8.90	2.27	20.23													
		3	B1	40.74	0.14	22.78	5.79	2.89	16.77													
		4	B2	16.00	0.14	14.44	2.19	3.58	7.82													
		5	B3	19.11	0.12	16.11	2.29	3.41	7.83													
		8	B6	52.07	0.15	22.22	7.55	2.93	22.13													
		9	B7	2.46	0.12	12.22	0.30	3.83	1.13													
		10	B8	9.52	0.12	13.33	1.14	3.70	4.22													
		18	OS-A1	4.06	0.27	12.56	1.09	3.79	4.12													
		19	OS-A2	4.45	0.12	11.39	0.53	3.93	2.10													

Note: Rainfall intensity from Figure 6-5 IDF Equations

$$I_5 = -1.5\ln(t_{c,min}) + 7.583$$

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

PROPOSED CONDITIONS

DATE: 5/7/2024

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		1	A1	19.55	0.44	23.14	8.56	4.82	41.24													
		2	A2	59.51	0.41	34.44	24.49	3.82	93.46													
		3	B1	40.74	0.41	22.78	16.55	4.86	80.40													
		4	B2	16.00	0.40	14.44	6.43	6.01	38.64													
		5	B3	19.11	0.39	16.11	7.45	5.73	42.71													
		8	B6	52.07	0.41	22.22	21.26	4.92	104.60													
		9	B7	2.46	0.39	12.22	0.96	6.43	6.17													
		10	B8	9.52	0.39	13.33	3.71	6.21	23.05													
		18	OS-A1	4.06	0.50	12.56	2.02	6.36	12.86													
		19	OS-A2	4.45	0.39	11.39	1.74	6.60	11.46													

Note: Rainfall intensity from Figure 6-5 IDF Equations $I_{100} = -2.52 \ln(t_{c,min}) + 12.735$

Kimley»Horn

PROJECT NAME: Overlook 5/7/2024
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS			% IMPERVIOUS
			Q2	Q5	Q100	
PDR Basins						
1	A1	19.55	5.41	10.41	41.24	15%
2	A2	59.51	8.87	20.23	93.46	11%
3	B1	40.74	6.97	16.77	80.40	10%
4	B2	16.00	3.10	7.82	38.64	9%
5	B3	19.11	2.61	7.83	42.71	7%
8	B6	52.07	9.39	22.13	104.60	10%
9	B7	2.46	0.38	1.13	6.17	7%
10	B8	9.52	1.41	4.22	23.05	7%
18	OS-A1	4.06	2.57	4.12	12.86	25%
19	OS-A2	4.45	0.70	2.10	11.46	7%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		79.06	14.28	30.64	134.69	12%
BASIN B TOTAL		139.90	23.86	59.90	295.56	9%
ON-SITE TOTAL		**218.96**	**23.86**	**59.90**	**295.56**	**10%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	3.27	6.22	24.32	15%
OFF-SITE TOTAL		**8.51**	**3.27**	**6.22**	**24.32**	**15%**
SITE TOTAL		**227.47**	**27.12**	**66.12**	**319.88**	**10%**

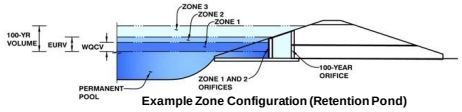
APPENDIX D: HYDRUALICS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook A2 WQCV

Basin ID:



Example Zone Configuration (Retention Pond)

VOLUME USED IN POND SIZING

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	2.87	acres
Watershed Length =	1,000	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	100.00%	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 =	Denver - Capitol Building	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.120	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.324	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.281	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.360	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.424	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.487	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.550	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.619	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.777	acre-feet		inches
Approximate 2-yr Detention Volume =	0.263	acre-feet		
Approximate 5-yr Detention Volume =	0.340	acre-feet		
Approximate 10-yr Detention Volume =	0.412	acre-feet		
Approximate 25-yr Detention Volume =	0.442	acre-feet		
Approximate 50-yr Detention Volume =	0.458	acre-feet		
Approximate 100-yr Detention Volume =	0.470	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.120	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.205	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.146	acre-feet
Total Detention Basin Volume =	0.470	acre-feet
Initial Surcharge Volume (ISV) =	16	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio (R_{LW}) =		

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

Depth Increment = ft

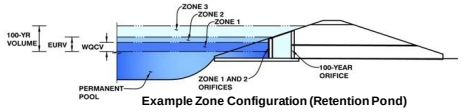
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook A2 Prelim Pond Sizing

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		
Watershed Area =	58.27	acres	
Watershed Length =	3,500	ft	
Watershed Length to Centroid =	1,750	ft	
Watershed Slope =	0.100	ft/ft	Steep Slope > 0.06 ft/ft
Watershed Imperviousness =	12.00%	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 =	Denver - Capitol Building		

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) =	0.120	acre-feet	0.120	acre-feet
Excess Urban Runoff Volume (EURV) =	0.667	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.873	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.836	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.787	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.448	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.593	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.228	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	10.226	acre-feet		inches
Approximate 2-yr Detention Volume =	0.434	acre-feet		
Approximate 5-yr Detention Volume =	0.670	acre-feet		
Approximate 10-yr Detention Volume =	1.290	acre-feet		
Approximate 25-yr Detention Volume =	1.747	acre-feet		
Approximate 50-yr Detention Volume =	1.835	acre-feet		
Approximate 100-yr Detention Volume =	2.346	acre-feet		

Define Zones and Basin Geometry

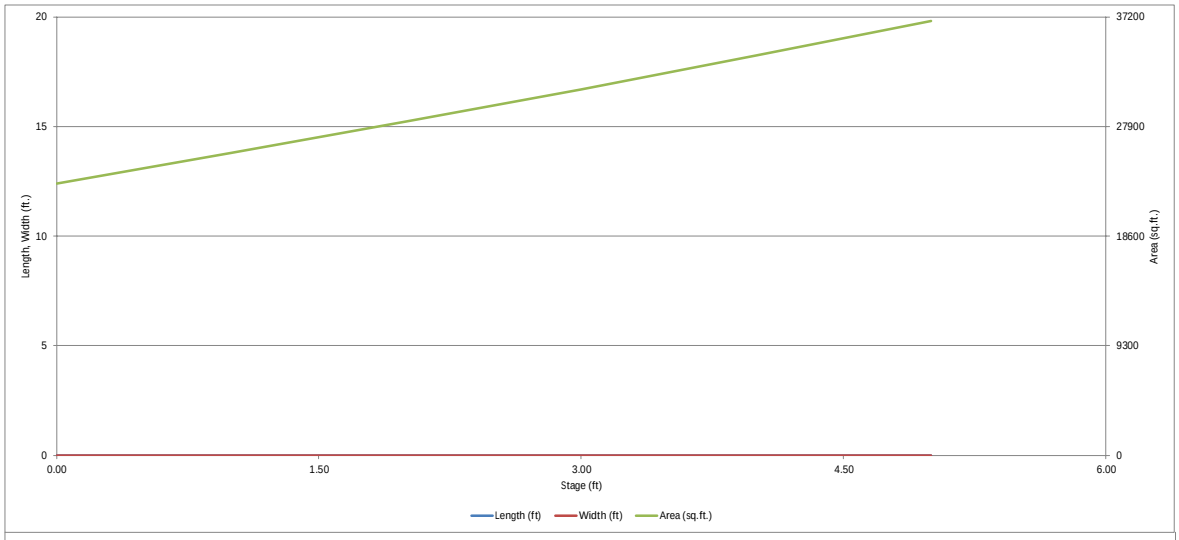
Zone 1 Volume (WQCV) =	0.120	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.547	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.679	acre-feet
Total Detention Basin Volume =	2.346	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio (R_{LW}) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

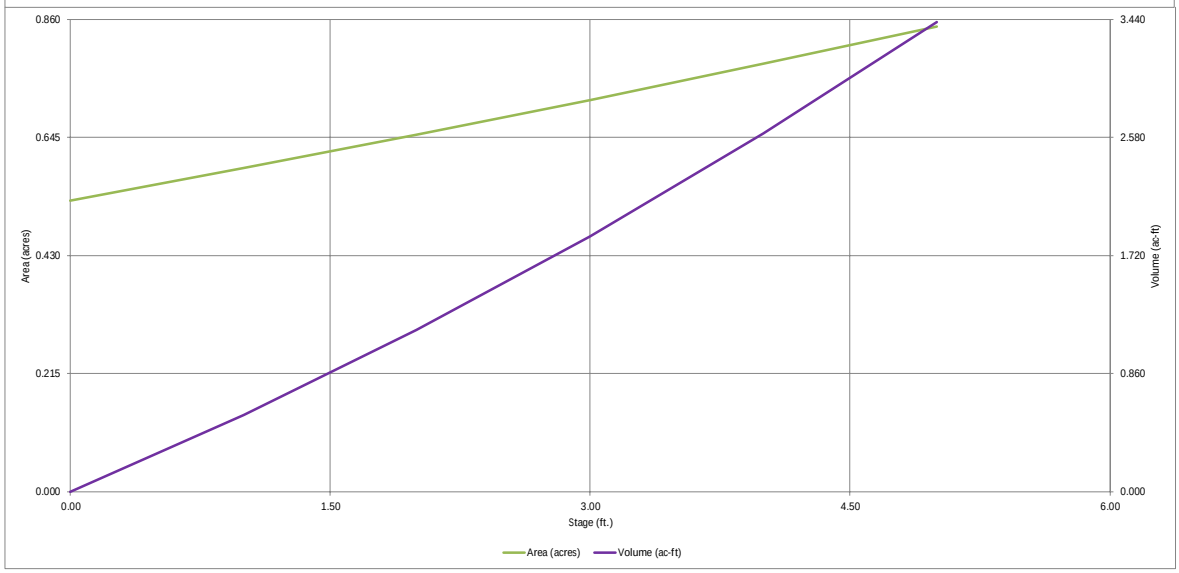
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	23,106	0.530		
	--	1.00	--	--	--	25,662	0.589	24,384	0.560
	--	2.00	--	--	--	28,319	0.650	51,375	1.179
	--	3.00	--	--	--	31,076	0.713	81,072	1.861
	--	4.00	--	--	--	33,934	0.779	113,577	2.607
	--	5.00	--	--	--	36,892	0.847	148,990	3.420

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



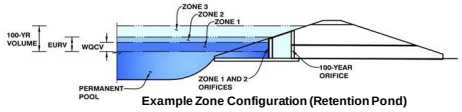


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook B1 WQCV

Basin ID:



Example Zone Configuration (Retention Pond)

VOLUME USED IN POND SIZING

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	1.16	acres
Watershed Length =	500	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.100	ft/ft
Watershed Imperviousness =	100.00%	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 =	Denver - Capitol Building	

Steep Slope > 0.06 ft/ft

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.048	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.131	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =		acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =		acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =		acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =		acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =		acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =		acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =		acre-feet	inches
Approximate 2-yr Detention Volume =		acre-feet	
Approximate 5-yr Detention Volume =		acre-feet	
Approximate 10-yr Detention Volume =		acre-feet	
Approximate 25-yr Detention Volume =		acre-feet	
Approximate 50-yr Detention Volume =		acre-feet	
Approximate 100-yr Detention Volume =		acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	6	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio (R_{LW}) =		

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

Depth Increment = ft

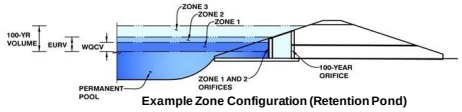
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook B1 Prelim Pond Sizing

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	40.74	acres
Watershed Length =	3,000	ft
Watershed Length to Centroid =	1,500	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	10.00%	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 =	Denver - Capitol Building	

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) =	0.048 acre-feet	0.048	acre-feet
Excess Urban Runoff Volume (EURV) =	0.383 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.544 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.202 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.858 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.027 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.825 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.973 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	7.066 acre-feet		inches
Approximate 2-yr Detention Volume =	0.244 acre-feet		
Approximate 5-yr Detention Volume =	0.383 acre-feet		
Approximate 10-yr Detention Volume =	0.796 acre-feet		
Approximate 25-yr Detention Volume =	1.112 acre-feet		
Approximate 50-yr Detention Volume =	1.163 acre-feet		
Approximate 100-yr Detention Volume =	1.503 acre-feet		

Define Zones and Basin Geometry

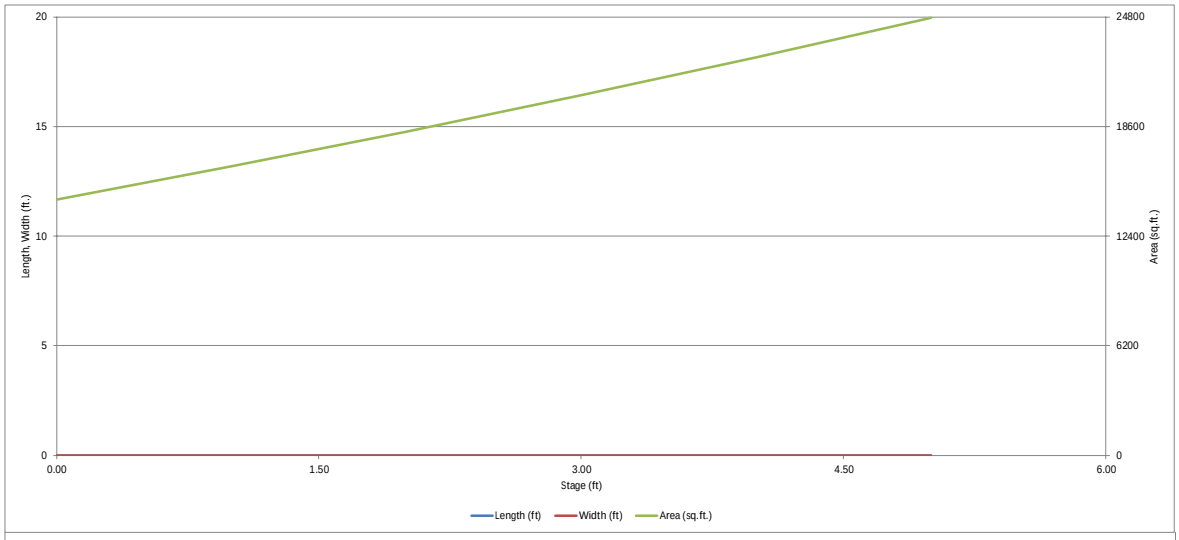
Zone 1 Volume (WQCV) =	0.048	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.335	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.120	acre-feet
Total Detention Basin Volume =	1.503	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio (R_{LW}) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

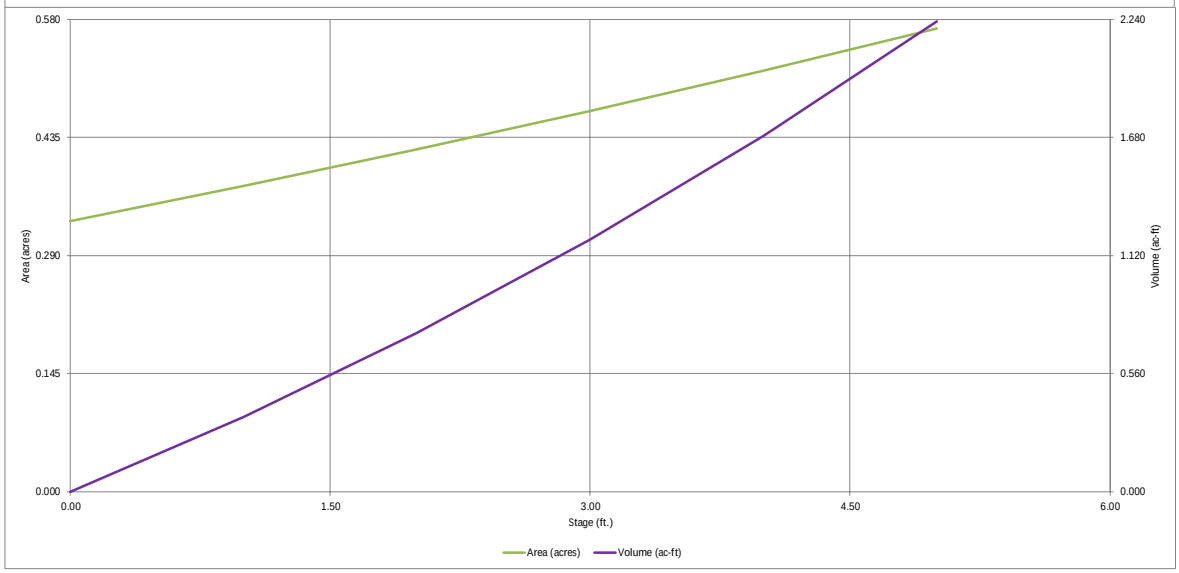
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	14,485	0.333		
	--	1.00	--	--	--	16,343	0.375	15,414	0.354
	--	2.00	--	--	--	18,301	0.420	32,736	0.752
	--	3.00	--	--	--	20,359	0.467	52,066	1.195
	--	4.00	--	--	--	22,519	0.517	73,505	1.687
	--	5.00	--	--	--	24,778	0.569	97,153	2.230

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



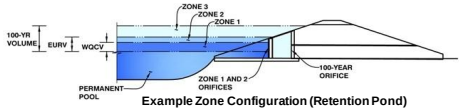


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook B8 WQCV

Basin ID:



Example Zone Configuration (Retention Pond)

VOLUME USED IN POND SIZING

Watershed Information

Selected BMP Type =	EDB		Note: L / W Ratio > 8
Watershed Area =	1.66	acres	L / W Ratio = 13.83
Watershed Length =	1,000	ft	
Watershed Length to Centroid =	500	ft	
Watershed Slope =	0.035	ft/ft	
Watershed Imperviousness =	100.00%	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 =	Denver - Capitol Building		

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.069	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.188	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =		acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =		acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =		acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =		acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =		acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =		acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =		acre-feet		inches
Approximate 2-yr Detention Volume =		acre-feet		
Approximate 5-yr Detention Volume =		acre-feet		
Approximate 10-yr Detention Volume =		acre-feet		
Approximate 25-yr Detention Volume =		acre-feet		
Approximate 50-yr Detention Volume =		acre-feet		
Approximate 100-yr Detention Volume =		acre-feet		

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	9	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio (R_{LW}) =		
Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

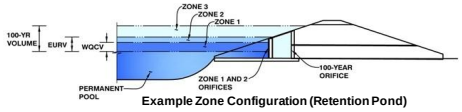
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook B8 Preliminary Pond Sizing

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	62.83	acres
Watershed Length =	4,000	ft
Watershed Length to Centroid =	2,000	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	9.00%	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 =	Denver - Capitol Building	

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) =	0.069	acre-feet	0.069	acre-feet
Excess Urban Runoff Volume (EURV) =	0.527	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.793	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.795	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.801	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.614	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.843	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.619	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	10.846	acre-feet		inches
Approximate 2-yr Detention Volume =	0.333	acre-feet		
Approximate 5-yr Detention Volume =	0.527	acre-feet		
Approximate 10-yr Detention Volume =	1.146	acre-feet		
Approximate 25-yr Detention Volume =	1.628	acre-feet		
Approximate 50-yr Detention Volume =	1.697	acre-feet		
Approximate 100-yr Detention Volume =	2.207	acre-feet		

Define Zones and Basin Geometry

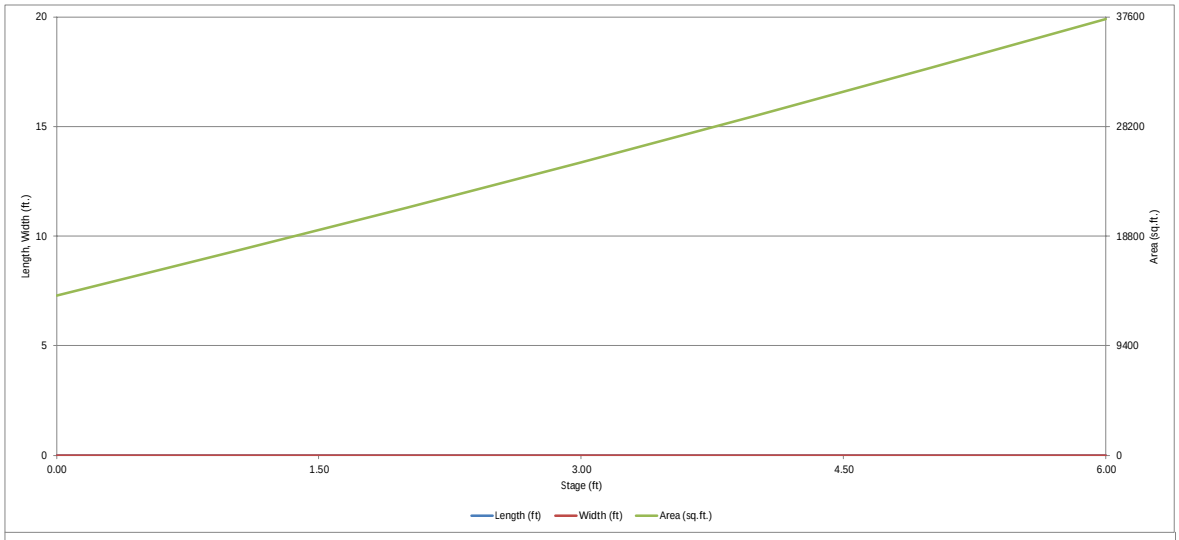
Zone 1 Volume (WQCV) =	0.069	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.458	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.680	acre-feet
Total Detention Basin Volume =	2.207	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio (R_{LW}) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

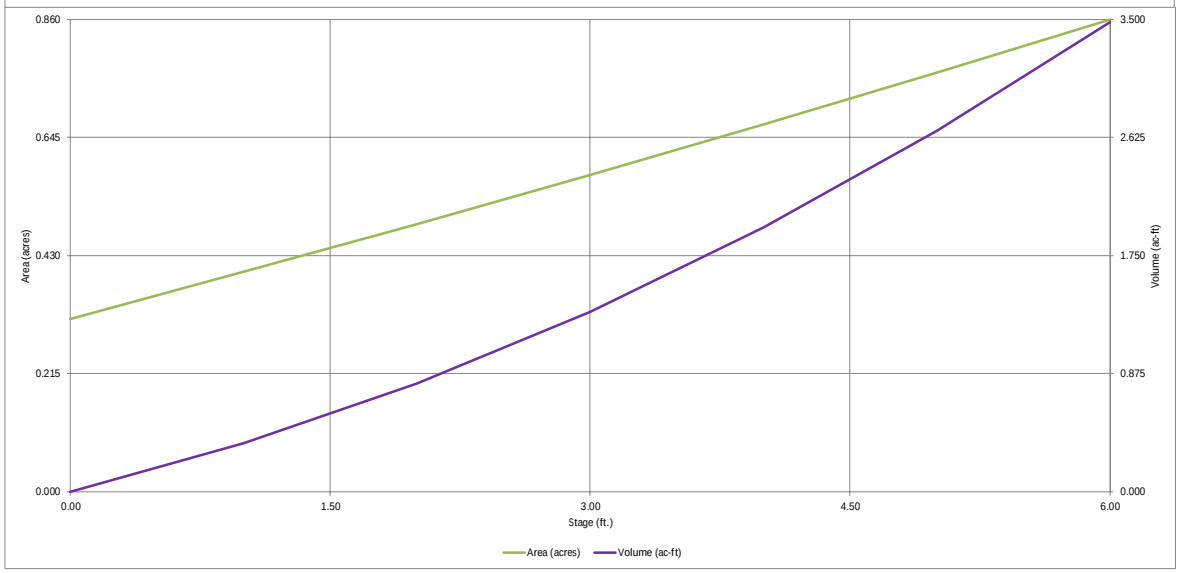
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	13,730	0.315		
	--	1.00	--	--	--	17,427	0.400	15,578	0.358
	--	2.00	--	--	--	21,230	0.487	34,907	0.801
	--	3.00	--	--	--	25,133	0.577	58,088	1.334
	--	4.00	--	--	--	29,138	0.669	85,224	1.956
	--	5.00	--	--	--	33,243	0.763	116,414	2.673
	--	6.00	--	--	--	37,448	0.860	151,759	3.484

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





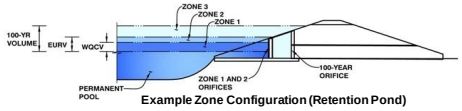
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook

Basin ID: TSB B1

TSB B1 AND STANDPIPE SIZING



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		
Watershed Area =	40.70	acres	
Watershed Length =	1,600	ft	
Watershed Length to Centroid =	800	ft	
Watershed Slope =	0.060	ft/ft	
Watershed Imperviousness =	10.00%	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 =	72.0	hours	Drain Time Too Long
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) =	0.227	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.383	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.541	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.195	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.848	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.010	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.803	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.945	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	7.025	acre-feet	inches
Approximate 2-yr Detention Volume =	0.244	acre-feet	
Approximate 5-yr Detention Volume =	0.383	acre-feet	
Approximate 10-yr Detention Volume =	0.795	acre-feet	
Approximate 25-yr Detention Volume =	1.110	acre-feet	
Approximate 50-yr Detention Volume =	1.162	acre-feet	
Approximate 100-yr Detention Volume =	1.502	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (User Defined) =	0.939	acre-feet	
Select Zone 2 Storage Volume (Optional) =		acre-feet	
Select Zone 3 Storage Volume (Optional) =		acre-feet	Total detention volume is less than 100-year volume.
Total Detention Basin Volume =	0.939	acre-feet	
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial Surcharge Depth (ISD) =	user	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	user	ft	
Slope of Trickle Channel (S_{TC}) =	user	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio (R_{LW}) =	user		

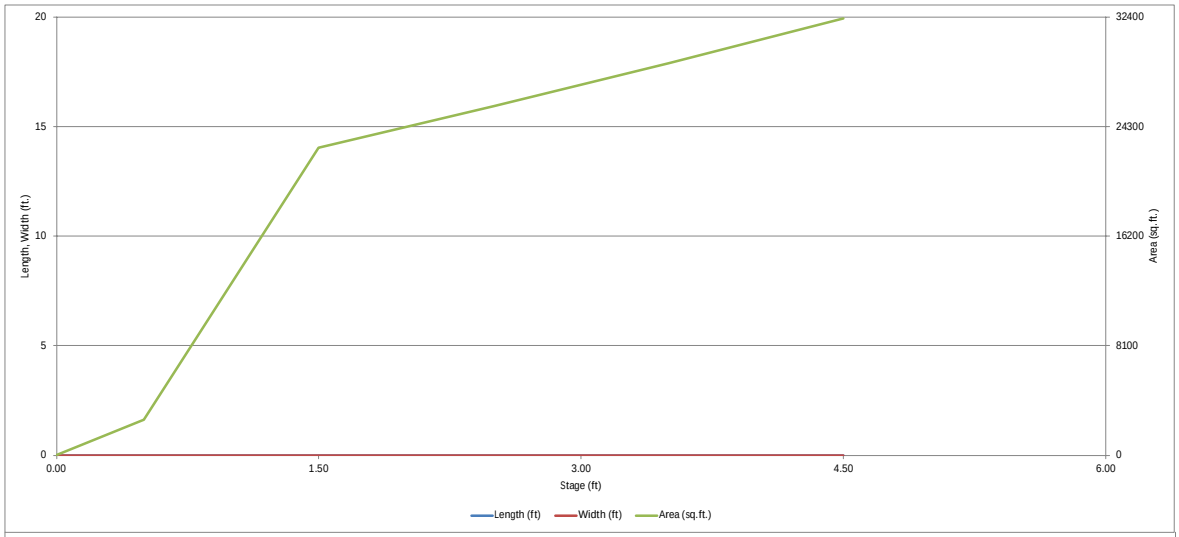
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

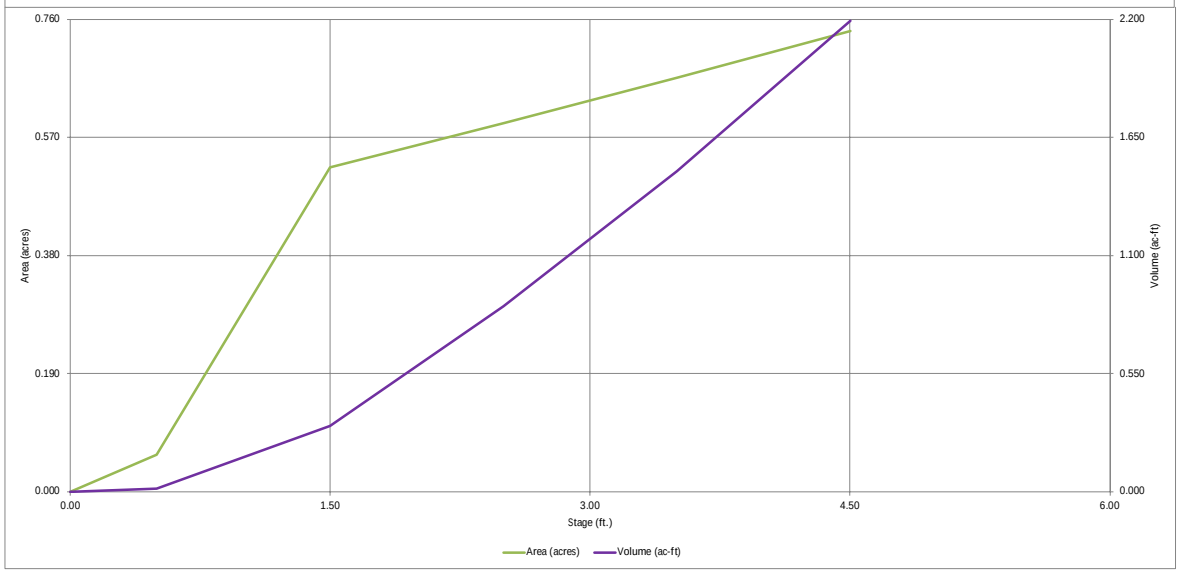
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
7192.5 Top of Micropool	--	0.00	--	--	--	16	0.000		
7193	--	0.50	--	--	--	2,596	0.060	653	0.015
7194	--	1.50	--	--	--	22,714	0.521	13,308	0.306
7195	--	2.50	--	--	--	25,811	0.593	37,570	0.862
7196	--	3.50	--	--	--	29,009	0.666	64,980	1.492
7197	--	4.50	--	--	--	32,308	0.742	95,639	2.196

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



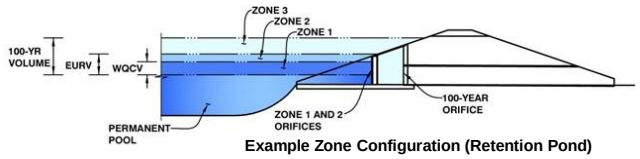


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook

Basin ID: TSB B1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	2.63	0.939	Orifice Plate
Zone 2			Not Utilized
Zone 3			Not Utilized
Total (all zones)		0.939	

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 =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.96	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 =	N/A	sq. 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)	0.15	0.65	0.85					
Orifice Area (sq. inches)	0.78	0.78	0.78					

	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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orific

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

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

Calculated Parameters for Overflow Wei

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

	Not Selected	Not Selected			Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.227	0.383	0.541	1.195	1.848	3.010	3.803	4.945
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.541	1.195	1.848	3.010	3.803	4.945
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	6.3	17.4	25.9	45.4	56.9	71.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.15	0.43	0.64	1.12	1.40	1.75
Peak Inflow Q (cfs) =	N/A	N/A	9.8	21.1	29.6	48.9	60.3	74.6
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	68	89	108	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	75	97	118	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.34	1.65	1.91	3.01	3.98	4.50	4.50	4.50
Area at Maximum Ponding Depth (acres) =	0.45	0.53	0.55	0.63	0.70	0.74	0.74	0.74
Maximum Volume Stored (acre-ft) =	0.228	0.385	0.525	1.168	1.820	2.196	2.196	2.196

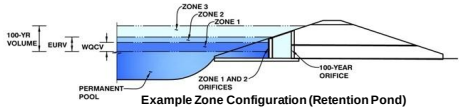
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

TSB A2 AND STANDPIPE SIZING

Project: Overlook

Basin ID: TSB A2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		
Watershed Area =	63.96	acres	
Watershed Length =	2,400	ft	
Watershed Length to Centroid =	1,200	ft	
Watershed Slope =	0.030	ft/ft	
Watershed Imperviousness =	11.00%	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 =	72.0	hours	Drain Time Too Long
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) =	0.387	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.666	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.906	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.951	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.988	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.818	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	6.073	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.872	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	11.161	acre-feet		inches
Approximate 2-yr Detention Volume =	0.429	acre-feet		
Approximate 5-yr Detention Volume =	0.669	acre-feet		
Approximate 10-yr Detention Volume =	1.332	acre-feet		
Approximate 25-yr Detention Volume =	1.832	acre-feet		
Approximate 50-yr Detention Volume =	1.921	acre-feet		
Approximate 100-yr Detention Volume =	2.469	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (User Defined) =	1.500	acre-feet	
Select Zone 2 Storage Volume (Optional) =		acre-feet	
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	1.500	acre-feet	Total detention volume is less than 100-year volume.
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial Surcharge Depth (ISD) =	user	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	user	ft	
Slope of Trickle Channel (S_{TC}) =	user	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio (R_{LW}) =	user		

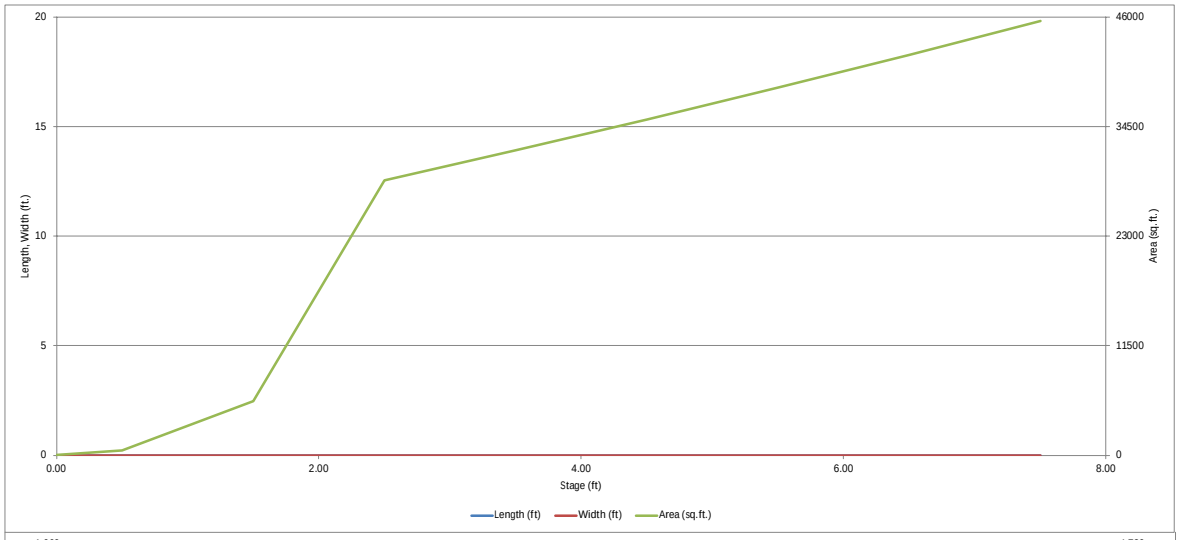
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

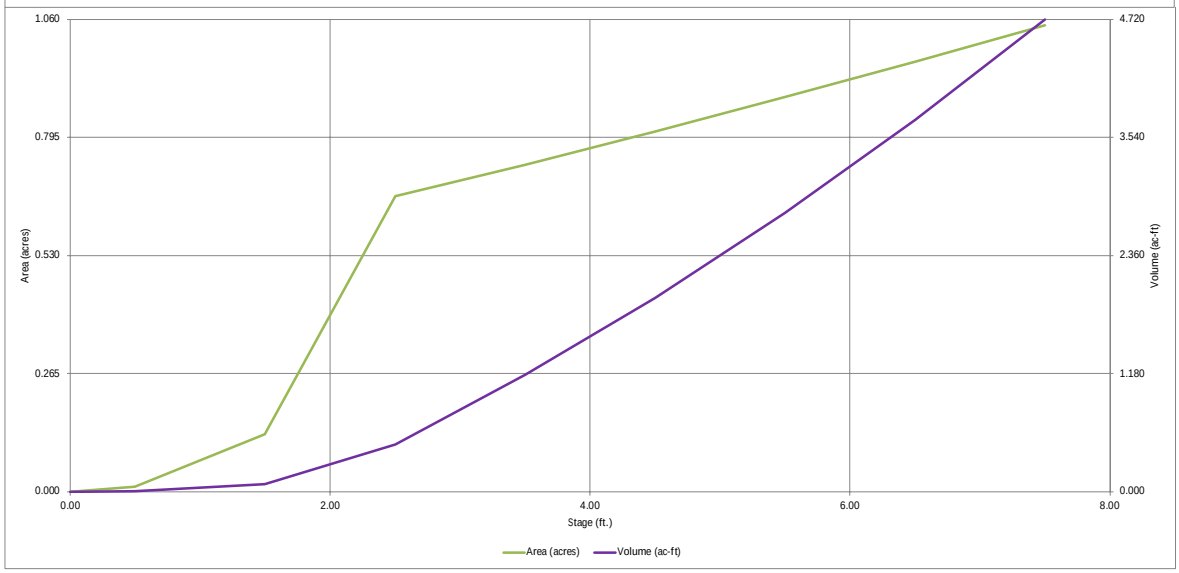
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
7192.5 Top of Micropool	--	0.00	--	--	--	16	0.000		
7193	--	0.50	--	--	--	495	0.011	128	0.003
7194	--	1.50	--	--	--	5,651	0.130	3,201	0.073
7195	--	2.50	--	--	--	28,880	0.663	20,466	0.470
7196	--	3.50	--	--	--	31,980	0.734	50,896	1.168
7197	--	4.50	--	--	--	35,208	0.808	84,490	1.940
7198	--	5.50	--	--	--	38,566	0.885	121,377	2.786
7199	--	6.50	--	--	--	42,053	0.965	161,687	3.712
7200	--	7.50	--	--	--	45,628	1.047	205,527	4.718

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



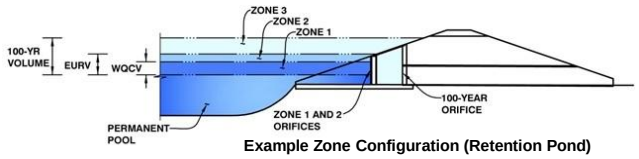


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Overlook

Basin ID: TSB A2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	3.95	1.500	Orifice Plate
Zone 2			Not Utilized
Zone 3			Not Utilized
Total (all zones)		1.500	

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 =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.95	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 =	N/A	sq. 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)	0.50	0.75	1.25					
Orifice Area (sq. inches)	0.78	0.78	0.78					

	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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orific

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

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

Calculated Parameters for Overflow Wei

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

	Not Selected	Not Selected			Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.387	0.666	0.906	1.951	2.988	4.818	6.073	7.872
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.906	1.951	2.988	4.818	6.073	7.872
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	7.3	20.3	30.7	55.1	69.1	88.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.32	0.48	0.86	1.08	1.38
Peak Inflow Q (cfs) =	N/A	N/A	12.2	25.7	36.4	59.9	73.9	93.1
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	65	93	117	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	73	102	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	2.37	2.80	3.10	4.47	5.68	7.50	7.50	7.50
Area at Maximum Ponding Depth (acres) =	0.59	0.68	0.71	0.81	0.90	1.05	1.05	1.05
Maximum Volume Stored (acre-ft) =	0.388	0.672	0.880	1.915	2.947	4.718	4.718	4.718

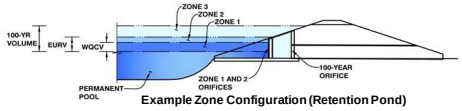
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: _____

Basin ID: _____

TSB B8 AND STANDPIPE SIZING



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		
Watershed Area =	61.60	acres	
Watershed Length =	1,900	ft	
Watershed Length to Centroid =	950	ft	
Watershed Slope =	0.085	ft/ft	Steep Slope > 0.06 ft/
Watershed Imperviousness =	8.00%	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 =	72.0	hours	Drain Time Too Long
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) =	0.284	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.455	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.726	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.688	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.660	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	4.432	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.623	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.355	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	10.487	acre-feet	inches
Approximate 2-yr Detention Volume =	0.284	acre-feet	
Approximate 5-yr Detention Volume =	0.454	acre-feet	
Approximate 10-yr Detention Volume =	1.044	acre-feet	
Approximate 25-yr Detention Volume =	1.509	acre-feet	
Approximate 50-yr Detention Volume =	1.567	acre-feet	
Approximate 100-yr Detention Volume =	2.051	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (User Defined) =	1.330	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.330	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio (R_{LW}) =	user	

Total detention volume is less than 100-year volume.

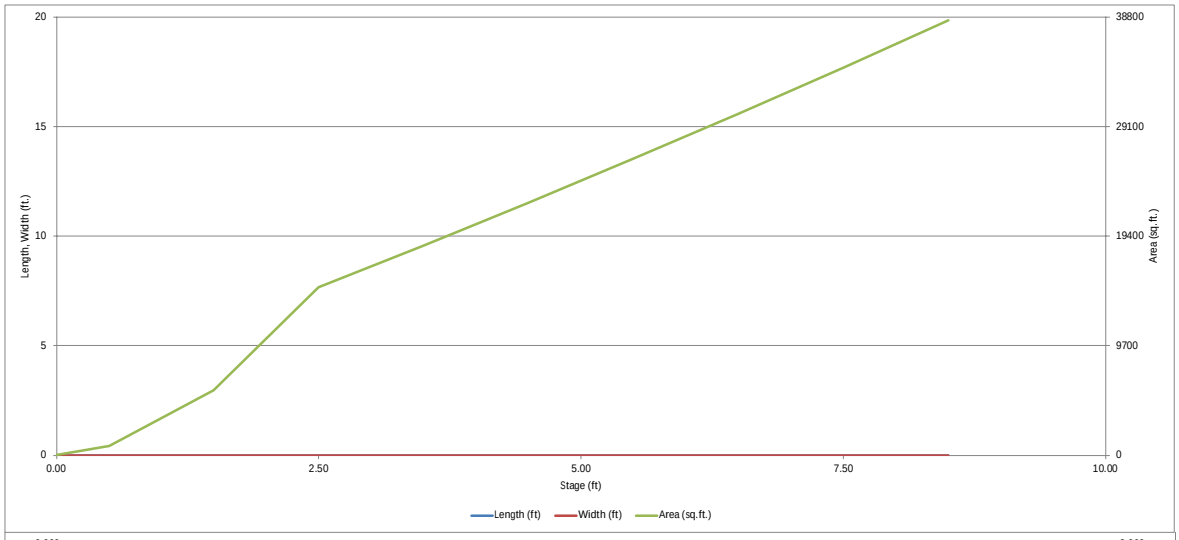
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

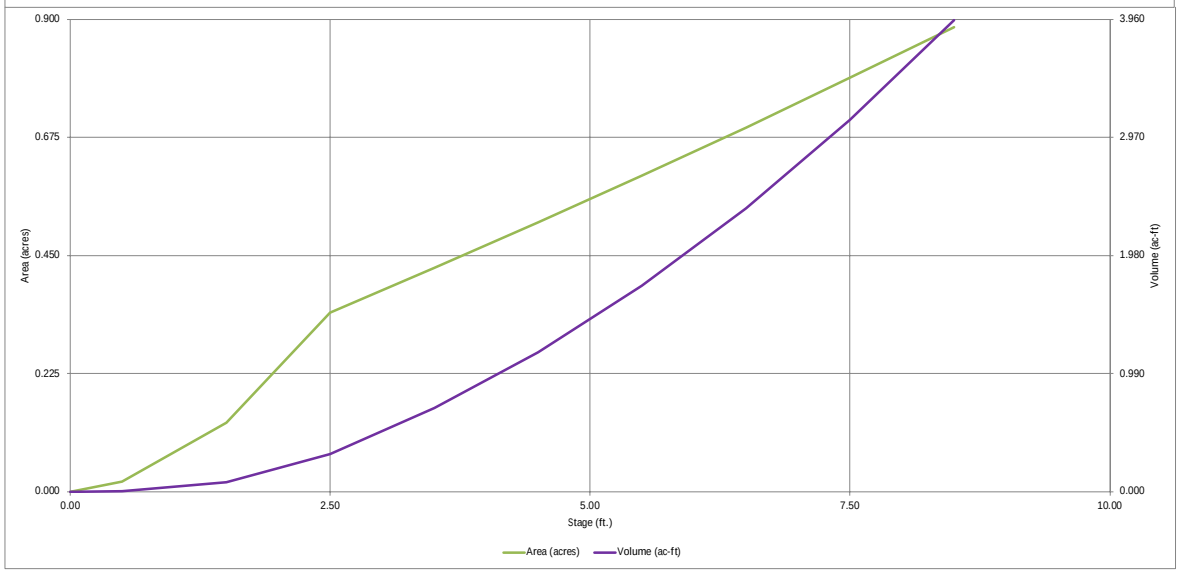
Depth Increment = ft

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	--	--	--	16	0.000		
7185	--	0.50	--	--	--	833	0.019	212	0.005
7186	--	1.50	--	--	--	5,730	0.132	3,494	0.080
7187	--	2.50	--	--	--	14,884	0.342	13,801	0.317
7188	--	3.50	--	--	--	18,561	0.426	30,523	0.701
7189	--	4.50	--	--	--	22,345	0.513	50,976	1.170
7190	--	5.50	--	--	--	26,237	0.602	75,267	1.728
7191	--	6.50	--	--	--	30,235	0.694	103,503	2.376
7192	--	7.50	--	--	--	34,340	0.788	135,791	3.117
7193	--	8.50	--	--	--	38,551	0.885	172,236	3.954

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



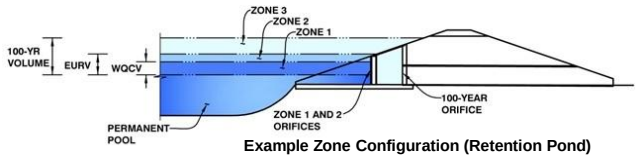


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (User)	4.81	1.330	Orifice Plate
Zone 2			Not Utilized
Zone 3			Not Utilized
Total (all zones)		1.330	

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 =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.79	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 =	N/A	sq. 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)	0.25	1.00	2.25					
Orifice Area (sq. inches)	0.78	0.78	0.78					

	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
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
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orific

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

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

Calculated Parameters for Overflow Wei

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

	Not Selected	Not Selected			Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plat

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.284	0.455	0.726	1.688	2.660	4.432	5.623	7.355
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.726	1.688	2.660	4.432	5.623	7.355
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	10.4	28.6	42.2	73.6	92.1	115.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.17	0.46	0.69	1.20	1.50	1.87
Peak Inflow Q (cfs) =	N/A	N/A	14.7	32.9	46.6	77.4	95.7	119.0
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	69	89	114	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	74	95	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	2.41	2.89	3.52	5.39	6.85	8.50	8.50	8.50
Area at Maximum Ponding Depth (acres) =	0.32	0.37	0.43	0.59	0.73	0.89	0.89	0.89
Maximum Volume Stored (acre-ft) =	0.287	0.456	0.705	1.656	2.625	3.954	3.954	3.954

Exiting Conditions Natural Channels Flow Summary							
Channel ID	Contributing Basins	Tributary Area (ac)	Basin Area (ac)	Basin 100-yr Flow (cfs)	Channel 100-yr Flow (cfs)	Velocity (ft/s)	Normal Depth (ft)
A1-1	A1	19.92	19.92	38.41	38.41	2.56	0.47
A2-3	A2, OS-A2	48.30 (A2) + 4.45 (OS-A2)	61.50 (A2) + 4.45 (OS-A2)	87.58 (A2) + 11.46 (OS-A2)	80.24	4.88	0.89
A2-4	A2	2.73	61.50	87.58	2.71	1.49	0.23
A2-5	A2, B1	7.38 (A2) + 2.81 (B1)	61.50 (A2) + 45.75 (B1)	87.58 (A2) + 72.48 (B1)	14.96	1.99	0.26
B1-2	B1	16.60	45.75	72.48	26.30	3.66	0.23
B1-3	B1	6.15	45.75	72.48	9.74	2.52	0.27
B1-6	B1	13.08	45.75	72.48	20.72	2.96	0.36
B2-1	B2	4.52	42.42	69.09	7.36	2.25	0.19
B2-2	B2	36.7	42.42	69.09	59.77	4.90	0.49
B7-1	B3	2.20	25.42	43.40	3.76	1.73	0.20
B8-1	B3	17.57	25.42	43.40	30.00	3.41	0.29

Proposed Conditions Natural Channels Flow Summary								
Channel ID	Contributing Basins	Tributary Area (ac)	Basin Area (ac)	Basin 100-yr Flow (cfs)	Channel 100-yr Flow (cfs)	Velocity (ft/s)	Normal Depth (ft)	Lining
A1-1	A1	19.55	19.55	41.24	41.24	2.62	0.48	
A2-1	A2, OS-A2	32.76 (A2) + 3.25 (OS-A2)	58.72 (A2) + 4.45 (OS-A2)	92.96 (A2) + 11.46 (OS-A2)	60.42	3.82	0.59	
A2-2	A2	9.06	58.27	92.96	14.45	2.48	0.18	
A2-3	A2	11.45	58.27	92.96	18.27	3.09	0.40	
A2-4	A2	1.70	58.27	92.96	2.71	1.49	0.02	
A2-5	A2, B1	7.75 (A2) + 3.44 (B1)	58.72 (A2) + 40.74 (B1)	92.96 (A2) + 80.40 (B1)	19.06	2.17	0.3	
A2-6	A2, B1	2.46 (A2) + 3.44 (B1)	58.72 (A2) + 40.74 (B1)	92.96 (A2) + 80.40 (B1)	10.72	1.86	0.18	
A2-7	A2	1.74	58.27	92.96	2.78	0.94	0.08	
B1-1	B1	10.19	40.74	80.40	20.11	2.71	0.28	
B1-2	B1	14.29	40.74	80.40	28.20	3.76	0.24	
B1-3	B1	13.43	40.74	80.40	26.50	3.46	0.47	
B1-4	B1	4.03	40.74	80.40	7.95	2.52	0.02	
B1-5	B1	2.54	40.74	80.40	5.01	1.68	0.11	
B1-6	B1	2.72	40.74	80.40	5.37	1.84	0.17	
B2-1	B2	4.92	16.00	38.64	11.88	2.69	0.25	
B2-2	B2	9.77	16.00	38.64	23.59	3.54	0.29	
B6-1	B6	11.58	53.31	106.95	23.23	6.67	0.29	TRM
B7-1	B7	2.25	2.46	6.17	5.64	1.91	0.23	
B8-1	B8, B6	3.32 (B8) + 53.31 (B6)	9.52 (B8) + 53.31 (B6)	23.05 (B8) + 106.95 (B6)	114.99	5.39	0.63	

Worksheet for A1-1 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.015 ft/ft
Discharge	38.41 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	41.00
0+35	36.00
0+64	36.00
1+00	41.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 41.00)	(0+35, 36.00)	0.040
(0+35, 36.00)	(0+64, 36.00)	0.040
(0+64, 36.00)	(1+00, 41.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

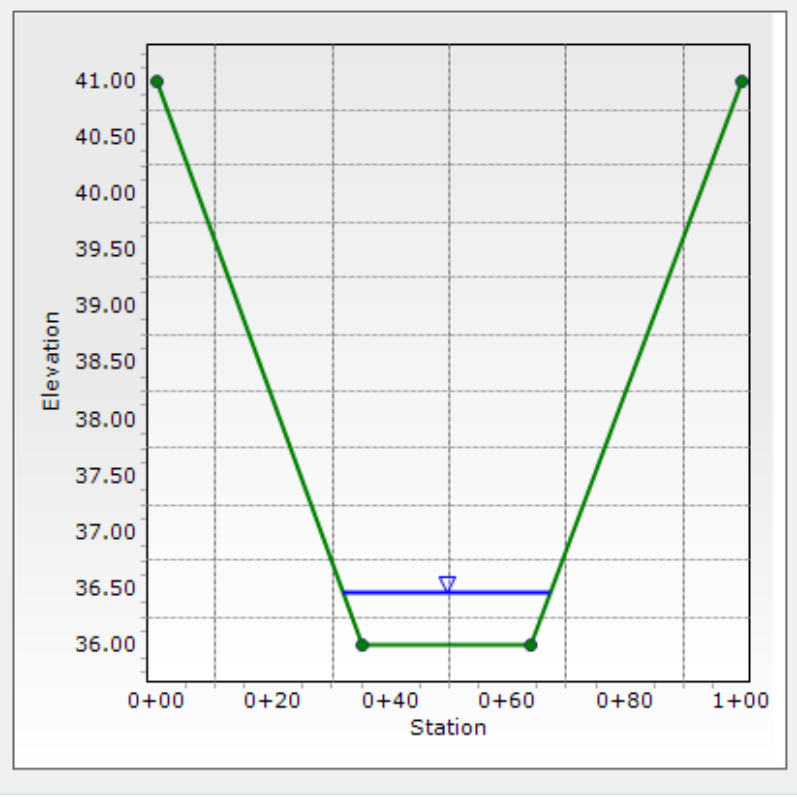
Normal Depth	5.6 in
Roughness Coefficient	0.040
Elevation	36.47 ft
Elevation Range	36.0 to 41.0 ft
Flow Area	15.0 ft²
Wetted Perimeter	35.7 ft
Hydraulic Radius	5.1 in
Top Width	35.61 ft
Normal Depth	5.6 in
Critical Depth	4.4 in
Critical Slope	0.033 ft/ft
Velocity	2.56 ft/s
Velocity Head	0.10 ft
Specific Energy	0.57 ft
Froude Number	0.694

Worksheet for A1-1 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	5.6 in
Critical Depth	4.4 in
Channel Slope	0.015 ft/ft
Critical Slope	0.033 ft/ft



Worksheet for A2-3 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.030 ft/ft
Discharge	80.24 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	11.00
0+51	4.00
0+63	4.00
0+98	9.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 11.00)	(0+51, 4.00)	0.040
(0+51, 4.00)	(0+63, 4.00)	0.040
(0+63, 4.00)	(0+98, 9.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

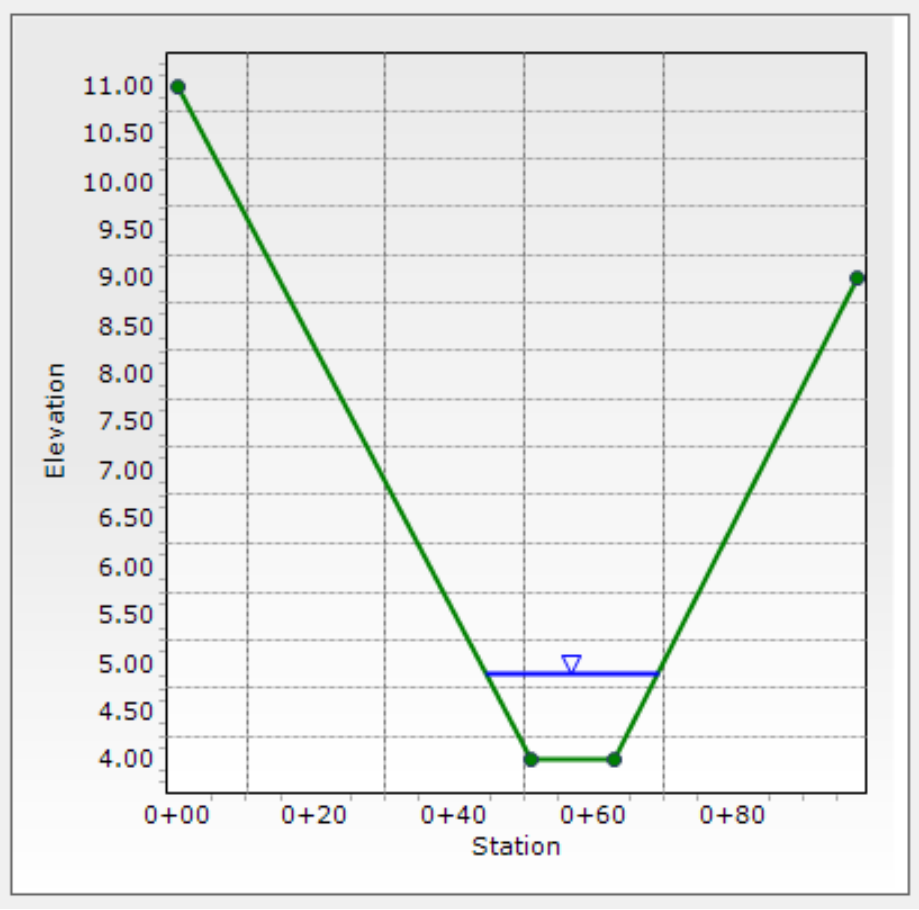
Results

Normal Depth	10.7 in
Roughness Coefficient	0.040
Elevation	4.89 ft
Elevation Range	4.0 to 11.0 ft
Flow Area	16.4 ft²
Wetted Perimeter	24.9 ft
Hydraulic Radius	7.9 in
Top Width	24.77 ft
Normal Depth	10.7 in
Critical Depth	11.1 in
Critical Slope	0.027 ft/ft
Velocity	4.88 ft/s
Velocity Head	0.37 ft
Specific Energy	1.26 ft
Froude Number	1.056
Flow Type	Supercritical

Worksheet for A2-3 (Existing Conditions)

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.7 in
Critical Depth	11.1 in
Channel Slope	0.030 ft/ft
Critical Slope	0.027 ft/ft



Worksheet for A2-4 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.029 ft/ft
Discharge	2.71 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+15	14.00
0+32	12.75
0+47	12.50
0+98	18.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+15, 14.00)	(0+32, 12.75)	0.040
(0+32, 12.75)	(0+47, 12.50)	0.040
(0+47, 12.50)	(0+98, 18.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

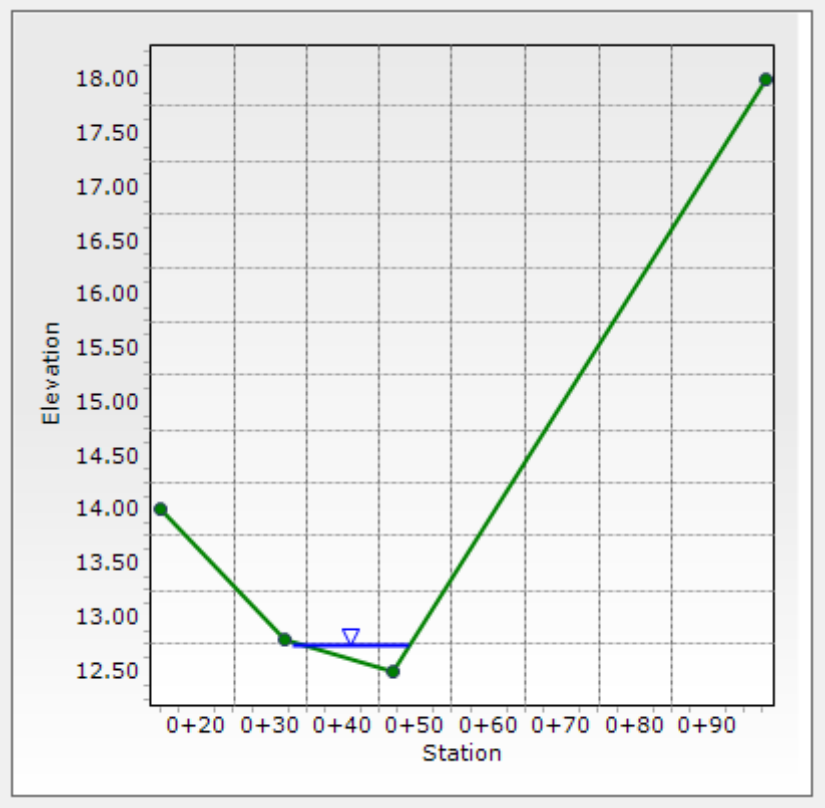
Normal Depth	2.7 in
Roughness Coefficient	0.040
Elevation	12.73 ft
Elevation Range	12.5 to 18.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	15.9 ft
Hydraulic Radius	1.4 in
Top Width	15.86 ft
Normal Depth	2.7 in
Critical Depth	2.5 in
Critical Slope	0.050 ft/ft
Velocity	1.49 ft/s
Velocity Head	0.03 ft
Specific Energy	0.26 ft
Froude Number	0.778

Worksheet for A2-4 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.7 in
Critical Depth	2.5 in
Channel Slope	0.029 ft/ft
Critical Slope	0.050 ft/ft



Worksheet for A2-5 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	14.96 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	15.00
0+43	12.00
0+68	12.00
1+25	16.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 15.00)	(0+43, 12.00)	0.040
(0+43, 12.00)	(0+68, 12.00)	0.040
(0+68, 12.00)	(1+25, 16.75)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

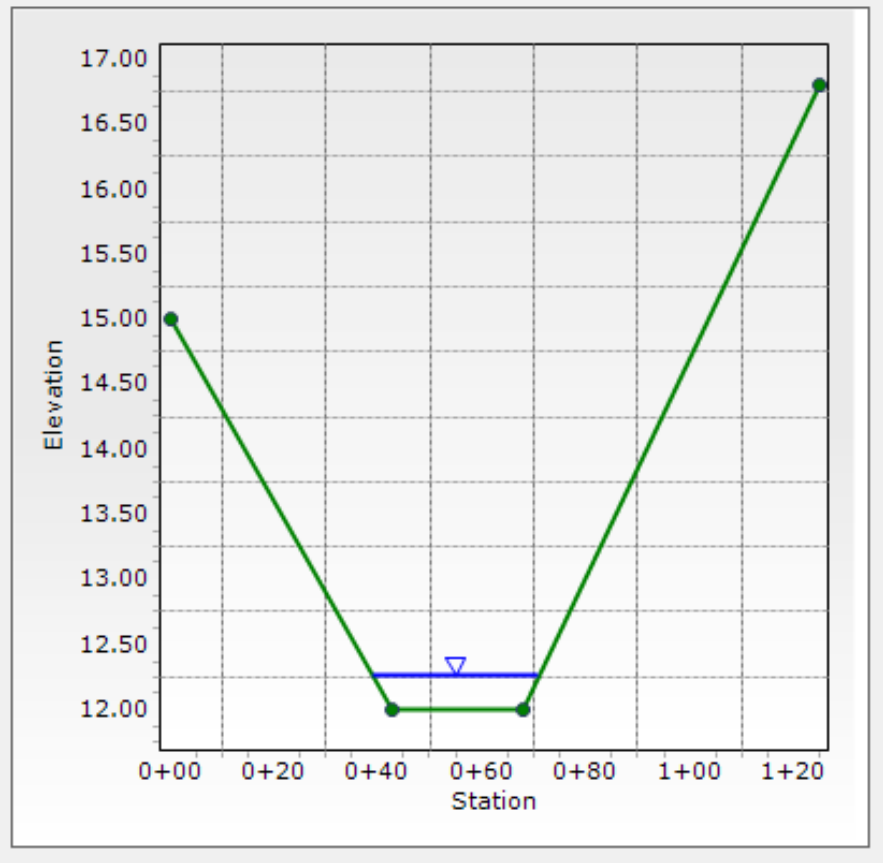
Normal Depth	3.1 in
Roughness Coefficient	0.040
Elevation	12.26 ft
Elevation Range	12.0 to 16.8 ft
Flow Area	7.5 ft²
Wetted Perimeter	32.2 ft
Hydraulic Radius	2.8 in
Top Width	32.15 ft
Normal Depth	3.1 in
Critical Depth	2.6 in
Critical Slope	0.040 ft/ft
Velocity	1.99 ft/s
Velocity Head	0.06 ft
Specific Energy	0.32 ft
Froude Number	0.727

Worksheet for A2-5 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.1 in
Critical Depth	2.6 in
Channel Slope	0.020 ft/ft
Critical Slope	0.040 ft/ft



Worksheet for B1-2 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.075 ft/ft
Discharge	26.30 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.00
0+31	0.00
0+60	0.00
1+00	4.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.00)	(0+31, 0.00)	0.040
(0+31, 0.00)	(0+60, 0.00)	0.040
(0+60, 0.00)	(1+00, 4.84)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

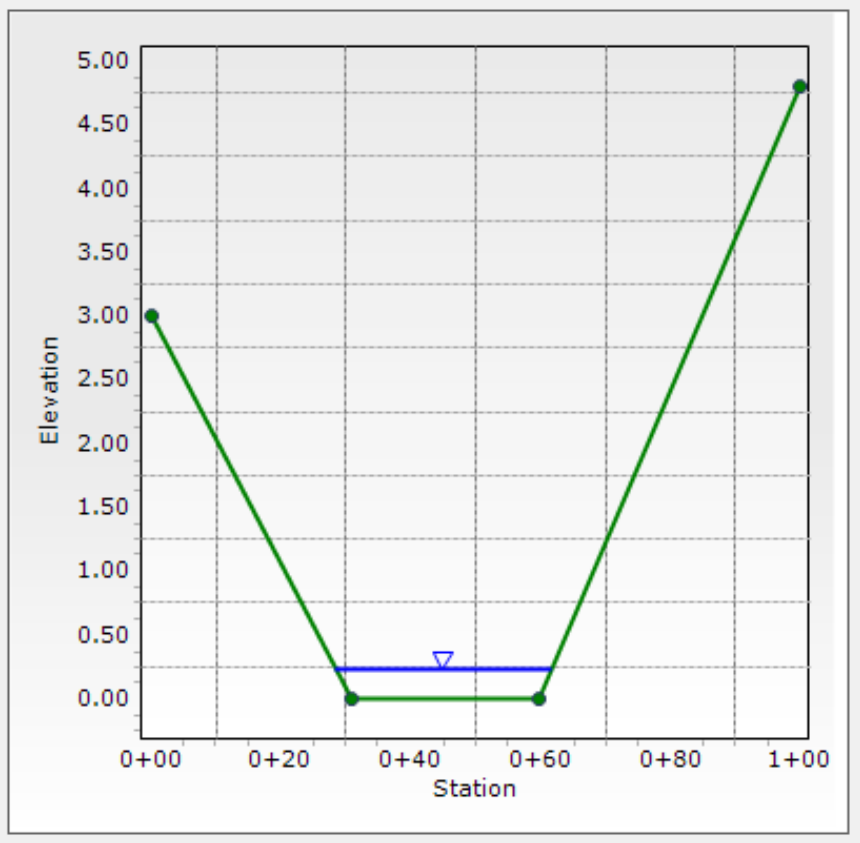
Results

Normal Depth	2.8 in
Roughness Coefficient	0.040
Elevation	0.23 ft
Elevation Range	0.0 to 4.8 ft
Flow Area	7.2 ft²
Wetted Perimeter	33.2 ft
Hydraulic Radius	2.6 in
Top Width	33.16 ft
Normal Depth	2.8 in
Critical Depth	3.4 in
Critical Slope	0.036 ft/ft
Velocity	3.66 ft/s
Velocity Head	0.21 ft
Specific Energy	0.44 ft
Froude Number	1.386
Flow Type	Supercritical

Worksheet for B1-2 (Existing Conditions)

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.8 in
Critical Depth	3.4 in
Channel Slope	0.075 ft/ft
Critical Slope	0.036 ft/ft



Worksheet for B1-3 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.033 ft/ft
Discharge	9.74 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	19.00
0+45	14.00
0+56	14.00
0+98	18.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 19.00)	(0+45, 14.00)	0.040
(0+45, 14.00)	(0+56, 14.00)	0.040
(0+56, 14.00)	(0+98, 18.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

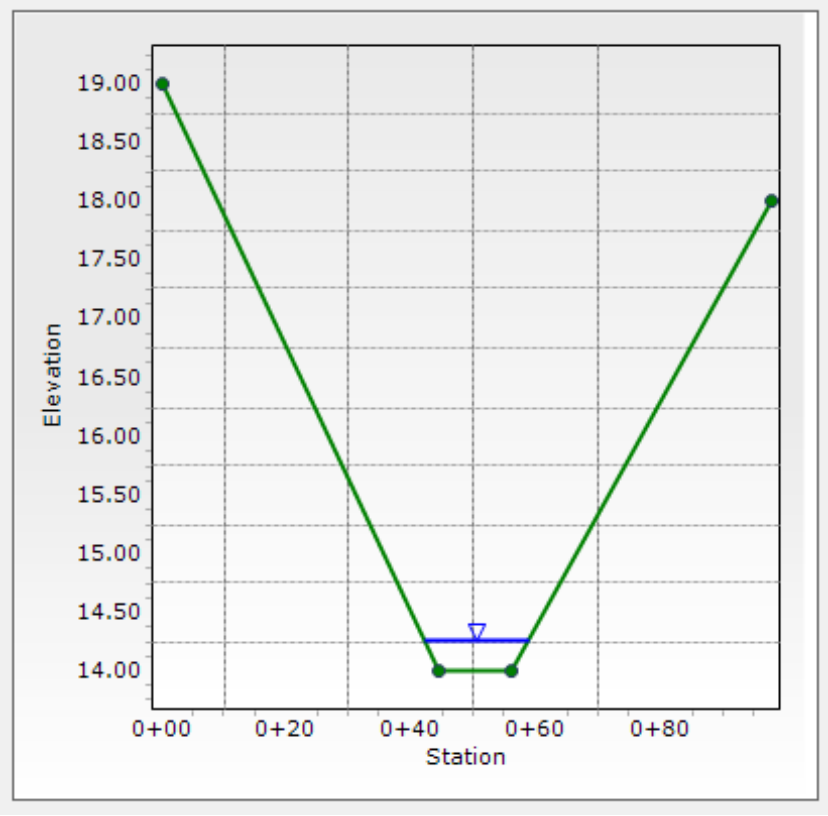
Normal Depth	3.2 in
Roughness Coefficient	0.040
Elevation	14.27 ft
Elevation Range	14.0 to 19.0 ft
Flow Area	3.9 ft²
Wetted Perimeter	17.0 ft
Hydraulic Radius	2.7 in
Top Width	16.96 ft
Normal Depth	3.2 in
Critical Depth	3.1 in
Critical Slope	0.039 ft/ft
Velocity	2.52 ft/s
Velocity Head	0.10 ft
Specific Energy	0.37 ft
Froude Number	0.929

Worksheet for B1-3 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.2 in
Critical Depth	3.1 in
Channel Slope	0.033 ft/ft
Critical Slope	0.039 ft/ft



Worksheet for B1-6 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.030 ft/ft
Discharge	20.72 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	22.00
0+35	18.00
0+51	18.00
0+92	23.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 22.00)	(0+35, 18.00)	0.040
(0+35, 18.00)	(0+51, 18.00)	0.040
(0+51, 18.00)	(0+92, 23.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

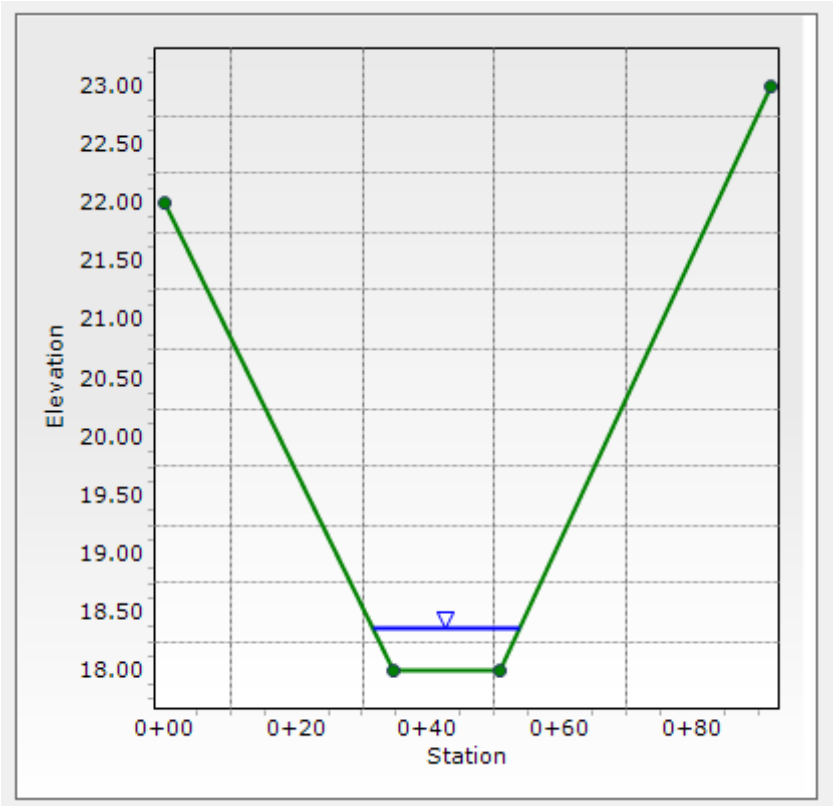
Normal Depth	4.3 in
Roughness Coefficient	0.040
Elevation	18.36 ft
Elevation Range	18.0 to 23.0 ft
Flow Area	7.0 ft²
Wetted Perimeter	22.4 ft
Hydraulic Radius	3.7 in
Top Width	22.37 ft
Normal Depth	4.3 in
Critical Depth	4.2 in
Critical Slope	0.035 ft/ft
Velocity	2.96 ft/s
Velocity Head	0.14 ft
Specific Energy	0.50 ft
Froude Number	0.934

Worksheet for B1-6 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.3 in
Critical Depth	4.2 in
Channel Slope	0.030 ft/ft
Critical Slope	0.035 ft/ft



Worksheet for B2-1 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.037 ft/ft
Discharge	7.36 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5.00
0+42	0.00
0+58	0.00
0+75	4.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5.00)	(0+42, 0.00)	0.040
(0+42, 0.00)	(0+58, 0.00)	0.040
(0+58, 0.00)	(0+75, 4.50)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

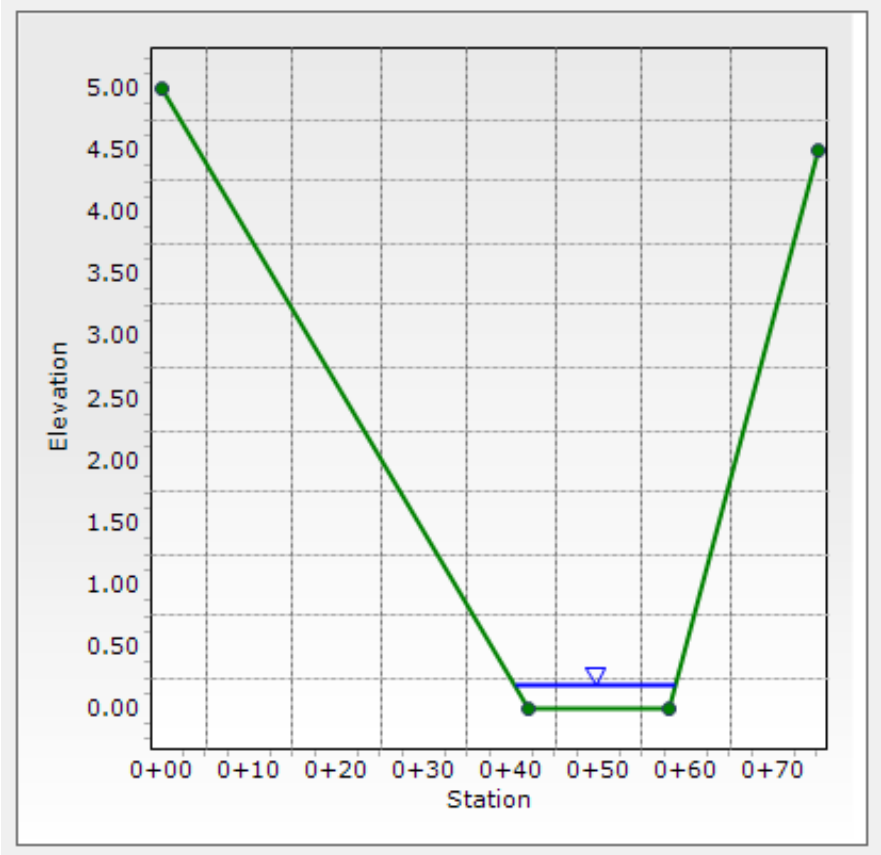
Results

Normal Depth	2.3 in
Roughness Coefficient	0.040
Elevation	0.19 ft
Elevation Range	0.0 to 5.0 ft
Flow Area	3.3 ft²
Wetted Perimeter	18.4 ft
Hydraulic Radius	2.1 in
Top Width	18.32 ft
Normal Depth	2.3 in
Critical Depth	2.2 in
Critical Slope	0.042 ft/ft
Velocity	2.25 ft/s
Velocity Head	0.08 ft
Specific Energy	0.27 ft
Froude Number	0.942
Flow Type	Subcritical

Worksheet for B2-1 (Existing Conditions)

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.3 in
Critical Depth	2.2 in
Channel Slope	0.037 ft/ft
Critical Slope	0.042 ft/ft



Worksheet for B2-2 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.054 ft/ft
Discharge	59.77 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	13.00
0+38	8.00
0+59	8.00
0+96	13.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 13.00)	(0+38, 8.00)	0.040
(0+38, 8.00)	(0+59, 8.00)	0.040
(0+59, 8.00)	(0+96, 13.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

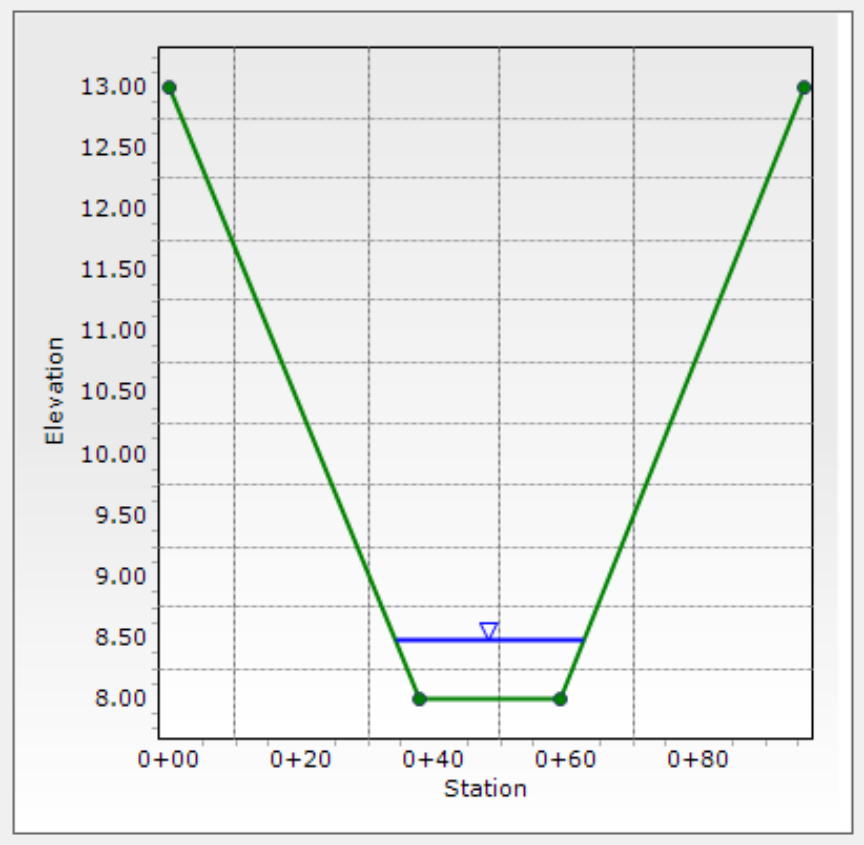
Results

Normal Depth	5.9 in
Roughness Coefficient	0.040
Elevation	8.49 ft
Elevation Range	8.0 to 13.0 ft
Flow Area	12.2 ft²
Wetted Perimeter	28.5 ft
Hydraulic Radius	5.1 in
Top Width	28.40 ft
Normal Depth	5.9 in
Critical Depth	7.0 in
Critical Slope	0.029 ft/ft
Velocity	4.90 ft/s
Velocity Head	0.37 ft
Specific Energy	0.87 ft
Froude Number	1.320
Flow Type	Supercritical

Worksheet for B2-2 (Existing Conditions)

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.9 in
Critical Depth	7.0 in
Channel Slope	0.054 ft/ft
Critical Slope	0.029 ft/ft



Worksheet for B7-1 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.046 ft/ft
Discharge	3.76 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	95.00
0+25	92.00
0+50	91.75
0+90	98.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 95.00)	(0+25, 92.00)	0.040
(0+25, 92.00)	(0+50, 91.75)	0.040
(0+50, 91.75)	(0+90, 98.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

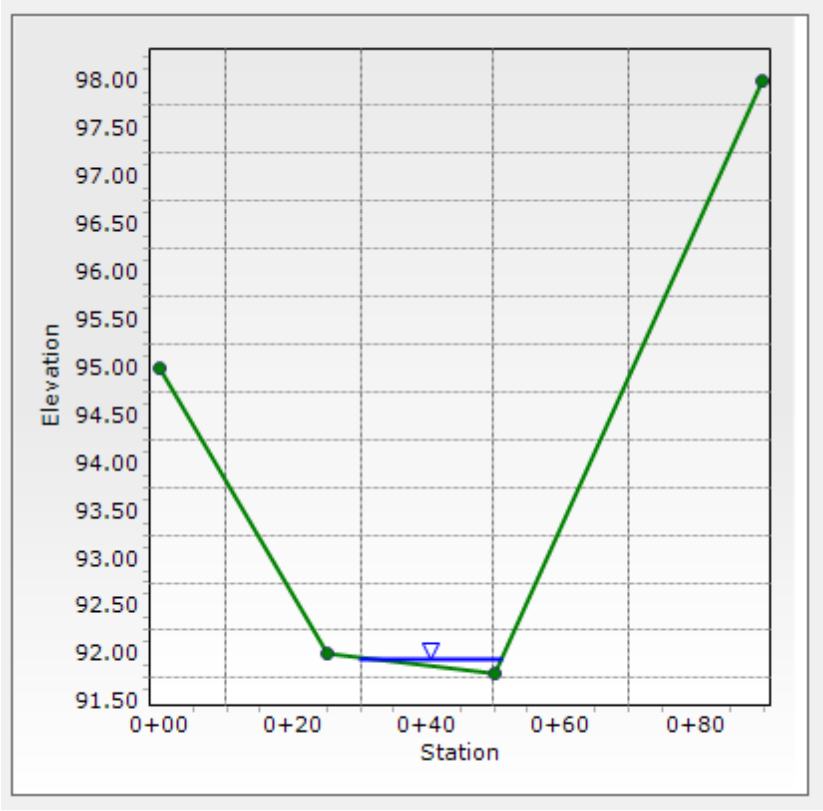
Normal Depth	2.4 in
Roughness Coefficient	0.040
Elevation	91.95 ft
Elevation Range	91.8 to 98.0 ft
Flow Area	2.2 ft²
Wetted Perimeter	21.5 ft
Hydraulic Radius	1.2 in
Top Width	21.51 ft
Normal Depth	2.4 in
Critical Depth	2.4 in
Critical Slope	0.050 ft/ft
Velocity	1.73 ft/s
Velocity Head	0.05 ft
Specific Energy	0.25 ft
Froude Number	0.959

Worksheet for B7-1 (Existing Conditions)

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.4 in
Critical Depth	2.4 in
Channel Slope	0.046 ft/ft
Critical Slope	0.050 ft/ft



Worksheet for B8-1 (Existing Conditions)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.050 ft/ft
Discharge	30.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	202.00
0+52	198.00
0+79	198.00
1+06	201.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 202.00)	(0+52, 198.00)	0.040
(0+52, 198.00)	(0+79, 198.00)	0.040
(0+79, 198.00)	(1+06, 201.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

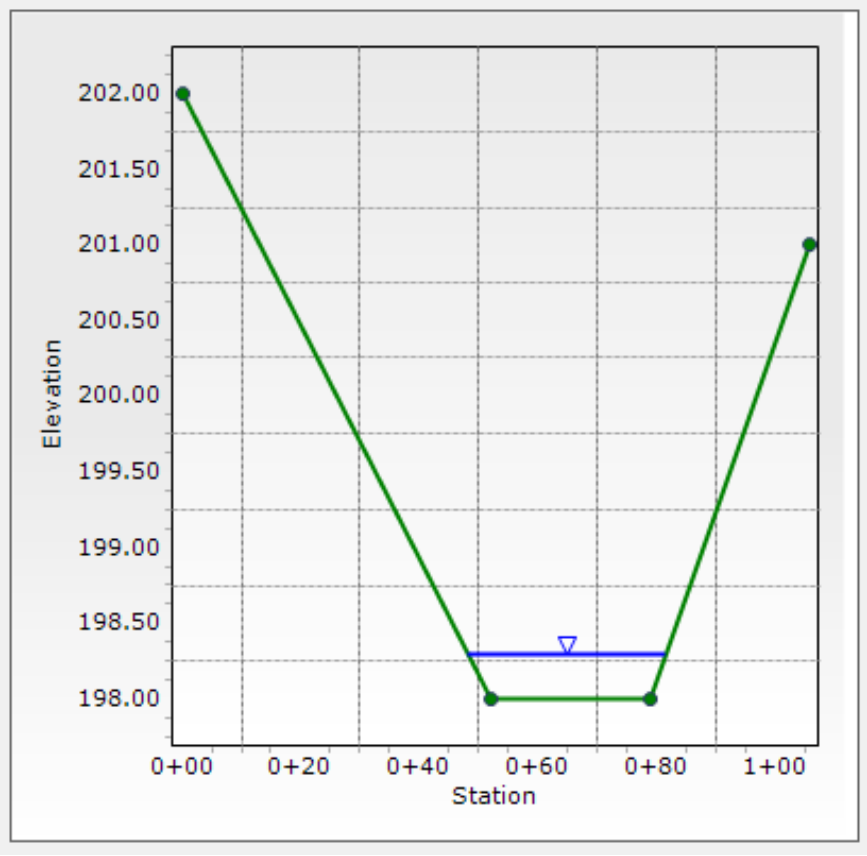
Normal Depth	3.5 in
Roughness Coefficient	0.040
Elevation	198.29 ft
Elevation Range	198.0 to 202.0 ft
Flow Area	8.8 ft²
Wetted Perimeter	33.4 ft
Hydraulic Radius	3.2 in
Top Width	33.41 ft
Normal Depth	3.5 in
Critical Depth	3.9 in
Critical Slope	0.035 ft/ft
Velocity	3.41 ft/s
Velocity Head	0.18 ft
Specific Energy	0.47 ft
Froude Number	1.172

Worksheet for B8-1 (Existing Conditions)

Results	
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.5 in
Critical Depth	3.9 in
Channel Slope	0.050 ft/ft
Critical Slope	0.035 ft/ft



Worksheet for A1-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.015 ft/ft
Discharge	41.24 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	41.00
0+35	36.00
0+64	36.00
1+00	41.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 41.00)	(0+35, 36.00)	0.040
(0+35, 36.00)	(0+64, 36.00)	0.040
(0+64, 36.00)	(1+00, 41.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

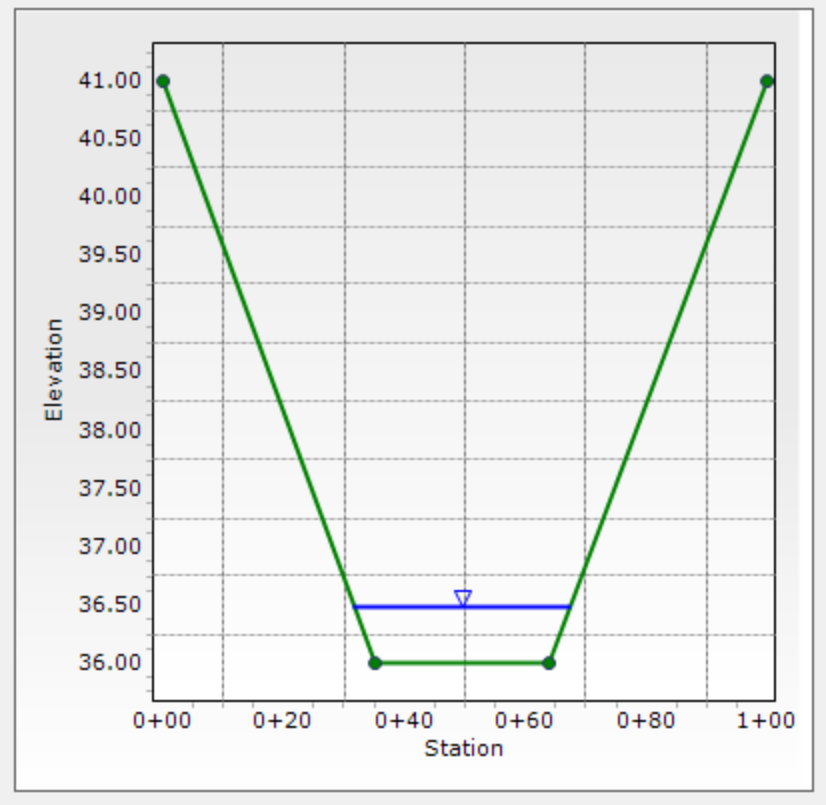
Normal Depth	5.8 in
Roughness Coefficient	0.040
Elevation	36.48 ft
Elevation Range	36.0 to 41.0 ft
Flow Area	15.7 ft²
Wetted Perimeter	36.0 ft
Hydraulic Radius	5.3 in
Top Width	35.89 ft
Normal Depth	5.8 in
Critical Depth	4.6 in
Critical Slope	0.033 ft/ft
Velocity	2.62 ft/s
Velocity Head	0.11 ft
Specific Energy	0.59 ft
Froude Number	0.698

Worksheet for A1-1

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	5.8 in
Critical Depth	4.6 in
Channel Slope	0.015 ft/ft
Critical Slope	0.033 ft/ft



Worksheet for A2-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.028 ft/ft
Discharge	60.42 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	47.00
0+66	42.00
0+87	42.00
1+25	47.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 47.00)	(0+66, 42.00)	0.040
(0+66, 42.00)	(0+87, 42.00)	0.040
(0+87, 42.00)	(1+25, 47.75)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

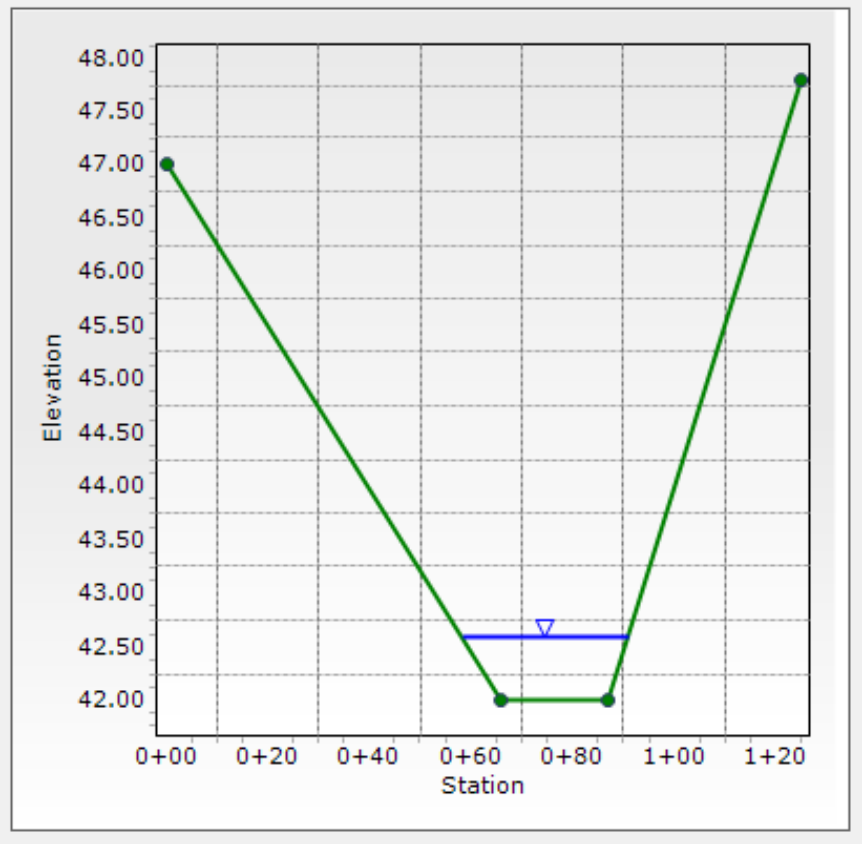
Normal Depth	7.1 in
Roughness Coefficient	0.040
Elevation	42.59 ft
Elevation Range	42.0 to 47.8 ft
Flow Area	15.8 ft²
Wetted Perimeter	32.7 ft
Hydraulic Radius	5.8 in
Top Width	32.67 ft
Normal Depth	7.1 in
Critical Depth	6.9 in
Critical Slope	0.030 ft/ft
Velocity	3.82 ft/s
Velocity Head	0.23 ft
Specific Energy	0.82 ft
Froude Number	0.969

Worksheet for A2-1

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.1 in
Critical Depth	6.9 in
Channel Slope	0.028 ft/ft
Critical Slope	0.030 ft/ft



Worksheet for A2-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.046 ft/ft
Discharge	14.45 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	23.00
0+43	16.00
0+72	16.00
1+25	20.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 23.00)	(0+43, 16.00)	0.040
(0+43, 16.00)	(0+72, 16.00)	0.040
(0+72, 16.00)	(1+25, 20.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

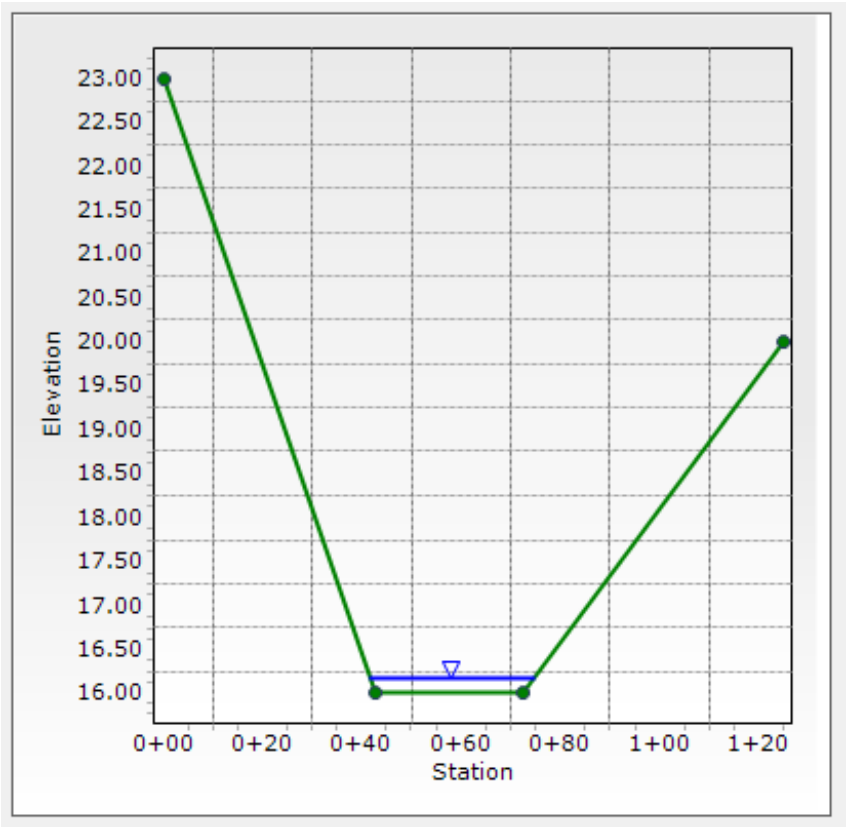
Normal Depth	2.2 in
Roughness Coefficient	0.040
Elevation	16.18 ft
Elevation Range	16.0 to 23.0 ft
Flow Area	5.8 ft²
Wetted Perimeter	33.3 ft
Hydraulic Radius	2.1 in
Top Width	33.30 ft
Normal Depth	2.2 in
Critical Depth	2.3 in
Critical Slope	0.041 ft/ft
Velocity	2.48 ft/s
Velocity Head	0.10 ft
Specific Energy	0.28 ft
Froude Number	1.048

Worksheet for A2-2

Results	
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.2 in
Critical Depth	2.3 in
Channel Slope	0.046 ft/ft
Critical Slope	0.041 ft/ft



Worksheet for A2-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.030 ft/ft
Discharge	18.27 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	11.00
0+51	4.00
0+63	4.00
0+98	9.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 11.00)	(0+51, 4.00)	0.040
(0+51, 4.00)	(0+63, 4.00)	0.040
(0+63, 4.00)	(0+98, 9.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

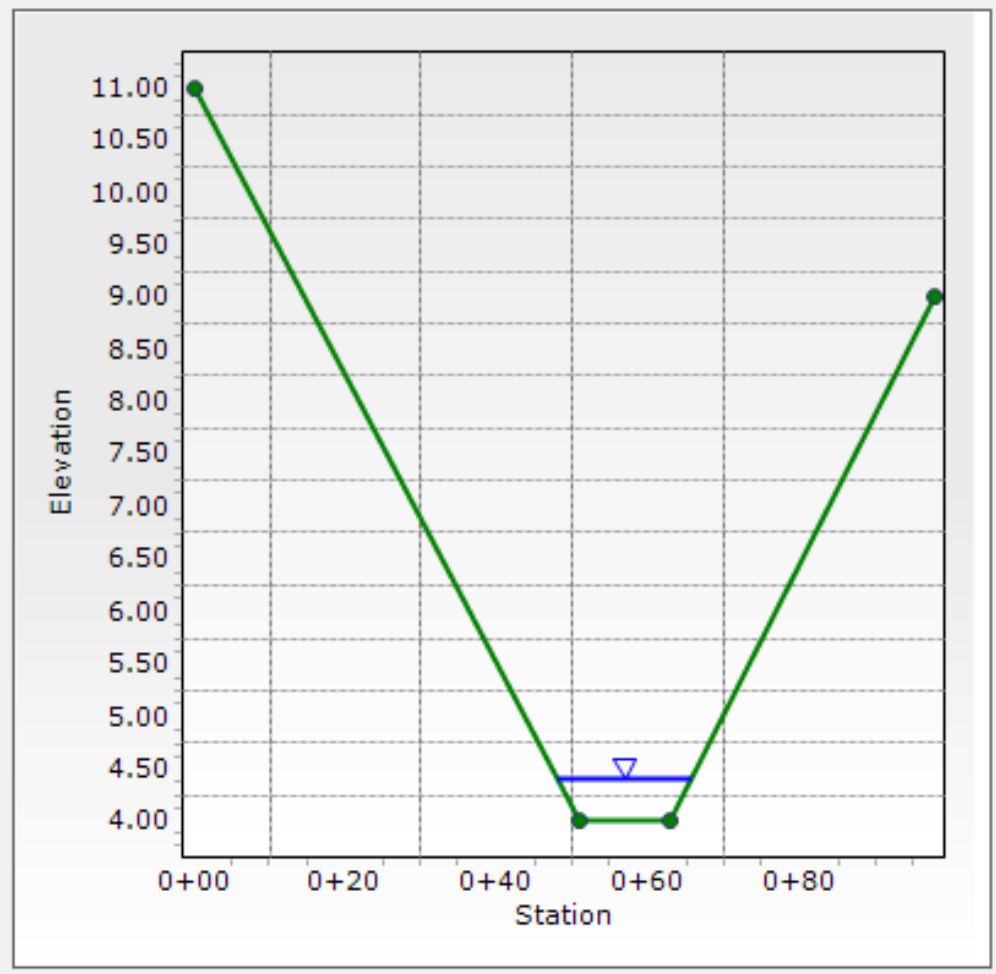
Results

Normal Depth	4.8 in
Roughness Coefficient	0.040
Elevation	4.40 ft
Elevation Range	4.0 to 11.0 ft
Flow Area	5.9 ft²
Wetted Perimeter	17.7 ft
Hydraulic Radius	4.0 in
Top Width	17.69 ft
Normal Depth	4.8 in
Critical Depth	4.6 in
Critical Slope	0.034 ft/ft
Velocity	3.09 ft/s
Velocity Head	0.15 ft
Specific Energy	0.55 ft
Froude Number	0.942
Flow Type	Subcritical

Worksheet for A2-3

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.8 in
Critical Depth	4.6 in
Channel Slope	0.030 ft/ft
Critical Slope	0.034 ft/ft



Worksheet for A2-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.029 ft/ft
Discharge	2.71 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+15	14.00
0+32	12.75
0+47	12.50
0+98	18.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+15, 14.00)	(0+32, 12.75)	0.040
(0+32, 12.75)	(0+47, 12.50)	0.040
(0+47, 12.50)	(0+98, 18.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

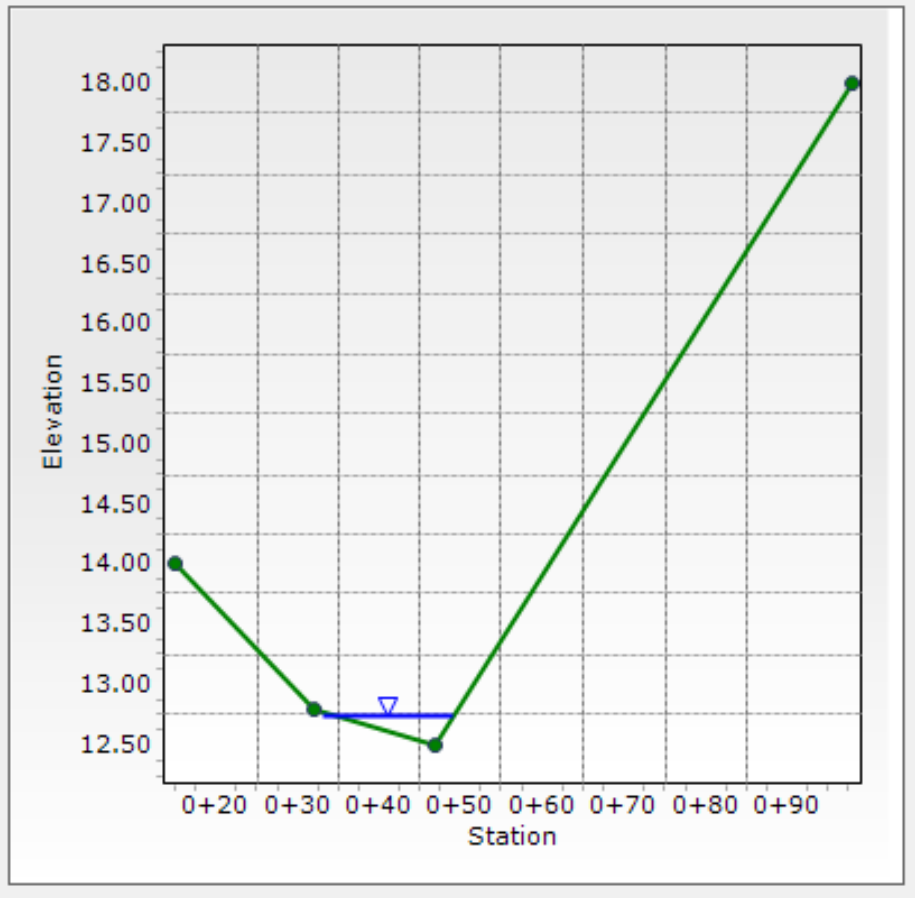
Normal Depth	2.7 in
Roughness Coefficient	0.040
Elevation	12.73 ft
Elevation Range	12.5 to 18.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	15.9 ft
Hydraulic Radius	1.4 in
Top Width	15.86 ft
Normal Depth	2.7 in
Critical Depth	2.5 in
Critical Slope	0.050 ft/ft
Velocity	1.49 ft/s
Velocity Head	0.03 ft
Specific Energy	0.26 ft
Froude Number	0.778

Worksheet for A2-4

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.7 in
Critical Depth	2.5 in
Channel Slope	0.029 ft/ft
Critical Slope	0.050 ft/ft



Worksheet for A2-5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	19.06 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	15.00
0+43	12.00
0+68	12.00
1+25	16.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 15.00)	(0+43, 12.00)	0.040
(0+43, 12.00)	(0+68, 12.00)	0.040
(0+68, 12.00)	(1+25, 16.75)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

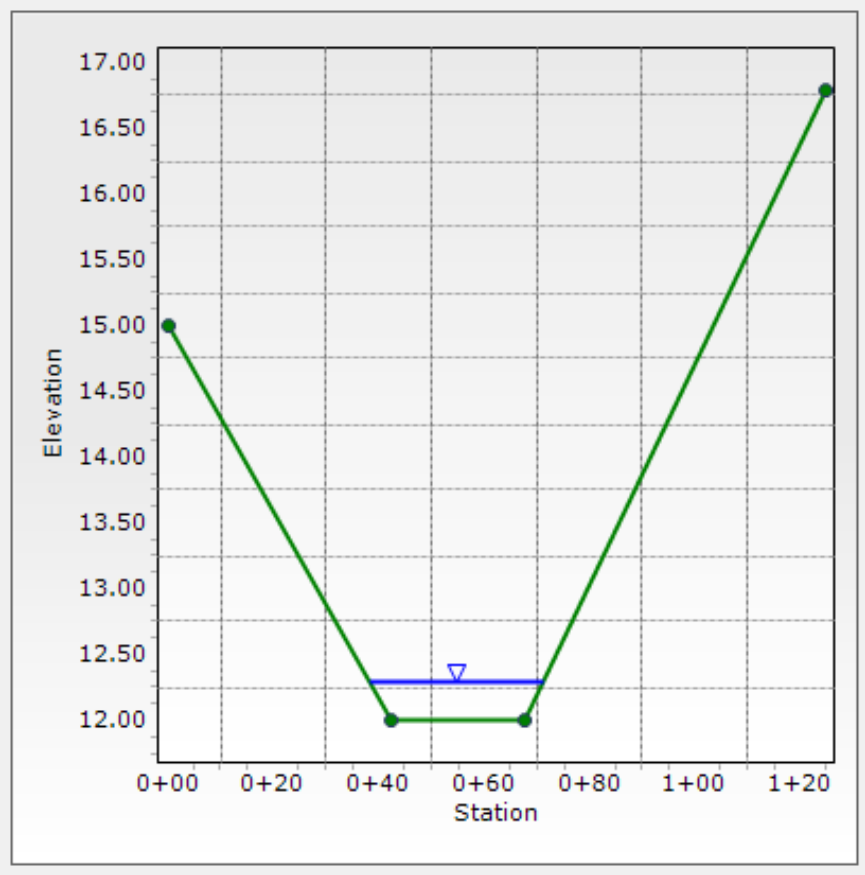
Normal Depth	3.6 in
Roughness Coefficient	0.040
Elevation	12.30 ft
Elevation Range	12.0 to 16.8 ft
Flow Area	8.8 ft²
Wetted Perimeter	33.2 ft
Hydraulic Radius	3.2 in
Top Width	33.18 ft
Normal Depth	3.6 in
Critical Depth	3.0 in
Critical Slope	0.038 ft/ft
Velocity	2.17 ft/s
Velocity Head	0.07 ft
Specific Energy	0.37 ft
Froude Number	0.742

Worksheet for A2-5

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.6 in
Critical Depth	3.0 in
Channel Slope	0.020 ft/ft
Critical Slope	0.038 ft/ft



Worksheet for A2-6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.027 ft/ft
Discharge	10.72 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	30.00
0+31	28.00
0+59	28.00
0+94	30.25

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 30.00)	(0+31, 28.00)	0.040
(0+31, 28.00)	(0+59, 28.00)	0.040
(0+59, 28.00)	(0+94, 30.25)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

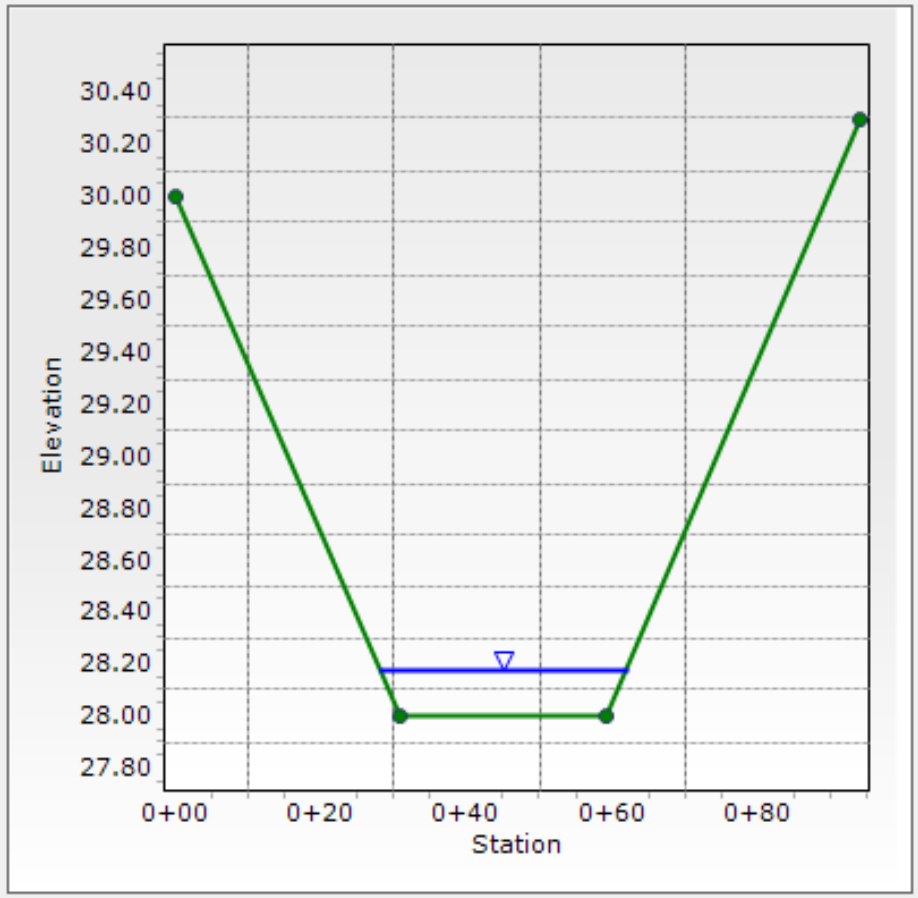
Normal Depth	2.2 in
Roughness Coefficient	0.040
Elevation	28.18 ft
Elevation Range	28.0 to 30.3 ft
Flow Area	5.8 ft²
Wetted Perimeter	34.2 ft
Hydraulic Radius	2.0 in
Top Width	34.16 ft
Normal Depth	2.2 in
Critical Depth	1.9 in
Critical Slope	0.044 ft/ft
Velocity	1.86 ft/s
Velocity Head	0.05 ft
Specific Energy	0.24 ft
Froude Number	0.800

Worksheet for A2-6

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.2 in
Critical Depth	1.9 in
Channel Slope	0.027 ft/ft
Critical Slope	0.044 ft/ft



Worksheet for A2-7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	2.78 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+18	201.00
0+36	200.00
0+73	200.00
1+00	202.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+18, 201.00)	(0+36, 200.00)	0.040
(0+36, 200.00)	(0+73, 200.00)	0.040
(0+73, 200.00)	(1+00, 202.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

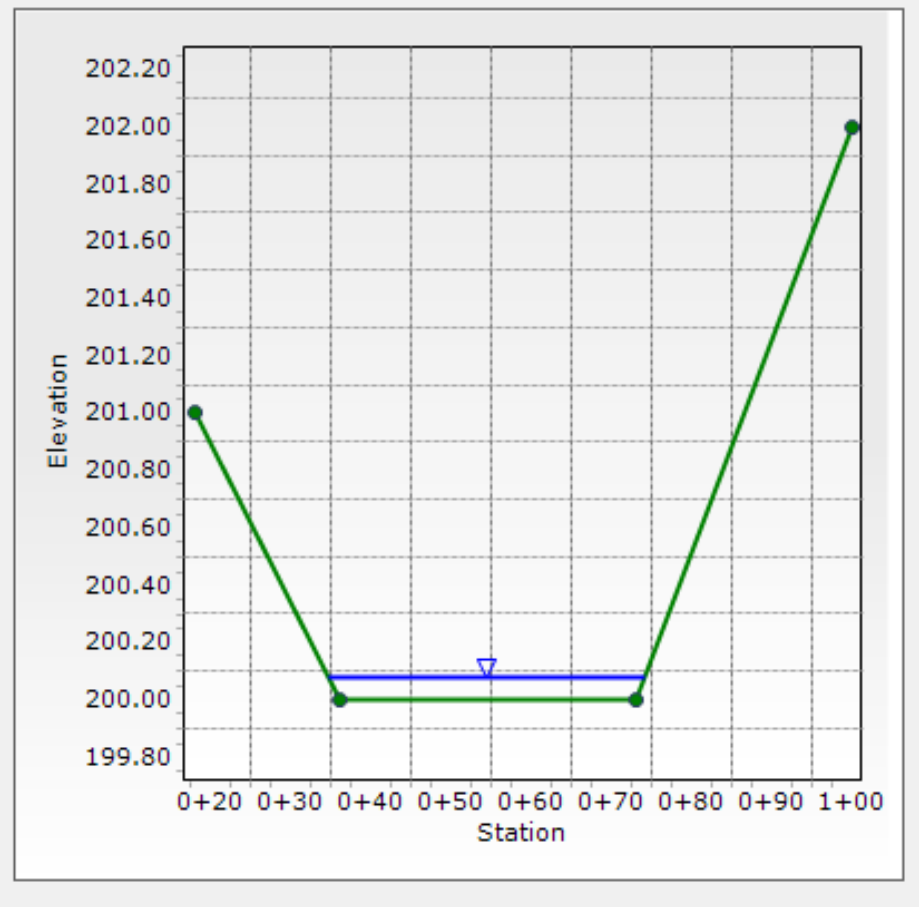
Normal Depth	0.9 in
Roughness Coefficient	0.040
Elevation	200.08 ft
Elevation Range	200.0 to 202.0 ft
Flow Area	3.0 ft²
Wetted Perimeter	39.5 ft
Hydraulic Radius	0.9 in
Top Width	39.45 ft
Normal Depth	0.9 in
Critical Depth	0.7 in
Critical Slope	0.062 ft/ft
Velocity	0.94 ft/s
Velocity Head	0.01 ft
Specific Energy	0.09 ft
Froude Number	0.602

Worksheet for A2-7

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.9 in
Critical Depth	0.7 in
Channel Slope	0.020 ft/ft
Critical Slope	0.062 ft/ft



Worksheet for B1-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.034 ft/ft
Discharge	20.11 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	26.00
0+54	20.00
0+76	20.00
1+25	22.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 26.00)	(0+54, 20.00)	0.040
(0+54, 20.00)	(0+76, 20.00)	0.040
(0+76, 20.00)	(1+25, 22.75)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

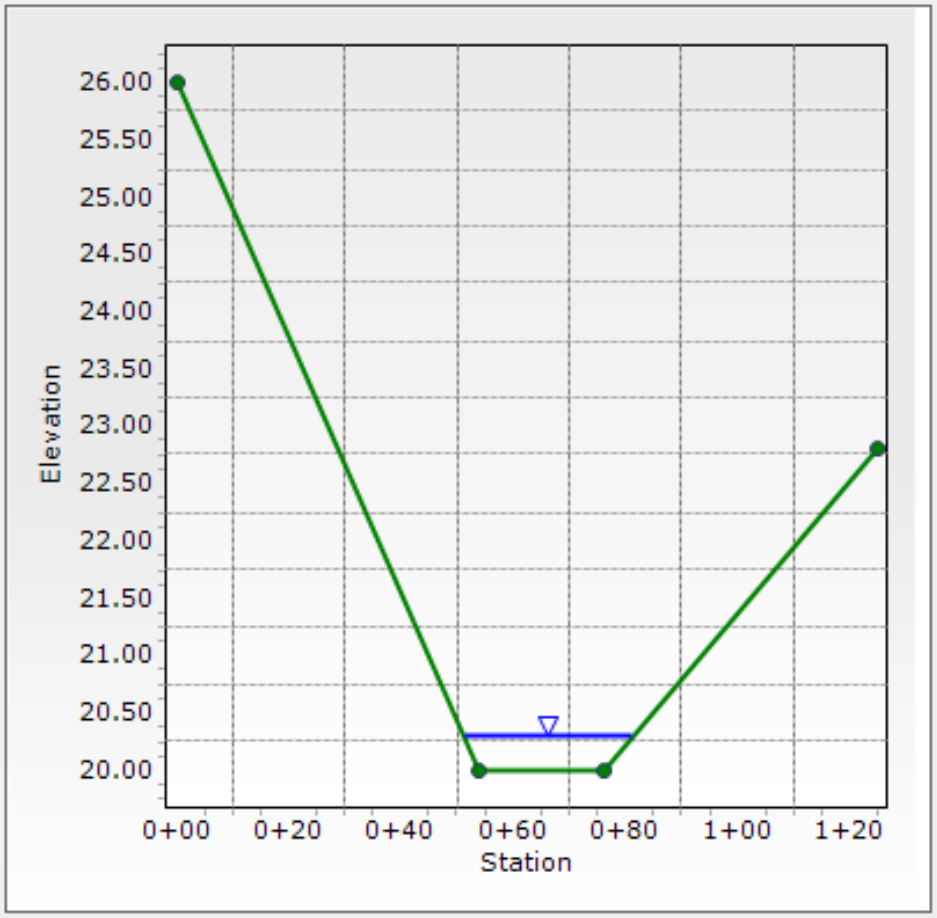
Normal Depth	3.4 in
Roughness Coefficient	0.040
Elevation	20.29 ft
Elevation Range	20.0 to 26.0 ft
Flow Area	7.4 ft²
Wetted Perimeter	29.7 ft
Hydraulic Radius	3.0 in
Top Width	29.69 ft
Normal Depth	3.4 in
Critical Depth	3.3 in
Critical Slope	0.037 ft/ft
Velocity	2.71 ft/s
Velocity Head	0.11 ft
Specific Energy	0.40 ft
Froude Number	0.958

Worksheet for B1-1

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.4 in
Critical Depth	3.3 in
Channel Slope	0.034 ft/ft
Critical Slope	0.037 ft/ft



Worksheet for B1-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.075 ft/ft
Discharge	28.20 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.00
0+31	0.00
0+60	0.00
1+00	4.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.00)	(0+31, 0.00)	0.040
(0+31, 0.00)	(0+60, 0.00)	0.040
(0+60, 0.00)	(1+00, 4.84)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

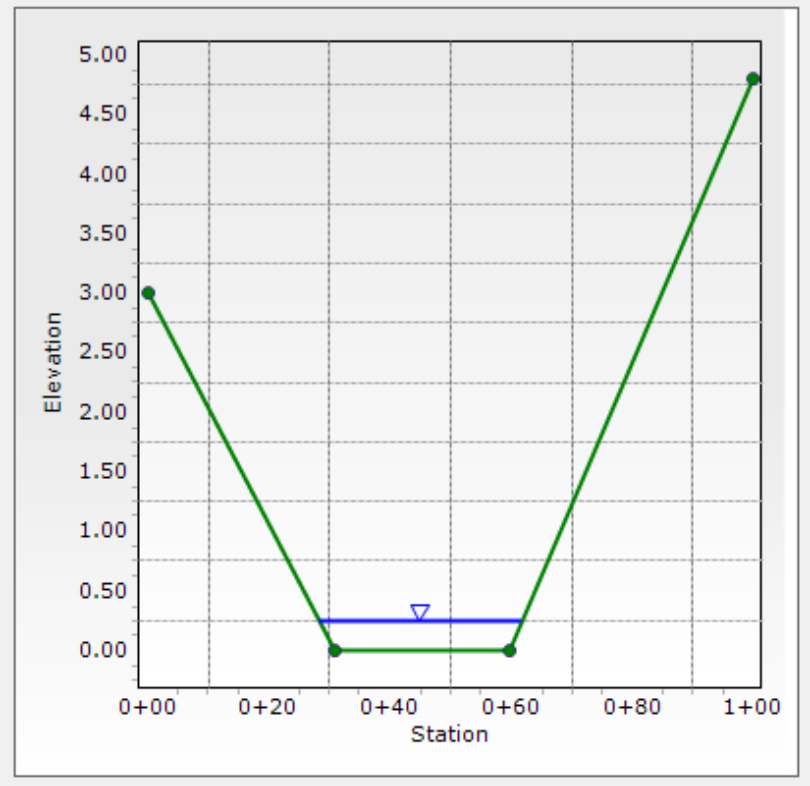
Results

Normal Depth	2.9 in
Roughness Coefficient	0.040
Elevation	0.24 ft
Elevation Range	0.0 to 4.8 ft
Flow Area	7.5 ft²
Wetted Perimeter	33.4 ft
Hydraulic Radius	2.7 in
Top Width	33.34 ft
Normal Depth	2.9 in
Critical Depth	3.6 in
Critical Slope	0.036 ft/ft
Velocity	3.76 ft/s
Velocity Head	0.22 ft
Specific Energy	0.46 ft
Froude Number	1.396
Flow Type	Supercritical

Worksheet for B1-2

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.9 in
Critical Depth	3.6 in
Channel Slope	0.075 ft/ft
Critical Slope	0.036 ft/ft



Worksheet for B1-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.033 ft/ft
Discharge	26.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	19.00
0+45	14.00
0+56	14.00
0+98	18.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 19.00)	(0+45, 14.00)	0.040
(0+45, 14.00)	(0+56, 14.00)	0.040
(0+56, 14.00)	(0+98, 18.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

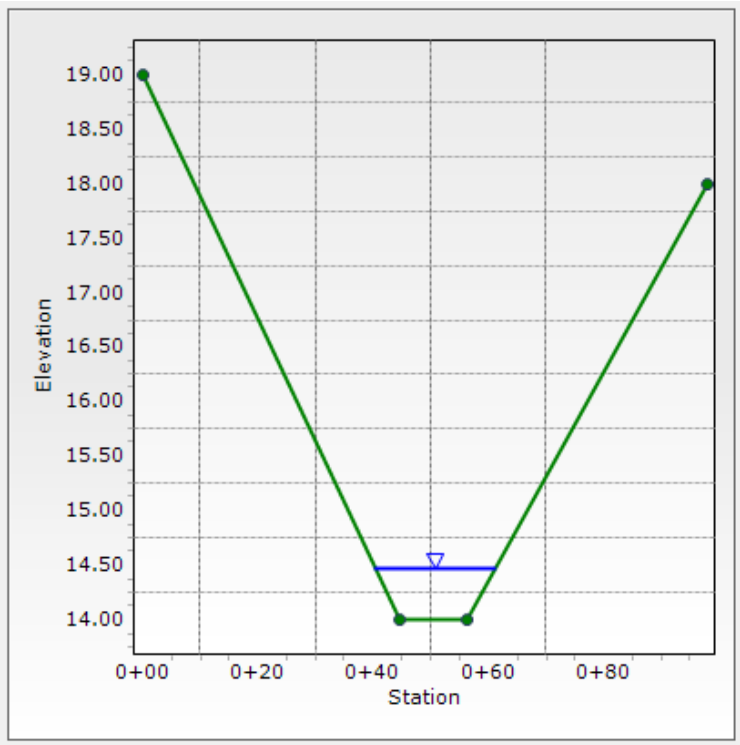
Normal Depth	5.6 in
Roughness Coefficient	0.040
Elevation	14.47 ft
Elevation Range	14.0 to 19.0 ft
Flow Area	7.7 ft²
Wetted Perimeter	20.9 ft
Hydraulic Radius	4.4 in
Top Width	20.85 ft
Normal Depth	5.6 in
Critical Depth	5.7 in
Critical Slope	0.033 ft/ft
Velocity	3.46 ft/s
Velocity Head	0.19 ft
Specific Energy	0.66 ft
Froude Number	1.005

Worksheet for B1-3

Results	
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.6 in
Critical Depth	5.7 in
Channel Slope	0.033 ft/ft
Critical Slope	0.033 ft/ft



Worksheet for B1-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.063 ft/ft
Discharge	7.95 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	34.00
0+26	30.00
0+47	30.00
0+75	35.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 34.00)	(0+26, 30.00)	0.040
(0+26, 30.00)	(0+47, 30.00)	0.040
(0+47, 30.00)	(0+75, 35.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

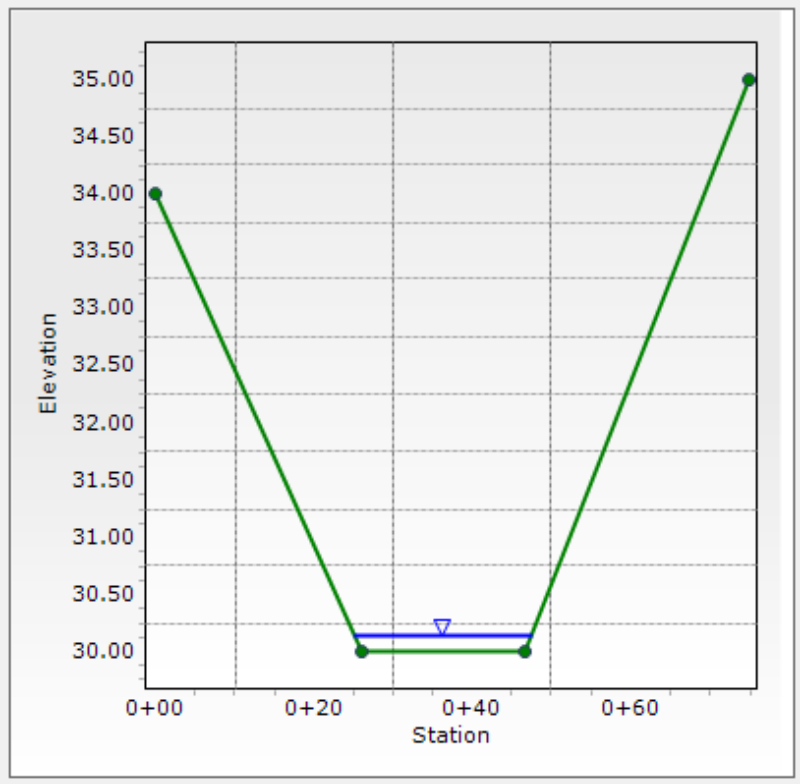
Normal Depth	1.8 in
Roughness Coefficient	0.040
Elevation	30.15 ft
Elevation Range	30.0 to 35.0 ft
Flow Area	3.2 ft²
Wetted Perimeter	22.5 ft
Hydraulic Radius	1.7 in
Top Width	22.52 ft
Normal Depth	1.8 in
Critical Depth	2.0 in
Critical Slope	0.043 ft/ft
Velocity	2.52 ft/s
Velocity Head	0.10 ft
Specific Energy	0.24 ft
Froude Number	1.185

Worksheet for B1-4

Results	
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.8 in
Critical Depth	2.0 in
Channel Slope	0.063 ft/ft
Critical Slope	0.043 ft/ft



Worksheet for B1-5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.039 ft/ft
Discharge	5.01 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	35.00
0+29	32.00
0+54	32.00
0+73	35.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 35.00)	(0+29, 32.00)	0.040
(0+29, 32.00)	(0+54, 32.00)	0.040
(0+54, 32.00)	(0+73, 35.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

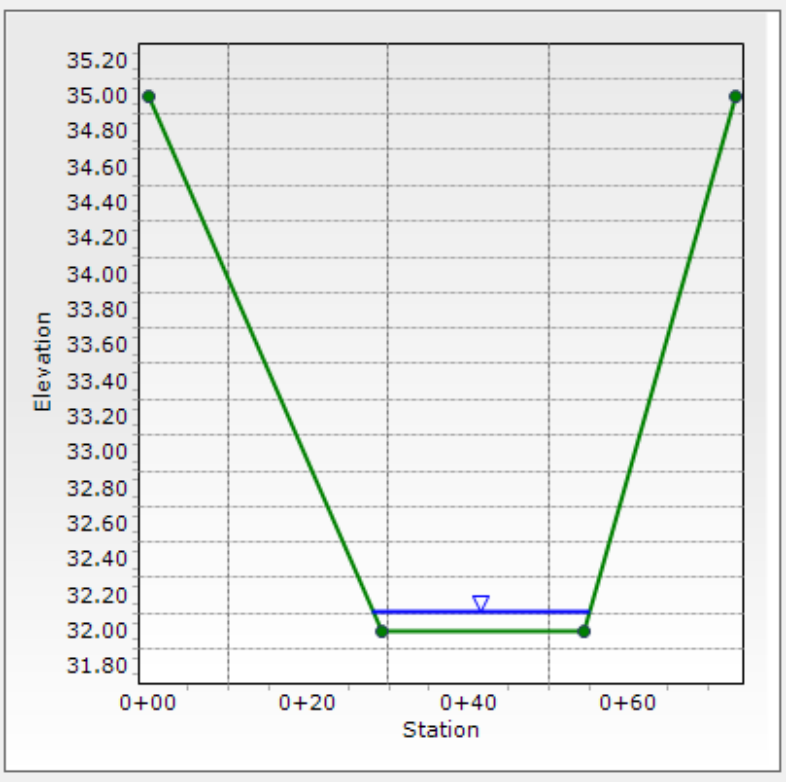
Normal Depth	1.4 in
Roughness Coefficient	0.040
Elevation	32.11 ft
Elevation Range	32.0 to 35.0 ft
Flow Area	3.0 ft²
Wetted Perimeter	27.1 ft
Hydraulic Radius	1.3 in
Top Width	27.07 ft
Normal Depth	1.4 in
Critical Depth	1.3 in
Critical Slope	0.050 ft/ft
Velocity	1.68 ft/s
Velocity Head	0.04 ft
Specific Energy	0.16 ft
Froude Number	0.894

Worksheet for B1-5

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	1.4 in
Critical Depth	1.3 in
Channel Slope	0.039 ft/ft
Critical Slope	0.050 ft/ft



Worksheet for B1-6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.030 ft/ft
Discharge	5.37 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	22.00
0+35	18.00
0+51	18.00
0+92	23.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 22.00)	(0+35, 18.00)	0.040
(0+35, 18.00)	(0+51, 18.00)	0.040
(0+51, 18.00)	(0+92, 23.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

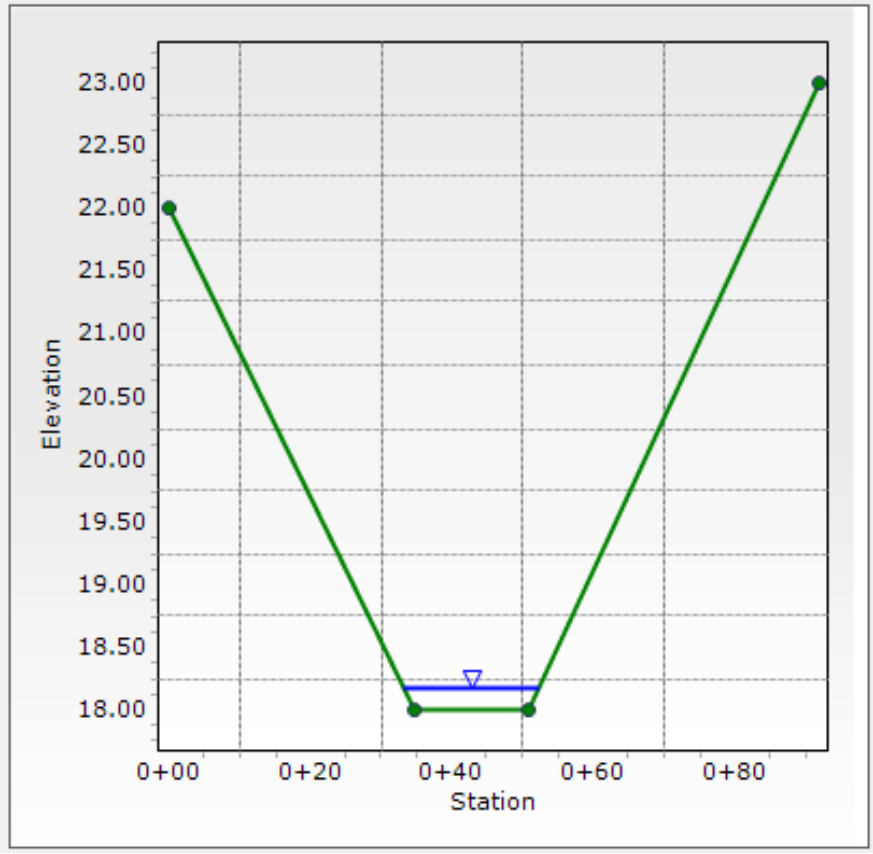
Normal Depth	2.0 in
Roughness Coefficient	0.040
Elevation	18.17 ft
Elevation Range	18.0 to 23.0 ft
Flow Area	2.9 ft²
Wetted Perimeter	19.1 ft
Hydraulic Radius	1.8 in
Top Width	19.04 ft
Normal Depth	2.0 in
Critical Depth	1.8 in
Critical Slope	0.045 ft/ft
Velocity	1.84 ft/s
Velocity Head	0.05 ft
Specific Energy	0.22 ft
Froude Number	0.829

Worksheet for B1-6

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.0 in
Critical Depth	1.8 in
Channel Slope	0.030 ft/ft
Critical Slope	0.045 ft/ft



Worksheet for B2-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.037 ft/ft
Discharge	11.88 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	5.00
0+42	0.00
0+58	0.00
0+75	4.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5.00)	(0+42, 0.00)	0.040
(0+42, 0.00)	(0+58, 0.00)	0.040
(0+58, 0.00)	(0+75, 4.50)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

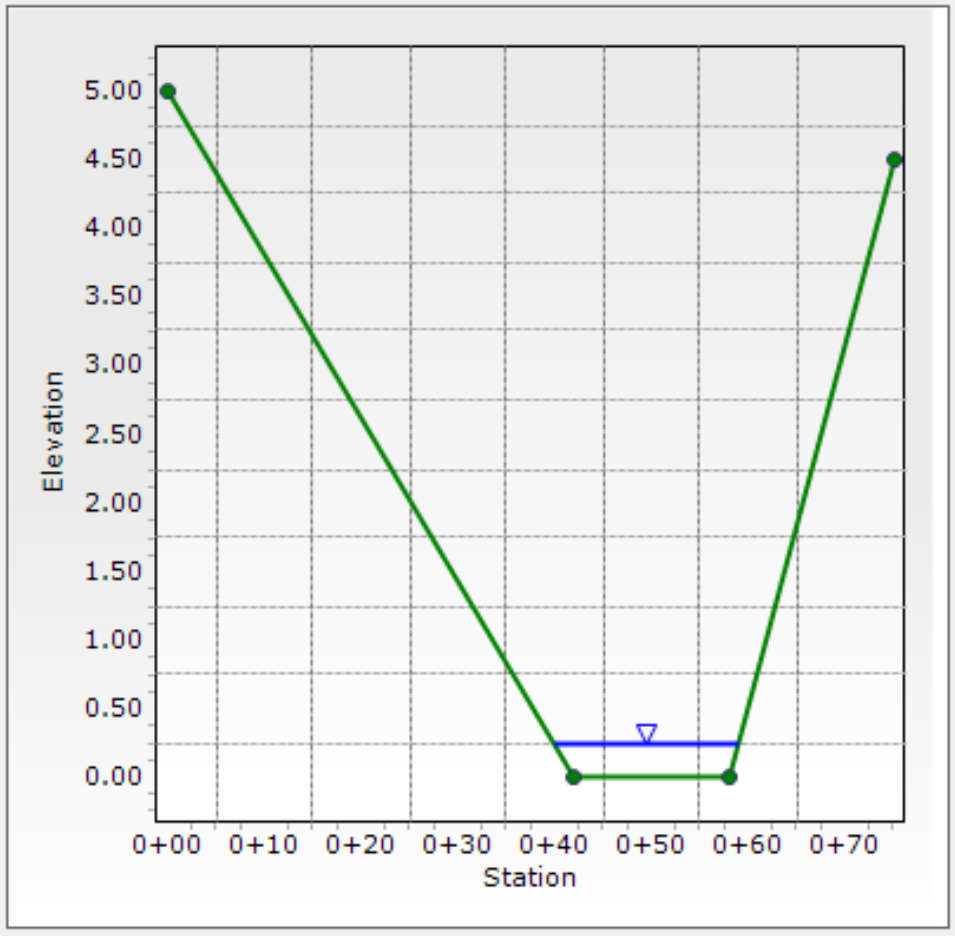
Results

Normal Depth	3.0 in
Roughness Coefficient	0.040
Elevation	0.25 ft
Elevation Range	0.0 to 5.0 ft
Flow Area	4.4 ft²
Wetted Perimeter	19.1 ft
Hydraulic Radius	2.8 in
Top Width	19.07 ft
Normal Depth	3.0 in
Critical Depth	3.0 in
Critical Slope	0.038 ft/ft
Velocity	2.69 ft/s
Velocity Head	0.11 ft
Specific Energy	0.36 ft
Froude Number	0.984
Flow Type	Subcritical

Worksheet for B2-1

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.0 in
Critical Depth	3.0 in
Channel Slope	0.037 ft/ft
Critical Slope	0.038 ft/ft



Worksheet for B2-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.054 ft/ft
Discharge	23.59 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	13.00
0+38	8.00
0+59	8.00
0+96	13.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 13.00)	(0+38, 8.00)	0.040
(0+38, 8.00)	(0+59, 8.00)	0.040
(0+59, 8.00)	(0+96, 13.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

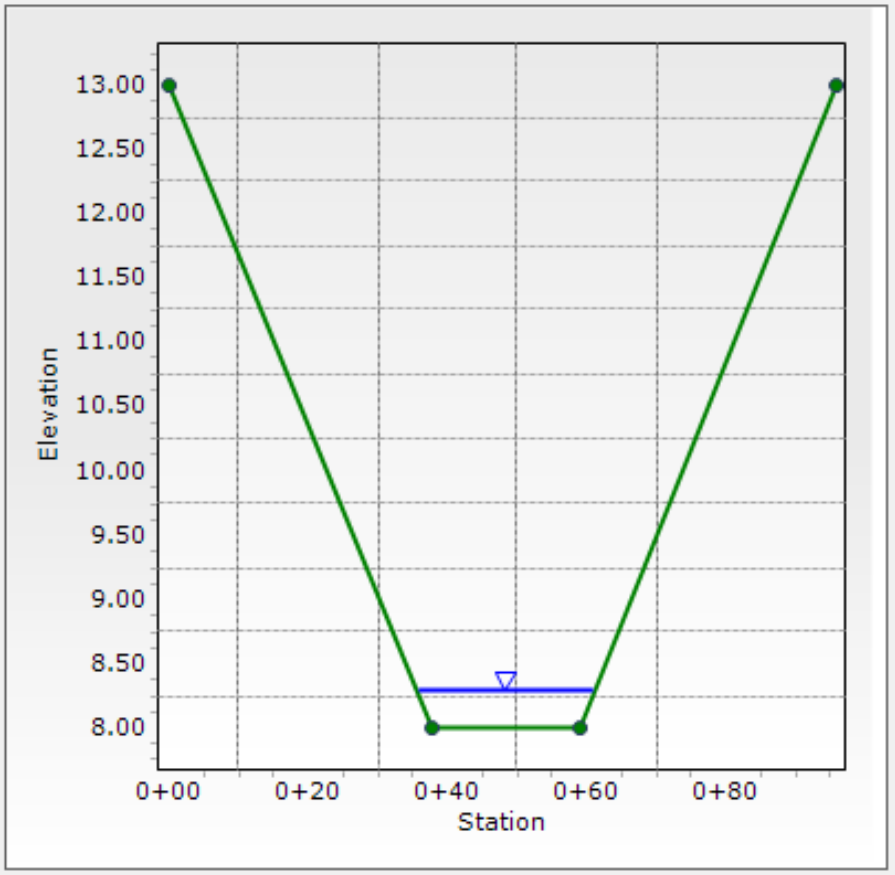
Results

Normal Depth	3.5 in
Roughness Coefficient	0.040
Elevation	8.29 ft
Elevation Range	8.0 to 13.0 ft
Flow Area	6.7 ft²
Wetted Perimeter	25.4 ft
Hydraulic Radius	3.2 in
Top Width	25.31 ft
Normal Depth	3.5 in
Critical Depth	3.9 in
Critical Slope	0.035 ft/ft
Velocity	3.54 ft/s
Velocity Head	0.19 ft
Specific Energy	0.48 ft
Froude Number	1.217
Flow Type	Supercritical

Worksheet for B2-2

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.5 in
Critical Depth	3.9 in
Channel Slope	0.054 ft/ft
Critical Slope	0.035 ft/ft



Worksheet for B6-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.190 ft/ft
Discharge	23.23 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	14.00
0+39	6.00
0+50	6.00
0+63	11.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 14.00)	(0+39, 6.00)	0.040
(0+39, 6.00)	(0+50, 6.00)	0.040
(0+50, 6.00)	(0+63, 11.50)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

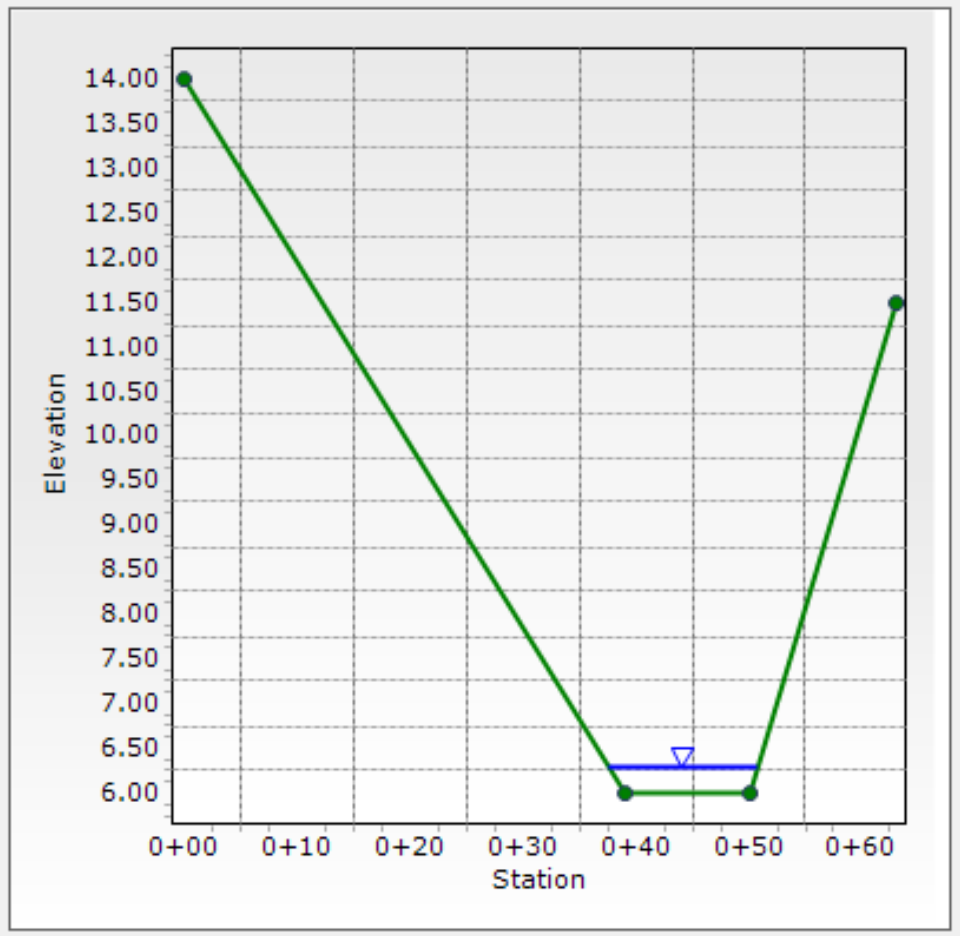
Results

Normal Depth	3.5 in
Roughness Coefficient	0.040
Elevation	6.29 ft
Elevation Range	6.0 to 14.0 ft
Flow Area	3.5 ft²
Wetted Perimeter	13.2 ft
Hydraulic Radius	3.2 in
Top Width	13.09 ft
Normal Depth	3.5 in
Critical Depth	5.9 in
Critical Slope	0.031 ft/ft
Velocity	6.67 ft/s
Velocity Head	0.69 ft
Specific Energy	0.98 ft
Froude Number	2.280
Flow Type	Supercritical

Worksheet for B6-1

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.5 in
Critical Depth	5.9 in
Channel Slope	0.190 ft/ft
Critical Slope	0.031 ft/ft



Worksheet for B7-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.046 ft/ft
Discharge	5.64 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	95.00
0+25	92.00
0+50	91.75
0+90	98.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 95.00)	(0+25, 92.00)	0.040
(0+25, 92.00)	(0+50, 91.75)	0.040
(0+50, 91.75)	(0+90, 98.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

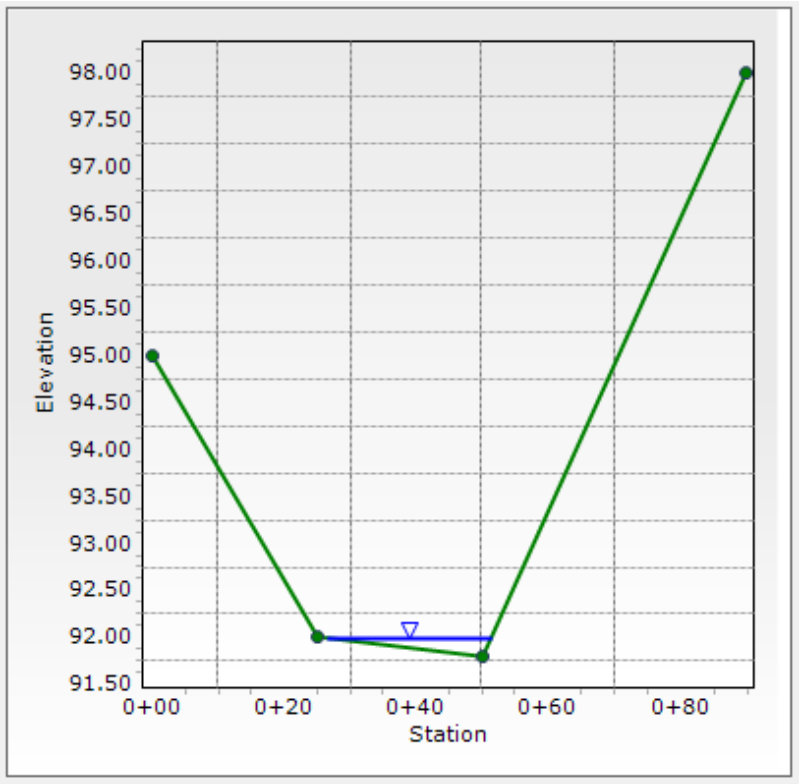
Normal Depth	2.8 in
Roughness Coefficient	0.040
Elevation	91.99 ft
Elevation Range	91.8 to 98.0 ft
Flow Area	2.9 ft²
Wetted Perimeter	25.1 ft
Hydraulic Radius	1.4 in
Top Width	25.05 ft
Normal Depth	2.8 in
Critical Depth	2.8 in
Critical Slope	0.048 ft/ft
Velocity	1.91 ft/s
Velocity Head	0.06 ft
Specific Energy	0.29 ft
Froude Number	0.983

Worksheet for B7-1

Results	
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.8 in
Critical Depth	2.8 in
Channel Slope	0.046 ft/ft
Critical Slope	0.048 ft/ft



Worksheet for B8-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.050 ft/ft
Discharge	114.99 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	202.00
0+52	198.00
0+79	198.00
1+06	201.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 202.00)	(0+52, 198.00)	0.040
(0+52, 198.00)	(0+79, 198.00)	0.040
(0+79, 198.00)	(1+06, 201.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

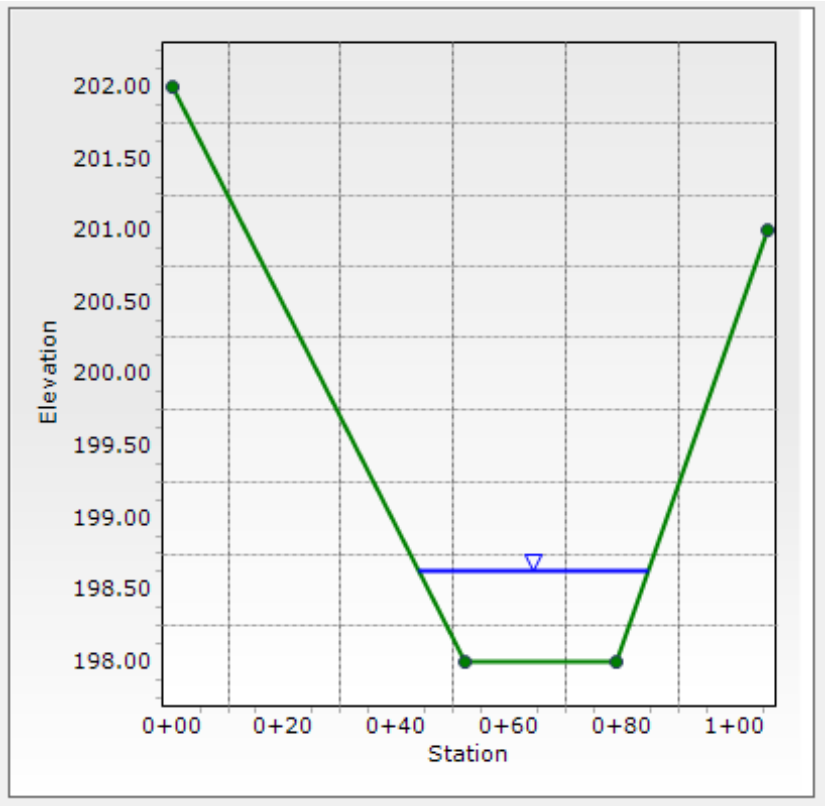
Normal Depth	7.6 in
Roughness Coefficient	0.040
Elevation	198.63 ft
Elevation Range	198.0 to 202.0 ft
Flow Area	21.4 ft²
Wetted Perimeter	40.9 ft
Hydraulic Radius	6.3 in
Top Width	40.85 ft
Normal Depth	7.6 in
Critical Depth	8.9 in
Critical Slope	0.028 ft/ft
Velocity	5.39 ft/s
Velocity Head	0.45 ft
Specific Energy	1.08 ft
Froude Number	1.313

Worksheet for B8-1

Results	
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.6 in
Critical Depth	8.9 in
Channel Slope	0.050 ft/ft
Critical Slope	0.028 ft/ft



ROADSIDE DITCH SUMMARY TABLE

ROADWAY	FROM STA	TO STA	PROPOSED SLOPE (%)	SIDE	SIDE SLOPE	CHANNEL DEPTH (FT)	FRICTION FACTOR	BASIN	Q100 FLOW (CFS)	DITCH FLOW % OF BASIN	DITCH FLOW (CFS)	Q100 DEPTH (FT)	Q100 VELOCITY (FT/S)	DITCH LINING	NOTES
HATBAND DRIVE	1+30	2+80	2.75%	LEFT	4:1/3:1	3	0.04	A1	41.29	100.0%	41.29	1.53	5.02	GRASS	
HATBAND DRIVE	1+30	3+40	2.75%	RIGHT	4:1/3:1	3	0.04	A2	92.96	1.0%	0.93	0.37	1.95	GRASS	
HATBAND DRIVE	2+80	3+80	2.75%	LEFT	4:1/3:1	3	0.04	A2	92.96	1.0%	0.93	0.37	1.95	GRASS	
HATBAND DRIVE	4+90	7+20	2.75%	LEFT	4:1/3:1	3	0.04	A2	92.96	1.0%	0.93	0.37	1.95	GRASS	
HATBAND DRIVE	6+13	7+20	2.75%	RIGHT	4:1/3:1	3	0.04	A2	92.96	1.0%	0.93	0.37	1.95	GRASS	
HATBAND DRIVE	12+60	15+00	1.00%	LEFT	4:1/3:1	3	0.04	B1	80.40	0.7%	0.56	0.37	1.17	GRASS	
HATBAND DRIVE	12+60	15+00	1.00%	RIGHT	4:1/3:1	3	0.04	B1	80.40	0.5%	0.40	0.33	1.08	GRASS	
HATBAND DRIVE	15+00	18+00	2.00%	LEFT	4:1/3:1	3	0.04	B1	80.40	25.0%	20.10	1.24	3.72	GRASS	
HATBAND DRIVE	15+00	18+00	2.00%	RIGHT	4:1/3:1	3	0.04	B1	80.40	0.6%	0.48	0.31	1.46	GRASS	
HATBAND DRIVE	19+75	20+45	3.00%	RIGHT	4:1/3:1	3	0.04	B1	80.40	0.1%	0.08	0.14	1.09	GRASS	
HATBAND DRIVE	20+45	22+00	2.00%	RIGHT	4:1/3:1	3	0.04	B2	38.64	1.0%	0.39	0.28	1.39	GRASS	
HATBAND DRIVE	20+20	22+75	2.40%	LEFT	4:1/3:1	3	0.04	B1	80.40	1.3%	1.05	0.40	1.90	GRASS	
SALOON DRIVE	3+30	5+70	1.25%	LEFT	4:1/3:1	3	0.04	A2	92.96	0.40%	0.37	0.30	1.15	GRASS	
SALOON DRIVE	3+30	6+10	1.50%	RIGHT	4:1/3:1	3	0.04	A2	92.96	45.0%	41.83	1.75	4.02	GRASS	
SALOON DRIVE	7+00	10+80	6.00%	LEFT	4:1/3:1	3	0.04	A2	92.96	2.0%	1.86	0.42	3.10	GRASS	
SALOON DRIVE	10+80	END	1.30%	LEFT	4:1/3:1	3	0.04	A2	92.96	1.0%	0.93	0.43	1.47	GRASS	
CAMPOUT DRIVE	7+95	8+90	9.50%	RIGHT	4:1/3:1	3	0.04	B1	80.40	0.2%	0.16	0.15	1.99	GRASS	
CAMPOUT DRIVE	11+10	12+40	7.75%	RIGHT	4:1/3:1	3	0.04	B1	80.40	0.4%	0.32	0.20	2.20	GRASS	
CAMPOUT DRIVE	11+20	14+50	5.15%	LEFT	4:1/3:1	3	0.04	B6	106.95	23.0%	24.60	1.13	5.58	GRASS	
CAMPOUT DRIVE	16+80	25+80	1.00%	LEFT	4:1/3:1	3	0.04	B6	106.95	85.0%	90.91	2.49	4.19	GRASS	
CAMPOUT DRIVE	25+80	END	1.00%	LEFT	4:1/3:1	3	0.04	B6	106.95	13.0%	13.90	1.23	2.62	GRASS	
CAMPOUT DRIVE	27+80	29+60	1.00%	RIGHT	4:1/3:1	3	0.04	B6	106.95	0.3%	0.28	0.28	0.99	GRASS	
APEX RANCH ROAD	START	3+65	2.20%	LEFT	4:1/3:1	3	0.04	OS-C1	59.93	4.3%	15.90*	1.12	3.64	GRASS	* INLCUDES FOLW FROM SUB-BASINS OS-C1, OS-A2, AND A2
APEX RANCH ROAD	3+65	4+85	4.65%	LEFT	4:1/3:1	3	0.04	OS-A2	11.46	27.0%	13.31*	0.91	4.62	GRASS	* INLCUDES FLOW FROM SUB-BASINS OS-A2, AND A2
APEX RANCH ROAD	3+70	4+30	4.20%	RIGHT	4:1/3:1	3	0.04	OS-A2	11.46	1.4%	0.16	0.18	1.47	GRASS	
APEX RANCH ROAD	12+20	16+60	10.00%	LEFT	4:1/3:1	3	0.04	A2	92.96	2.0%	1.86	0.38	3.75	GRASS	
APEX RANCH ROAD	16+60	18+30	5.15%	LEFT	4:1/3:1	3	0.04	A2	92.96	0.7%	0.65	0.28	2.25	GRASS	
APEX RANCH ROAD	12+65	16+60	10.00%	RIGHT	4:1/3:1	3	0.04	B6	106.95	2.0%	2.14	0.40	3.89	GRASS	
APEX RANCH ROAD	16+60	18+65	5.15%	RIGHT	4:1/3:1	3	0.04	B6	106.95	0.4%	0.43	0.25	2.03	GRASS	

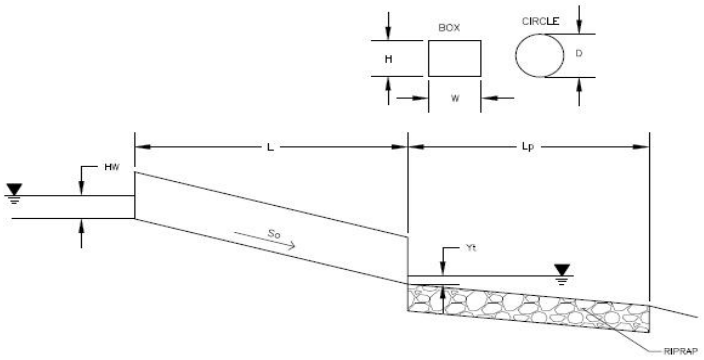
Culvert & Riprap Summary													
Culvert Details							*Riprap Details*						
Culvert ID	Basin	Q100 flow (cfs)	Flow % of Basin	Flows (cfs)	HW/D Ratio	Diameter (in)	Length (ft)	Width (ft)	D50 Type	D50 Size (in)	D50 Thickness (in)	Normal Depth in Pipe (ft)	Upstream Headwater Elevation (ft)
A2-A	A2	92.96	10.00%	9.30	1.39	18	7	4	VL	6	12	0.75	7211.83
A2-B	A2	92.96	8.00%	7.44	1.12	18	5	3	VL	6	12	0.56	7221.28
A2-C	A2	92.96	49.00%	45.55	1.21	36	21	8	L	9	18	1.17	7223.80
A2-D	A2	92.96	11.00%	10.23	0.86	24	6	4	VL	6	12	0.89	7315.02
B1-A	B1	80.40	28.00%	22.51	0.99	30	11	5	VL	6	12	0.85	7218.23
B1-B	B1	80.40	34.00%	27.34	1.16	30	14	6	L	9	18	1.52	7221.92
B6	B6	106.95	100.00%	106.95	1.01	36 (3 Barrels)	30	15	L	9	18	1.50	7231.07

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: OVERLOOK

ID: CULVERT A2-A



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	9.3	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7209.75	ft
Outlet Elevation OR Slope	Elev OUT =	7207.31	ft
Culvert Length	L =	93	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.75	ft
Culvert Critical Depth	Y_c =	1.18	ft
Froude Number	Fr =	2.40	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	1.44	
Sum of All Loss Coefficients	k_s =	2.94	ft
Headwater:			
Inlet Control Headwater	HW_I =	2.08	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7211.83	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.39	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

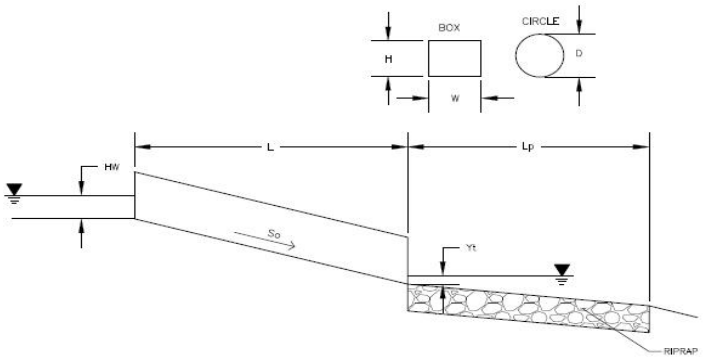
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.37	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.05	
Flow Area at Max Channel Velocity	A_t =	1.86	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	7	ft
Width of Riprap Protection at Downstream End	T =	4	ft
Adjusted Diameter for Supercritical Flow	Da =	1.13	ft
Minimum Theoretical Riprap Size	d_{50} min=	5	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	Type =	VL	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: OVERLOOK

ID: CULVERT A2-B



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	7.44	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7219.6	ft
Outlet Elevation OR Slope	Elev OUT =	7215.35	ft
Culvert Length	L =	87.8	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.56	ft
Culvert Critical Depth	Y_c =	1.06	ft
Froude Number	Fr =	3.39	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	1.36	
Sum of All Loss Coefficients	k_s =	2.86	ft
Headwater:			
Inlet Control Headwater	HW_I =	1.68	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7221.28	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.12	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

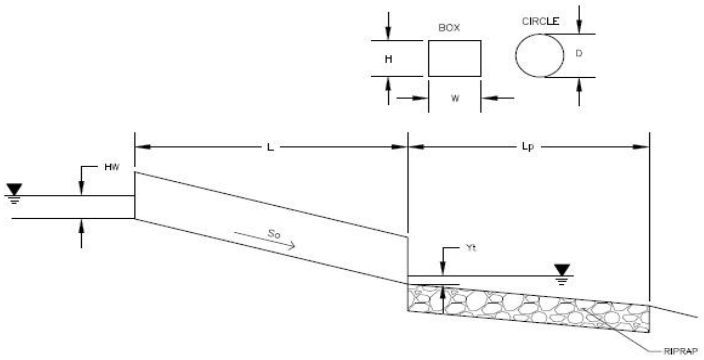
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.70	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.79	
Flow Area at Max Channel Velocity	A_t =	1.49	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	5	ft
Width of Riprap Protection at Downstream End	T =	3	ft
Adjusted Diameter for Supercritical Flow	Da =	1.03	ft
Minimum Theoretical Riprap Size	d_{50} min=	4	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	Type =	VL	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: OVERLOOK

ID: CULVERT A2-C



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	45.55	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7220.18	ft
Outlet Elevation OR Slope	Elev OUT =	7216.35	ft
Culvert Length	L =	101.4	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.17	ft
Culvert Critical Depth	Y_c =	2.20	ft
Froude Number	Fr =	3.35	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.62	
Sum of All Loss Coefficients	k_s =	2.12	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.62	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7223.80	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.21	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

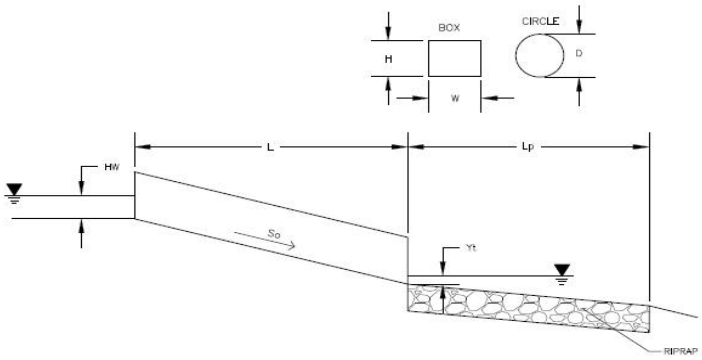
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.92	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.49	
Flow Area at Max Channel Velocity	A_t =	9.11	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	21	ft
Width of Riprap Protection at Downstream End	T =	8	ft
Adjusted Diameter for Supercritical Flow	Da =	2.09	ft
Minimum Theoretical Riprap Size	d_{50} min=	8	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	Type =	L	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Overlook

ID: A2-D



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	10.23	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7313.3	ft
Outlet Elevation OR Slope	Elev OUT =	7312.4	ft
Culvert Length	L =	86.6	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	3.14	ft^2
Culvert Normal Depth	Y_n =	0.89	ft
Culvert Critical Depth	Y_c =	1.14	ft
Froude Number	Fr =	1.62	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.91	
Sum of All Loss Coefficients	k_s =	2.41	ft
Headwater:			
Inlet Control Headwater	HW_I =	1.72	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7315.02	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	0.86	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

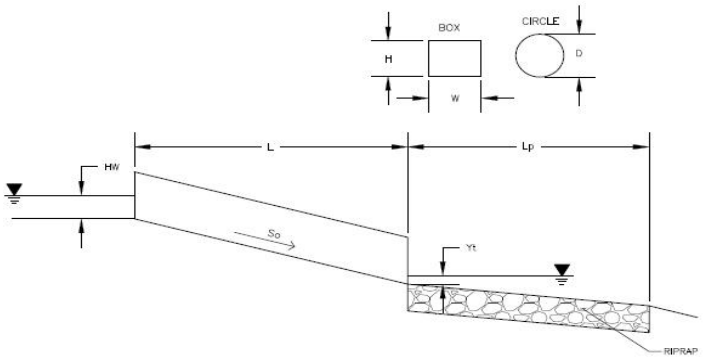
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	1.81	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.80	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	5.93	
Flow Area at Max Channel Velocity	A_t =	2.05	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	6	ft
Width of Riprap Protection at Downstream End	T =	4	ft
Adjusted Diameter for Supercritical Flow	Da =	1.45	ft
Minimum Theoretical Riprap Size	d_{50} min=	3	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	Type =	VL	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: OVERLOOK

ID: CULVERT B1-A



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	22.51	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7215.76	ft
Outlet Elevation OR Slope	Elev OUT =	7210.52	ft
Culvert Length	L =	125.2	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	4.91	ft^2
Culvert Normal Depth	Y_n =	0.85	ft
Culvert Critical Depth	Y_c =	1.61	ft
Froude Number	Fr =	3.45	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.98	
Sum of All Loss Coefficients	k_s =	2.48	ft
Headwater:			
Inlet Control Headwater	HW_I =	2.47	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7218.23	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	0.99	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

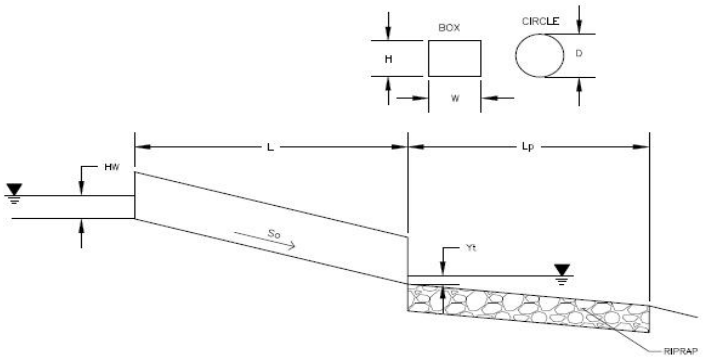
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.28	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.00	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	5.36	
Flow Area at Max Channel Velocity	A_t =	4.50	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	11	ft
Width of Riprap Protection at Downstream End	T =	5	ft
Adjusted Diameter for Supercritical Flow	Da =	1.67	ft
Minimum Theoretical Riprap Size	d_{50} min=	5	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	Type =	VL	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: OVERLOOK

ID: CULVERT B1-B



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	27.34	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7219.01	ft
Outlet Elevation OR Slope	Elev OUT =	7218.46	ft
Culvert Length	L =	68.26	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

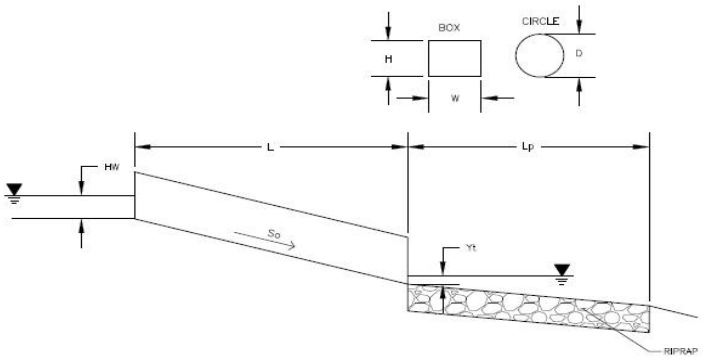
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Culvert Normal Depth	Y_n =	1.52	ft
Culvert Critical Depth	Y_c =	1.78	ft
Froude Number	Fr =	1.37	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.53	
Sum of All Loss Coefficients	k_s =	2.03	ft
Headwater:			
Inlet Control Headwater	HW_I =	2.91	ft
Outlet Control Headwater	HW_O =	2.57	ft
Design Headwater Elevation	HW =	7221.92	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.16	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.77	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.00	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.70	
Flow Area at Max Channel Velocity	A_t =	5.47	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	14	ft
Width of Riprap Protection at Downstream End	T =	6	ft
Adjusted Diameter for Supercritical Flow	Da =	2.01	ft
Minimum Theoretical Riprap Size	d_{50} min=	6	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	Type =	L	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Overlook

ID: CULVERT B6



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	106.95	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	3	
Inlet Elevation	Elev IN =	7228.05	ft
Outlet Elevation OR Slope	Elev OUT =	7227.55	ft
Culvert Length	L =	51.93	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.50	ft
Culvert Critical Depth	Y_c =	1.94	ft
Froude Number	Fr =	1.63	Supercritical!
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.32	
Sum of All Loss Coefficients	k_s =	1.82	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.02	ft
Outlet Control Headwater	HW_O =	2.69	ft
Design Headwater Elevation	HW =	7231.07	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	1.01	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.29	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	5.35	
Flow Area at Max Channel Velocity	A_t =	21.39	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	9.00	ft
Length of Riprap Protection	L_p =	30	ft
Width of Riprap Protection at Downstream End	T =	15	ft
Adjusted Diameter for Supercritical Flow	Da =	2.25	ft
Minimum Theoretical Riprap Size	d_{50} min=	6	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	Type =	L	

APPENDIX E: EL PASO COUNTY DRAINAGE BASIN MAP

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

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

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

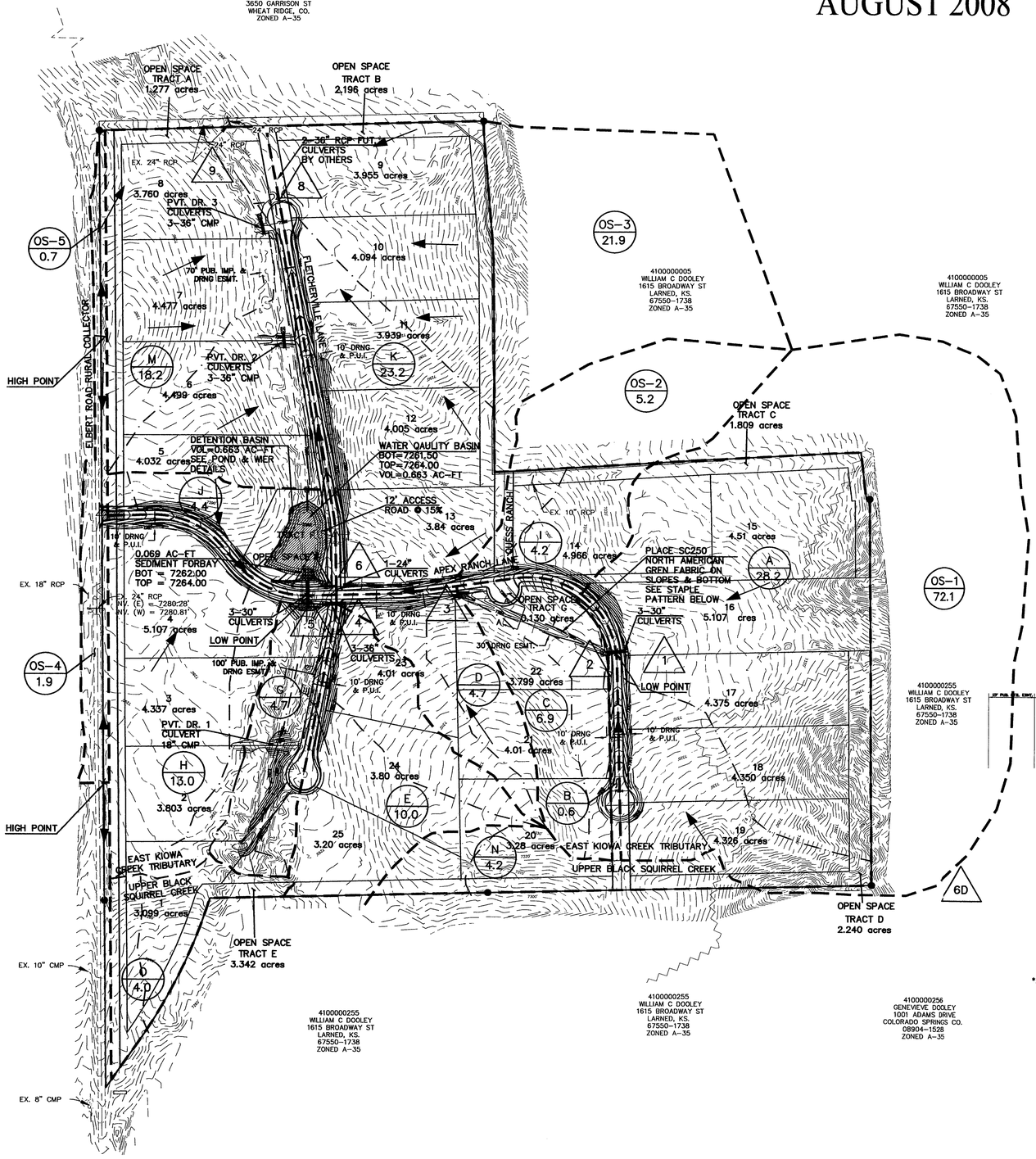
APPENDIX F: APEX RANCH DRAINAGE REPORT

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer: QUENTIN ARMIJO
Company: TERRA NOVA ENG.
Date: April 2, 2008
Project: APEX RANCH ESTATES
Location: PEYTON, CO

1. Basin Storage Volume		
A) Tributary Area's Imperviousness Ratio (i = I_a / 100)	I_a = 10.00 % i = 0.10	
B) Contributing Watershed Area (Area)	Area = 76.80	acres
C) Water Quality Capture Volume (WQCV) (WQCV =1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))	WQCV = 0.07	watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 0.515	acre-feet
2. Outlet Works		
A) Outlet Type (Check One)	X Orifice Plate Perforated Riser Pipe Other:	
B) Depth at Outlet Above Lowest Perforation (H)	H = 2.50	feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 0.81	square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 1.0000 W =	inches, **OR** inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 1	number
F) Actual Design Outlet Area per Row (A_o)	A_o = 0.79	square inches
G) Number of Rows (nr)	nr = 8	number
H) Total Outlet Area (A_{ot})	A_{ot} = 5.89	square inches
3. Trash Rack		
A) Needed Open Area: A_t = 0.5 * (Figure 7 Value) * A_{ot}	A_t = 200	square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** 2" High **Rectangular** Other:	
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a): i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 9	inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 54	inches

APEX RANCH ESTATES
EL PASO COUNTY, COLORADO
FINAL DRAINAGE MAP
AUGUST 2008

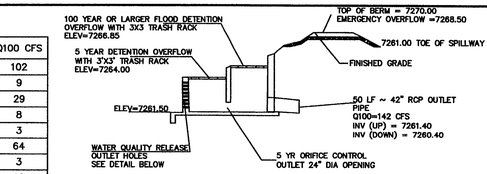


DEVELOPED CONDITIONS

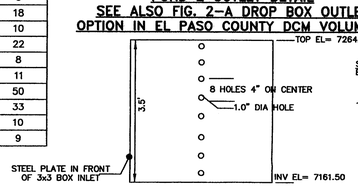
BASIN	ACRES	Q5 CFS	Q100 CFS
OS-1	72.1	45	102
OS-2	5.2	4	9
OS-3	21.9	13	29
OS-4	1.9	4	8
OS-5	0.7	1	3
A	28.2	29	64
B	0.6	2	3
C	6.9	6	12
D	4.7	4	9
E	10.0	8	18
G	4.7	5	10
H	13.0	10	22
I	4.2	4	8
J	4.4	5	11
K	23.2	22	50
M	18.2	15	33
N	4.2	5	10
O	4.0	4	9

DESIGN POINT SUMMARY

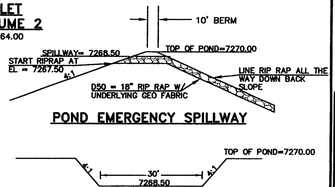
DP	CONTRIBUTING BASINS	Q5 CFS	Q100 CFS
1	OS-1 & A	58	130
2	DP-1 & B	59	131
3	DP-2 & C	61	134
4	DP-3, D & E	68	148
5	DP-4, G & H	78	170
6	OS-2 & I	8	18
7	DP-5, DP-6, J & OS-4	87	188
8	OS-3 & K	29	64
9	DP-8, L, M, OS-5 & POND RELEASE	102	227
10	N & O	8	19



POND 2 OUTLET DETAIL
SEE ALSO FIG. 2-A DROP BOX OUTLET OPTION IN EL PASO COUNTY DCM VOLUME 2

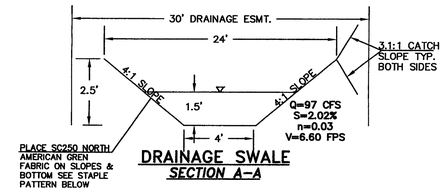


POND PERFORATED HOLE PATTERN

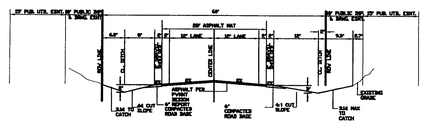


POND EMERGENCY SPILLWAY

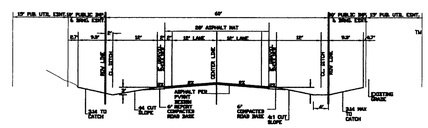
POND OVERFLOW WEIR DETAIL



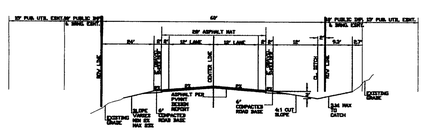
DRAINAGE SWALE
SECTION A-A



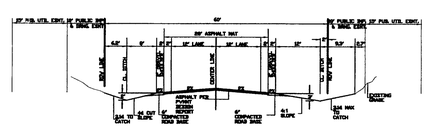
TYPICAL STREET SECTION APEX RANCH LANE
STA. 1+00.00 TO 8+00
NOT TO SCALE



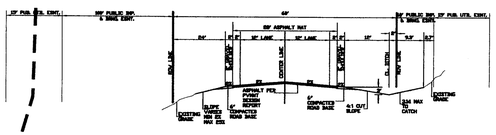
TYPICAL STREET SECTION APEX RANCH ROAD
STA. 8+00 TO 14+30
NOT TO SCALE



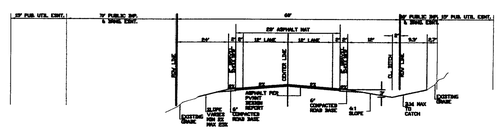
TYPICAL STREET SECTION APEX RANCH ROAD
STA. 14+30 TO 18+71
NOT TO SCALE



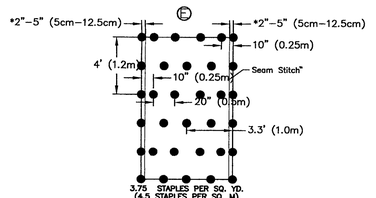
TYPICAL STREET SECTION APEX RANCH ROAD
STA. 18+71 TO 24+90
NOT TO SCALE



TYPICAL STREET SECTION FLETCHERVILLE LANE
STA. 2+57.48 TO 7+65.83
NOT TO SCALE

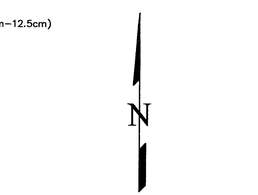


TYPICAL STREET SECTION FLETCHERVILLE LANE
STA. 7+65.83 TO 20+00
NOT TO SCALE



3.75 STAPLES PER SQ. YD.
(4.5 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System place staples/stakes through each of the YELLOW colored dots.

STAPLE PATTERN E
FOR SC250 FABRIC



SCALE: 1"=200'

LEGEND

- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- PROPOSED CULVERT
- DIRECTION OF FLOW
- BASIN BOUNDARY
- TIME OF CONCENTRATION
- BASIN ID
- ACRES
- DESIGN POINT
- DETENTION AREA

REVISIONS NO.	DESCRIPTION	DATE
1.	REVISED PER COUNTY COMMENTS	11/9/07

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEM FOR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
APEX RANCH ESTATES, LLC
ATTN: CRAIG MCCONNELL
P.O. BOX 267
PEYTON, COLORADO 80831

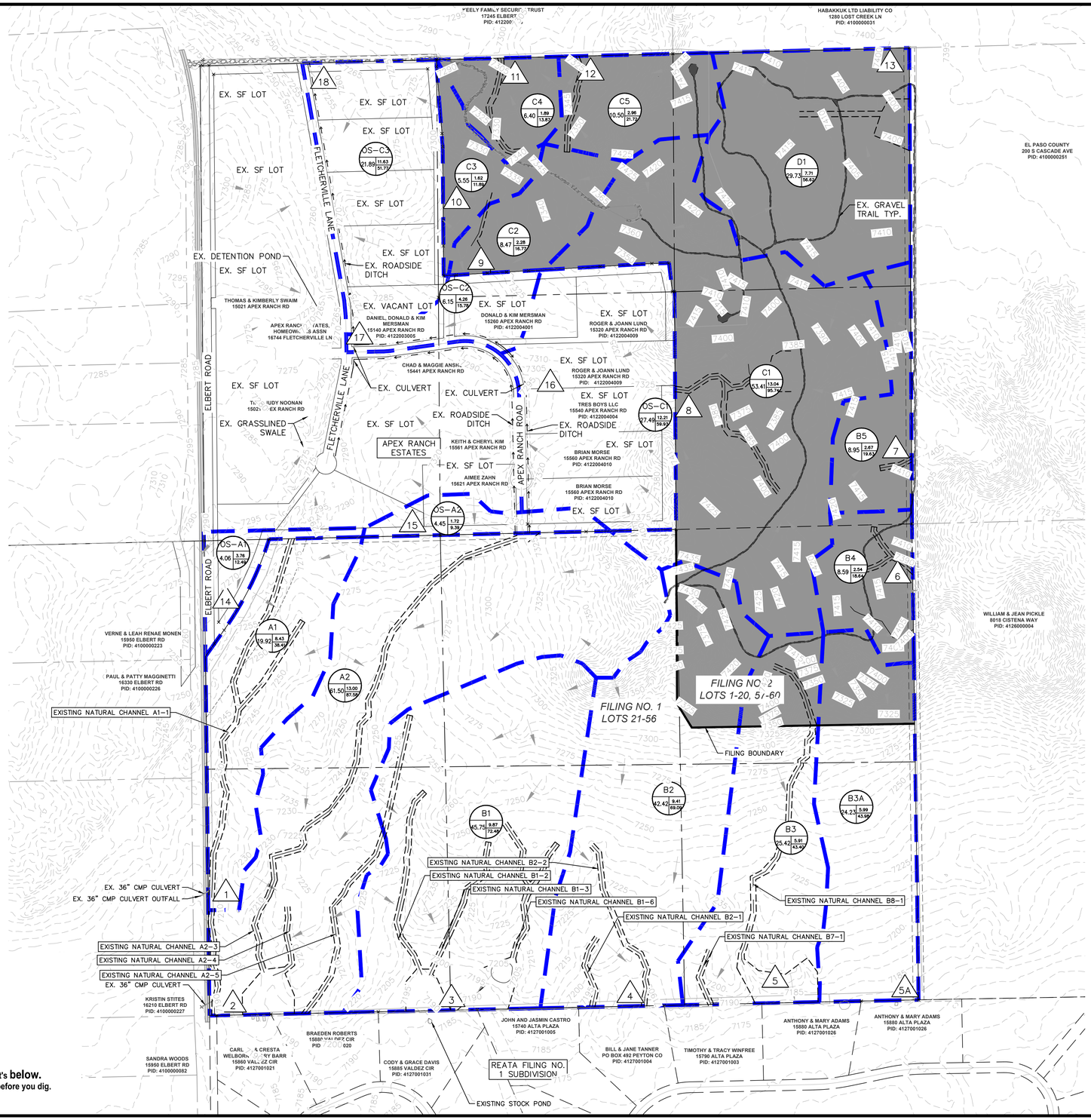
Terra Nova Engineering, Inc.
Creative Civil Engineering
123 N. WAHSATCH AVE., SUITE 101
COLORADO SPRINGS, CO. 80903
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnsinc.com

APEX RANCH ESTATES

FINAL DRAINAGE MAP
DEVELOPED CONDITIONS

DESIGNED BY	QNA
DRAWN BY	LAE
CHECKED BY	LDR
H-SCALE	1"=200'
V-SCALE	
JOB NO.	0565.00
DATE ISSUED	8/26/08
SHEET NO.	1 OF 1

APPENDIX G: DRAINAGE MAPS



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

EXISTING FLOW DIRECTION

PROPOSED PROPERTY LINE

EXISTING PROPERTY LINE

PROPOSED EASEMENT LINE

DRAINAGE BASIN BOUNDARY

EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

PHASE 2 OF DEVELOPMENT

A - Upper Black Squirrel Drainage Basin (CHBS2000)
B - La Vega Ranch Drainage Basin (CHBR0400)
C - East Kiowa Creek Drainage Basin (KIKI0400)
D - Bijou Creek Drainage Basin (BIBI0200)

Kimley»Horn

PROJECT NAME: Overlook 1/24/2024
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS Q2	CFS Q5	CFS Q100	% IMPERVIOUS
FDR Basins						
1	A1	19.92	4.19	8.43	38.41	8%
2	A2	61.50	3.44	13.00	87.58	1%
3	B1	45.75	1.98	9.87	72.48	0%
4	B2	42.42	1.88	9.41	69.09	0%
5	B3	25.42	1.18	5.91	43.40	0%
5A	B3A	24.23	1.20	5.99	43.98	0%
14	OS-A1	4.06	2.27	3.62	12.02	19%
15	OS-A2	4.45	0.70	2.10	11.46	7%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		81.42	7.63	21.43	125.99	3%
BASIN B TOTAL		137.82	6.24	31.18	228.94	0%
ON-SITE TOTAL		**219.24**	**13.87**	**52.61**	**354.92**	**1%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	2.97	5.72	23.48	13%
OFF-SITE TOTAL		**8.51**	**2.97**	**5.72**	**23.48**	**13%**
SITE TOTAL		**227.75**	**16.84**	**58.33**	**378.41**	**1%**

NORTH

GRAPHIC SCALE IN FEET
0 ### ### ###

Know what's below. Call before you dig.

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2023 KIMLEY-HORN AND ASSOCIATES, INC.
2 N NEVADA ST, SUITE 900
COLORADO SPRINGS, CO 80903 719-453-0180

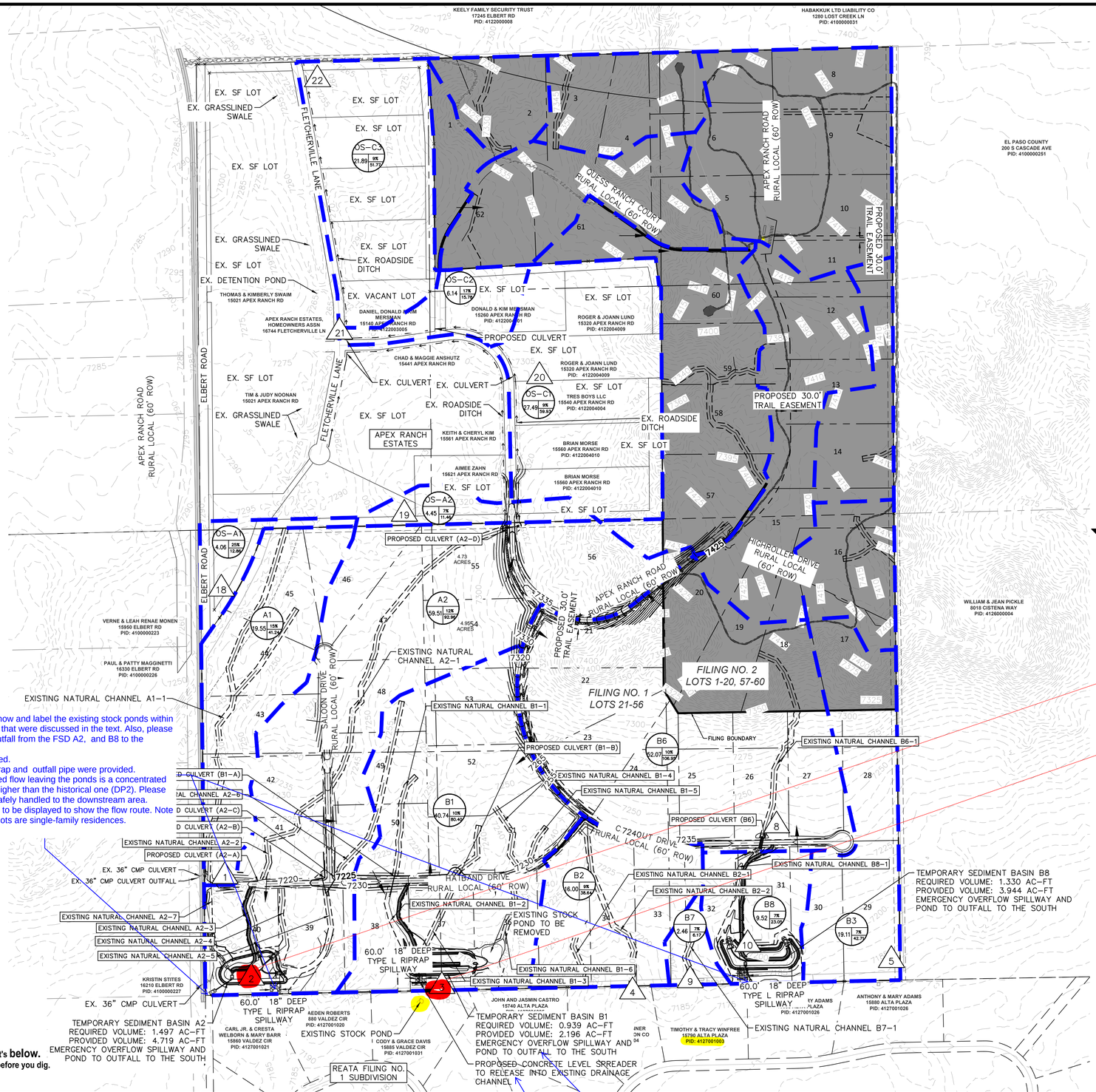
DESIGNED BY: KRK
DRAWN BY: AJL
CHECKED BY: KRK
DATE: 11/27/23

OVERLOOK FILING NO. 1
EL PASO COUNTY, COLORADO
PRELIMINARY DESIGN PLANS
EXISTING DRAINAGE MAP

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO. 196239003

SHEET
EX-1



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

PROPOSED FLOW DIRECTION
PROPOSED PROPERTY LINE
EXISTING PROPERTY LINE
PROPOSED EASEMENT LINE
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR

Kimley»Horn

PROJECT NAME: Overlook
PROJECT NUMBER: 196239003
CALCULATED BY: GKS
CHECKED BY: KRK
1/24/2024

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS Q2	CFS Q5	CFS Q100	% IMPERVIOUS
FDR Basins						
1	A1	19.92	4.19	8.43	38.41	8%
2	A2	61.50	3.44	13.00	87.58	1%
3	B1	45.75	1.98	9.87	72.48	0%
4	B2	42.42	1.88	9.41	69.09	0%
5	B3	25.42	1.18	5.91	43.40	0%
5A	B3A	24.23	1.20	5.99	43.98	0%
14	OS-A1	4.06	2.27	3.62	12.02	19%
15	OS-A2	4.45	0.70	2.10	11.46	7%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		81.42	7.63	21.43	125.99	3%
BASIN B TOTAL		137.82	6.24	31.18	228.94	0%
ON-SITE TOTAL		**219.24**	**13.87**	**52.61**	**354.92**	**1%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	2.97	5.72	23.48	13%
OFF-SITE TOTAL		**8.51**	**2.97**	**5.72**	**23.48**	**13%**
SITE TOTAL		**227.75**	**16.84**	**58.33**	**378.41**	**1%**

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS Q2	CFS Q5	CFS Q100	% IMPERVIOUS
PDR Basins						
1	A1	19.55	5.41	10.41	41.24	15%
2	A2	59.51	8.87	20.23	93.46	11%
3	B1	40.74	6.97	16.77	80.40	10%
4	B2	16.00	3.10	7.82	38.64	9%
5	B3	19.11	2.61	7.83	42.71	7%
8	B6	52.07	9.39	22.13	104.60	10%
9	B7	2.46	0.38	1.13	6.17	7%
10	B8	9.52	1.41	4.22	23.05	7%
18	OS-A1	4.06	2.57	4.12	12.86	25%
19	OS-A2	4.45	0.70	2.10	11.46	7%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		79.06	14.28	30.64	134.69	12%
BASIN B TOTAL		139.90	23.86	59.90	295.56	9%
ON-SITE TOTAL		**218.96**	**23.86**	**59.90**	**295.56**	**10%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	3.27	6.22	24.32	15%
OFF-SITE TOTAL		**8.51**	**3.27**	**6.22**	**24.32**	**15%**
SITE TOTAL		**227.47**	**27.12**	**66.12**	**319.88**	**10%**

Review C1: Please show and label the existing stock ponds within the adjacent property that were discussed in the text. Also, please show and label the outfall from the FSD A2, and B8 to the existing stock ponds.
Review C2: Unresolved.
Acknowledge that riprap and outfall pipe were provided. However, the proposed flow leaving the ponds is a concentrated flow, and significant higher than the historical one (DP2). Please show how it can be safely handled to the downstream area. Offsite contours need to be displayed to show the flow route. Note that the downstream lots are single-family residences.

Please review hydrology for the release rates between existing and proposed which show a marked increase at the early grading stage and still exceed historic release rates to the downstream areas in a more concentrated type flow at pts 2 and 3

Review C1: Please show and label the outfall connecting Pond B1 to the downstream facilities.
Review C2: Unresolved. Please display and label the existing drainage channel, showing that the flows leaving the site can be safely handled by the existing channel. Also, please provide calculations demonstrating that the existing channel has the capacity to carry these flows.

Review C1: Please show and label the outfall connecting Pond B1 to the downstream facilities.
Review C2: Unresolved. Please clearly show and label : outfall pipe & erosion protection at the end of oufall pipe (type, size), spillway riprap (type, size). Level spreader. Details are required in GEC plan.

NORTH

GRAPHIC SCALE IN FEET
0 150 300 600

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

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2023 KIMLEY–HORN AND ASSOCIATES, INC.
2 N NEVADA ST, SUITE 900
COLORADO SPRINGS, CO 80903 719–453–0180

DESIGNED BY: KRK
DRAWN BY: AJL
CHECKED BY: KRK
11/27/23

OVERLOOK FILING NO. 1
EL PASO COUNTY, COLORADO
PRELIMINARY DESIGN PLANS
PROPOSED DRAINAGE MAP

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
196239003

SHEET
EX-2

EX. ROADSIDE DITCH

EX. ROADSIDE DITCH

APEX RANCH RD

KEI
15561 APEX RANCH RD

BRIAN MORSE
15560 APEX RANCH RD
PID: 4122004010

AIMEE ZAHN
15621 APEX RANCH RD

BRIAN MORSE
15560 APEX RANCH RD
PID: 4122004010

OS–A2 | 4.45 | 7% | 11.46

OS–A1 | 4.06 | 25% | 12.86

ELBERT ROAD

PROPOSED CULVERT

4.73 ACRES

LOT 55

LOT 56

LOT 57

LOT 14

B5 | 8.95 | 7% | 21.85

LOT 15

LOT 16

B4 | 8.50 | 7% | 20.55

LOT 46

LOT 45

A2 | 58.27 | 12% | 92.96

A1 | 19.55 | 15% | 41.24

LOT 47

4.97 ACRES

LOT 54

LOT 20

LOT 21

LOT 19

LOT 18

LOT 17

VERNE & LEAH RENAE MONEN
15950 ELBERT RD
PID: 4100000223

LOT 44

PAUL & PATTY MAGGINETTI
16330 ELBERT RD
PID: 4100000226

FILING BOUNDARY

FILING NO. 2
LOTS 1-20, 57-60

LOT 48

LOT 53

LOT 22

FILING NO. 1
LOTS 21-56

LOT 43

B6 | 53.31 | 10% | 106.95

LOT 23

LOT 49

LOT 52

LOT 24

LOT 25

LOT 26

LOT 27

LOT 28

LOT 42

B1 | 40.74 | 10% | 80.40

PROPOSED EXEMPT AREA: 14,351 SF

PROPOSED CULVERT

PROPOSED CULVERT

PROPOSED CULVERT

LOT 41

LOT 50

PROPOSED CULVERT

LOT 51

PROPOSED CULVERT

PROPOSED CULVERT

B2 | 16.00 | 9% | 38.64

B8 | 9.52 | 7% | 23.05

LOT 32

LOT 31

LOT 30

LOT 29

LOT 33

LOT 34

LOT 35

B7 | 2.46 | 7% | 6.17

B3 | 19.11 | 7% | 42.71

EX. CULVERT

ELBERT ROAD

LOT 40

LOT 39

LOT 38

LOT 37

LOT 36

PROPOSED FULL SPECTRUM EXTENDED DETENTION BASIN (A2)

KRISTIN STITES
16210 ELBERT RD
PID: 4100000227

JOHN AND JASMIN CASTRO
15740 ALTA PLAZA
PID: 4127001005

ANTHONY & MARY ADAMS
15880 ALTA PLAZA
PID: 4127001026

ANTHONY & MARY ADAMS
15880 ALTA PLAZA
PID: 4127001026

BRAEDEN ROBERTS
15880 VALDEZ CIR
PID: 4127001020

CARL JR. & CRESTA WELBORN & MARY BARR
15860 VALDEZ CIR
PID: 4127001021

CODY & GRACE DAVIS
15885 VALDEZ CIR
PID: 4127001031

BILL & JANE TANNER
PO BOX 492 PEYTON CO
PID: 4127001004

TIMOTHY & TRACY WINFREE
15790 ALTA PLAZA
PID: 4127001003

SANDRA WOODS
15950 ELBERT RD
PID: 4100000082

PROPOSED FULL SPECTRUM EXTENDED DETENTION BASIN (B1)

PROPOSED FULL SPECTRUM EXTENDED DETENTION BASIN (B8)

VALDEZ CIRCLE

ALTA PLAZA

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

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

PROPOSED PROPERTY LINE
EXISTING PROPERTY LINE
PROPOSED EASEMENT LINE
DRAINAGE BASIN BOUNDARY
THE LARGE LOT EXCLUSION I.7.1.B.5
TRIBUTARY TO POND A2
TRIBUTARY TO POND B1
TRIBUTARY TO POND B8
PROPOSED EXEMPT AREA

EXEMPT AREAS (ECM I.7.1.C.1)

BASIN A1	= ±16,482 SF
BASIN B2	= ±26,947 SF
TOTAL	= ±43,429 SF (0.99 ACRES)

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2023 KIMLEY-HORN AND ASSOCIATES, INC.
2 N NEVADA ST, SUITE 900
COLORADO SPRINGS, CO 80903 719-453-0180

DESIGNED BY: KRK
DRAWN BY: AJL
CHECKED BY: KRK
DATE: 11/27/23

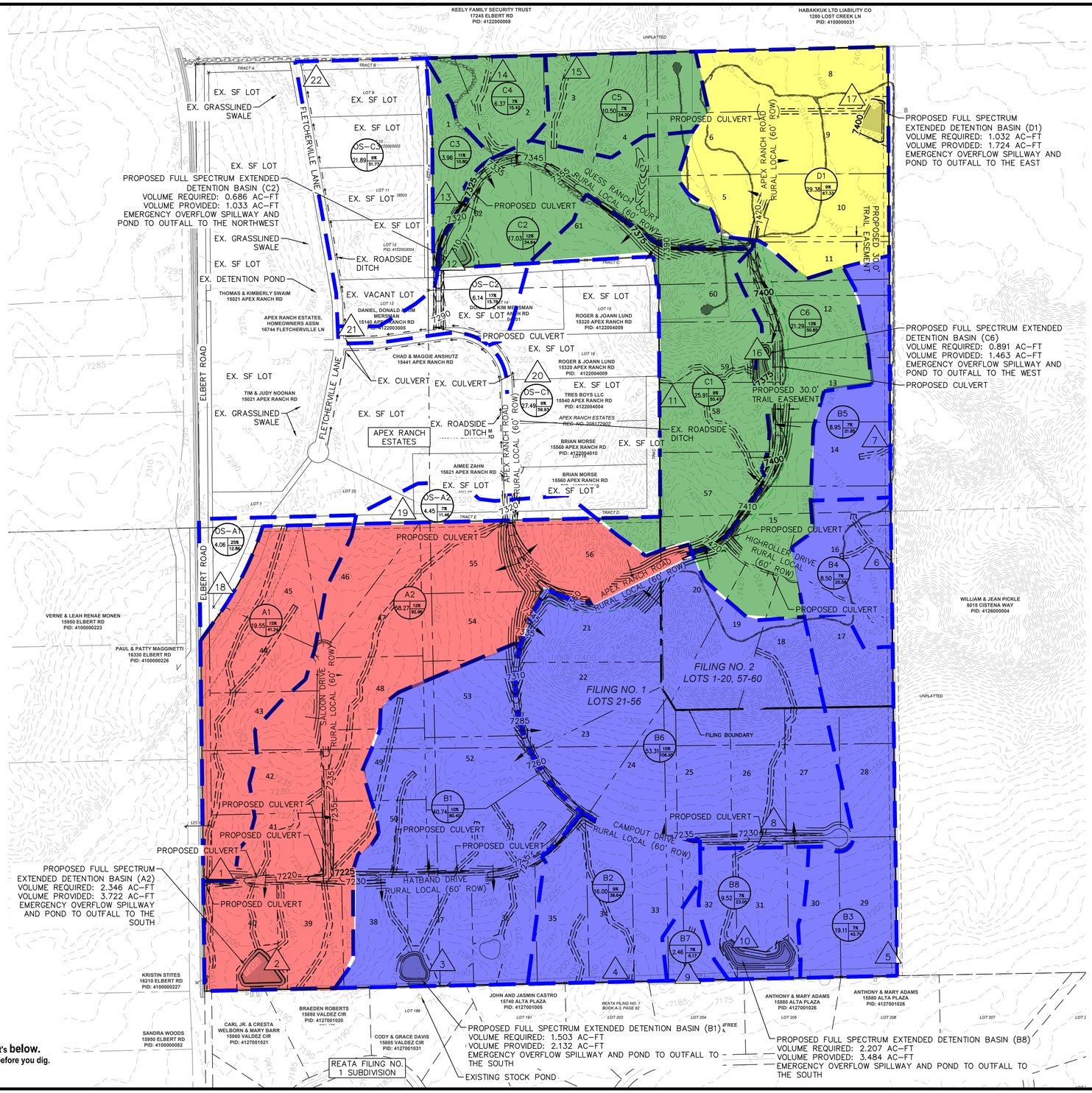
OVERLOOK FILING NO. 1
EL PASO COUNTY, COLORADO
PRELIMINARY DESIGN PLANS
EXCLUSION EXHIBIT DRAINAGE MAP-FILING NO. 1

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
196239003

SHEET
EX-3

Drainage Basin Exhibit



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

PROPOSED FLOW DIRECTION
PROPOSED PROPERTY LINE
EXISTING PROPERTY LINE
PROPOSED EASEMENT LINE
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR

EASEMENT NOTE

1. ALL PROPOSED EASEMENTS ARE 30' DRAINAGE EASEMENTS UNLESS OTHERWISE NOTED

A - Upper Black Squirrel Drainage Basin (CHBS2000)
B - La Vega Ranch Drainage Basin (CHBR0400)
C - East Kiowa Creek Drainage Basin (KIKI0400)
D - Bijou Creek Drainage Basin (BIBI0200)

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS Q2	CFS Q5	CFS Q100	% IMPERVIOUS
PDR Basins						
1	A1	19.55	5.41	10.41	41.24	15%
2	A2	58.27	9.71	20.99	92.96	12%
3	B1	40.74	6.97	16.77	80.40	10%
4	B2	16.00	3.10	7.82	38.64	9%
5	B3	19.11	2.61	7.83	42.71	7%
6	B4	8.50	1.25	3.77	20.58	7%
7	B5	8.95	1.33	4.01	21.85	7%
8	B6	53.31	9.52	22.55	106.95	10%
9	B7	2.46	0.38	1.13	6.17	7%
10	B8	9.52	1.41	4.22	23.05	7%
11	C1	25.91	4.42	11.18	55.47	9%
12	C2	17.03	3.87	8.08	34.64	12%
13	C3	3.96	1.04	2.36	10.80	11%
14	C4	6.37	0.94	2.83	15.42	7%
15	C5	10.50	1.48	4.44	24.20	7%
16	C6	21.29	6.09	12.27	50.85	13%
17	D1	29.38	5.34	13.56	67.33	9%
18	OS-A1	4.06	2.57	4.12	12.86	25%
19	OS-A2	4.45	0.70	2.10	11.46	7%
20	OS-C1	27.49	4.90	12.21	59.93	9%
21	OS-C2	6.15	2.35	4.26	15.78	17%
22	OS-C3	21.89	5.33	11.63	51.77	11%
ON-SITE BASIN TOTAL						
BASIN A TOTAL		77.82	15.12	31.40	134.20	12%
BASIN B TOTAL		158.59	26.57	68.09	340.34	8%
BASIN C TOTAL		85.06	17.84	41.15	191.38	10%
BASIN D TOTAL		29.38	4.90	12.21	59.93	9%
ON-SITE TOTAL		**350.85**	**49.75**	**122.80**	**599.06**	**10%**
OFF-SITE BASIN TOTAL						
OFF-SITE BASIN A		8.51	3.27	6.22	24.32	15%
OFF-SITE BASIN C		55.53	12.58	28.11	127.48	11%
OFF-SITE TOTAL		**64.04**	**15.85**	**34.33**	**151.80**	**12%**
SITE TOTAL		**414.89**	**65.60**	**157.13**	**750.86**	**10%**

NORTH

GRAPHIC SCALE IN FEET
0 150 300 600

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2023 KIMLEY–HORN AND ASSOCIATES, INC.
2 N NEVADA ST, SUITE 900
COLORADO SPRINGS, CO 80903 719–453–0180

DESIGNED BY: KRK
DRAWN BY: AJL
CHECKED BY: KRK
DATE: 11/27/23

OVERLOOK FILING NO. 1
EL PASO COUNTY, COLORADO
PRELIMINARY DESIGN PLANS
PROPOSED DRAINAGE MAP

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
196239003

SHEET
EX-2

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