PHASE III DRAINAGE REPORT
FOR
HILLCAMP TRAIL

Prepared for:

Rampart Range Metropolitan District No. 1
2001 16th Street, Suite 1700
Denver, CO 80202
Contact: Nic Carlson
(303) 779-5710

Prepared by:

JR ENGINEERING
7200 S Alton Way, Suite C400
Centennial, Colorado 80112
(303) 740-9393
Contact: Kevin Rohrbough, P.E.

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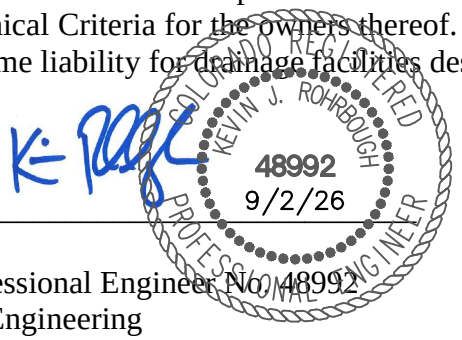
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CERTIFICATION

"I hereby certify that this report for the Drainage Design of the Hillcamp Trail was prepared under my direct supervision in accordance with the provisions from the Douglas County Storm Drainage Criteria Design and Technical Criteria for the owners thereof. I understand that Douglas County does not and will not assume liability for drainage facilities designed by others."



Kevin Rohrbough, P.E.
Colorado Registered Professional Engineer No. 48992
For and On Behalf of JR Engineering

Rampart Range Metropolitan District No. 1 hereby certifies that the storm water drainage facilities for Hillcamp Trail shall be constructed according to the design presented in this report. I understand that the City of Lone Tree does not and will not assume liability for the drainage facilities designed and/or certified by engineer. I understand that the City of Lone Tree reviews drainage plans pursuant to Colorado Revised Statues Title 30, Article 28; but cannot guarantee that final drainage design review will absolve Rampart Range Metropolitan District No. 1 and/or their successors and/or their assigns of future liability for improper design. I further understand that the approval does not imply approval of my engineer's drainage design.

Rampart Range Metropolitan District No. 1

Nic Carlson

Authorized Signature

1 INTRODUCTION

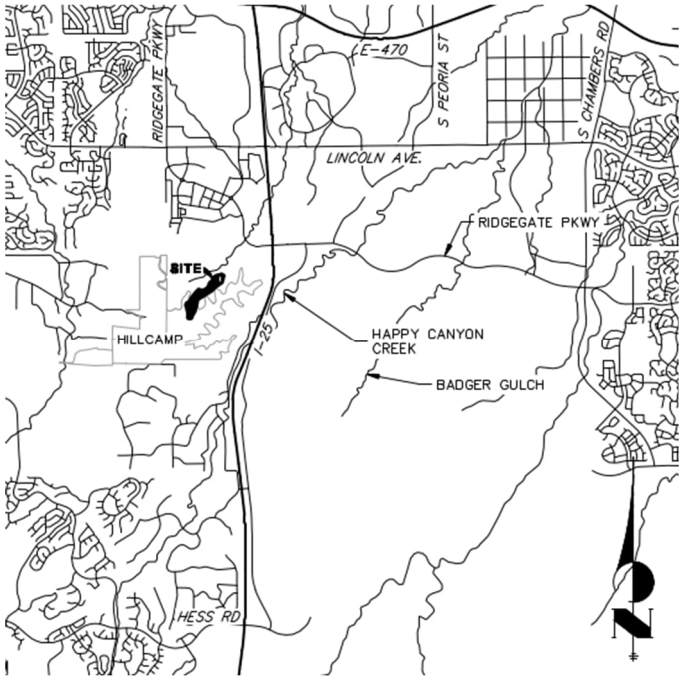
The purpose of this Phase III Drainage Report is to investigate the existing and proposed conditions drainage patterns, and to develop drainage improvements for the proposed Hillcamp Trail. The proposed drainage improvements are intended to maintain existing drainage patterns and minimize drainage impacts from the proposed development.

1.1 Site Location and Project Description

The Site is located in Sections 22, Township 6 South, Range 67 West of the 6th Principal Meridian, City of Lone Tree, Douglas County, Colorado. The site is located west of Interstate Highway 25 (I-25), south of existing open space and residential lots, and northeast of the proposed Hillcamp residential development. This project serves to be the main point of access for the proposed Hillcamp residential development. The site is shown on the Vicinity Map, see **Appendix A** as well as **Figure 1** below. The property is currently vacant and undeveloped, apart from several gravel recreational trails.

Along the north side of proposed Hillcamp Trail is a small single-family development, Retreat at Ridgegate. This development is downstream from the site and excerpts of the drainage report are included in **Appendix D**.

Figure 1: Vicinity Map



1.2 Geotechnical Description

The soils in the proposed development as classified by the Natural Resource Conservation Service (NRCS) include Hydrologic Groups C and D. Hydrologic Group C soils are described as “soils that have low infiltration rates when thoroughly wet and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.” Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clayey soils with high swelling capacity or potential, (2) soils with a high permanent water table, (3) soils with claypan or clay layer at or near the surface, and

(4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission. Hydrologic Soil Group D soils are characterized by very slow infiltration rates, even when thoroughly wetted, and have a high runoff potential. Excerpts from the NRCS soils report are provided in **Appendix A**.

Two separate Geotechnical studies were performed for the project area.

- UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION AND SLOPE STABILITY EVALUATION RIDGEGATE – MESA TOPS ROAD ALIGNMENT;– CTL THOMPSON (NOVEMBER 2025)
- GEOTECHNICAL INVESTIGATION RIDGEGATE MESA TOPS PEDESTRIAN BRIDGE SOUTHWEST OF RIDGEGATE PARKWAY AND INTERSTATE 25;– CTL THOMPSON (NOVEMBER 2025)

Within these geotechnical studies several recommendations were provided to ensure that maximum slope stability was achieved. Among these recommendations was that a Sub-Fill drain be installed along the extents of existing drainageways that are being filled by roadway construction. This recommendation was implemented into the design of the stormwater system for the project.

In addition to these sub-fill drains, JR engineering has also implemented several low tailwater basins upstream of flared end sections in the areas that CTL Thompson identified as debris flow susceptible areas. These low tailwater basins will allow for any debris that flows down the existing drainageways to settle prior to entering the piped system. Excerpts from these Geotechnical study can be found in **Appendix D.**

1.3 Related Drainage Studies

The site is located in the Cottonwood Creek Watershed which is tributary to the Cherry Creek Reservoir. The site is located in Flood Zone X, areas determined outside the 500-year floodplain, as shown on Flood Insurance Rate Map Community Panels No. 08035C0044G, Effective September 4, 2020, which is included in **Appendix A**. This Site has an associated Master Drainage Plan (MDP) as well as numerous other Drainage Reports that amends this MDP. These reports are listed below.

Cottonwood Creek Drainage Studies:

- MASTER DRAINAGE PLAN FOR RIDGEGATE – COTTONWOOD CREEK DRAINAGE BASIN;– MERRICK AND COMPANY (JANUARY 2012)
- PHASE 3 DRAINAGE REPORT FOR TRACT O ACCESS ROAD (COTTONWOOD CREEK FLOW CONTROL STRUCTURE) RAMPART RANGE METRO DISTRICT;– MERRICK AND COMPANY (APRIL 2012)
- PHASE 3 DRAINAGE REPORT FOR DETENTION POND 311 RETROFIT RAMPART RANGE METRO DISTRICT;– MERRICK AND COMPANY (DECEMBER 2013)
- RIDEGATE-SECTION 22, FILING NO.1 PHASE 3 DRAINAGE REPORT;– CALIBRE ENGINEERING INC (JANUARY 2017)
- PHASE 3 DRAINAGE REPORT FOR HILLCAMP;– JR ENGINEERING (IN REVIEW AT TIME OF THIS REPORT)

No adverse downstream impacts will be produced by the proposed Hillcamp Trail development, as developed runoff will be at or below the assumed flow rates at relevant design points according to the 2017 Report by Calibre Engineering. References from these studies are included in **Appendix D**.

2 HISTORIC DRAINAGE SYSTEM

2.1 Major Drainage Basins Descriptions

The site is located within the Cottonwood Creek Major Drainage Basin.

2.1.1 Cottonwood Creek

This drainage basin begins just northeast of the existing northern property line of the site, and is directly downstream of the proposed development. According to the **2012 MDP for Ridgegate - Cottonwood Creek Drainage Basin – Merrick and Company,** flows are to be conveyed down the existing slopes until they channelize in the steep existing slopes drainageways. Once channelized, the flows converge to one drainageway and ultimately in to Cottonwood Creek. These flows are then to be conveyed along this path until they reach Ridgegate Parkway where an existing 48" RCP culvert conveys flows under RidgeGate Parkway until eventually reaching the existing CDOT MS4 Pond 311 located near the intersection of Lincoln Ave and Interstate 25. The **Ridgegate – Section 22, Filing No. 1 Phase III Drainage Report – Calibre 2017** followed this MDP and added design for a small subdivision (Retreat at Ridgegate). When this project was developed, the drainage patterns of the area were altered slightly to allow for development, and the existing 48" RCP Culvert at Ridgegate Parkway had a restrictor plate added to it to help attenuate the developed flows from Ridgegate – Section 22, Filing No. 1. This existing culvert lies within the newly improved Cottonwood Creek drainage channel as part of The Ridgegate – Section 22, Filing No. 1 improvements along with several other new culverts being used to attenuate flows through the development. These downstream drainageways will be slightly modified by the construction of Hillcamp Trail. But will not have adverse impacts to the downstream infrastructure. Developed flows will be conveyed to the locations as described by the 2017 Calibre Report, at or below their assumed flow rates. In addition to the **2012 MDP by Merrick,** the **2017 Calibre** report also used the design described within both the **Phase 3 Drainage Report for Pond 311 (Merrick December 2013),** and also the **Phase 3 Drainage Report for Tract O Access Road (Merrick April 2012)** to prove downstream detention and water quality is possible within Pond 311. Excerpts from these reports can be found in **Appendix D.**

2.2 Sub-Basin Description

2.2.1 Cottonwood Creek

According to the **2012 MDP For Ridgegate - Merrick and Co**, there are four (4) existing Sub-Basins that the project will impact. These Proposed Sub-Basins are named according to the naming convention from the **2012 MDP For Ridgegate - Merrick and Co**; C15-C, C15-E, C15-F, and C-15-G. This site is located directly within these existing Sub-Basins.

In addition to the **2012 MDP** by **Merrick and Co** there is also the **Ridgegate – Section 22 Filing 1 Phase III Drainage Report** by **Calibre – 2017**. This Drainage Report outlines improvements made by the construction of the Retreat at Ridgegate Subdivision, this report shows several offsite Sub-Basins and several on-site Sub-Basins that this development is capturing with swales, and then conveying to a central drainage channel within the development itself. This central channel (Sub-basin CH, **Calibre 2017**) is attenuated to historic release rates by use of an existing 48" RCP culvert located below Bluffside Drive; this culvert is referenced in the **Calibre** drainage report as the Ex-Cottonwood Creek Flow Control Structure. To help attenuate developed flows created by the Retreat at Ridgegate development's added imperviousness, a restrictor plate was installed on the Ex-Cottonwood Creek Flow Control Structure to

restrict major flows to **325.17 CFS** based upon the studies performed on downstream Pond 311's (Previously mentioned CDOT MS4 Pond) allowable capacity.

The Sub-Basins 1-4 on the **Calibre** SWMM Map located in **Appendix D** will be altered by the proposed Hillcamp Trail construction. The downstream Retreat at Ridgegate storm infrastructure that is to convey flows from these sub-basins into the Retreat at Ridgegate central channel (Sub-Basin 9 – SWMM MAP, **Calibre 2017)**, were designed using hydrology that reflected the assumed alignment, and added impervious of both this site (Hillcamp Trail), and the proposed Hillcamp Subdivision. The **2017 Calibre** Design Points that are potentially affected by the proposed Hillcamp Trail are named 15C, 15E, and 15F1.1, on the **Calibre SWMM Map**, and 1.1, 2.1, and 4.1 respectively on the **Calibre Proposed Drainage Plan.** Table 1 below summarizes the assumed flow rates that were calculated at these design points. See **Appendix D** for detailed Hydrology and routing from the **2017 Calibre Drainage Report.**

Note that due to the March 2024 Updates to the USDCM Volume 1, Chapter 6, the percent impervious values have changed to become more conservative since the time that the referenced report was approved.

Table 1: Existing Calibre Design Point Assumed Flows

Ex Calibre Design Point	EX Q_5 (cfs)	EX Q_{100} (cfs)
1.1	13.9	82.1
2.1	2.5	28.5
4.1	2.4	24.6

3 DRAINAGE DESIGN CRITERIA

This Drainage Report was prepared in accordance with the "Storm Drainage Design and Technical Criteria" by Douglas County, the "Urban Storm Drainage Criteria Manual" (USDCM) by Mile High Flood District (MHFD), the 2017 Report by Calibre Engineering, and associated Cottonwood Creek MDP that have been referenced throughout. Any tables, charts and graphs referenced from the drainage criteria manuals for this report are contained in **Appendix A**.

3.1 Hydrology

The one-hour rainfall depth data was obtained from Chapter 6 of the "Storm Drainage Design and Technical Criteria" by Douglas County, which states a one-hour precipitation value for 5- and 100-year events in Zone 1 to be 1.43 inches and 2.60 inches respectively.

Colorado Urban Hydrograph Procedure was used to determine runoff values for the proposed site for a conservative planning stage. These flows were used to preliminarily plan infrastructure size and locations. The minor storm was analyzed as the 5-year event and the major storm was analyzed as the 100-year event.

CUHP Flows were used for all design on this site; this includes inlets, swales, pipes, culverts, and riprap. CUHP was used to mirror how the previous **2017 Calibre** flow rates were calculated for the final design of the Retreat at Ridgegate infrastructure downstream of the proposed Hillcamp Trail site.

Final Design CUHP results are provided in **Appendix B**. As well as the associated CUHP inputs.

3.2 Hydraulics

All inlets, swales, culverts, and pipes have been designed for the 100-year storm. The latest version of Mile High Flood District's workbook "MHFD-Inlet (Version 5.02, August 2022)" has been used to size the inlets and for street capacity. Street capacity is based on allowable spread and the maximum depth of flow at the curb.

The inflows at the inlets are based on the CUHP 5-year-minor/100-year-major storm results and can be referenced from the CUHP outputs in **Appendix B**. The proposed storm sewer pipes used to convey flows, are sized using Bentley's StormCAD software. This Software is also being used to calculate the hydraulic grade lines, velocity, and Froude Number in the storm sewer pipes and results can be found in **Appendix C**.

Swales and concrete trickle channels have been sized to not overtop with the expected flows to each using Bentley's Flowmaster version 10.03. Flowmaster results can be found in **Appendix C.**

4 PROPOSED DRAINAGE FACILITY DESIGN

4.1 General Concept

This report uses the five aforementioned Reports as the general basis for determining the drainage design, with modifications to reflect the latest USDCM criteria manual in these Sub-Basins. Roadway flows are to be routed within the roadway to Type R inlets on either side of the street crown at 3 different locations. Offsite flows are to be routed via existing vegetated Swales towards the locations of the existing Retreat at Ridgegate Infrastructure. Where the proposed roadway bisects existing **Calibre** sub-basins, flared end sections or depressed type D inlets will convey flows beneath Hillcamp Trail to the existing Retreat at Ridgegate infrastructure.

4.2 Proposed Basin Descriptions

A Basins:

Basins A1 – A2 are located on the southwest side of the Site within the Cottonwood Creek watershed and these basins will consist of small portions of single-family lots, asphalt roads, curb and gutter, landscaping, pedestrian bridge, concrete sidewalk, gravel trail, and natural vegetation. These Sub-Basins flows will be conveyed via curb and gutter to a pair of sump condition Type R Inlets located at DP's A1 and DP A2, respectively. These flows are then conveyed via storm sewer to DP 1.3, through the storm sewer to the proposed Hydrodynamic Separator (HDS) A for water quality treatment, ultimately the flows will outfall into the Proposed TRM Lined Swale downstream.

B Basins:

Basins B1 – B2 are located on the central portion of the Site within the Cottonwood Creek watershed and these basins will consist of asphalt roads, curb and gutter, retaining walls, landscaping, concrete sidewalk, and natural vegetation. These Sub-Basins flows will be conveyed via curb and gutter to a pair of on-grade Type R Inlets located at DP B1 and DP B2 Respectively. These flows are then conveyed via storm sewer to DP C4.1 where proposed HDS C is located, where flows are treated for water quality, then ultimately flows outfall into the existing Retreat at Ridgegate storm infrastructure.

C Basins:

Basins C1 – C2 are located on the northeast end portion of the Site within the Cottonwood Creek watershed and these basins will consist of asphalt roads, curb and gutter, retaining walls, landscaping, concrete sidewalk, and natural vegetation. These Sub-Basins flows will be conveyed via curb and gutter to a pair of on-grade Type R Inlets located at DP C1 and DP C2 Respectively. These flows are then conveyed via storm sewer to DP C4.1, where HDS C is proposed to treat the flows for water quality, these flows then outfall into the existing Retreat at Ridgegate storm facilities and towards **Existing Calibre DP 4.1**.

OS Basins:

Sub-basin OS1.1 is located to the southeast of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slope away from the Hillcamp Development towards existing vegetated swales that will convey channelized flows to DP 1. At this point flows enter the proposed Hillcamp Trail storm sewer. Flows are piped from the on-grade type D at DP 1 until outfalling on the north side of proposed Hillcamp Trail to DP P1.1, and ultimately enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 1.1**. Any developed flows leaving the Hillcamp Subdivision are to be treated for water quality before entering proposed Hillcamp Trail Sub-Basin OS1.1.

Sub-basin OS1.2 is located to the south of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slope away from the Hillcamp Development towards existing vegetated swales that will convey channelized flows to DP 2 where a proposed 36" FES is located within a proposed low tailwater rip rap basin. At this point flows enter the proposed Hillcamp Trail storm infrastructure, flow is conveyed via storm sewer until outfalling to DP P1.1. At this point flows enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 1.1.** Any developed flows leaving the Hillcamp Subdivision are to be treated for water quality before entering Proposed Hillcamp Trail Sub-Basin OS1.2.

Sub-basin OS1.21 is located to the southeast of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slope away from the Hillcamp Development towards a proposed back of wall trickle channel that will convey channelized flows to DP 2.1. At this point flows enter the proposed Hillcamp Trail storm sewer. Flows are piped from the on-grade type D at DP 2 until outfalling on the north side of proposed Hillcamp Trail to DP P1.1, and ultimately enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 1.1**. Any developed flows leaving the Hillcamp Subdivision are to be treated for water quality before entering proposed Hillcamp Trail Sub-Basin OS1.21.

Sub-basin OS1.3 is located to the north of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slope towards Hillcamp Trail. Flows will be conveyed via a proposed swale to DP P1.1 At this point flows enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 1.1**.

Sub-basin OS2 is located to the southeast of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slopes towards a proposed rear wall concrete swale that will convey channelized flows to DP OS2 where a proposed Type D inlet is located. At this point flows enter the proposed Hillcamp Trail Storm infrastructure, flow is conveyed via storm sewer until outfalling to DP P2.1. At this point flows enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 2.1**.

Sub-basin OS2.1 is located to the north of the proposed Hillcamp Trail roadway. Flows sheet flow down the existing slope towards an existing vegetated swale that will convey channelized flows to DP P2.1. At this point flows enter the Retreat at Ridgegate Detention Facilities at **Existing Calibre DP 2.1**.

Sub-basin OS4 is located to the east of the proposed Hillcamp Trail roadway, just south of the proposed intersection of Hillcamp Trail and Viewside Drive. Flows sheet flow down the existing slope away from the Hillcamp Development towards existing vegetated swales that will convey channelized flows to DP

OS4 where a proposed 30" FES is located within a proposed low tailwater rip rap basin. At this point flows enter the proposed Hillcamp Trail storm infrastructure, flow is conveyed via storm sewer to DP C4.1 where HDS C is proposed to treat the flows for water quality, these flows then outfall into the existing Retreat at Ridgegate storm system and towards **Existing Calibre DP 4.1**. From this point the flows continue through the existing Retreat at Ridgegate Storm Facilities until outfalling into Cottonwood Creek at **Existing Calibre DP 4. (See Appendix D for relevant Calibre references.)**

Sub-basin OS4.1 is located to the east of the proposed Hillcamp Trail roadway, just south of the proposed intersection of Hillcamp Trail and Viewside Drive. Flows sheet flow down the existing slopes towards a proposed trickle channel above retaining walls that will convey channelized flows to DP OS4.1 where a proposed Type D inlet is located. At this point flows enter the proposed Hillcamp Trail storm infrastructure, flow is conveyed via storm sewer to DP C4.1 where HDS C is proposed to treat the flows for water quality, these flows then outfall into the existing Retreat at Ridgegate storm facilities at **Existing Calibre DP 4.1**. From this point the flows continue through the existing Retreat at Ridgegate Storm Facilities until outfalling into Cottonwood Creek at **Existing Calibre DP 4. (See Appendix D for relevant Calibre references.)**

Sub-basin OS5 is located to the north of the proposed Hillcamp Trail roadway, just west of the proposed intersection of Hillcamp Trail and Viewside Drive. This sub-basin is unchanged from the existing condition. Flows sheet flow down the existing slopes towards an existing vegetated swale, DP OS5. Flows are conveyed to the existing Retreat at Ridgegate Storm Facilities at **Existing Calibre DP 4.1.** From this point the flows continue through the existing Retreat at Ridgegate Storm Facilities until outfalling into Cottonwood Creek at **Existing Calibre DP 4. (See Appendix D for relevant Calibre references.)**

Sub-basin UD1 is located where the proposed Hillcamp roadway meets the existing Cabela Drive. These Sub-basins' flows are conveyed by the proposed curb and gutter until reaching DP UD1. At this point the flows leave untreated.

Sub-basin UD2 is located where the proposed Hillcamp roadway meets the existing Cabela Drive. These Sub-basins' flows are conveyed by the proposed curb and gutter until reaching DP UD1. At this point the flows leave untreated.

All of the basins described above are a slightly modified version of the OS basins found in the 2017 Calibre Drainage report. The previous **2017 Calibre Phase III Drainage Report** took these developed flows into account when designing the downstream infrastructure, and as shown in Table 2 below the calculated flow rates hitting the downstream Retreat at Ridgegate Storm infrastructure has been reduced overall. There is a small increase in the 5-year storm flows for **Ex Calibre Design Points 2.1**, this can be explained by slight variations in where flows are being routed to, as well as the overall increase in imperviousness according to the March 2025 USDCM Volume 1 Chapter 6 updates (**See Appendix D for complete updated imperviousness chart**). Overall, the sum of flows hitting the downstream Retreat at Ridgegate Storm infrastructure is less than calculated by the **2017 Calibre** report for Existing Calibre DP's 1.1 and 2.1. Existing Calibre DP 4.1 is seeing an increase in total flows, because of this, JR Engineering is proposing a HDS upstream of the existing attenuation basin.

Below in **Table 2** is a summary of the affected existing **Calibre Design Points** in comparison to the flow rates calculated JR Engineering for this report, showing an overall reduction in total flows reaching the central channel within the Retreat at Ridgegate Development for both the Minor and Major storm events. This means that no negative downstream effects will occur with the addition of the proposed Hydrodynamic Separators treating for water quality upstream of any existing Retreat at Ridgegate Storm Infrastructure.

Table 2: Existing Calibre Design Point Assumed Flow Rates vs. Proposed Flow Rates

DESIGN POINT DELTA TABLE (CUHP-SWMM FLOWS)

Ex Calibre Design Point	EX Q_5 (cfs)	EX Q_{100} (cfs)	Prop JR Design Point	PROP Q_5 (cfs)	PROP Q_{100} (cfs)
*1.1	13.9	82.6	P1.1	7.8	53.8
*2.1	2.5	28.5	P2.1	2.4	20.6
*4.1	2.4	47.0	P4.1	3.5	25.9
EX TOTAL FLOWS	18.8	158.1	PROPOSED TOTAL FLOWS	13.6	100.3

*FLOWS FROM RETREAT AT RIDGEGATE DRAINAGE REPORT

5 WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

5.1 Non-Structural BMP's

In several locations surrounding the proposed Hillcamp Trail roadway, there are existing vegetated drainageways that are being altered by the proposed improvements. These existing drainageways have steep slopes and dense vegetation. JR Engineering has made an effort to minimize impacts to these existing drainageways by minimizing grading daylights where possible, and leaving the drainageways as close to existing as possible. Where these drainageways are being affected by the proposed roadway grading, JR is proposing 14' wide TRM-Lined (Turf Reinforcement Mat) swales. With 14' of TRM being the minimum width to achieve 1' of reinforcement above the 100-year WSEL. This will allow for the affected drainageways to re-establish vegetation as well as providing increased shear resistance due to the high velocities being produced upstream by the steep slopes within the existing drainageways. These TRM-Lined swales are shown in proposed Sub-Basins OS1.2 and OS1.3 on the Proposed Detailed Drainage Maps found in **Appendix E.** Flowmaster results can be found in **Appendix C**. The swales' capacity was calculated using the total flow from each sub-basin, based on this approach and the physical locations of the swales, they will never reach their max capacity.

Where the grading required retaining walls, JR Engineering is proposing 2' wide 6" depth concrete trickle channels behind the top of wall. These have been sized to convey the expected amount of flows without overtopping. Flowmaster results can be found in **Appendix C.**

5.2 MS4 Permit Requirements

The Hillcamp Trail Roadway Basins meets the requirements of the "WQCV Standard" in accordance with CDPS General Permit COR080000, Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s). All proposed Sub-Basins' flows resulting in an increased runoff from predeveloped condition are routed through the proposed Hillcamp Trail Storm System to one of the two proposed hydrodynamic separators where the flows are treated for Water Quality and then discharged to their historic location at or below 90% of the pre-developed flows calculated in the **2017 Calibre report** (**See Appendix D for Calibre Calculations)**

- WQCV Standard: The control measure(s) is designed to provide treatment and/or infiltration of the WQCV and:

1. 100% of the applicable development site is captured, except the permittee may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area when the permittee has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures. In addition, the permittee must also determine that the implementation of a separate control measure for that portion of the site is not practicable (e.g., driveway access that drains directly to street).
2. Evaluation of the minimum drain time shall be based on the pollutant removal mechanism and functionality of the control measure implemented. Consideration of drain time shall include maintaining vegetation necessary for operation of the control measure (e.g., wetland vegetation).

The proposed Sub-Basins OS1-OS1.3, and OS2-OS2.1 are showing a reduction in flows compared to the **2017 Calibre report** (**See Appendix D for Calibre Calculations)**. Therefore, no additional treatment will be proposed for these locations.

The proposed Sub-Basins UD1, and UD2 are leaving the site undetained. These basins acreage comes out to a total of 0.67 AC, therefore, no additional improvements will be proposed for these locations.

The **2017 Calibre Report** shows calculations for the downstream MS4 pond 311 and Cottonwood Creek flood control structure. These calculations are being referenced from the previous **April 2012 and December 2013 Drainage Reports by Merrick**. Within the **Calibre** report it is described that the downstream Pond 311, will provide water quality and detention for the (at the time of approval **2017**) future developed flows coming from the construction of the Hillcamp Subdivision and Hillcamp Trail. (**See Appendix D for Pond 311 and Tract O Access Road Drainage Report Excerpts**). Since the time of Approval in 2017, Regulation #72 from the Cherry Creek Reservoir Control Regulation has been updated, triggering the requirement for upstream water quality.

6 CONCLUSIONS

6.1 Impact of Improvements

This proposed Hillcamp Trail Roadway development follows the assumed/existing drainage patterns shown in the **2012 MDP for Ridgegate - Cottonwood Creek Drainage Basin by Merrick and Company,** and the **2017 Calibre Ridgegate – Section 22, Filing No. 1 Phase III Drainage Report**. As shown by the CUHP results in **Appendix B** as well as **Table 2** above, even with the higher impervious values due to the aforementioned updates to the USDCM Volume 1, flows hitting the existing Retreat at Ridgegate infrastructure have been reduced for existing DP's 1.1, 2.1 and 4.1. Therefore, this proposed Hillcamp Trail Roadway development will have no adverse impact on quantity, quality, or timing of stormwater discharges to its downstream tributary historic drainage systems.

(See Appendix D for relevant Calibre references.)

6.2 Compliance with Applicable Criteria

For the Hillcamp Trail Proposed Storm Sewer system there will be several exemptions requested. The Hillcamp Trail Storm Sewer System was primarily designed with the intent of reducing erosion at each outfall as much as possible to protect the downstream natural environment. The "Storm Drainage Design and Technical Criteria" by Douglas County states the following in Section 9.8.1.

- *Minimum Velocity – The need to maintain a self-cleaning storm sewer system is recognized as a goal to minimize the costs for maintenance of storm sewer facilities. Sediment deposits, once established, are generally difficult to remove even with pressure cleaning equipment. A minimum velocity of 4-fps is required when the storm sewer pipes convey runoff from frequently occurring storm events…*

There are several locations where due to the steep slopes across the existing topography, in order to meet the maximum velocity constraint, the major storm EGL constraint, as well as reducing the velocity at the outfall of each storm system, the minimum velocity inside the storm pipes cannot meet the 4 feet per second (fps) minimum. Drop manholes are being used to reduce the velocities in the major event, once flows have reduced for the 5-year storm event, the resulting velocities are below the required minimum of 4 fps. The areas that will have associated variance requests are described below (**All relevant Stormcad profiles can be found in Appendix C)**.

6.2.1 Minor Storm Velocity Exemptions

The 5YR stormcad profile for DP-01 and DP-OS1.21 show areas where the velocity inside the storm pipe falls below 4 fps. This is due to several conditions limiting the design of the storm sewer. In order to meet maximum velocity requirements, as well as containing the major EGL to 1’ below grade, several drop manholes were required. These drop manholes paired with gradual downstream conduit slope in order to meet criteria, leaves sub-4-fps velocities when the flow inside the pipe drops from major to minor flows. This as well as limited cover, and also limited horizontal clearance due to property lines, limited the options to meet all of the County’s storm design criteria.

This hydrologic analysis indicates that the proposed improvements will comply with the applicable drainage criteria for the “Storm Drainage Design and Technical Criteria” by Douglas County sparing these aforementioned criteria variance requests, Mile High Flood District “Urban Storm Drainage Criteria Manual”, and will be consistent with the two (2) Drainage Studies and Master Drainage Plan that have been referenced throughout the report.

6.2.2 Major Storm Velocity Exemptions

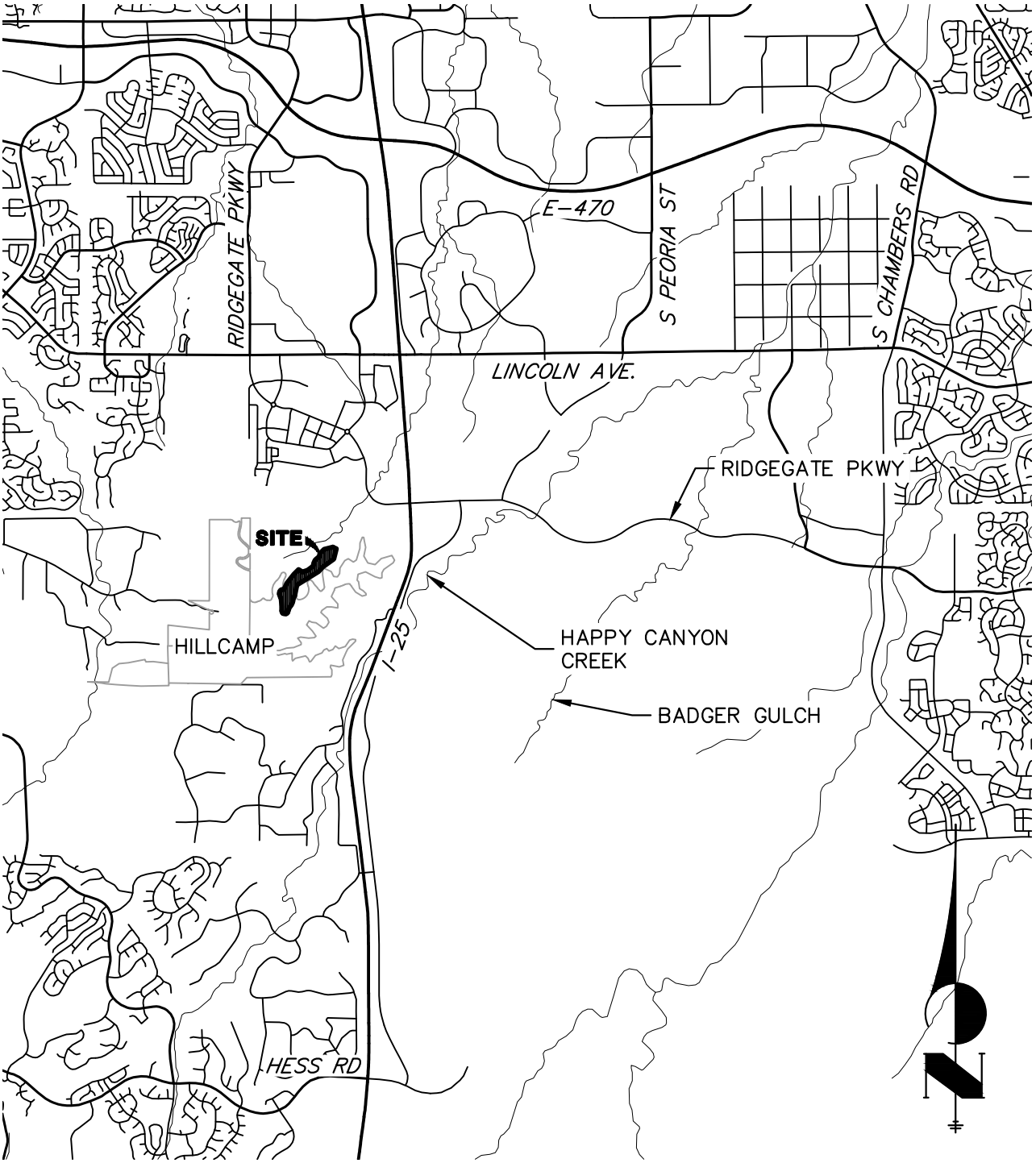
The 100YR stormcad profile for DP-01 shows a conduit where the velocity inside the storm pipe falls below 4 fps. This is due to several conditions limiting the design of the storm sewer. In order to meet maximum velocity requirements, as well as containing the major EGL to 1’ below grade, several drop manholes were required. These drop manholes paired with gradual downstream conduit slope in order to meet criteria, leaves sub-4-fps velocities when the flow inside the pipe drops from major to minor flows. This as well as limited cover, and also limited horizontal clearance due to property lines, limited the options to meet all of the County’s storm design criteria.

7 REFERENCES

1. UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION AND SLOPE STABILITY EVALUATION RIDGEGATE – MESA TOPS ROAD ALIGNMENT;– CTL THOMPSON (NOVEMBER 2025)
2. GEOTECHNICAL INVESTIGATION RIDGEGATE MESA TOPS PEDESTRIAN BRIDGE SOUTHWEST OF RIDGEGATE PARKWAY AND INTERSTATE 25;– CTL THOMPSON (NOVEMBER 2025)
3. MASTER DRAINAGE PLAN FOR RIDGEGATE – COTTONWOOD CREEK DRAINAGE BASIN; Merrick and Company, January 2012.
4. Ridgegate – Section 22, Filing No.1 Phase 3 Drainage Report –; Calibre Engineering, January 2017.
5. PHASE 3 DRAINAGE REPORT FOR TRACT O ACCESS ROAD (COTTONWOOD CREEK FLOW CONTROL STRUCTURE) RAMPART RANGE METRO DISTRICT;– MERRICK AND COMPANY (APRIL 2012)
6. PHASE 3 DRAINAGE REPORT FOR HILLCAMP;– JR ENGINEERING (IN REVIEW AT TIME OF THIS REPORT)
7. PHASE 3 DRAINAGE REPORT FOR DETENTION POND 311 RETROFIT RAMPART RANGE METRO DISTRICT;– MERRICK AND COMPANY (DECEMBER 2013)
8. Storm Drainage Design and Technical Criteria; Douglas County, Updated June 2022.
9. Urban Storm Drainage Criteria Manual Volumes I, II and III; Mile High Flood District, Updated March 2024.
10. CDPS General Permit COR080000, Stormwater Discharges Associated With Municipal Separate Storm Sewers (MS4s), Authorization to Discharge Under the Colorado Discharge Permit System; Colorado Department of Public Health and Environment, Effective May 2018.

APPENDIX A

FIGURES



VICINITY MAP

SCALE 1'=5000'

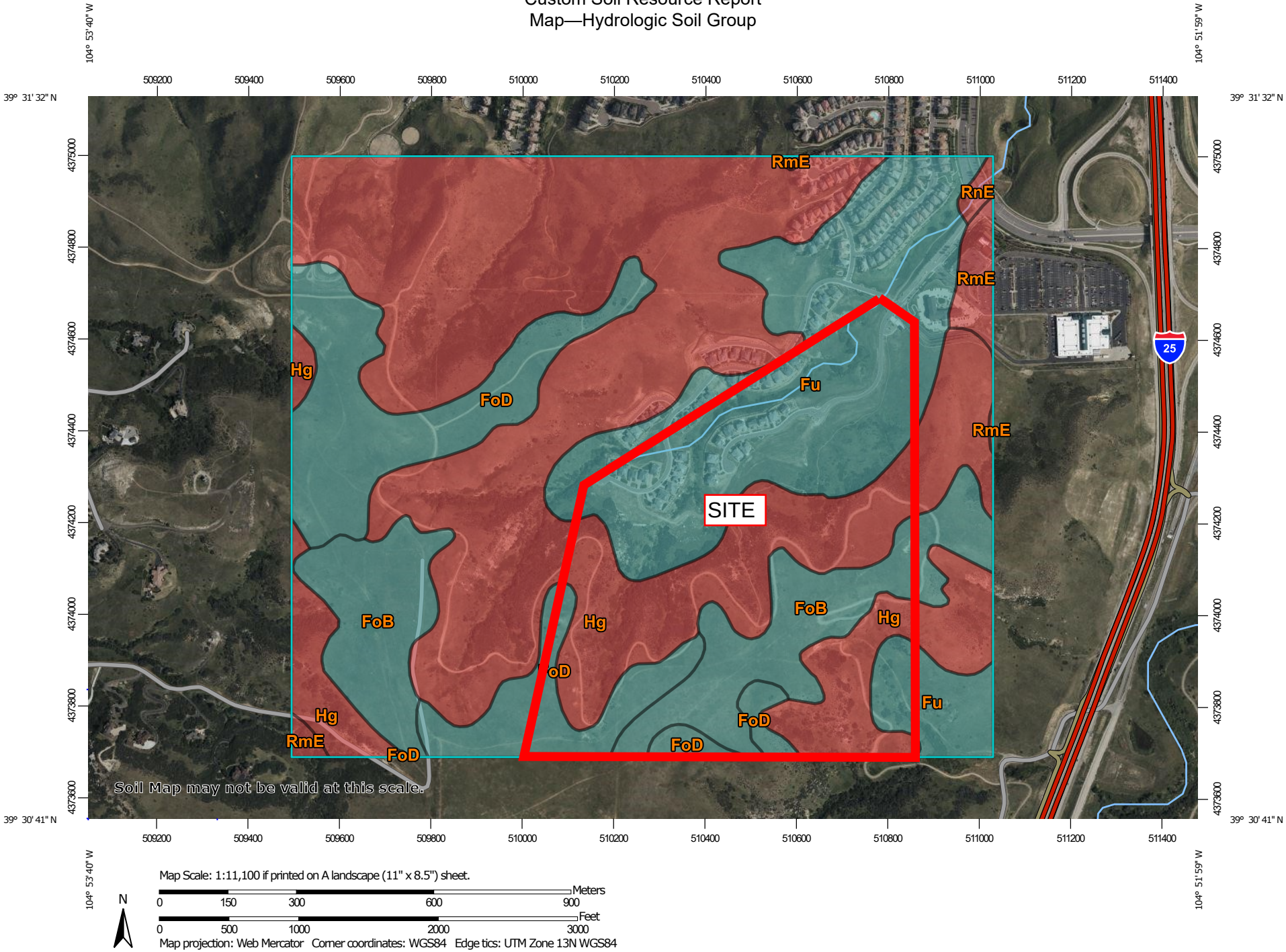
15950.02
01/10/2022
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

X:\1590000.all\1595012\1595018 Cabela Drive\Drawings\Blocks\1595018 Vicinity Map.dwg, 8.5x11 Portrait, 3/19/2025 8:02:04 AM, poseyb

Custom Soil Resource Report
Map—Hydrologic Soil Group



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 1:20,000.

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: Castle Rock Area, Colorado
Survey Area Data: Version 17, Aug 29, 2024

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FoB	Fondis clay loam, 1 to 3 percent slopes	C	57.8	11.6%
FoD	Fondis clay loam, 3 to 9 percent slopes	C	65.0	13.0%
Fu	Fondis-Kutch association	C	108.2	21.7%
Hg	Hilly gravelly land	D	259.4	52.0%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	6.9	1.4%
RnE	Renohill-Manzanola clay loams, 3 to 20 percent slopes	D	1.5	0.3%
Totals for Area of Interest			**498.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°52'58"W 39°31'20"N



Feet

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

1:6,000

104°52'21"W 39°30'52"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/18/2025 at 7:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B

HYDROLOGY

Subdivision:	Hillcamp Drive Extension	**Project No.:**	15950.18
Location:	Lone Tree	**Date:**	3/25/26

SUB-BASIN SUMMARY TABLE (CUHP-SWMM)

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A1	4.31	36.1%	0.33	0.63	1.70	7.23
A2	2.30	40.7%	0.37	0.65	0.57	2.32
B1	0.32	74.1%	0.64	0.79	0.30	0.79
B2	0.40	36.5%	0.33	0.63	0.13	0.56
C1	1.10	37.4%	0.34	0.64	0.34	1.42
C2	0.69	33.7%	0.31	0.62	0.16	0.73
OS1.1	9.62	7.7%	0.10	0.51	1.33	11.76
OS1.2	12.86	16.5%	0.17	0.55	3.01	18.88
OS1.21	0.40	7.3%	0.09	0.51	0.07	0.60
OS1.3	10.04	5.6%	0.08	0.51	1.65	15.37
OS2	12.51	6.8%	0.09	0.51	2.29	19.93
OS2.1	0.62	7.2%	0.09	0.51	0.07	0.62
OS4	10.23	6.4%	0.09	0.51	1.73	15.50
OS4.1	2.46	8.9%	0.11	0.52	0.44	3.57
OS5	2.83	6.6%	0.09	0.51	0.36	3.37
UD1	0.10	77.0%	0.67	0.80	0.09	0.22
UD2	0.57	14.1%	0.15	0.54	0.09	0.61
TOTAL	**71.36**	**12.7%**	---	---	**14.33**	**103.48**
PROP TOTAL	**9.12**	**38.6%**	---	---	**3.20**	**13.05**
OFFSITE TOTAL	**61.57**	**8.8%**	---	---	**10.95**	**89.60**
UD TOTAL	**0.67**	**23.5%**	---	---	**0.18**	**0.83**

*FLOWS FROM RETREAT AT RIDGEGATE DRAINAGE REPORT

PROP DESIGN POINT TABLE (CUHP-SWMM)

Design Point	Q_5 (cfs)	Q_{100} (cfs)
A1	1.70	7.23
A2	0.57	2.32
A3.1 / HDS-A1	1.70	7.23
1	1.33	11.76
2	3.01	18.88
2.1	0.07	0.60
3.1	3.96	30.43
1.3	1.65	15.37
P1.1	7.76	53.84
OS2	2.29	19.93
OS2.1	0.07	0.62
P2.1	2.36	20.55
B1	0.30	0.79
B2	0.13	0.56
B3.1	0.43	1.31
OS4	1.73	15.50
OS4.1	0.44	3.57
OS4.2	1.73	15.69
C1.1	2.63	21.02
C2	0.16	0.73
C3.1	2.79	21.68
C1	0.34	1.42
C4.1 / HDS C1	2.64	19.09
P4.1	3.47	25.93

DESIGN POINT DELTA TABLE (CUHP-SWMM FLOWS)

Ex Calibre Design Point	EX Q_5 (cfs)	EX Q_{100} (cfs)	Prop JR Design Point	PROP Q_5 (cfs)	PROP Q_{100} (cfs)
*1.1	13.9	82.6	P1.1	7.8	53.8
*2.1	2.5	28.5	P2.1	2.4	20.6
*4.1	2.4	47.0	P4.1	3.5	25.9
EX TOTAL FLOWS	**18.8**	**158.1**	**PROPOSED TOTAL FLOWS**	**13.6**	**100.3**

*FLOWS FROM RETREAT AT RIDGEGATE DRAINAGE REPORT

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Hillcamp Drive Extension
Location: Lone Tree

Basin ID	Total Area (ac)	SFH-Low			SFH-Rural			Asphalt\Walk			Maintenance Path			Receiving Pervious Area			Undisturbed Native Grasses			Extended Detention Basin			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
A1	4.31	55%	0.44	5.6%	35%	0.00	0.0%	95%	1.06	23.4%	60%	0.30	4.2%	20%	0.00	0.0%	5%	2.51	2.9%	25%	0.00	0.0%	36.1%
A2	2.30	55%	0.33	7.9%	35%	0.00	0.0%	95%	0.68	28.0%	60%	0.08	2.2%	20%	0.00	0.0%	5%	1.21	2.6%	25%	0.00	0.0%	40.7%
B1	0.32	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.25	73.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.07	1.1%	25%	0.00	0.0%	74.1%
B2	0.40	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.14	33.3%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.26	3.3%	25%	0.00	0.0%	36.5%
C1	1.10	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.40	34.2%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.70	3.2%	25%	0.00	0.0%	37.4%
C2	0.69	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.22	30.3%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.47	3.4%	25%	0.00	0.0%	33.7%
OS1.1	9.62	55%	0.41	2.3%	35%	0.00	0.0%	95%	0.02	0.2%	60%	0.00	0.0%	20%	0.24	0.5%	5%	8.96	4.7%	25%	0.00	0.0%	7.7%
OS1.2	12.86	55%	0.00	0.0%	35%	4.44	12.1%	95%	0.02	0.1%	60%	0.23	1.1%	20%	0.03	0.0%	5%	8.14	3.2%	25%	0.00	0.0%	16.5%
OS1.21	0.40	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.01	2.4%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.39	4.9%	25%	0.00	0.0%	7.3%
OS1.3	10.04	55%	0.01	0.1%	35%	0.00	0.0%	95%	0.00	0.0%	60%	0.04	0.2%	20%	0.23	0.5%	5%	9.76	4.9%	25%	0.00	0.0%	5.6%
OS2	12.51	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.00	0.0%	60%	0.42	2.0%	20%	0.00	0.0%	5%	12.09	4.8%	25%	0.00	0.0%	6.8%
OS2.1	0.62	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.09	2.9%	5%	0.53	4.3%	25%	0.00	0.0%	7.2%
OS4	10.23	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.00	0.0%	60%	0.26	1.5%	20%	0.00	0.0%	5%	9.97	4.9%	25%	0.00	0.0%	6.4%
OS4.1	2.46	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.08	3.1%	60%	0.05	1.1%	20%	0.00	0.0%	5%	2.34	4.8%	25%	0.00	0.0%	8.9%
OS5	2.83	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.00	0.0%	60%	0.00	0.0%	20%	0.04	0.3%	5%	2.59	4.6%	25%	0.20	1.8%	6.6%
UD1	0.10	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.08	76.0%	60%	0.00	0.0%	20%	0.00	0.0%	5%	0.02	1.0%	25%	0.00	0.0%	77.0%
UD2	0.57	55%	0.00	0.0%	35%	0.00	0.0%	95%	0.05	8.3%	60%	0.01	1.3%	20%	0.00	0.0%	5%	0.51	4.5%	25%	0.00	0.0%	14.1%
TOTAL	**71.36**																						**12.74%**
PROP TOTAL	**9.12**																						**38.56%**
OFFSITE TOTAL	**61.57**																						**8.79%**
UD TOTAL	**0.67**																						**23.46%**

C VALUE FOR MINOR AND MAJOR STORM CALCULATIONS

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Hillcamp Drive Extension
Location: Lone Tree

Project Name: Hillcamp Drive
Project No.: 15950.18
Calculated By: BMP
Checked By: BMP
Date: 3/25/26

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
A1	4.31	36.1%	0.00	0.00	4.31	0%	0%	100%	0.23	0.28	0.33	0.39	0.60	0.63	0.33	0.63
A2	2.30	40.7%	0.00	0.00	2.30	0%	0%	100%	0.27	0.32	0.37	0.43	0.62	0.65	0.37	0.65
B1	0.32	74.1%	0.00	0.00	0.32	0%	0%	100%	0.59	0.62	0.64	0.69	0.77	0.79	0.64	0.79
B2	0.40	36.5%	0.00	0.00	0.40	0%	0%	100%	0.24	0.29	0.33	0.40	0.60	0.63	0.33	0.63
C1	1.10	37.4%	0.00	0.00	1.10	0%	0%	100%	0.25	0.29	0.34	0.40	0.60	0.64	0.34	0.64
C2	0.69	33.7%	0.00	0.00	0.69	0%	0%	100%	0.22	0.26	0.31	0.37	0.58	0.62	0.31	0.62
OS1.1	9.62	7.7%	0.00	0.00	9.62	0%	0%	100%	0.03	0.05	0.10	0.17	0.46	0.51	0.10	0.51
OS1.2	12.86	16.5%	0.00	0.00	12.86	0%	0%	100%	0.09	0.12	0.17	0.24	0.50	0.55	0.17	0.55
OS1.21	0.40	7.3%	0.00	0.00	0.40	0%	0%	100%	0.03	0.05	0.09	0.17	0.46	0.51	0.09	0.51
OS1.3	10.04	5.6%	0.00	0.00	10.04	0%	0%	100%	0.02	0.04	0.08	0.15	0.45	0.51	0.08	0.51
OS2	12.51	6.8%	0.00	0.00	12.51	0%	0%	100%	0.03	0.05	0.09	0.16	0.46	0.51	0.09	0.51
OS2.1	0.62	7.2%	0.00	0.00	0.62	0%	0%	100%	0.03	0.05	0.09	0.17	0.46	0.51	0.09	0.51
OS4	10.23	6.4%	0.00	0.00	10.23	0%	0%	100%	0.03	0.04	0.09	0.16	0.46	0.51	0.09	0.51
OS4.1	2.46	8.9%	0.00	0.00	2.46	0%	0%	100%	0.04	0.06	0.11	0.18	0.47	0.52	0.11	0.52
OS5	2.83	6.6%	0.00	0.00	2.83	0%	0%	100%	0.03	0.05	0.09	0.16	0.46	0.51	0.09	0.51
UD1	0.10	77.0%	0.00	0.00	0.10	0%	0%	100%	0.62	0.65	0.67	0.71	0.79	0.80	0.67	0.80
UD2	0.57	14.1%	0.00	0.00	0.57	0%	0%	100%	0.07	0.10	0.15	0.22	0.49	0.54	0.15	0.54

C VALUE FOR 2 YEAR STORM, USED FOR HDS SIZING

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS - FOR HDS

Subdivision: Hillcamp Drive Extension
Location: Lone Tree

Project Name: Hillcamp Drive
Project No.: 15950.18
Calculated By: BMP
Checked By: BMP
Date: 3/25/26

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_2	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{2,A}$	$C_{2,B}$	$C_{2,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
A1	4.31	36.1%	0.00	0.00	4.31	0%	0%	100%	0.22	0.25	0.26	0.39	0.60	0.63	0.26	0.63
A2	2.30	40.7%	0.00	0.00	2.30	0%	0%	100%	0.26	0.29	0.30	0.43	0.62	0.65	0.30	0.65
B1	0.32	74.1%	0.00	0.00	0.32	0%	0%	100%	0.57	0.59	0.59	0.69	0.77	0.79	0.59	0.79
B2	0.40	36.5%	0.00	0.00	0.40	0%	0%	100%	0.23	0.26	0.27	0.40	0.60	0.63	0.27	0.63
C1	1.10	37.4%	0.00	0.00	1.10	0%	0%	100%	0.23	0.27	0.28	0.40	0.60	0.64	0.28	0.64
C2	0.69	33.7%	0.00	0.00	0.69	0%	0%	100%	0.20	0.24	0.25	0.37	0.58	0.62	0.25	0.62
OS1.1	9.62	7.7%	0.00	0.00	9.62	0%	0%	100%	0.03	0.04	0.05	0.17	0.46	0.51	0.05	0.51
OS1.2	12.86	16.5%	0.00	0.00	12.86	0%	0%	100%	0.08	0.10	0.11	0.24	0.50	0.55	0.11	0.55
OS1.3	10.04	5.6%	0.00	0.00	10.04	0%	0%	100%	0.02	0.03	0.03	0.15	0.45	0.51	0.03	0.51
OS2	12.51	6.8%	0.00	0.00	12.51	0%	0%	100%	0.03	0.04	0.04	0.16	0.46	0.51	0.04	0.51
OS2.1	0.62	7.2%	0.00	0.00	0.62	0%	0%	100%	0.03	0.04	0.04	0.17	0.46	0.51	0.04	0.51
OS4	10.23	6.4%	0.00	0.00	10.23	0%	0%	100%	0.02	0.03	0.04	0.16	0.46	0.51	0.04	0.51
OS4.1	2.46	8.9%	0.00	0.00	2.46	0%	0%	100%	0.04	0.05	0.05	0.18	0.47	0.52	0.05	0.52
OS5	2.83	6.6%	0.00	0.00	2.83	0%	0%	100%	0.03	0.04	0.04	0.16	0.46	0.51	0.04	0.51
UD1	0.10	77.0%	0.00	0.00	0.10	0%	0%	100%	0.60	0.62	0.62	0.71	0.79	0.80	0.62	0.80
UD2	0.57	14.1%	0.00	0.00	0.57	0%	0%	100%	0.06	0.09	0.09	0.22	0.49	0.54	0.09	0.54

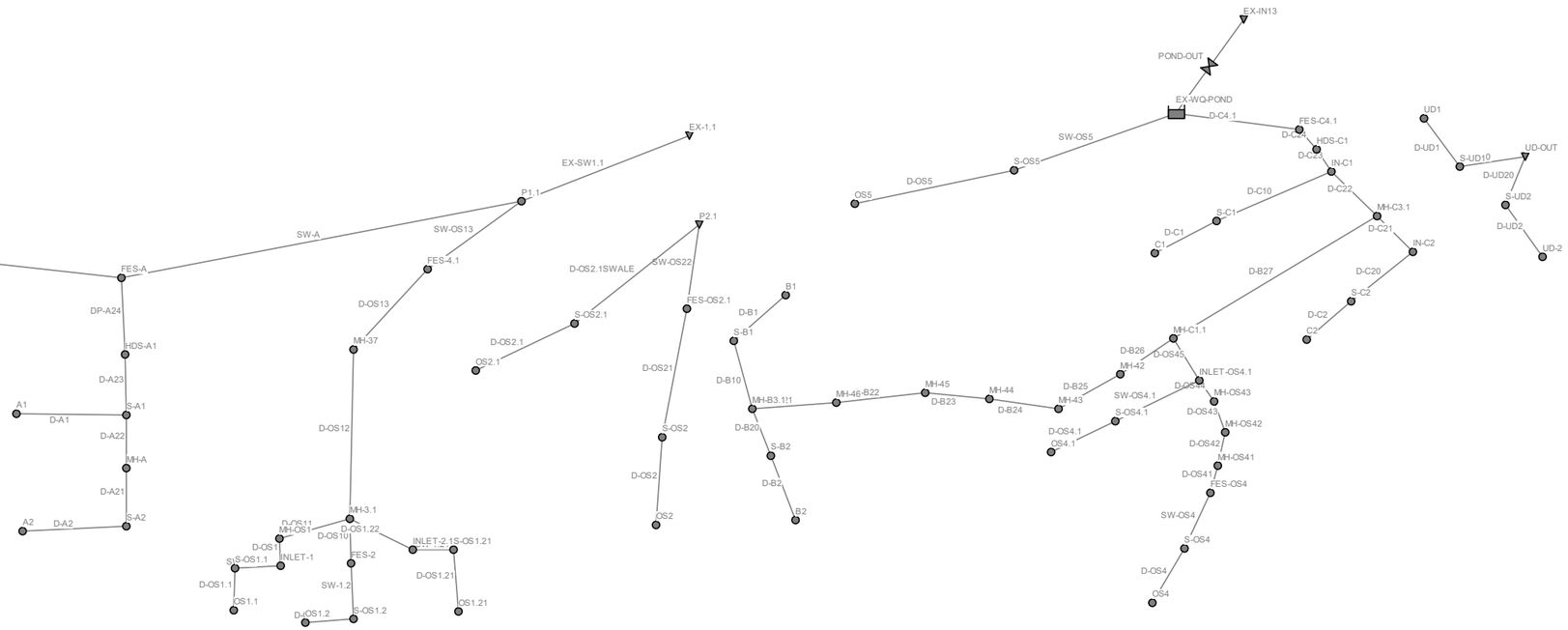
HYDRODYNAMIC SEPARATOR SIZING CALCULATIONS

	TRIBUTARY SUB-BASINS	DESIGN POINT	AREA (AC)	Basins Total Weighted C_2	tc (min) (minutes)	I (in/hr)	C*A (AC)	TREATMENT FLOWRATE (2-YR) (CFS)	PEAK 100YR FLOWRATE (CFS)	PIPE IN SIZE (in)	PIPE OUT SIZE (in)	INVERT UP	INVERT DOWN	RIM
HDS A1	A1	A1	4.31	0.26	19.4	2.12	1.14	2.41	7.23					
	A2	A2	2.30	0.30	7.2	3.23	0.69	2.25	2.32					
		A3.1	6.61		19.4	2.12	1.83	3.88	7.23	18	18	6204.10	6203.90	6210.41
HDS C1	B1	B1	0.32	0.59	6.0	3.42	0.19	0.65	0.79					
	B2	B2	0.40	0.27	9.4	2.94	0.11	0.32	0.56					
	OS4	OS4	10.23	0.04	16.8	2.28	0.39	0.89	15.50					
	OS4.1	OS4.1	2.46	0.05	11.1	2.74	0.14	0.37	3.57					
	C1	C1	1.10	0.28	7.1	3.24	0.30	0.98	1.42					
	C2	C2	0.69	0.25	6.7	3.31	0.17	0.56	0.73					
		C4.1	15.20		16.8	2.28	1.29	2.95	19.09	36	36	6139.27	6139.07	6147.40

100 YEAR FLOWS FROM SWMM MODEL RESULTS. 2 YEAR FLOWS CALCULATED FOR HDS SIZING "TREATMENT FLOWRATE"

I = A*P1/(B+Tc)^C (in/hr)

Entity	1-hr Point Rainfall Depth (in) = P1						A	B	C	Notes
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr				
Lone Tree	1.06	1.46	1.66		2.26	2.60	28.50	10.00	0.786	Douglas County Zone 1


OS1.3
D-OS1.3
S-OS1.3
SW-OS1.3
FES-A
DP-A24
HDS-A1
D-A23
A1
D-A1
S-A1
D-A22
MH-A
D-A21
A2
D-A2
S-A2
SW-A
EX-SW1.1
EX-1.1
P1.1
SW-OS13
FES-4.1
D-OS13
MH-37
D-OS12
MH-3.1
D-OS11
MH-OS1
D-OS1
S-OS1.1
INLET-1
D-OS1.1
OS1.1
D-OS10
D-OS1.22
INLET-2.1
S-OS1.21
FES-2
SW-1.2
D-OS1.21
OS1.21
D-OS1.2
S-OS1.2
D-OS2.1SWALE
SW-OS22
P2.1
FES-OS2.1
S-OS2.1
D-OS2.1
OS2.1
D-OS21
S-OS2
D-OS2
OS2
B1
D-B1
S-B1
D-B10
MH-B3.1.1
MH-46-B22
MH-45
D-B23
MH-44
D-B24
D-B20
S-B2
D-B2
B2
EX-IN13
POND-OUT
EX-WQ-POND
D-C4.1
FES-C4.1
D-C4
HDS-C1
D-C3
IN-C1
SW-OS5
S-OS5
D-OS5
OS5
D-C10
D-C22
S-C1
D-C1
C1
MH-C3.1
D-C21
IN-C2
D-B27
D-C20
S-C2
D-C2
C2
MH-C1.1
D-B26
D-OS45
MH-42
INLET-OS4.1
D-B25
MH-43
SW-OS4.1
S-OS4.1
D-OS4.1
OS4.1
D-OS44
MH-OS43
D-OS43
MH-OS42
D-OS42
MH-OS41
D-OS41
FES-OS4
SW-OS4
S-OS4
D-OS4
OS4
UD1
D-UD1
S-UD10
UD-OUT
D-UD20
S-UD2
D-UD2
UD-2

5Y

NODE INFLOW

Node	Type	Maximum Total Inflow CFS
A1	JUNCTION	0
A2	JUNCTION	0
B1	JUNCTION	0
B2	JUNCTION	0
C1	JUNCTION	0
C2	JUNCTION	0
EX-1.1	OUTFALL	7.06
EX-IN13	OUTFALL	4.48
EX-WQ-POND	STORAGE	3
FES-2	JUNCTION	2.98
FES-4.1	JUNCTION	3.96
FES-A	JUNCTION	3.12
FES-C4.1	JUNCTION	2.64
FES-OS2.1	JUNCTION	2.29
FES-OS4	JUNCTION	1.73
HDS-A1	JUNCTION	1.7
HDS-C1	JUNCTION	2.64
IN-C1	JUNCTION	2.64
IN-C2	JUNCTION	0.16
INLET-1	JUNCTION	1.2
INLET-2.1	JUNCTION	0.07
INLET-OS4.1	JUNCTION	1.73
MH-3.1	JUNCTION	3.96
MH-37	JUNCTION	3.96
MH-42	JUNCTION	0.42
MH-43	JUNCTION	0.42
MH-44	JUNCTION	0.42
MH-45	JUNCTION	0.42
MH-46	JUNCTION	0.43
MH-A	JUNCTION	0.57
MH-B3.1	JUNCTION	0.43

MH-C1.1	JUNCTION	2.14
MH-C3.1	JUNCTION	2.3
MH-OS1	JUNCTION	1.2
MH-OS41	JUNCTION	1.73
MH-OS42	JUNCTION	1.73
MH-OS43	JUNCTION	1.73
OS1.1	JUNCTION	0
OS1.2	JUNCTION	0
OS1.21	JUNCTION	0
OS1.3	JUNCTION	0
OS2.1	JUNCTION	0
OS2	JUNCTION	0
OS4.1	JUNCTION	0
OS4	JUNCTION	0
OS5	JUNCTION	0
P1.1	JUNCTION	7.07
P2.1	OUTFALL	2.35
S-A1	JUNCTION	1.7
S-A2	JUNCTION	0.57
S-B1	JUNCTION	0.3
S-B2	JUNCTION	0.13
S-C1	JUNCTION	0.34
S-C2	JUNCTION	0.16
S-OS1.1	JUNCTION	1.33
S-OS1.2	JUNCTION	3.01
S-OS1.21	JUNCTION	0.07
S-OS1.3	JUNCTION	1.65
S-OS2.1	JUNCTION	0.07
S-OS2	JUNCTION	2.29
S-OS4.1	JUNCTION	0.44
S-OS4	JUNCTION	1.73
S-OS5	JUNCTION	0.36
S-UD1	JUNCTION	0.09
S-UD2	JUNCTION	0.09
UD1	JUNCTION	0
UD-2	JUNCTION	0
UD-OUT	OUTFALL	0.17

5YR

Summary of CUHP Input Parameters (Version 2.0.1)

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A1	S-A1	LONE TREE 5	0.007	0.184	0.341	0.070	36.1	0.35	0.10	3.00	0.50	0.0018	0.00	0.72	0.19	33.70
A2	S-A2	LONE TREE 5	0.004	0.170	0.343	0.057	40.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.80	0.20	38.66
B1	S-B1	LONE TREE 5	0.001	0.024	0.085	0.057	74.1	0.35	0.10	3.00	0.50	0.0018	0.00	0.93	0.31	72.74
B2	S-B2	LONE TREE 5	0.001	0.037	0.086	0.057	36.5	0.35	0.10	3.00	0.50	0.0018	0.00	0.73	0.19	34.13
C1	S-C1	LONE TREE 5	0.002	0.081	0.143	0.057	37.4	0.35	0.10	3.00	0.50	0.0018	0.00	0.75	0.19	35.10
C2	S-C2	LONE TREE 5	0.001	0.073	0.143	0.057	33.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.67	0.18	31.14
OS1.1	S-OS1.1	LONE TREE 5	0.015	0.163	0.196	0.077	7.7	0.35	0.10	3.00	0.50	0.0018	1.00	0.08	0.15	5.77
OS1.2	S-OS1.2	LONE TREE 5	0.020	0.102	0.313	0.086	16.3	0.35	0.10	3.00	0.50	0.0018	1.00	0.19	0.23	12.97
OS1.21	S-OS1.21	LONE TREE 5	0.001	0.025	0.049	0.200	7.3	0.35	0.10	3.00	0.50	0.0018	1.00	0.00	0.15	5.34
OS1.3	S-OS1.3	LONE TREE 5	0.016	0.105	0.200	0.133	5.6	0.35	0.10	3.00	0.50	0.0018	1.00	0.06	0.11	4.16
OS2	S-OS2	LONE TREE 5	0.020	0.104	0.191	0.097	6.8	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.14	5.08
OS2.1	S-OS2.1	LONE TREE 5	0.001	0.038	0.152	0.160	7.2	0.35	0.10	3.00	0.50	0.0018	1.00	0.00	0.14	5.27
OS4	S-OS4	LONE TREE 5	0.016	0.098	0.227	0.130	6.4	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.13	4.77
OS4.1	S-OS4.1	LONE TREE 5	0.004	0.069	0.119	0.200	8.9	0.35	0.10	3.00	0.50	0.0018	1.00	0.10	0.18	6.70
OS5	S-OS5	LONE TREE 5	0.004	0.091	0.180	0.200	6.6	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.13	4.92
UD1	S-UD1	LONE TREE 5	0.000	0.016	0.031	0.015	77.0	0.35	0.10	3.00	0.50	0.0018	1.00	0.83	0.50	74.11
UD2	S-UD2	LONE TREE 5	0.001	0.027	0.058	0.015	14.1	0.35	0.10	3.00	0.50	0.0018	1.00	0.16	0.22	11.05

5YR

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1	0.097	0.046	49.4	3.25	25.7	2.29	5.4	4	15,645	0.42	6,600	40.0	1.1	6,574	0.26
A2	0.094	0.038	59.4	3.22	30.9	2.27	5.4	2	8,349	0.47	3,946	40.0	0.6	3,932	0.25
B1	0.079	0.020	18.5	1.79	9.6	1.27	3.0	1	1,162	0.83	963	30.0	0.3	913	0.94
B2	0.096	0.016	35.8	1.94	18.6	1.37	3.2	1	1,452	0.43	619	35.0	0.1	603	0.33
C1	0.096	0.026	41.2	2.31	21.4	1.63	3.8	1	3,993	0.44	1,741	35.0	0.3	1,712	0.31
C2	0.099	0.019	53.4	2.29	27.8	1.62	3.8	1	2,505	0.40	992	40.0	0.2	979	0.23
OS1.1	0.142	0.065	36.3	3.30	18.9	2.33	5.5	12	34,921	0.13	4,457	35.0	1.3	4,436	0.14
OS1.2	0.121	0.065	30.0	3.00	15.6	2.12	5.0	20	46,682	0.20	9,533	35.0	3.0	9,437	0.23
OS1.21	0.143	0.016	25.2	1.80	13.1	1.27	3.0	1	1,452	0.12	179	35.0	0.1	172	0.18
OS1.3	0.148	0.068	25.8	2.85	13.4	2.02	4.8	18	36,445	0.11	4,038	35.0	1.7	3,980	0.16
OS2	0.144	0.074	24.4	2.89	12.7	2.04	4.8	24	45,411	0.12	5,466	35.0	2.3	5,383	0.18
OS2.1	0.143	0.019	46.1	2.17	24.0	1.54	3.6	1	2,251	0.12	276	40.0	0.1	271	0.11
OS4	0.145	0.068	26.4	2.88	13.7	2.03	4.8	18	37,135	0.12	4,351	35.0	1.7	4,292	0.17
OS4.1	0.138	0.034	27.9	2.23	14.5	1.58	3.7	4	8,930	0.14	1,227	35.0	0.4	1,195	0.18
OS5	0.145	0.038	36.5	2.56	19.0	1.81	4.3	4	10,273	0.12	1,220	35.0	0.4	1,203	0.13
UD1	0.079	0.012	22.0	1.71	11.4	1.21	2.8	0	363	0.85	308	30.0	0.1	294	0.87
UD2	0.124	0.016	44.2	2.05	23.0	1.45	3.4	1	2,069	0.18	380	40.0	0.1	373	0.15

DESIGN POINT TOTALS	Peak Flow (cfs)
P1.1	7.76
P2.1	2.36
P4.1	3.47
UD	0.17

100YR NODE INFLOW		Maximum Total Inflow
Node	Type	CFS
A1	JUNCTION	0
A2	JUNCTION	0
B1	JUNCTION	0
B2	JUNCTION	0
C1	JUNCTION	0
C2	JUNCTION	0
DP-1.3	JUNCTION	43.45
DP-A4.1	JUNCTION	12.58
EX-1.1	OUTFALL	48.88
EX-IN13	OUTFALL	22.55
EX-WQ-POND	STORAGE	26.98
FES-C4.1	JUNCTION	23.57
FES-OS1.2	JUNCTION	43.45
FES-OS2.1	JUNCTION	19.92
HDS-A1	JUNCTION	12.58
HDS-C1	JUNCTION	23.59
IN-C1	JUNCTION	23.59
IN-C2	JUNCTION	1.19
INLET-1.2	JUNCTION	30.94
MH-30	JUNCTION	21.01
MH-35	JUNCTION	19.92
MH-37	JUNCTION	43.45
MH-42	JUNCTION	1.32
MH-43	JUNCTION	1.32
MH-44	JUNCTION	1.32
MH-45	JUNCTION	1.32

MH-46	JUNCTION	1.32
MH-B3.1	JUNCTION	1.32
MH-C1.1	JUNCTION	21.02
MH-C3.1	JUNCTION	22.12
OS1.1	JUNCTION	0
OS1.2	JUNCTION	0
OS1.3	JUNCTION	0
OS2.1	JUNCTION	0
OS2	JUNCTION	0
OS4.1	JUNCTION	0
OS4	JUNCTION	0
P1.1	JUNCTION	48.88
P2.1	OUTFALL	20.49
S-A1	JUNCTION	10.28
S-A2	JUNCTION	2.29
S-B1	JUNCTION	0.76
S-B2	JUNCTION	0.59
S-C1	JUNCTION	1.51
S-C2	JUNCTION	1.19
S-OS1.1	JUNCTION	12.08
S-OS1.2	JUNCTION	19.39
S-OS1.4	JUNCTION	5.48
S-OS2.1	JUNCTION	0.62
S-OS2	JUNCTION	19.93
S-OS4.1	JUNCTION	3.44
S-OS4	JUNCTION	19.71

100YR

Summary of CUHP Input Parameters (Version 2.0.1)

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
A1	S-A1	LONE TREE 100	0.007	0.184	0.341	0.070	36.1	0.35	0.10	3.00	0.50	0.0018	0.00	0.72	0.19	34.83
A2	S-A2	LONE TREE 100	0.004	0.170	0.343	0.057	40.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.80	0.20	39.61
B1	S-B1	LONE TREE 100	0.001	0.024	0.085	0.057	74.1	0.35	0.10	3.00	0.50	0.0018	0.00	0.93	0.31	73.37
B2	S-B2	LONE TREE 100	0.001	0.037	0.086	0.057	36.5	0.35	0.10	3.00	0.50	0.0018	0.00	0.73	0.19	35.24
C1	S-C1	LONE TREE 100	0.002	0.081	0.143	0.057	37.4	0.35	0.10	3.00	0.50	0.0018	0.00	0.75	0.19	36.18
C2	S-C2	LONE TREE 100	0.001	0.073	0.143	0.057	33.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.67	0.18	32.36
OS1.1	S-OS1.1	LONE TREE 100	0.015	0.163	0.196	0.077	7.7	0.35	0.10	3.00	0.50	0.0018	1.00	0.08	0.15	6.65
OS1.2	S-OS1.2	LONE TREE 100	0.020	0.102	0.313	0.086	16.3	0.35	0.10	3.00	0.50	0.0018	1.00	0.19	0.23	14.52
OS1.21	S-OS1.21	LONE TREE 100	0.001	0.025	0.049	0.200	7.3	0.35	0.10	3.00	0.50	0.0018	1.00	0.00	0.15	6.24
OS1.3	S-OS1.3	LONE TREE 100	0.016	0.105	0.200	0.133	5.6	0.35	0.10	3.00	0.50	0.0018	1.00	0.06	0.11	4.82
OS2	S-OS2	LONE TREE 100	0.020	0.104	0.191	0.097	6.8	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.14	5.87
OS2.1	S-OS2.1	LONE TREE 100	0.001	0.038	0.152	0.160	7.2	0.35	0.10	3.00	0.50	0.0018	1.00	0.00	0.14	6.15
OS4	S-OS4	LONE TREE 100	0.016	0.098	0.227	0.130	6.4	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.13	5.52
OS4.1	S-OS4.1	LONE TREE 100	0.004	0.069	0.119	0.200	8.9	0.35	0.10	3.00	0.50	0.0018	1.00	0.10	0.18	7.71
OS5	S-OS5	LONE TREE 100	0.004	0.091	0.180	0.200	6.6	0.35	0.10	3.00	0.50	0.0018	1.00	0.07	0.13	5.69
UD1	S-UD1	LONE TREE 100	0.000	0.016	0.031	0.015	77.0	0.35	0.10	3.00	0.50	0.0018	1.00	0.83	0.50	75.51
UD2	S-UD2	LONE TREE 100	0.001	0.027	0.058	0.015	14.1	0.35	0.10	3.00	0.50	0.0018	1.00	0.16	0.22	12.46

100YR

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1	0.096	0.047	48.1	3.23	25.0	2.28	5.4	4	15,645	1.66	25,920	50.0	4.9	25,808	1.14
A2	0.093	0.038	58.2	3.21	30.3	2.27	5.4	2	8,349	1.71	14,268	50.0	2.3	14,216	1.01
B1	0.079	0.021	18.5	1.79	9.6	1.27	3.0	1	1,162	2.09	2,432	35.0	0.8	2,305	2.46
B2	0.096	0.016	34.8	1.93	18.1	1.37	3.2	1	1,452	1.66	2,412	40.0	0.6	2,350	1.39
C1	0.095	0.026	40.2	2.30	20.9	1.63	3.8	1	3,993	1.67	6,674	45.0	1.4	6,563	1.29
C2	0.098	0.020	51.7	2.28	26.9	1.61	3.8	1	2,505	1.63	4,081	50.0	0.7	4,027	1.05
OS1.1	0.138	0.063	36.2	3.26	18.8	2.30	5.4	12	34,921	1.33	46,565	45.0	11.8	46,333	1.22
OS1.2	0.118	0.064	29.7	2.97	15.4	2.10	4.9	20	46,682	1.42	66,429	40.0	18.9	65,743	1.47
OS1.21	0.140	0.015	25.2	1.80	13.1	1.27	3.0	1	1,452	1.33	1,929	40.0	0.6	1,853	1.51
OS1.3	0.145	0.067	25.7	2.83	13.4	2.00	4.7	18	36,445	1.31	47,881	40.0	15.4	47,163	1.53
OS2	0.141	0.073	24.4	2.86	12.7	2.02	4.8	24	45,411	1.32	60,169	40.0	19.9	59,206	1.59
OS2.1	0.140	0.019	46.0	2.16	23.9	1.52	3.6	1	2,251	1.33	2,987	45.0	0.6	2,938	1.00
OS4	0.143	0.067	26.3	2.85	13.7	2.01	4.8	18	37,135	1.32	49,064	40.0	15.5	48,372	1.52
OS4.1	0.134	0.033	27.8	2.21	14.4	1.56	3.7	4	8,930	1.34	12,009	40.0	3.6	11,691	1.45
OS5	0.142	0.037	36.4	2.54	18.9	1.80	4.2	4	10,273	1.32	13,592	45.0	3.4	13,391	1.19
UD1	0.078	0.012	21.7	1.70	11.3	1.20	2.8	0	363	2.12	770	35.0	0.2	736	2.24
UD2	0.122	0.016	43.9	2.04	22.8	1.44	3.4	1	2,069	1.40	2,893	45.0	0.6	2,838	1.08

DESIGN POINT TOTALS	Peak Flow (cfs)
P1.1	53.84
P2.1	20.55
P4.1	25.93
UD	0.84

APPENDIX C
HYDRAULICS

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A1	A2	B1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.7	0.6	0.3
Major Q_{Known} (cfs)	7.2	2.3	0.8

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.7**	**0.6**	**0.3**
Major Total Design Peak Flow, Q (cfs)	**7.2**	**2.3**	**0.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B2	C1	C2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.1	0.3	0.2
Major Q_{Known} (cfs)	0.6	1.4	0.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	B1	B2
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

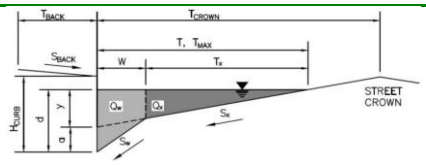
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.1**	**0.3**	**0.2**
Major Total Design Peak Flow, Q (cfs)	**0.6**	**1.4**	**0.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0

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

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

Project:
Inlet ID: **A1**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

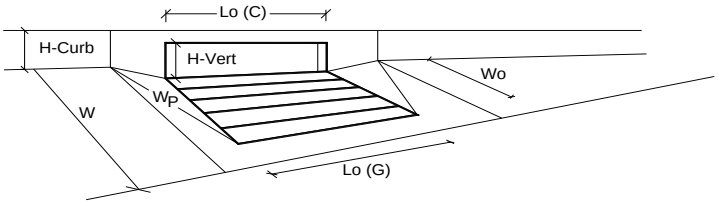
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	SUMP	SUMP	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	SUMP	SUMP	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

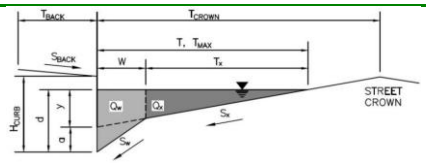


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.5	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	1.8	7.6	cfs
Interception with Clogging	Q_{wa} =	1.7	7.3	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	22.7	27.8	cfs
Interception with Clogging	Q_{oa} =	21.8	26.6	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	5.9	13.5	cfs
Interception with Clogging	Q_{ma} =	5.6	12.9	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**1.7**	**7.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	8.3	16.2	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.8	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.13	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.59	0.75	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.7**	**7.25**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.7	7.23	cfs

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

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

Project:
Inlet ID: **A2**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

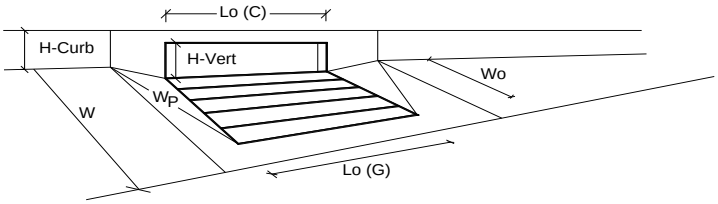
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	SUMP	SUMP	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	SUMP	SUMP	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

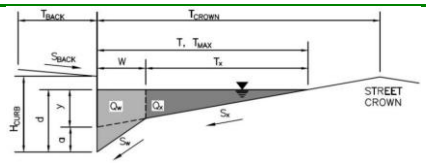


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.5	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	1.4	4.7	cfs
Interception with Clogging	Q_{wa} =	1.2	4.2	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	7.6	9.3	cfs
Interception with Clogging	Q_{oa} =	6.8	8.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	3.0	6.1	cfs
Interception with Clogging	Q_{ma} =	2.7	5.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**1.2**	**4.2**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	8.3	16.2	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.8	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.13	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.99	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.2**	**4.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	2.3	cfs

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

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

Project:
Inlet ID: **B1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.060	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	1.5	7.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**4.8**	**13.9**	**cfs**
Flow Velocity within the Gutter Section	V =	8.1	10.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	4.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

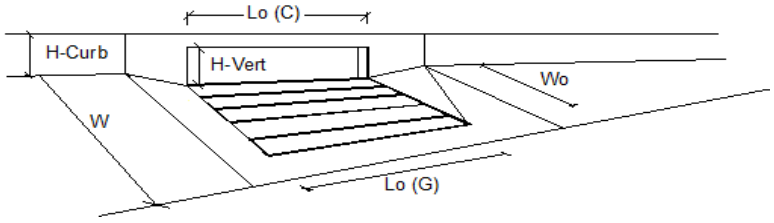
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	23.0	264.2	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	21.7	147.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	10.7	39.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	53.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	32.4	240.4	cfs
Average Flow Velocity Within the Gutter Section	V =	12.9	21.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.4	21.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.43	0.35	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**13.9**	**83.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.63	8.23	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.60	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.8**	**13.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.30 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.79 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

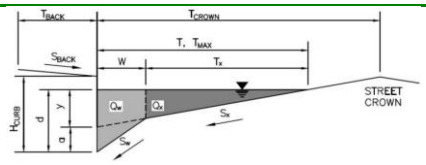


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.3	0.8	cfs
Water Spread Width	T =	1.4	1.9	ft
Water Depth at Flowline (outside of local depression)	d =	1.8	2.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	0.3	0.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.00	sq ft
Velocity within the Gutter Section W	V_W =	0.0	0.0	fps
Water Depth for Design Condition	d_{LOCAL} =	4.8	5.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.208	0.208	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.41	3.95	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.41	3.95	ft
Interception Capacity	Q_i =	0.3	0.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	2.41	3.95	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**0.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**0.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.00**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project:
Inlet ID: **B2**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.060	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	1.5	7.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**4.8**	**13.9**	**cfs**
Flow Velocity within the Gutter Section	V =	8.1	10.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	4.0	

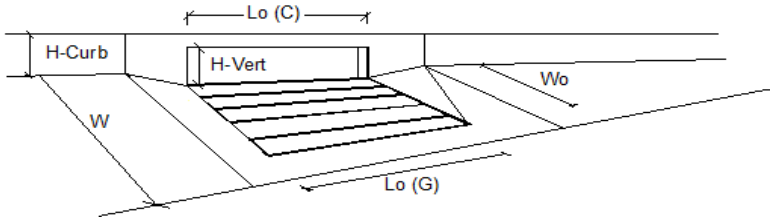
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	23.0	264.2	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	21.7	147.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	10.7	39.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	53.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	32.4	240.4	cfs
Average Flow Velocity Within the Gutter Section	V =	12.9	21.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.4	21.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.43	0.35	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**13.9**	**83.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.63	8.23	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.60	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.8**	**13.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.13 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.56 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



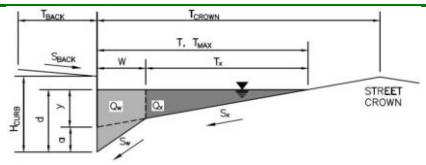
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.1	0.6	cfs
Water Spread Width	T =	1.0	1.7	ft
Water Depth at Flowline (outside of local depression)	d =	1.7	1.9	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	0.1	0.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.00	sq ft
Velocity within the Gutter Section W	V_W =	0.0	0.0	fps
Water Depth for Design Condition	d_{LOCAL} =	4.7	4.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.208	0.208	ft/ft
Required Length L_T to Have 100% Interception	L_T =	1.57	3.31	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	1.57	3.31	ft
Interception Capacity	Q_i =	0.1	0.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	1.57	3.31	ft
Actual Interception Capacity	**Q_a =**	**0.1**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.1**	**0.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project:
Inlet ID: **C1**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.058	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	1.5	7.4	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.3	6.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**4.7**	**13.7**	**cfs**
Flow Velocity within the Gutter Section	V =	8.0	10.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	4.0	

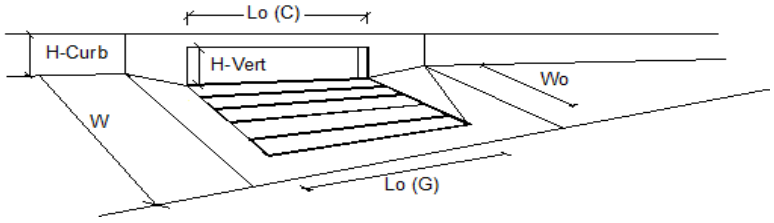
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	22.6	259.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	21.3	145.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	10.5	39.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	52.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	31.9	236.4	cfs
Average Flow Velocity Within the Gutter Section	V =	12.6	21.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.3	21.2	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.44	0.36	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.0**	**84.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.67	8.31	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.03	3.67	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.7**	**13.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.34 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.42 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

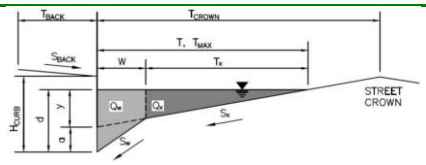


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.3	1.4	cfs
Water Spread Width	T =	1.4	3.7	ft
Water Depth at Flowline (outside of local depression)	d =	1.9	2.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.965	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.1	cfs
Discharge within the Gutter Section W	Q_w =	0.3	1.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.23	sq ft
Velocity within the Gutter Section W	V_W =	0.0	5.9	fps
Water Depth for Design Condition	d_{LOCAL} =	4.9	5.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.208	0.201	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.56	5.40	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.56	5.40	ft
Interception Capacity	Q_i =	0.3	1.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	2.56	5.40	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**1.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project:
Inlet ID: **C2**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.058	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	1.92	3.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	3.43	4.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	6.0	11.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.688	0.456	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	1.5	7.4	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.3	6.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**4.7**	**13.7**	**cfs**
Flow Velocity within the Gutter Section	V =	8.0	10.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	4.0	

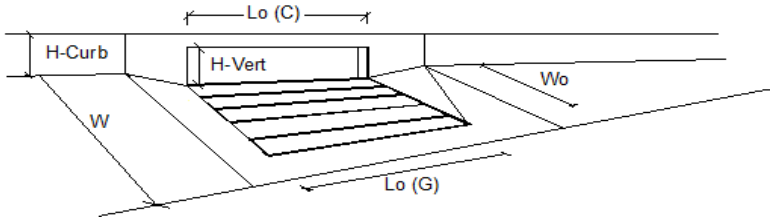
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	22.6	259.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	21.3	145.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	10.5	39.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	52.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	31.9	236.4	cfs
Average Flow Velocity Within the Gutter Section	V =	12.6	21.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	6.3	21.2	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.44	0.36	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.0**	**84.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.67	8.31	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.03	3.67	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.7**	**13.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.16 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.73 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	0.2	0.7	cfs
Water Spread Width	T =	1.1	1.9	ft
Water Depth at Flowline (outside of local depression)	d =	1.8	2.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	0.2	0.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.00	sq ft
Velocity within the Gutter Section W	V_W =	0.0	0.0	fps
Water Depth for Design Condition	d_{LOCAL} =	4.8	5.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.208	0.208	ft/ft
Required Length L_T to Have 100% Interception	L_T =	1.75	3.79	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	1.75	3.79	ft
Interception Capacity	Q_i =	0.2	0.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	1.75	3.79	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**0.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.2**	**0.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP-1	OS2	OS4.1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	AREA	AREA
Hydraulic Condition	Swale	Swale	Swale
Inlet Type	CDOT TYPE D (Parallel)	CDOT Type D (In Series & Depressed)	CDOT Type D (In Series & Depressed)

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3	2.3	0.4
Major Q_{Known} (cfs)	11.8	19.9	3.6

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

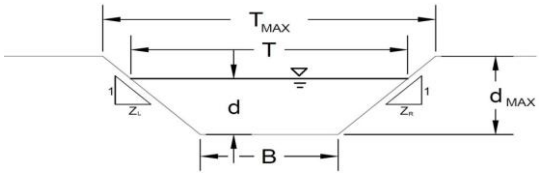
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**	**2.3**	**0.4**
Major Total Design Peak Flow, Q (cfs)	**11.8**	**19.9**	**3.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0

AREA INLET IN A SWALE

DP-1



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.013	
Channel Invert Slope	S_O =	0.0040	ft/ft
Bottom Width	B =	0.10	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	3.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	**T_{MAX} =**	**36.00**	**36.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	**d_{MAX} =**	**0.50**	**4.00**	**ft**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Maximum Allowable Top Width	**T_{MAX} =**	**36.00**	**36.00**	**ft**
Warning 02 Water Depth	d =	5.98	5.98	ft
Flow Area	A =	108.00	108.00	sq ft
Wetted Perimeter	P =	37.94	37.94	ft
Hydraulic Radius	R =	2.85	2.85	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	14.56	14.56	fps
Velocity-Depth Product	VR =	41.44	41.44	ft^2/s
Hydraulic Depth	D =	3.00	3.00	ft
Froude Number	Fr =	1.48	1.48	
Maximum Flow Based on Allowable Water Depth	**Q_T =**	**1,572.4**	**1,572.4**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Maximum Allowable Water Depth	**d_{MAX} =**	**0.50**	**4.00**	**ft**
Top Width	T =	3.10	24.10	ft
Flow Area	A =	0.80	48.40	sq ft
Wetted Perimeter	P =	3.26	25.40	ft
Hydraulic Radius	R =	0.25	1.91	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	2.84	11.14	fps
Velocity-Depth Product	VR =	0.70	21.23	ft^2/s
Hydraulic Depth	D =	0.26	2.01	ft
Froude Number	Fr =	0.99	1.39	
Maximum Flow Based On Allowable Water Depth	**Q_d =**	**2.3**	**539.3**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**2.3**	**539.3**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	**d_{allow} =**	**0.50**	**4.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	**Q_o =**	**1.3**	**11.8**	**cfs**
Water Depth	**d =**	**0.41**	**0.94**	**ft**
Top Width	T =	2.54	5.74	ft
Flow Area	A =	0.54	2.75	sq ft
Wetted Perimeter	P =	2.67	6.05	ft
Hydraulic Radius	R =	0.20	0.45	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	2.48	4.28	fps
Velocity-Depth Product	VR =	0.50	1.95	ft^2/s
Hydraulic Depth	D =	0.21	0.48	ft
Froude Number	Fr =	0.95	1.09	

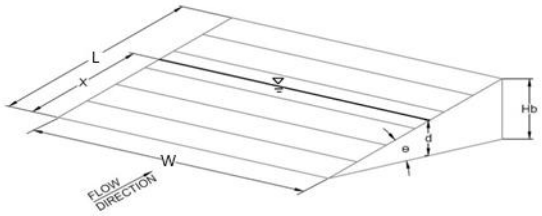
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

DP-1

Inlet Design Information (Input)

Type of Inlet	CDOT TYPE D (Parallel)	Inlet Type =	CDOT TYPE D (Parallel)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	6.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.76	
Orifice Coefficient		C_o =	0.50	
Weir Coefficient		C_w =	1.62	

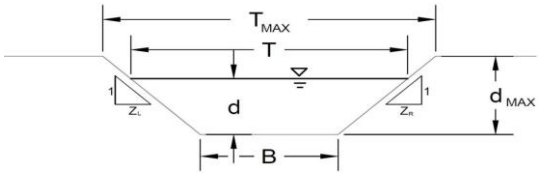


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.41	0.94	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	ft
Inclined Side Weir Flow	Q_{ws} =	2.2	7.7	cfs
Base Weir Flow	Q_{wb} =	6.3	22.1	cfs
Interception Without Cloggging	Q_{wi} =	10.7	37.6	cfs
Interception With Clogging	Q_{wa} =	6.7	23.5	cfs
Grate Capacity as an Orifice				
Interception Without Clogging	Q_{oi} =	32.5	49.4	cfs
Interception With Clogging	Q_{oa} =	20.3	30.9	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.7**	**23.5**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 02: Depth (d) exceeds USDCM Volume I recommendation.

AREA INLET IN A SWALE

OS2



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.013	
Channel Invert Slope	S_O =	0.0400	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Sloe	Z2 =	3.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	**T_{MAX} =**	**29.90**	**29.90**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	**d_{MAX} =**	**3.10**	**3.10**	**ft**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Maximum Allowable Top Width	**T_{MAX} =**	**29.90**	**29.90**	**ft**
Water Depth	d =	4.65	4.65	ft
Flow Area	A =	74.17	74.17	sq ft
Wetted Perimeter	P =	31.41	31.41	ft
Hydraulic Radius	R =	2.36	2.36	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	40.65	40.65	fps
Velocity-Depth Product	VR =	95.98	95.98	ft^2/s
Hydraulic Depth	D =	2.48	2.48	ft
Froude Number	Fr =	4.55	4.55	
Maximum Flow Based on Allowable Water Depth	**Q_T =**	**3,014.8**	**3,014.8**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Maximum Allowable Water Depth	**d_{MAX} =**	**3.10**	**3.10**	**ft**
Top Width	T =	20.60	20.60	ft
Flow Area	A =	35.03	35.03	sq ft
Wetted Perimeter	P =	21.61	21.61	ft
Hydraulic Radius	R =	1.62	1.62	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	31.64	31.64	fps
Velocity-Depth Product	VR =	51.29	51.29	ft^2/s
Hydraulic Depth	D =	1.70	1.70	ft
Froude Number	Fr =	4.28	4.28	
Maximum Flow Based On Allowable Water Depth	**Q_d =**	**1,108.2**	**1,108.2**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**1,108.2**	**1,108.2**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	**d_{allow} =**	**3.10**	**3.10**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	**Q_o =**	**2.3**	**19.9**	**cfs**
Water Depth	**d =**	**0.16**	**0.51**	**ft**
Top Width	T =	2.94	5.03	ft
Flow Area	A =	0.39	1.78	sq ft
Wetted Perimeter	P =	3.00	5.19	ft
Hydraulic Radius	R =	0.13	0.34	ft
Manning's n	n =	0.013	0.013	
Flow Velocity	V =	5.88	11.21	fps
Velocity-Depth Product	VR =	0.76	3.83	ft^2/s
Hydraulic Depth	D =	0.13	0.35	ft
Froude Number	Fr =	2.85	3.32	

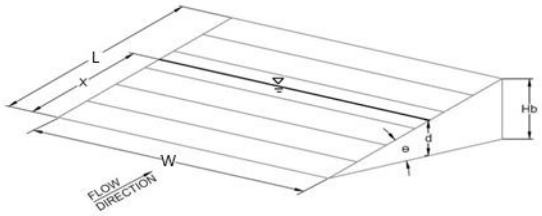
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

AREA INLET IN A SWALE

OS2

Inlet Design Information (Input)

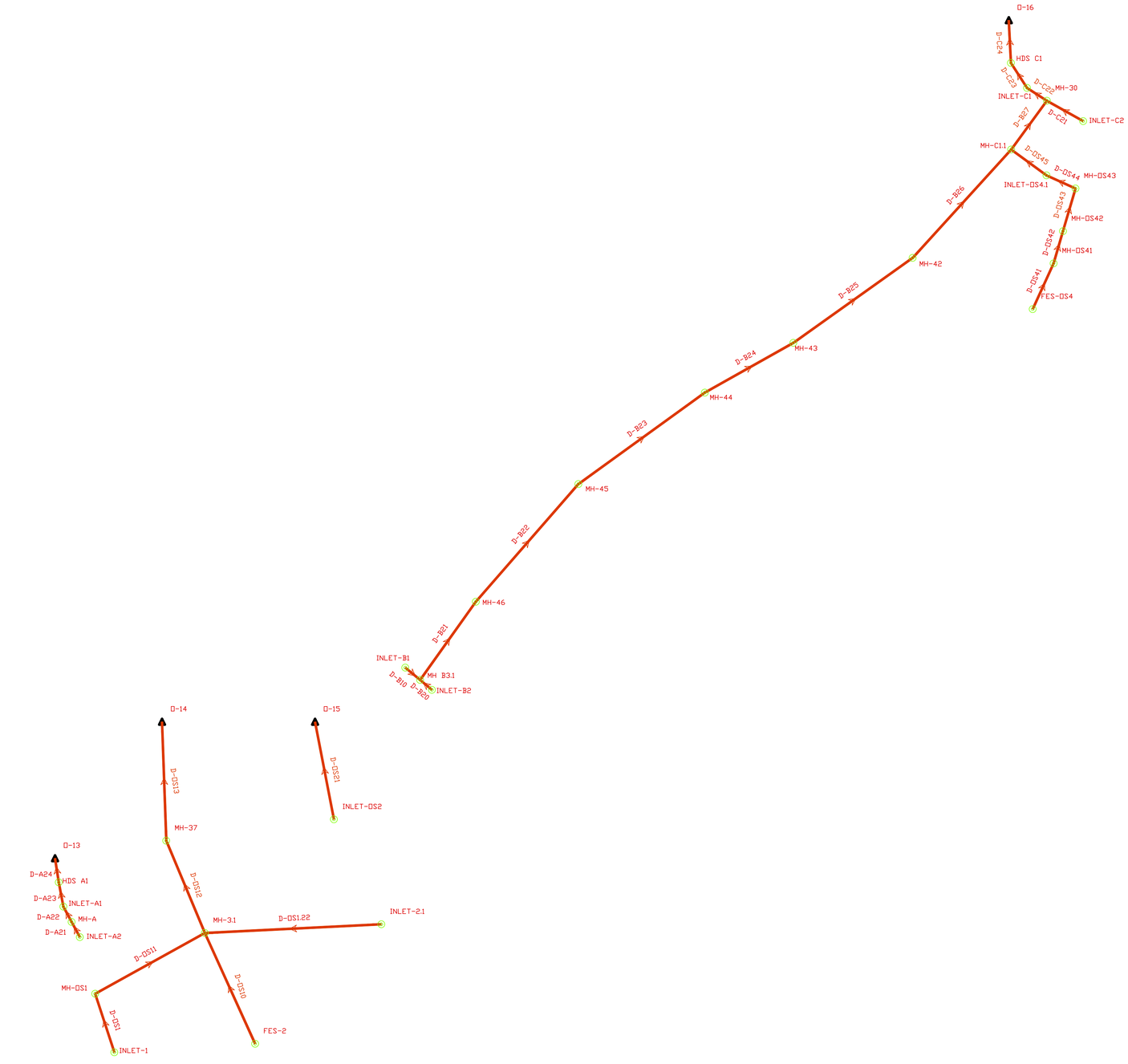
Type of Inlet: CDOT Type D (In Series & Depressed) — Inlet Type = CDOT Type D (In Series & Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00		degrees
Width of Grate	W =	3.00		ft
Length of Grate	L =	6.00		ft
Open Area Ratio	A_{RATIO} =	0.70		
Height of Inclined Grate	H_B =	0.00		ft
Clogging Factor	C_f =	0.38		
Grate Discharge Coefficient	C_d =	0.72		
Orifice Coefficient	C_o =	0.48		
Weir Coefficient	C_w =	1.53		

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.16	1.51	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	6.00	6.00	ft
Inclined Side Weir Flow	Q_{ws} =	20.0	29.7	cfs
Base Weir Flow	Q_{wb} =	14.3	21.2	cfs
Interception Without Cloggging	Q_{wi} =	54.3	80.6	cfs
Interception With Clogging	Q_{wa} =	34.0	50.4	cfs
Grate Capacity as an Orifice				
Interception Without Clogging	Q_{oi} =	51.9	59.2	cfs
Interception With Clogging	Q_{oa} =	32.4	37.0	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**32.4**	**37.0**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

HILLCAMP TRAIL
STORMCAD SCHEMATIC



STORMCAD SCHEMATIC
HILLCAMP TRAIL
JOB NO. 15950.18
2026-03-27
SHEET 1 OF 1

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C:\Users\Posey\DOCS\CCDocs\JR Engineering\15950\2\Project Files\STORMCAD\CABELAS DRIVE\2026-03-27 stormcad-planView.dwg, 24x36 Plot, 3/26/2026 4:44:42 PM, poseyb

FlexTable: Manhole Table

Active Scenario: 5YEAR

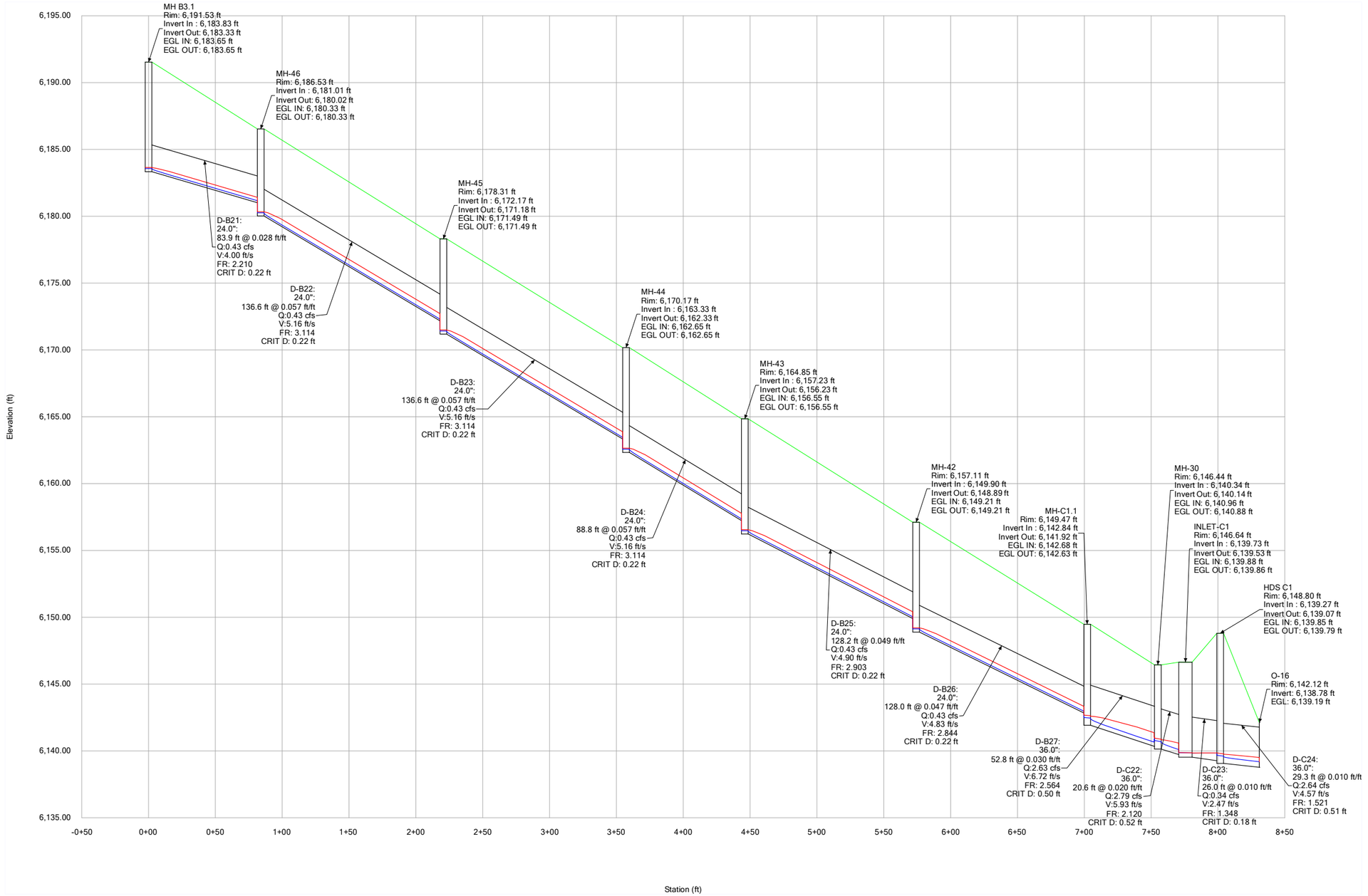
Label	Notes	Elevation (Ground) (ft)	Flow (Total Out) (cfs)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Method	HEC-22 Benching Method
FES-2	36" FES	6,203.91	3.01	6,200.58	6,201.19	6,201.16	6,201.38	6,201.35	HEC-22 Energy (Third Edition)	None
FES-OS4	30" FES	6,163.42	1.73	6,160.63	6,161.11	6,161.09	6,161.26	6,161.24	HEC-22 Energy (Third Edition)	None
HDS A1	5' HDS	6,211.95	1.70	6,203.91	6,204.44	6,204.44	6,204.62	6,204.62	HEC-22 Energy (Third Edition)	Half
HDS C1	5' HDS	6,148.80	2.64	6,139.07	6,139.68	6,139.61	6,139.85	6,139.79	HEC-22 Energy (Third Edition)	Half
INLET-1	TYPE D INLET	6,203.03	1.33	6,199.32	6,199.79	6,199.75	6,199.93	6,199.89	HEC-22 Energy (Third Edition)	Flat
INLET-2.1	TYPE D INLET	6,212.95	0.07	6,204.17	6,204.31	6,204.27	6,204.34	6,204.31	HEC-22 Energy (Third Edition)	Flat
INLET-A1	15' Type R Inlet	6,214.00	1.66	6,204.42	6,205.08	6,204.94	6,205.26	6,205.12	HEC-22 Energy (Third Edition)	Flat
INLET-A2	5' Type R Inlet	6,214.00	0.57	6,206.11	6,206.51	6,206.41	6,206.60	6,206.51	HEC-22 Energy (Third Edition)	Flat
INLET-B1	5' Type R Inlet	6,191.77	0.30	6,184.72	6,185.00	6,184.94	6,185.07	6,185.00	HEC-22 Energy (Third Edition)	Flat
INLET-B2	5' Type R Inlet	6,191.82	0.13	6,184.77	6,184.95	6,184.91	6,185.00	6,184.96	HEC-22 Energy (Third Edition)	Flat
INLET-C1	10' Type R Inlet	6,146.64	0.34	6,139.53	6,139.87	6,139.85	6,139.88	6,139.86	HEC-22 Energy (Third Edition)	Flat
INLET-C2	5' Type R Inlet	6,146.78	0.16	6,142.17	6,142.36	6,142.33	6,142.41	6,142.38	HEC-22 Energy (Third Edition)	Flat
INLET-OS2	TYPE D INLET (DEPRESSED)	6,197.02	2.29	6,192.18	6,192.73	6,192.68	6,192.89	6,192.85	HEC-22 Energy (Third Edition)	Flat
INLET-OS4.1	SLAB TOP 60" DIA MH	6,150.00	0.44	6,144.35	6,144.57	6,144.57	6,144.64	6,144.64	HEC-22 Energy (Third Edition)	Half
MH B3.1	5' MH	6,191.53	0.43	6,183.33	6,183.57	6,183.57	6,183.65	6,183.65	HEC-22 Energy (Third Edition)	Half
MH-3.1	6' MH	6,214.17	4.41	6,194.89	6,195.59	6,195.59	6,195.82	6,195.82	HEC-22 Energy (Third Edition)	Half
MH-30	SLAB TOP 60" DIA MH	6,146.44	2.79	6,140.14	6,140.78	6,140.70	6,140.96	6,140.88	HEC-22 Energy (Third Edition)	Half
MH-37	5' MH with Intermediate Platform	6,211.70	4.41	6,190.59	6,191.29	6,191.29	6,191.52	6,191.52	HEC-22 Energy (Third Edition)	Half
MH-42	5' MH	6,157.11	0.43	6,148.89	6,149.13	6,149.13	6,149.21	6,149.21	HEC-22 Energy (Third Edition)	Half
MH-43	5' MH	6,164.85	0.43	6,156.23	6,156.47	6,156.47	6,156.55	6,156.55	HEC-22 Energy (Third Edition)	Half
MH-44	5' MH	6,170.17	0.43	6,162.33	6,162.57	6,162.57	6,162.65	6,162.65	HEC-22 Energy (Third Edition)	Half
MH-45	5' MH	6,178.31	0.43	6,171.18	6,171.42	6,171.42	6,171.49	6,171.49	HEC-22 Energy (Third Edition)	Half
MH-46	5' MH	6,186.53	0.43	6,180.02	6,180.26	6,180.26	6,180.33	6,180.33	HEC-22 Energy (Third Edition)	Half
MH-A	5' MH	6,213.77	0.57	6,205.23	6,205.53	6,205.53	6,205.63	6,205.63	HEC-22 Energy (Third Edition)	Half
MH-C1.1	5' MH	6,149.47	2.63	6,141.92	6,142.50	6,142.46	6,142.68	6,142.63	HEC-22 Energy (Third Edition)	Half
MH-OS1	5' MH	6,211.15	1.33	6,198.25	6,198.73	6,198.68	6,198.87	6,198.82	HEC-22 Energy (Third Edition)	Half
MH-OS41	5' MH	6,164.04	1.73	6,158.39	6,158.85	6,158.85	6,159.00	6,159.00	HEC-22 Energy (Third Edition)	Half
MH-OS42	5' MH	6,162.77	1.73	6,153.05	6,153.52	6,153.49	6,153.66	6,153.63	HEC-22 Energy (Third Edition)	Flat
MH-OS43		6,154.81	1.73	6,147.01	6,147.51	6,147.47	6,147.66	6,147.62	HEC-22 Energy (Third Edition)	Flat

FlexTable: Conduit Table

Active Scenario: 5YEAR

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
D-A21	18.0	0.013	6,206.11	6,205.43	15.1	0.045	0.57	5.37	6,206.39	6,205.60	6,206.49	6,205.81
D-A22	18.0	0.013	6,205.23	6,204.61	15.2	0.041	0.57	5.20	6,205.51	6,205.25	6,205.61	6,205.26
D-A23	18.0	0.013	6,204.42	6,204.11	21.7	0.014	1.66	4.92	6,204.90	6,204.49	6,205.08	6,204.68
D-A24	18.0	0.013	6,203.91	6,203.69	21.6	0.010	1.70	4.42	6,204.40	6,204.10	6,204.58	6,204.39
D-B10	18.0	0.013	6,184.72	6,183.83	16.9	0.053	0.30	4.68	6,184.92	6,183.95	6,184.99	6,184.29
D-B20	18.0	0.013	6,184.77	6,183.83	13.5	0.070	0.13	4.00	6,184.90	6,183.90	6,184.95	6,184.15
D-B21	24.0	0.013	6,183.33	6,181.01	83.9	0.028	0.43	4.00	6,183.55	6,181.16	6,183.63	6,181.41
D-B22	24.0	0.013	6,180.02	6,172.17	136.6	0.057	0.43	5.16	6,180.24	6,172.30	6,180.32	6,172.71
D-B23	24.0	0.013	6,171.18	6,163.33	136.6	0.057	0.43	5.16	6,171.40	6,163.46	6,171.48	6,163.87
D-B24	24.0	0.013	6,162.33	6,157.23	88.8	0.057	0.43	5.16	6,162.56	6,157.36	6,162.63	6,157.77
D-B25	24.0	0.013	6,156.23	6,149.90	128.2	0.049	0.43	4.90	6,156.46	6,150.03	6,156.53	6,150.41
D-B26	24.0	0.013	6,148.89	6,142.84	128.0	0.047	0.43	4.83	6,149.11	6,142.97	6,149.19	6,143.33
D-B27	36.0	0.013	6,141.92	6,140.34	52.8	0.030	2.63	6.72	6,142.42	6,140.90	6,142.60	6,141.00
D-C21	18.0	0.013	6,142.17	6,141.59	9.7	0.060	0.16	4.02	6,142.32	6,141.67	6,142.37	6,141.93
D-C22	36.0	0.013	6,140.14	6,139.73	20.6	0.020	2.79	5.93	6,140.66	6,140.10	6,140.84	6,140.58
D-C23	36.0	0.013	6,139.53	6,139.27	26.0	0.010	0.34	2.47	6,139.85	6,139.85	6,139.86	6,139.85
D-C24	36.0	0.013	6,139.07	6,138.78	29.3	0.010	2.64	4.57	6,139.58	6,139.19	6,139.75	6,139.51
D-OS1	24.0	0.013	6,199.32	6,198.45	23.6	0.037	1.33	6.22	6,199.72	6,198.69	6,199.86	6,198.92
D-OS1.22	18.0	0.013	6,204.17	6,197.89	104.7	0.060	0.07	3.14	6,204.27	6,197.95	6,204.30	6,198.10
D-OS10	36.0	0.013	6,200.58	6,197.89	55.1	0.049	3.01	8.31	6,201.12	6,198.19	6,201.31	6,199.26
D-OS11	24.0	0.013	6,198.25	6,197.89	70.4	0.005	1.33	3.11	6,198.65	6,198.28	6,198.79	6,198.43
D-OS12	36.0	0.013	6,194.89	6,192.59	38.3	0.060	4.41	10.01	6,195.55	6,192.94	6,195.78	6,194.41
D-OS13	36.0	0.013	6,190.59	6,186.51	81.6	0.050	4.41	9.39	6,191.25	6,186.86	6,191.48	6,188.23
D-OS21	36.0	0.013	6,192.18	6,191.31	86.9	0.010	2.29	4.39	6,192.65	6,191.69	6,192.81	6,191.99
D-OS41	30.0	0.013	6,160.63	6,160.09	9.1	0.060	1.73	7.73	6,161.06	6,160.35	6,161.21	6,161.00
D-OS42	30.0	0.013	6,158.39	6,157.55	14.0	0.060	1.73	7.74	6,158.82	6,157.79	6,158.97	6,158.56
D-OS43	36.0	0.013	6,153.05	6,151.51	25.7	0.060	1.73	7.55	6,153.46	6,151.73	6,153.60	6,152.61
D-OS44	30.0	0.013	6,147.01	6,145.58	23.8	0.060	1.73	7.75	6,147.44	6,145.81	6,147.59	6,146.71
D-OS45	36.0	0.013	6,144.35	6,142.47	38.3	0.049	0.44	4.64	6,144.55	6,142.59	6,144.62	6,142.70

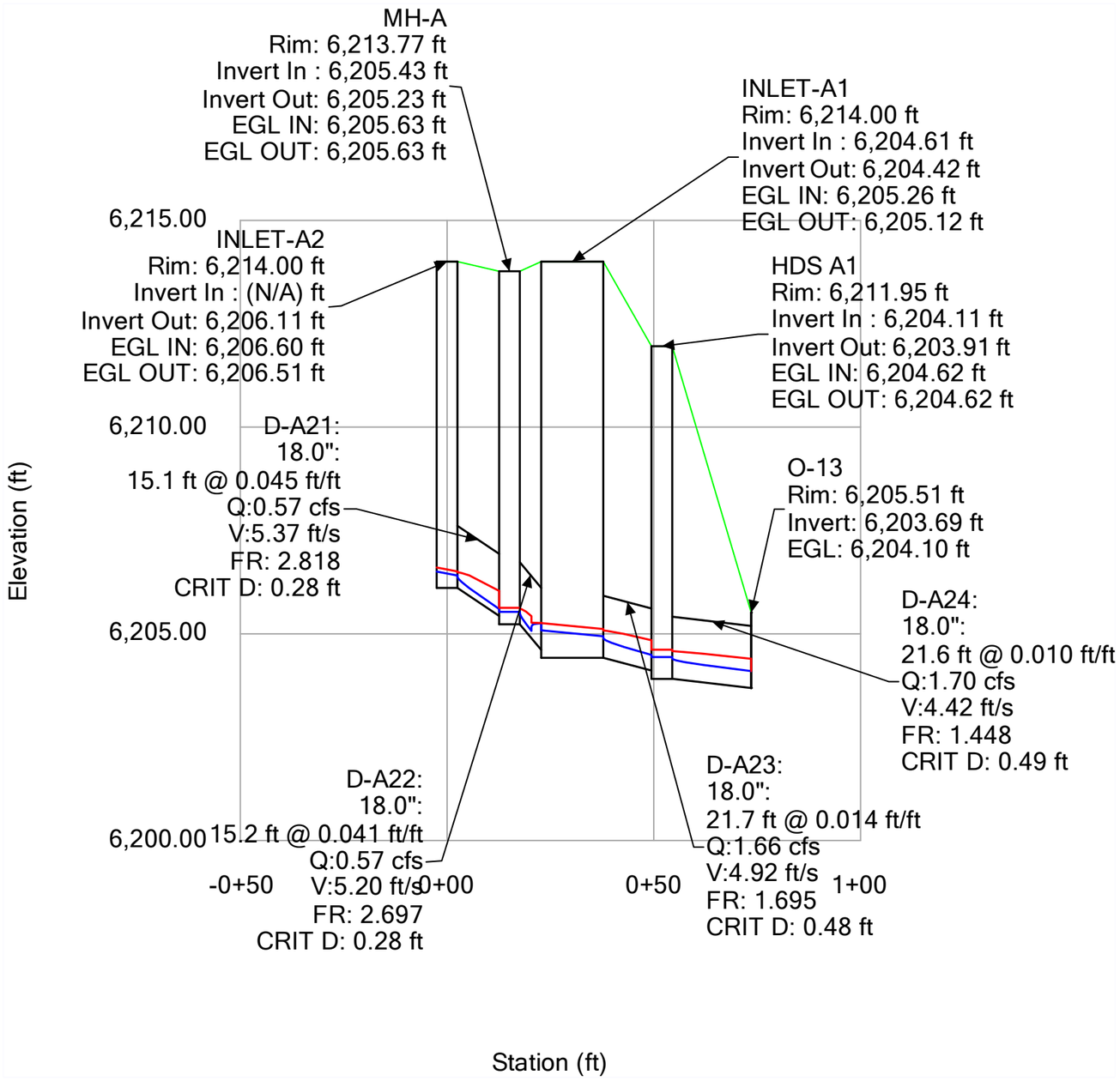
Profile Report
Engineering Profile - DP-01 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



Profile Report

Engineering Profile - DP-A (2026-03-13 CABELAS DRIVE.stsw)

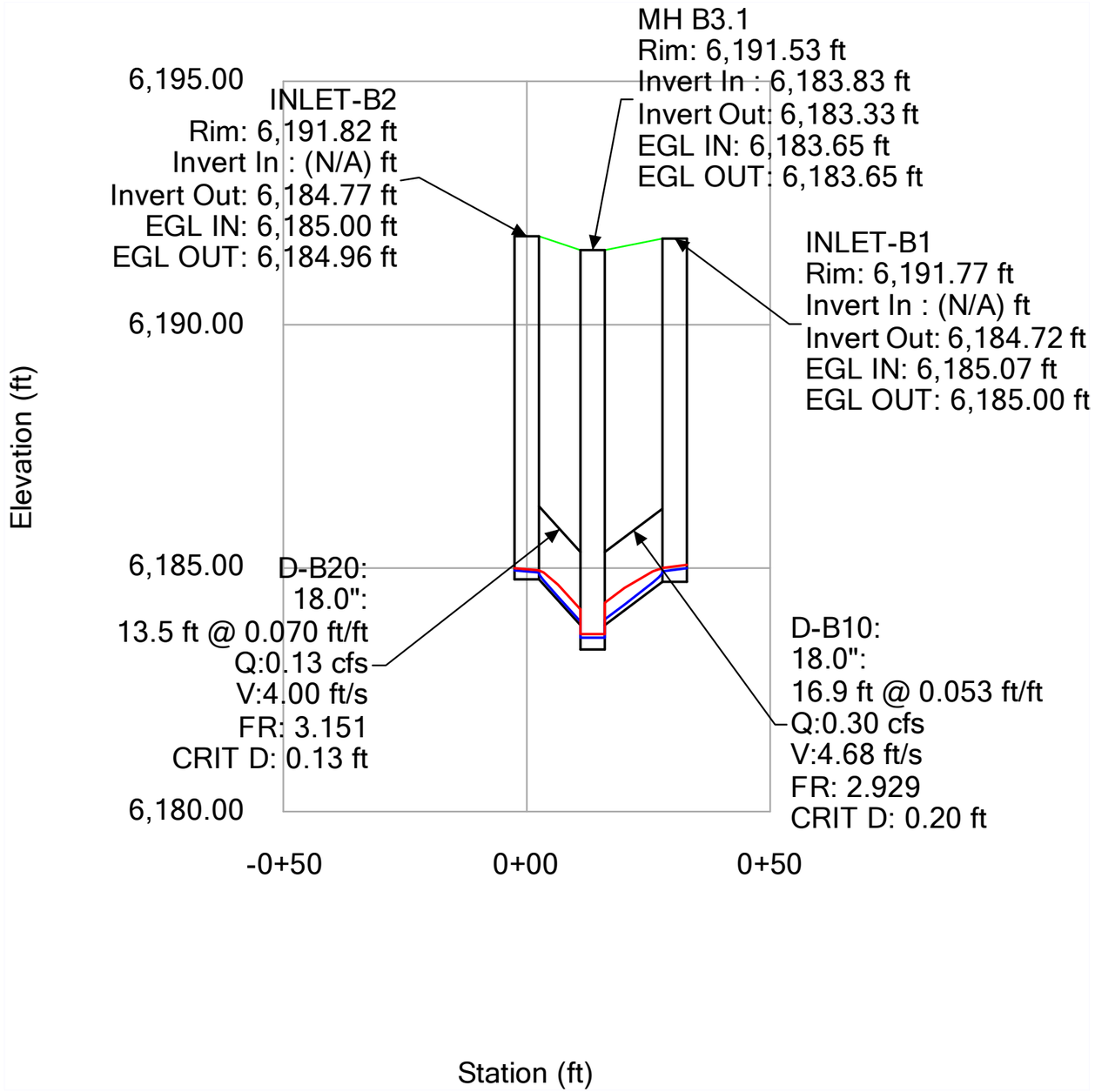
Active Scenario: 5YEAR



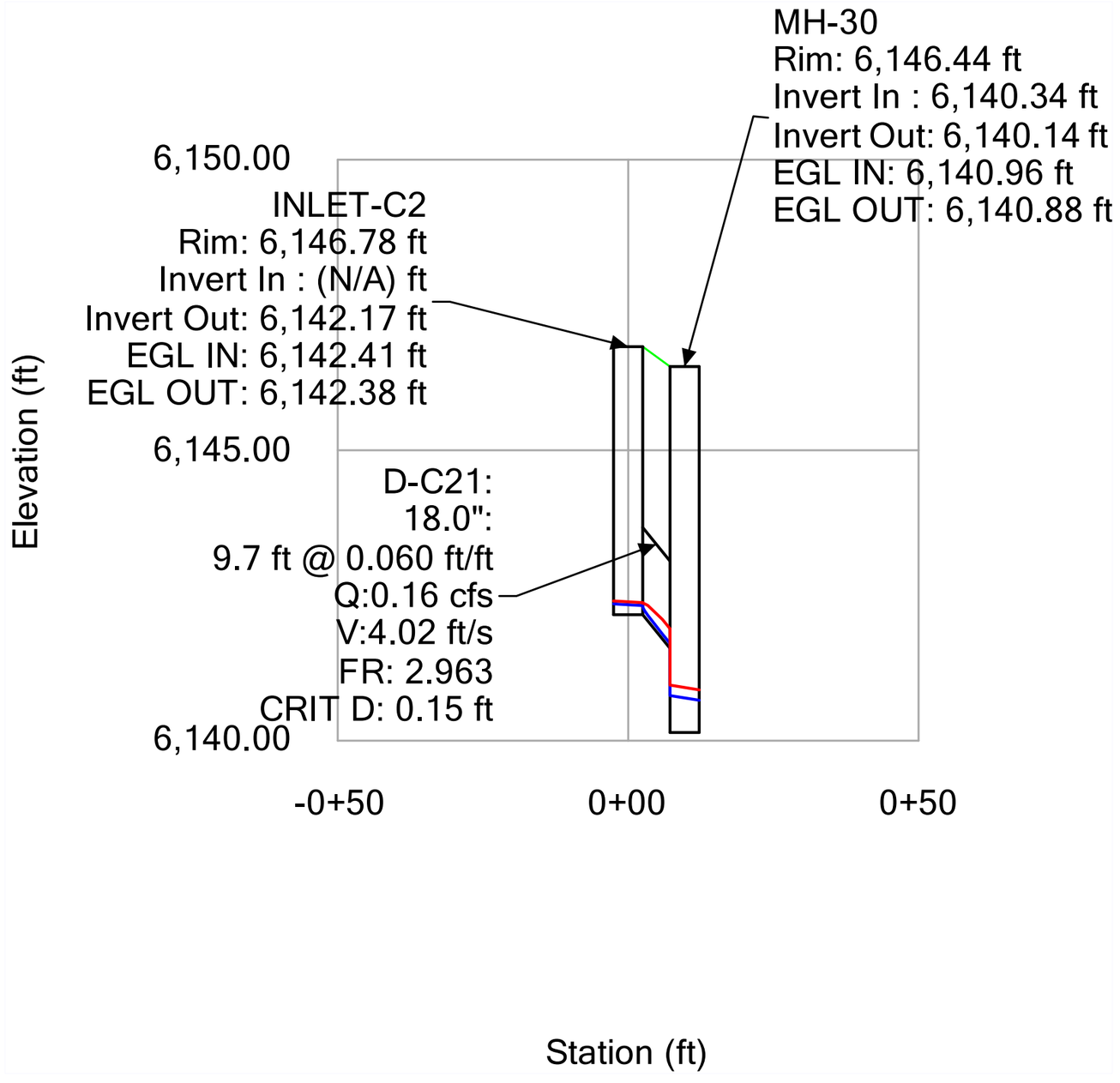
Profile Report

Engineering Profile - DP-B (2026-03-13 CABELAS DRIVE.stsw)

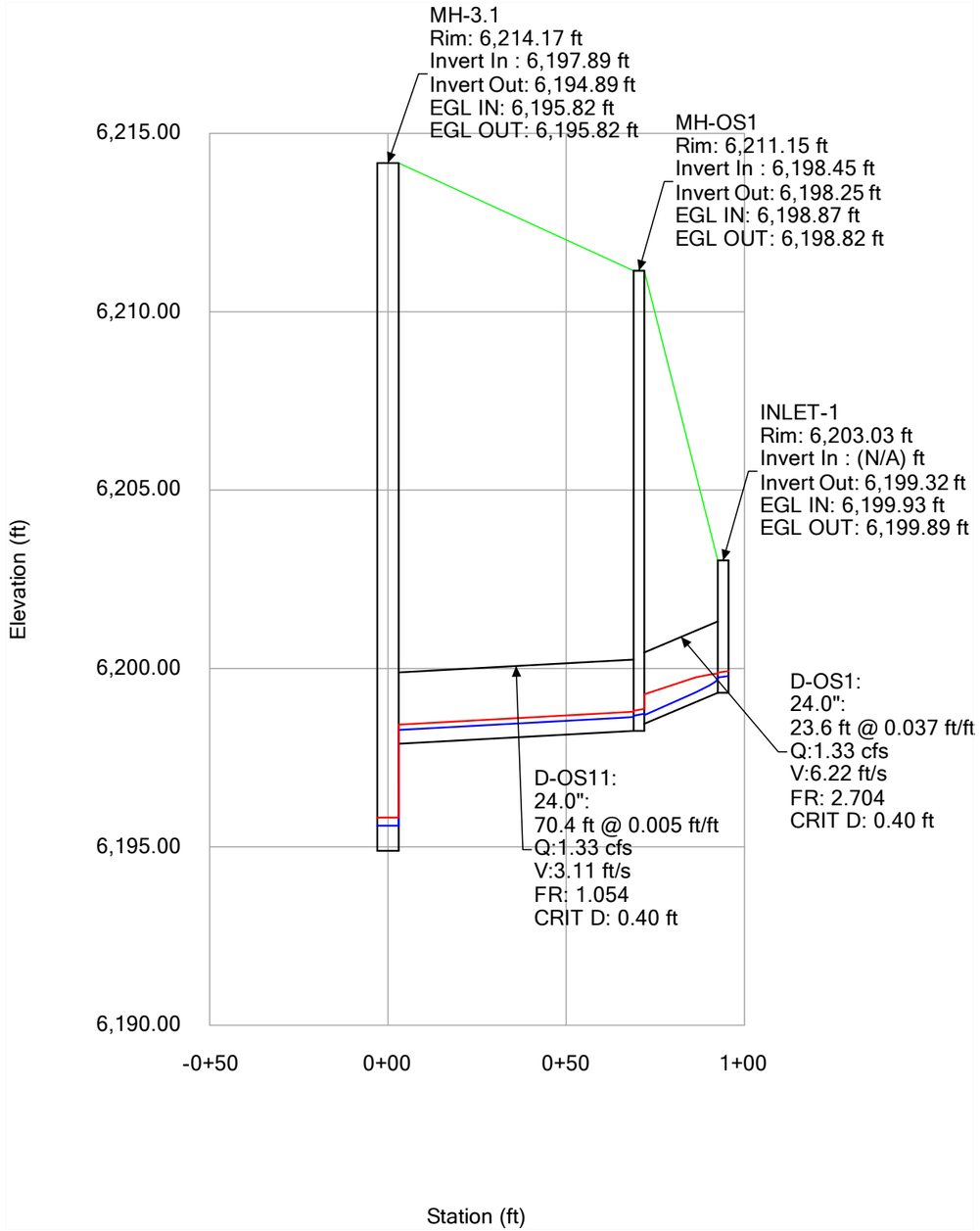
Active Scenario: 5YEAR



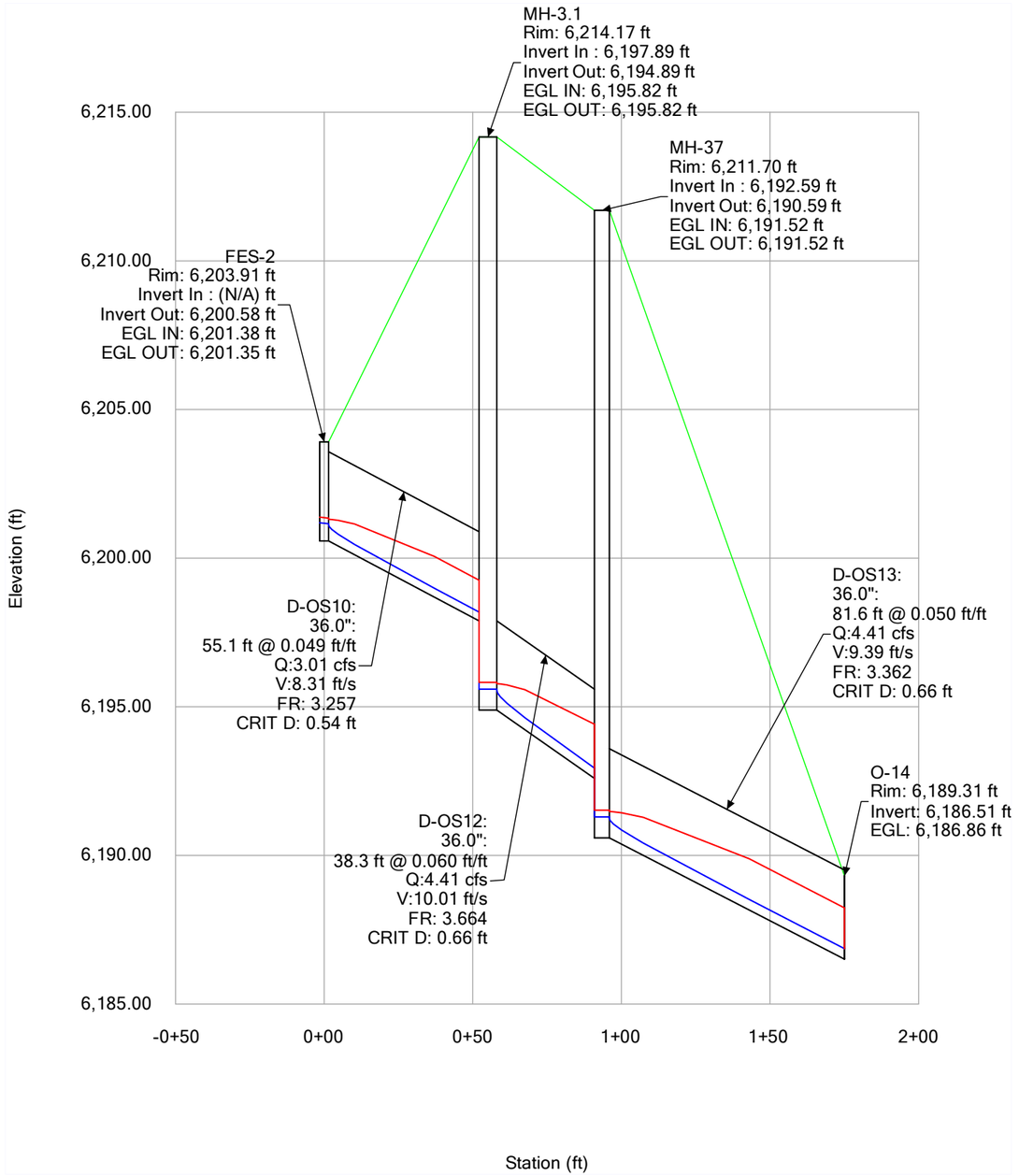
Profile Report
Engineering Profile - DP-C (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



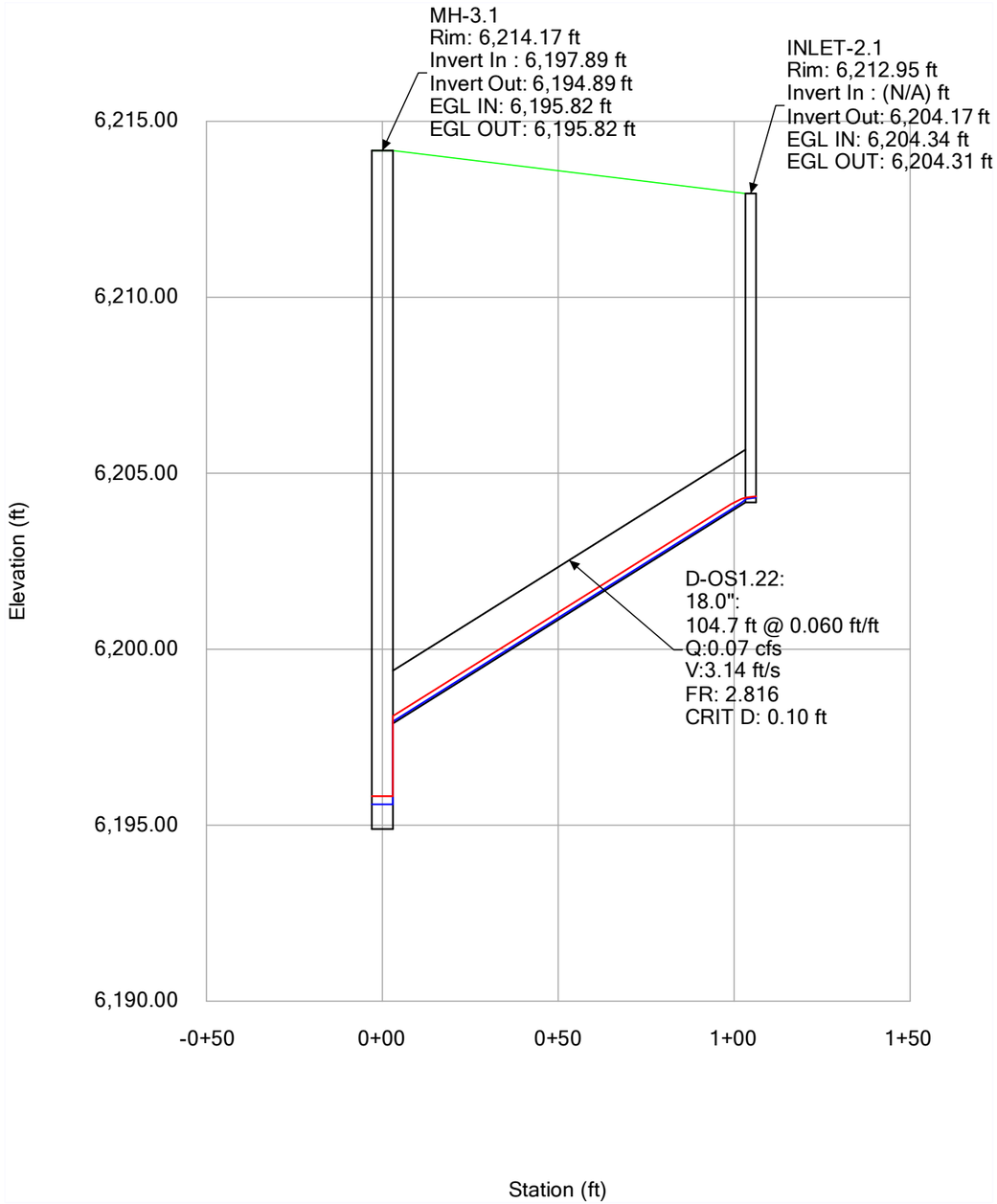
Profile Report
Engineering Profile - DP-OS1.1 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



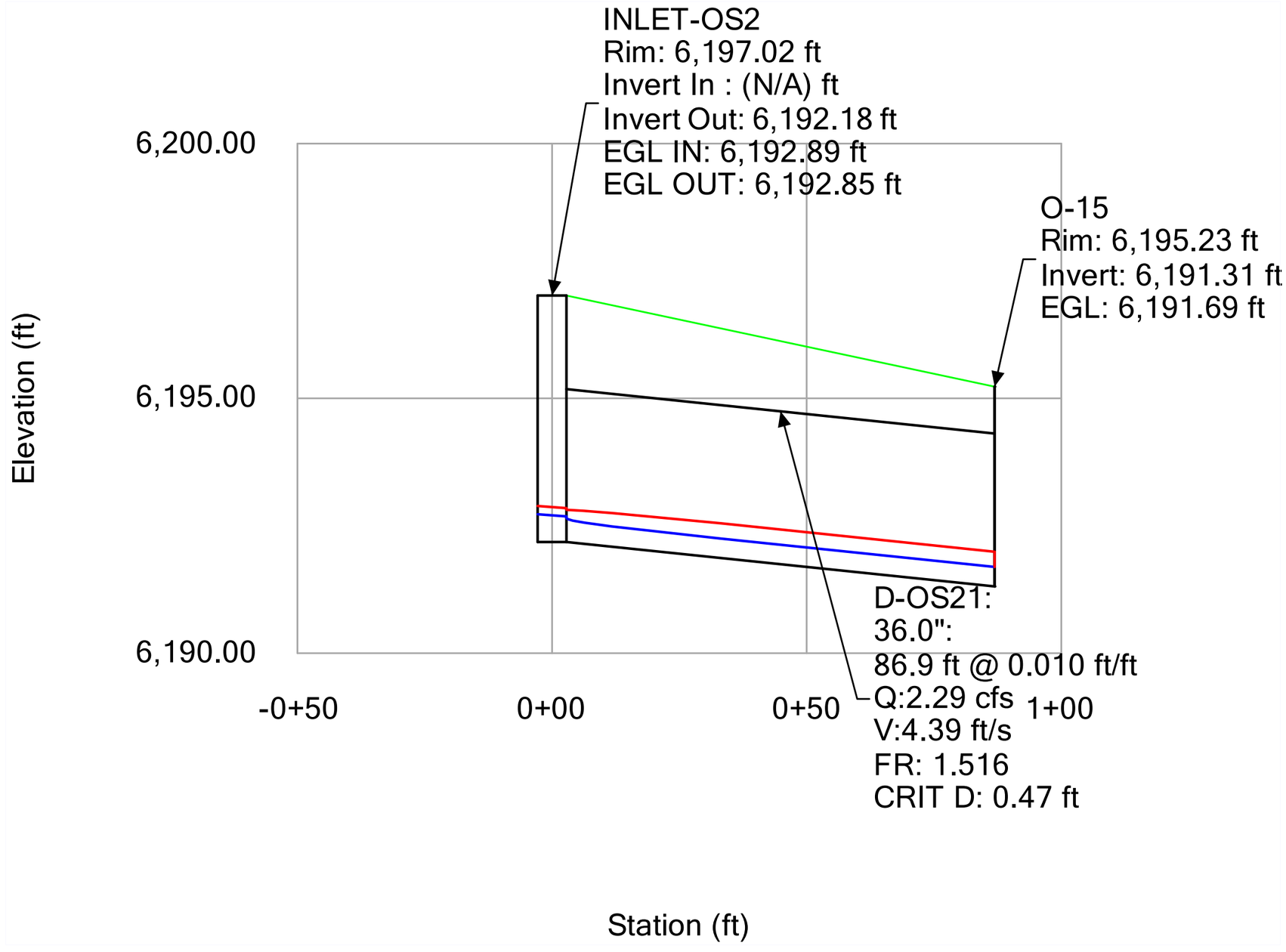
Profile Report
Engineering Profile - DP-OS1.2 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



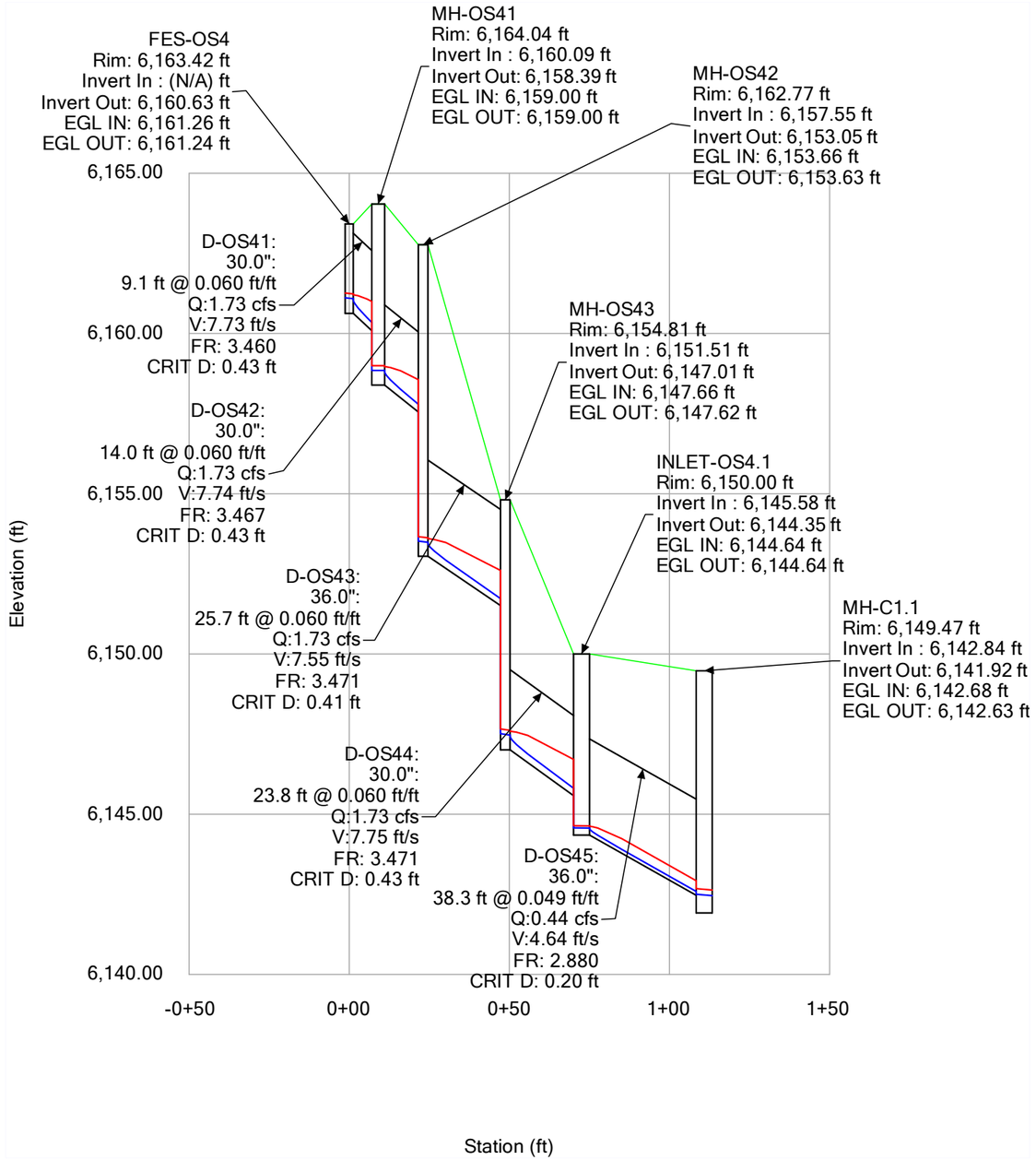
Profile Report
Engineering Profile - DP-OS1.21 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



Profile Report
Engineering Profile - DP-OS2 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



Profile Report
Engineering Profile - DP-OS4 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 5YEAR



FlexTable: Manhole Table

Active Scenario: 100YEAR

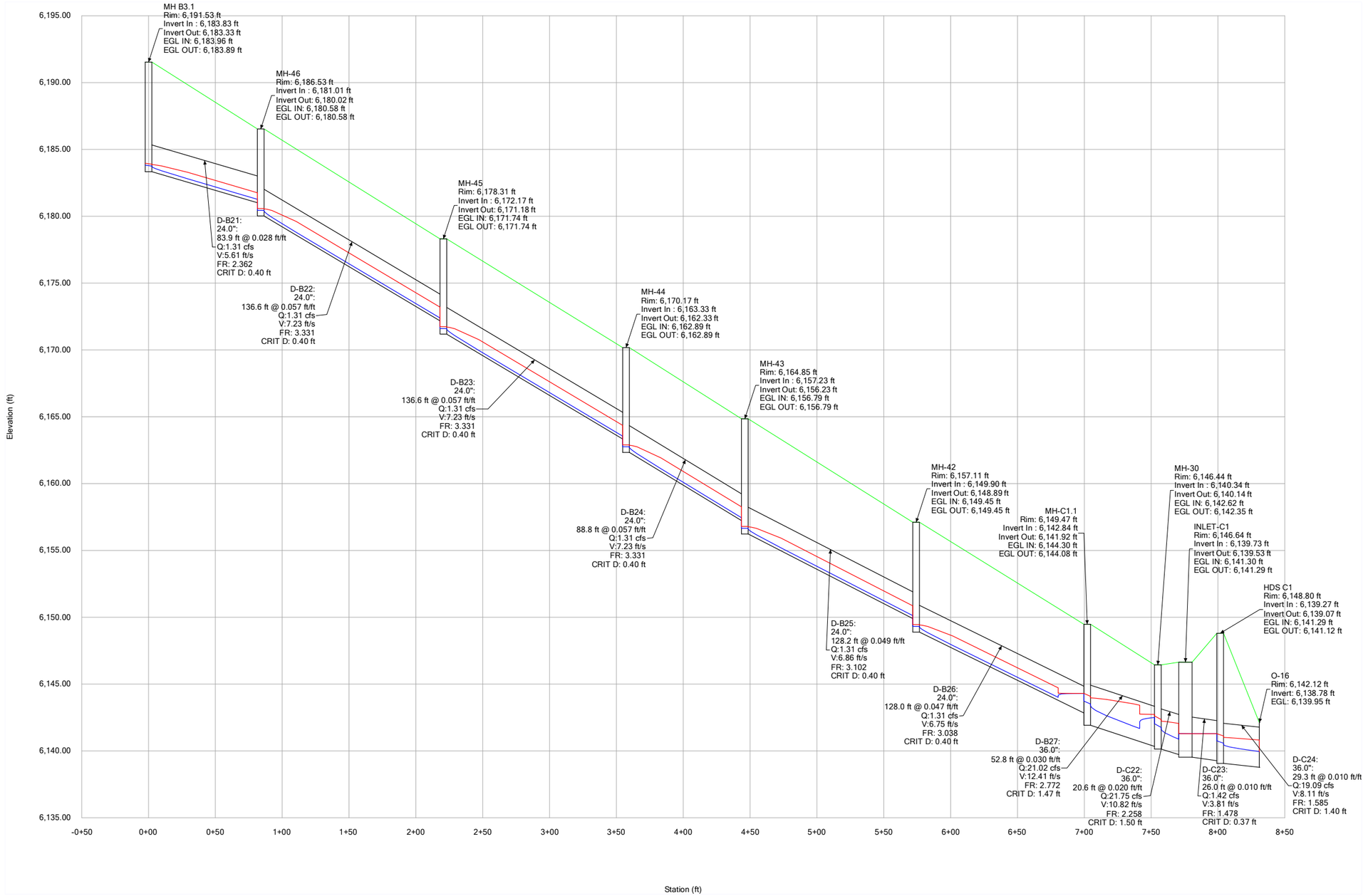
Label	Notes	Elevation (Ground) (ft)	Flow (Total Out) (cfs)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Method	HEC-22 Benching Method
FES-2	36" FES	6,203.91	18.88	6,200.58	6,202.13	6,202.08	6,202.66	6,202.62	HEC-22 Energy (Third Edition)	None
FES-OS4	30" FES	6,163.42	15.50	6,160.63	6,162.13	6,162.09	6,162.66	6,162.62	HEC-22 Energy (Third Edition)	None
HDS A1	5' HDS	6,211.95	7.23	6,203.91	6,205.12	6,205.12	6,205.60	6,205.60	HEC-22 Energy (Third Edition)	Half
HDS C1	5' HDS	6,148.80	19.09	6,139.07	6,140.75	6,140.58	6,141.29	6,141.12	HEC-22 Energy (Third Edition)	Half
INLET-1	TYPE D INLET	6,203.03	11.76	6,199.32	6,200.86	6,200.72	6,201.38	6,201.24	HEC-22 Energy (Third Edition)	Flat
INLET-2.1	TYPE D INLET	6,212.95	0.60	6,204.17	6,204.59	6,204.48	6,204.69	6,204.58	HEC-22 Energy (Third Edition)	Flat
INLET-A1	15' Type R Inlet	6,214.00	7.23	6,204.42	6,206.26	6,205.63	6,206.73	6,206.10	HEC-22 Energy (Third Edition)	Flat
INLET-A2	5' Type R Inlet	6,214.00	2.32	6,206.11	6,206.93	6,206.73	6,207.14	6,206.94	HEC-22 Energy (Third Edition)	Flat
INLET-B1	5' Type R Inlet	6,191.77	0.79	6,184.72	6,185.17	6,185.07	6,185.29	6,185.19	HEC-22 Energy (Third Edition)	Flat
INLET-B2	5' Type R Inlet	6,191.82	0.56	6,184.77	6,185.15	6,185.07	6,185.25	6,185.16	HEC-22 Energy (Third Edition)	Flat
INLET-C1	10' Type R Inlet	6,146.64	1.42	6,139.53	6,141.30	6,141.29	6,141.30	6,141.29	HEC-22 Energy (Third Edition)	Flat
INLET-C2	5' Type R Inlet	6,146.78	0.73	6,142.17	6,142.61	6,142.58	6,142.67	6,142.64	HEC-22 Energy (Third Edition)	Flat
INLET-OS2	TYPE D INLET (DEPRESSED)	6,197.02	19.93	6,192.18	6,193.82	6,193.72	6,194.38	6,194.28	HEC-22 Energy (Third Edition)	Flat
INLET-OS4.1	SLAB TOP 60" DIA MH	6,150.00	15.69	6,144.35	6,145.71	6,145.71	6,146.19	6,146.19	HEC-22 Energy (Third Edition)	Half
MH B3.1	5' MH	6,191.53	1.31	6,183.33	6,183.82	6,183.75	6,183.96	6,183.89	HEC-22 Energy (Third Edition)	Half
MH-3.1	6' MH	6,214.17	31.24	6,194.89	6,196.94	6,196.94	6,197.70	6,197.70	HEC-22 Energy (Third Edition)	Half
MH-30	SLAB TOP 60" DIA MH	6,146.44	21.75	6,140.14	6,142.03	6,141.76	6,142.62	6,142.35	HEC-22 Energy (Third Edition)	Half
MH-37	5' MH with Intermediate Platform	6,211.70	31.24	6,190.59	6,192.64	6,192.64	6,193.40	6,193.40	HEC-22 Energy (Third Edition)	Half
MH-42	5' MH	6,157.11	1.31	6,148.89	6,149.31	6,149.31	6,149.45	6,149.45	HEC-22 Energy (Third Edition)	Half
MH-43	5' MH	6,164.85	1.31	6,156.23	6,156.66	6,156.66	6,156.79	6,156.79	HEC-22 Energy (Third Edition)	Half
MH-44	5' MH	6,170.17	1.31	6,162.33	6,162.75	6,162.75	6,162.89	6,162.89	HEC-22 Energy (Third Edition)	Half
MH-45	5' MH	6,178.31	1.31	6,171.18	6,171.60	6,171.60	6,171.74	6,171.74	HEC-22 Energy (Third Edition)	Half
MH-46	5' MH	6,186.53	1.31	6,180.02	6,180.44	6,180.44	6,180.58	6,180.58	HEC-22 Energy (Third Edition)	Half
MH-A	5' MH	6,213.77	2.32	6,205.23	6,206.73	6,206.73	6,206.76	6,206.76	HEC-22 Energy (Third Edition)	Half
MH-C1.1	5' MH	6,149.47	21.02	6,141.92	6,143.73	6,143.51	6,144.30	6,144.08	HEC-22 Energy (Third Edition)	Half
MH-OS1	5' MH	6,211.15	11.76	6,198.25	6,200.01	6,199.68	6,200.50	6,200.17	HEC-22 Energy (Third Edition)	Half
MH-OS41	5' MH	6,164.04	15.50	6,158.39	6,159.85	6,159.85	6,160.38	6,160.38	HEC-22 Energy (Third Edition)	Half
MH-OS42	5' MH	6,162.77	15.00	6,153.05	6,154.46	6,154.38	6,154.92	6,154.84	HEC-22 Energy (Third Edition)	Flat
MH-OS43		6,154.81	15.00	6,147.01	6,148.55	6,148.44	6,149.07	6,148.95	HEC-22 Energy (Third Edition)	Flat

FlexTable: Conduit Table

Active Scenario: 100YEAR

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
D-A21	18.0	0.013	6,206.11	6,205.43	15.1	0.045	2.32	8.16	6,206.69	6,206.74	6,206.90	6,206.77
D-A22	18.0	0.013	6,205.23	6,204.61	15.2	0.041	2.32	7.89	6,206.72	6,206.72	6,206.75	6,206.74
D-A23	18.0	0.013	6,204.42	6,204.11	21.7	0.014	7.23	7.34	6,205.46	6,205.44	6,205.94	6,205.70
D-A24	18.0	0.013	6,203.91	6,203.69	21.6	0.010	7.23	6.48	6,204.95	6,204.62	6,205.43	6,205.24
D-B10	18.0	0.013	6,184.72	6,183.83	16.9	0.053	0.79	6.28	6,185.05	6,184.02	6,185.17	6,184.60
D-B20	18.0	0.013	6,184.77	6,183.83	13.5	0.070	0.56	6.23	6,185.05	6,183.98	6,185.14	6,184.56
D-B21	24.0	0.013	6,183.33	6,181.01	83.9	0.028	1.31	5.61	6,183.73	6,181.27	6,183.86	6,181.76
D-B22	24.0	0.013	6,180.02	6,172.17	136.6	0.057	1.31	7.23	6,180.41	6,172.39	6,180.55	6,173.20
D-B23	24.0	0.013	6,171.18	6,163.33	136.6	0.057	1.31	7.23	6,171.57	6,163.55	6,171.71	6,164.36
D-B24	24.0	0.013	6,162.33	6,157.23	88.8	0.057	1.31	7.23	6,162.73	6,157.45	6,162.87	6,158.26
D-B25	24.0	0.013	6,156.23	6,149.90	128.2	0.049	1.31	6.86	6,156.63	6,150.12	6,156.77	6,150.86
D-B26	24.0	0.013	6,148.89	6,142.84	128.0	0.047	1.31	6.75	6,149.29	6,144.30	6,149.42	6,144.31
D-B27	36.0	0.013	6,141.92	6,140.34	52.8	0.030	21.02	12.41	6,143.39	6,142.50	6,143.97	6,142.70
D-C21	18.0	0.013	6,142.17	6,141.59	9.7	0.060	0.73	6.39	6,142.57	6,142.62	6,142.63	6,142.62
D-C22	36.0	0.013	6,140.14	6,139.73	20.6	0.020	21.75	10.82	6,141.64	6,140.88	6,142.23	6,141.51
D-C23	36.0	0.013	6,139.53	6,139.27	26.0	0.010	1.42	3.81	6,141.29	6,141.29	6,141.29	6,141.29
D-C24	36.0	0.013	6,139.07	6,138.78	29.3	0.010	19.09	8.11	6,140.47	6,139.95	6,141.01	6,140.82
D-OS1	24.0	0.013	6,199.32	6,198.45	23.6	0.037	11.76	11.75	6,200.55	6,200.37	6,201.07	6,200.59
D-OS1.22	18.0	0.013	6,204.17	6,197.89	104.7	0.060	0.60	6.04	6,204.46	6,198.05	6,204.56	6,198.61
D-OS10	36.0	0.013	6,200.58	6,197.89	55.1	0.049	18.88	14.33	6,201.97	6,198.67	6,202.51	6,201.23
D-OS11	24.0	0.013	6,198.25	6,197.89	70.4	0.005	11.76	5.62	6,199.51	6,199.15	6,200.00	6,199.65
D-OS12	36.0	0.013	6,194.89	6,192.59	38.3	0.060	31.24	17.81	6,196.70	6,193.65	6,197.46	6,196.71
D-OS13	36.0	0.013	6,190.59	6,186.51	81.6	0.050	31.24	16.69	6,192.40	6,187.51	6,193.16	6,191.10
D-OS21	36.0	0.013	6,192.18	6,191.31	86.9	0.010	19.93	8.24	6,193.61	6,192.45	6,194.17	6,193.47
D-OS41	30.0	0.013	6,160.63	6,160.09	9.1	0.060	15.50	14.81	6,161.96	6,161.02	6,162.49	6,162.38
D-OS42	30.0	0.013	6,158.39	6,157.55	14.0	0.060	15.50	14.83	6,159.72	6,158.42	6,160.25	6,160.05
D-OS43	36.0	0.013	6,153.05	6,151.51	25.7	0.060	15.00	14.41	6,154.29	6,152.23	6,154.75	6,154.25
D-OS44	30.0	0.013	6,147.01	6,145.58	23.8	0.060	15.00	14.71	6,148.32	6,146.36	6,148.84	6,148.39
D-OS45	36.0	0.013	6,144.35	6,142.47	38.3	0.049	15.69	13.61	6,145.61	6,144.19	6,146.09	6,144.38

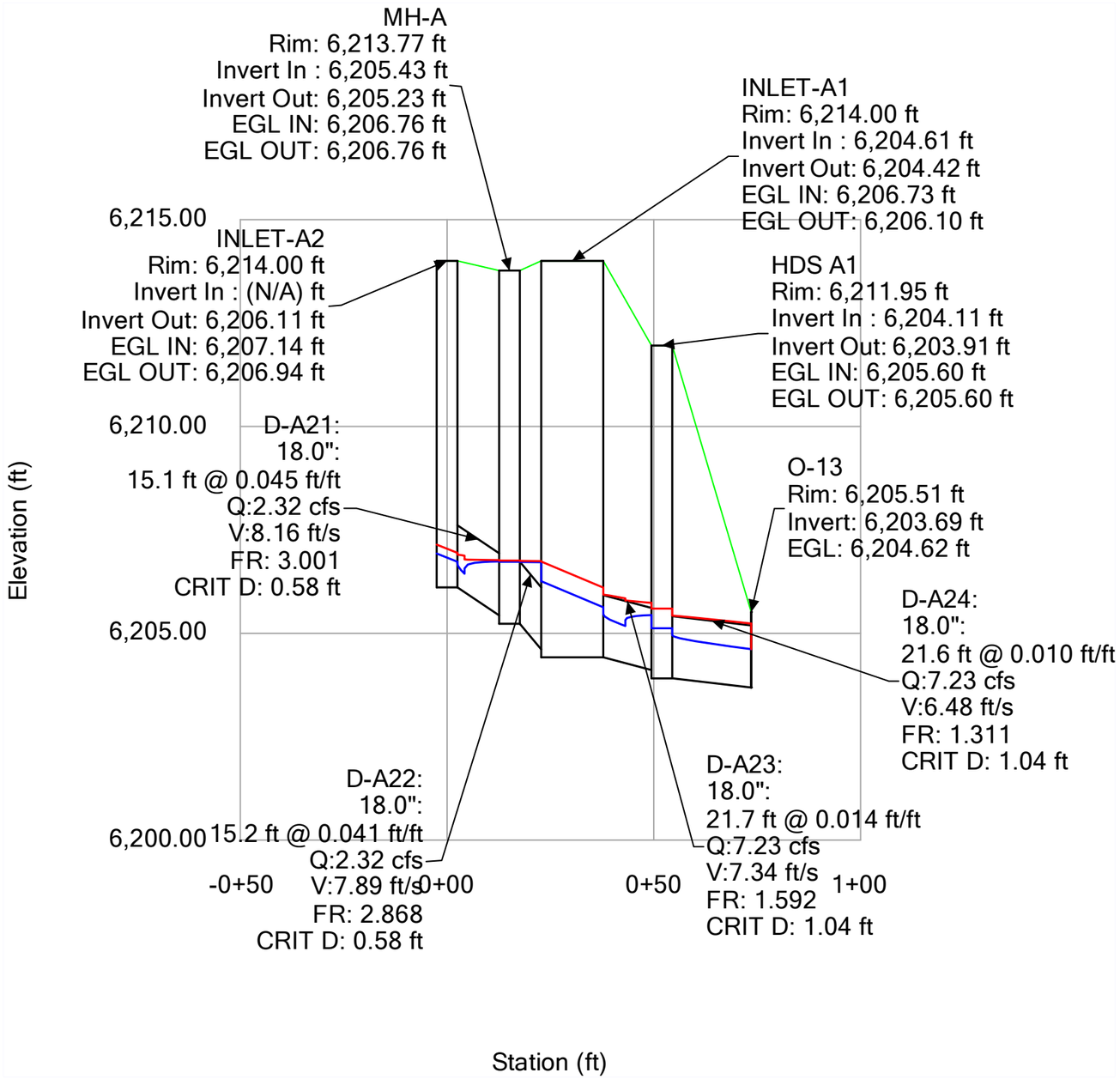
Profile Report
Engineering Profile - DP-01 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



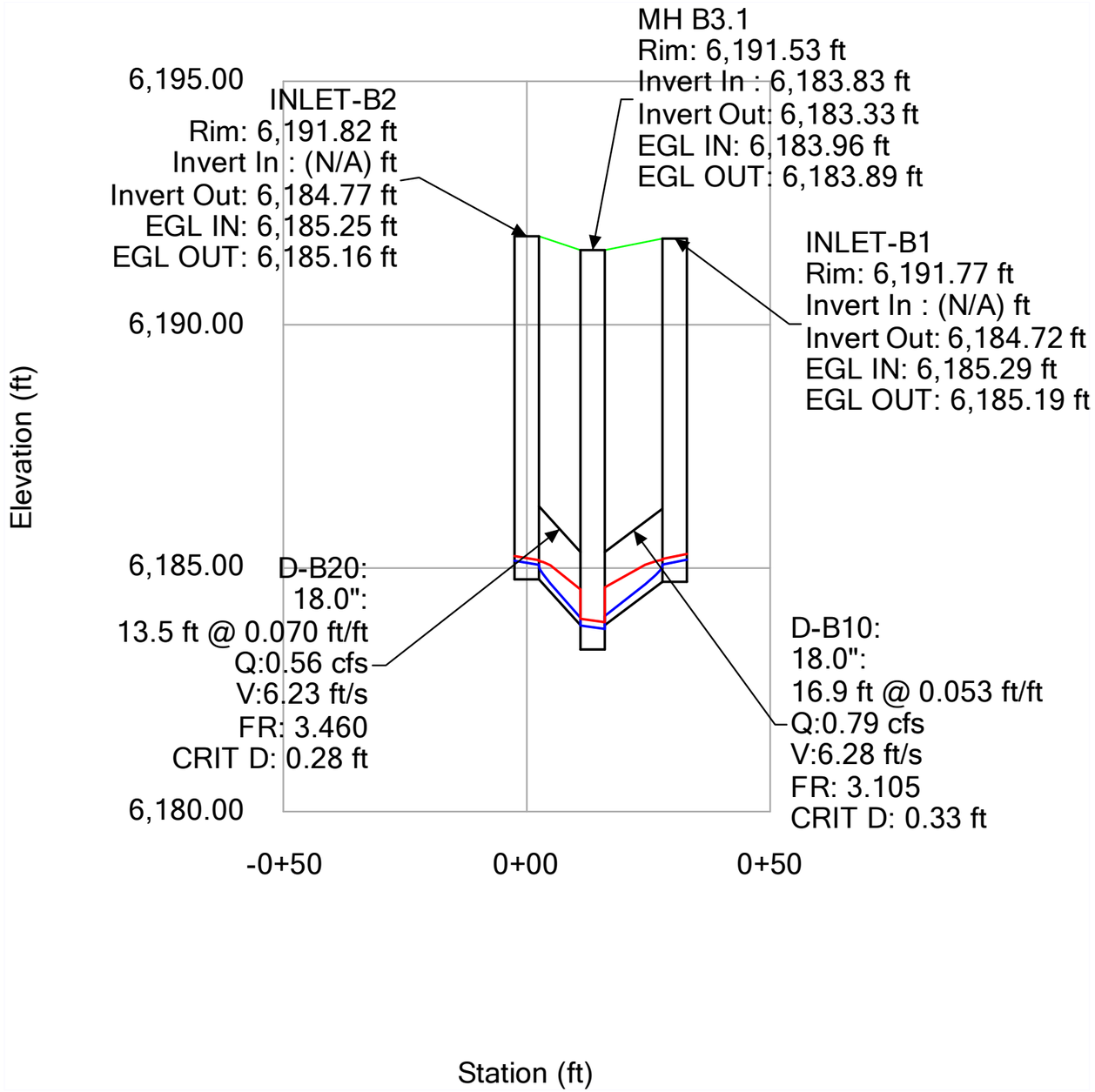
Profile Report

Engineering Profile - DP-A (2026-03-13 CABELAS DRIVE.stsw)

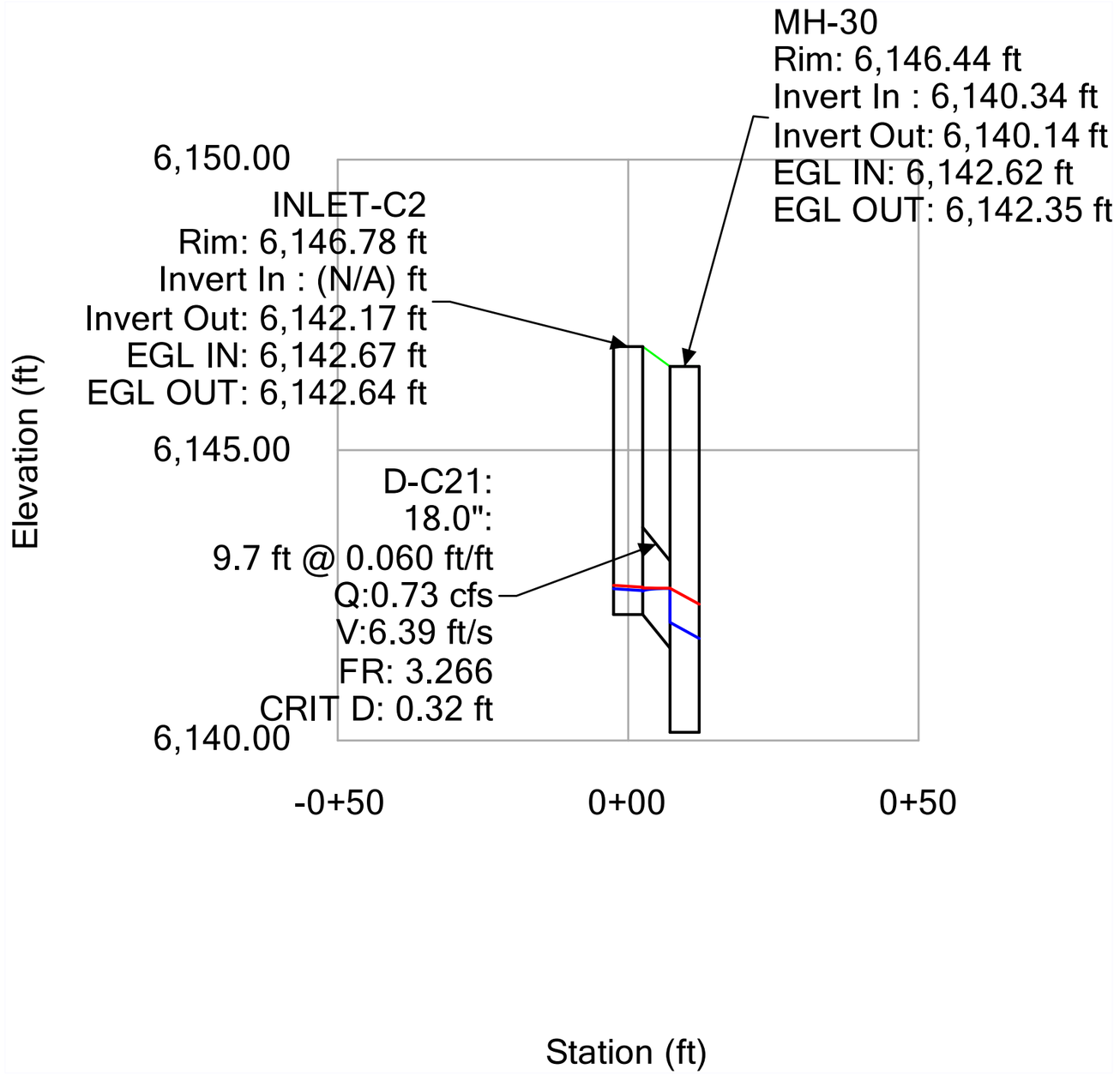
Active Scenario: 100YEAR



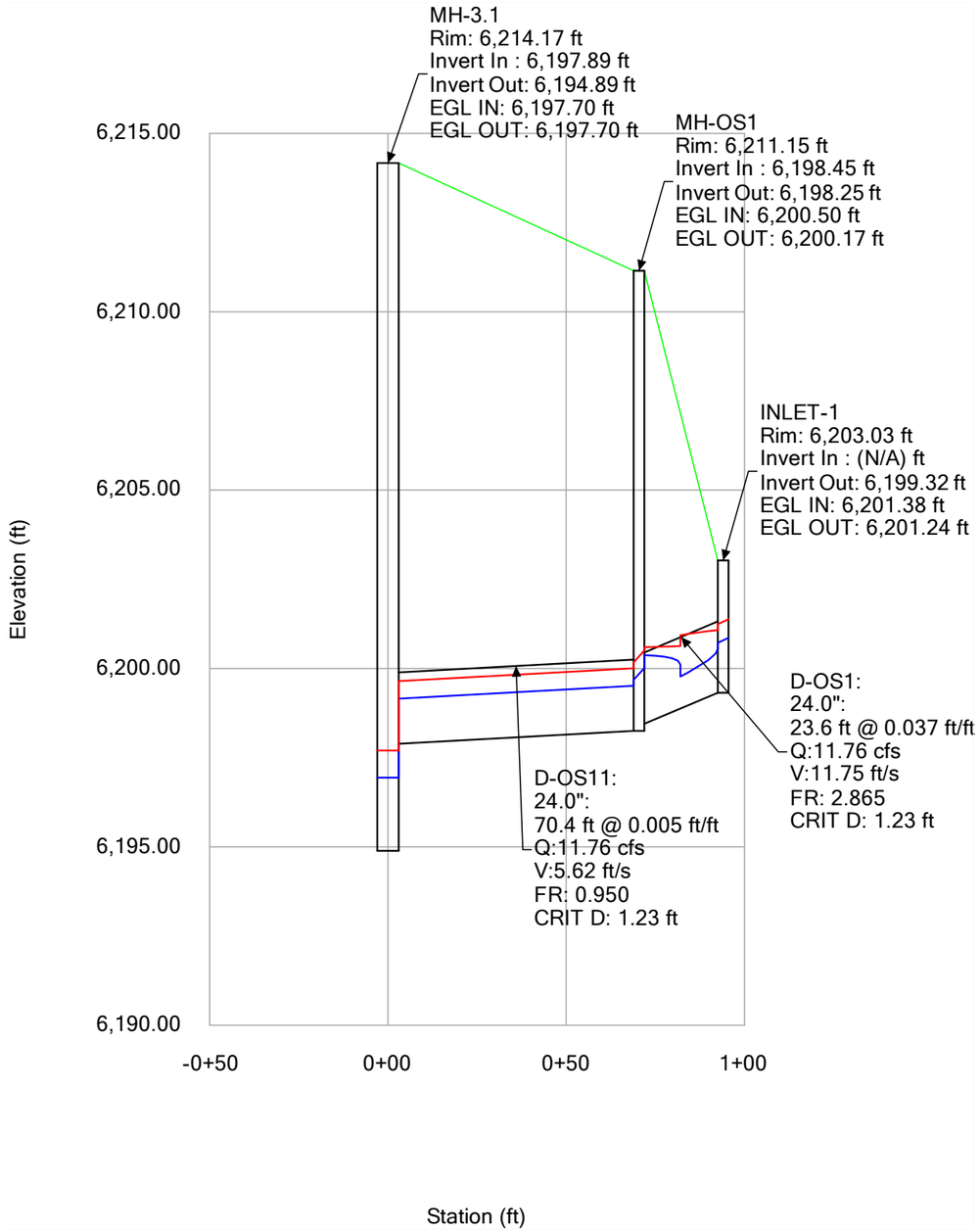
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Active Scenario: 100YEAR



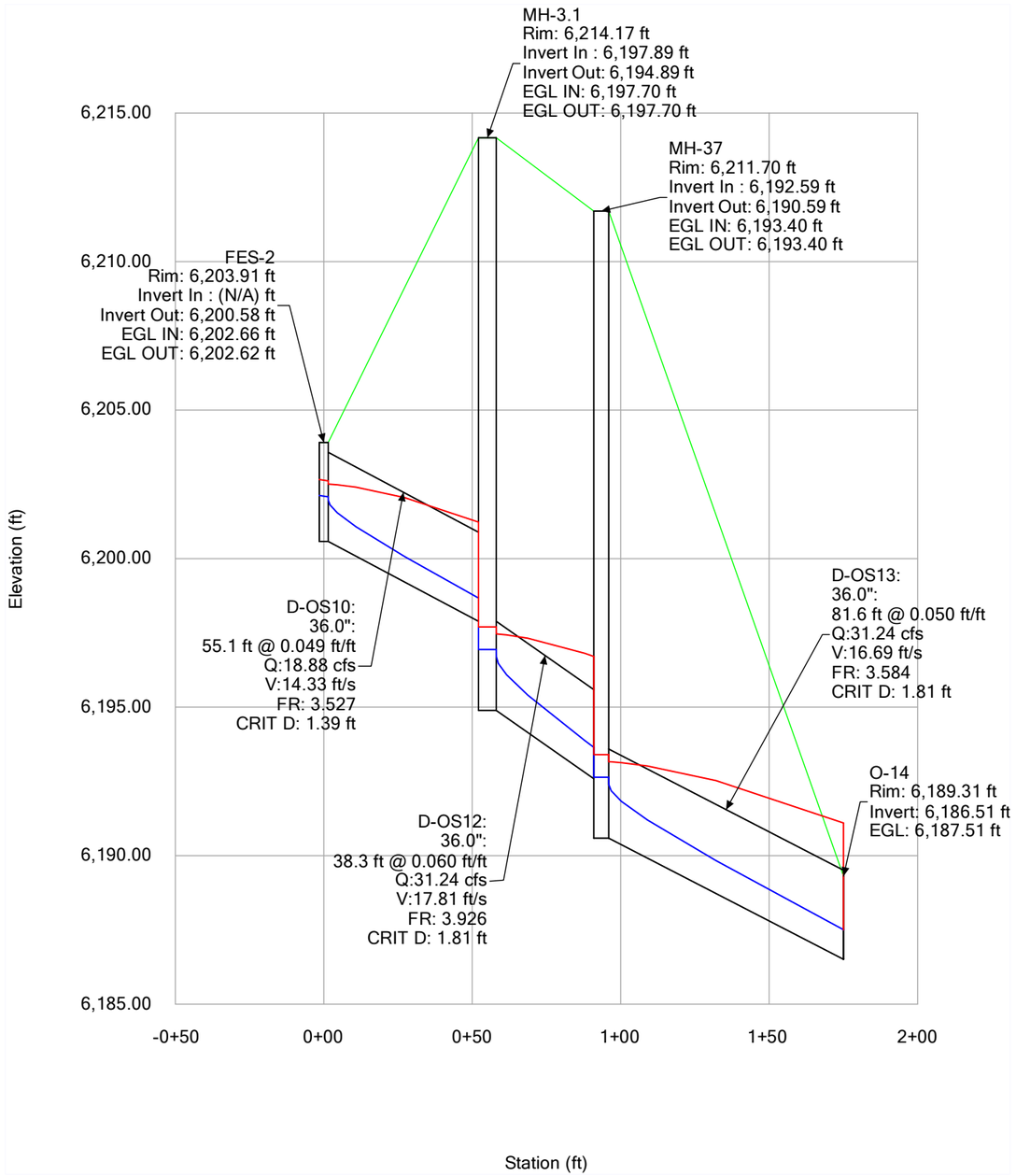
Profile Report
Engineering Profile - DP-C (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



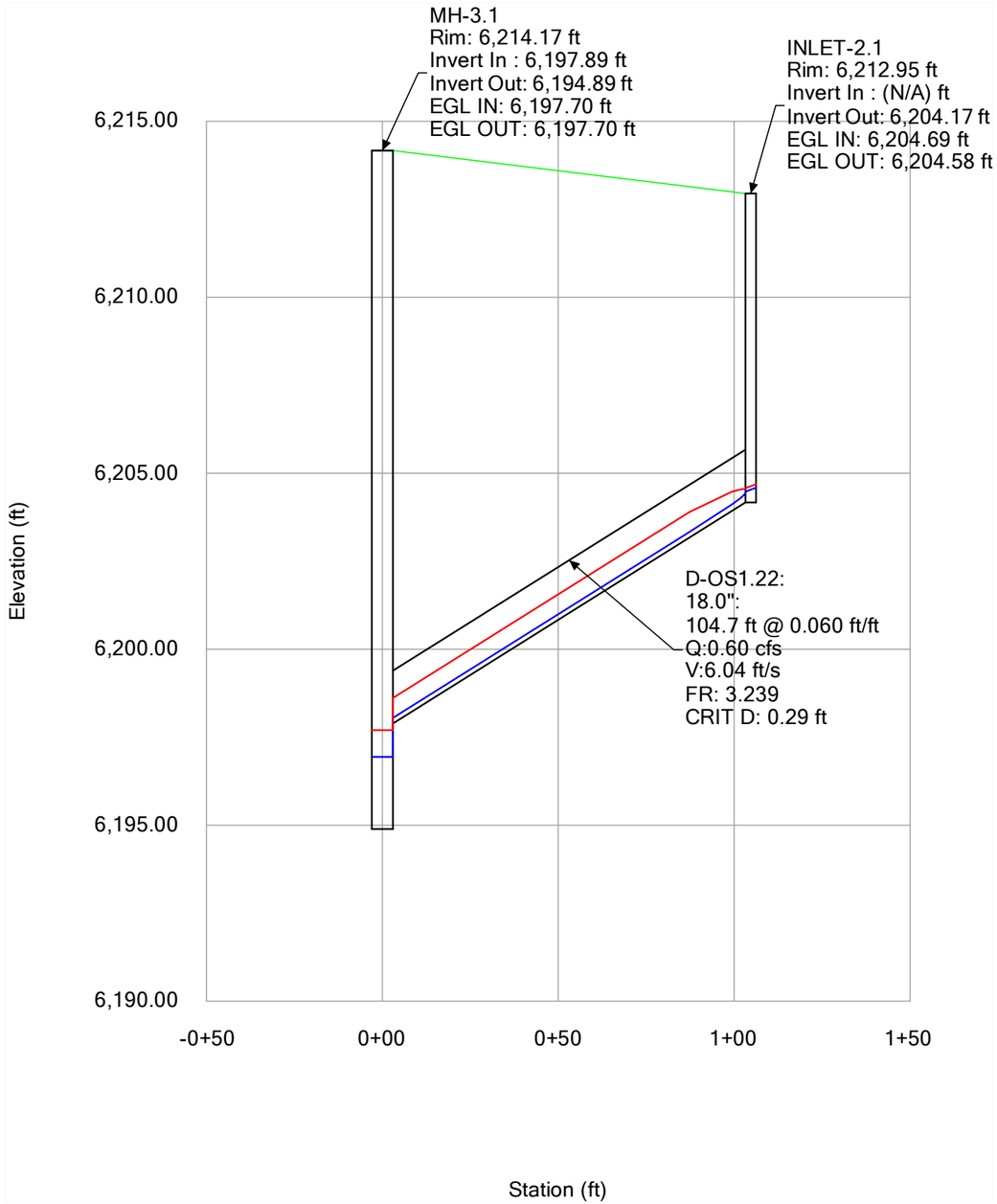
Profile Report
Engineering Profile - DP-OS1.1 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



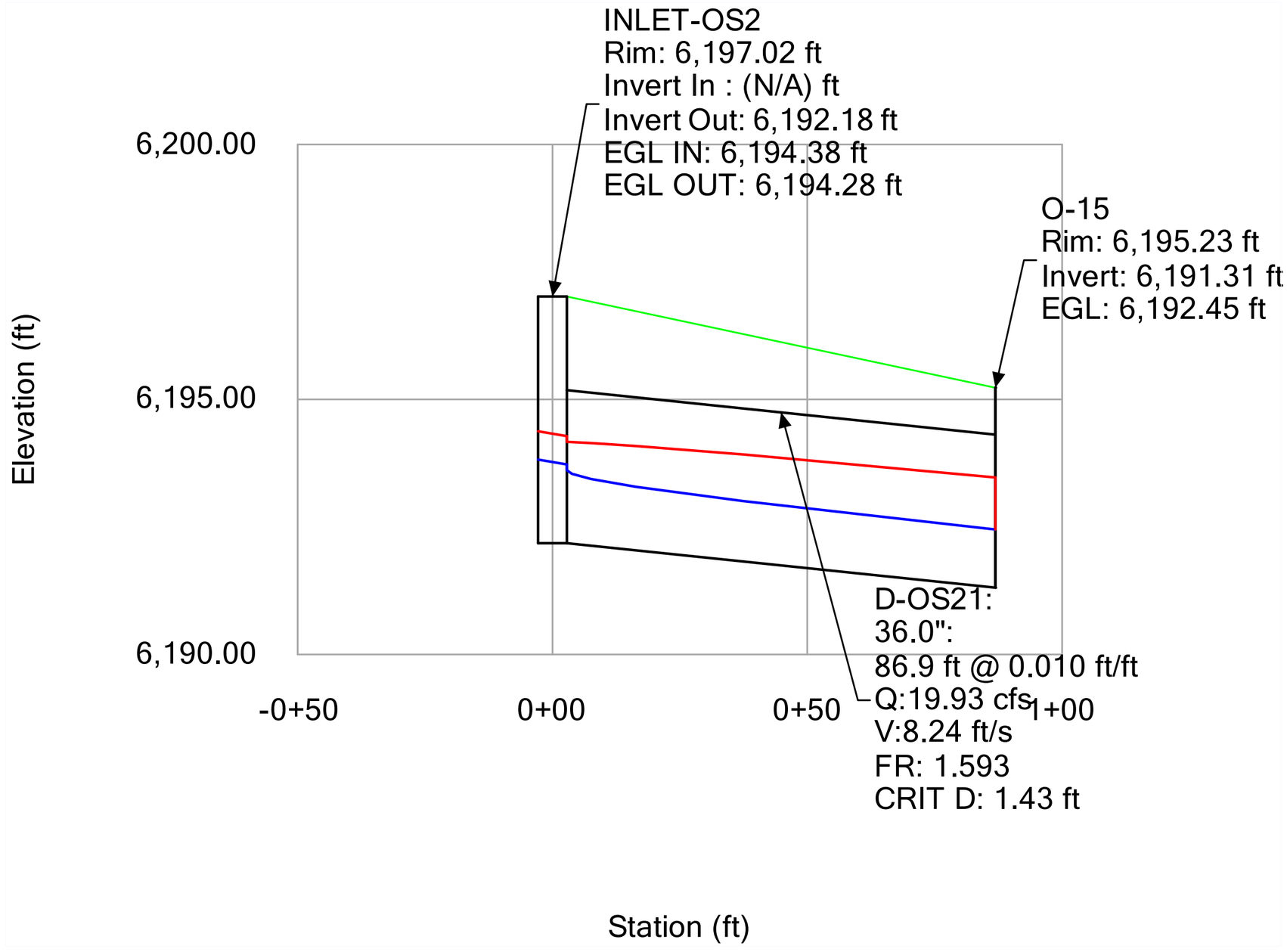
Profile Report
Engineering Profile - DP-OS1.2 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



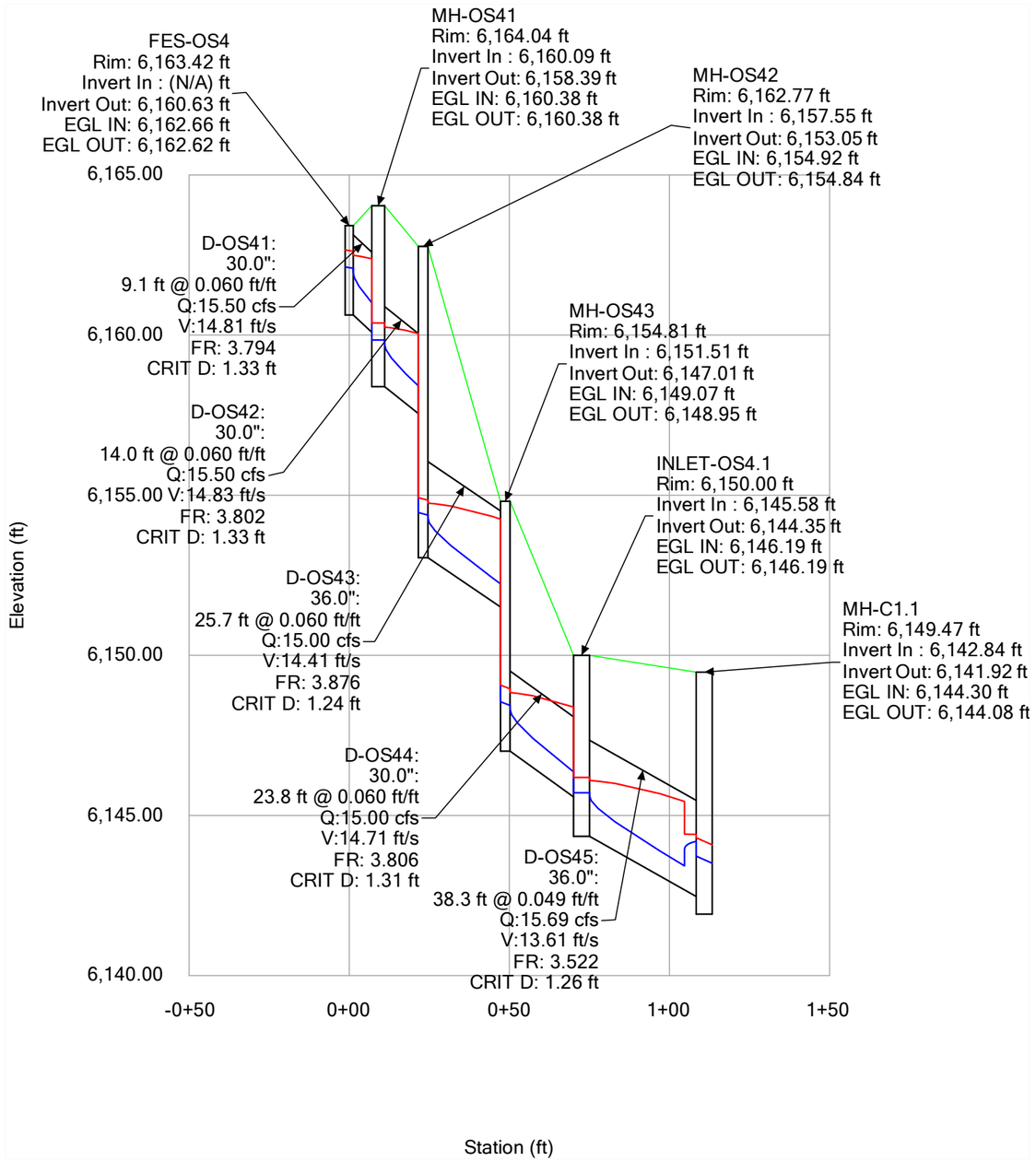
Profile Report
Engineering Profile - DP-OS1.21 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



Profile Report
Engineering Profile - DP-OS2 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



Profile Report
Engineering Profile - DP-OS4 (2026-03-13 CABELAS DRIVE.stsw)
Active Scenario: 100YEAR



PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Hillcamp Drive Extension
Location: Lone Tree

Project Name: Hillcamp Drive
Project No.: 15950.18
Calculated By: BMP
Checked By: BMP
Date: 3/25/26

	STORM DRAIN SYSTEM			
	3.1	**A3.1**	**C4.1**	**Notes**
Q_{100} (cfs):	30.4	7.2	19.1	
Conduit	Pipe	Pipe	Pipe	
D_c, Pipe Diameter (in):	36	24	36	
W, Box Width (ft):	N/A	N/A	N/A	
H, Box Height (ft):	N/A	N/A	N/A	
Y_t, Tailwater Depth (ft):	0.40	0.40	0.40	If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.13	0.20	0.13	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	1.95	1.28	1.22	
Supercritical?	Yes	Yes	Yes	
Y_n, Normal Depth (ft) [Supercritical]:	0.93	0.91	1.10	
D_a, H_a (in) [Supercritical]:	1.97	1.46	2.05	$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	20.59	5.35	12.76	
Riprap d_{50} (in) [Subcritical]:	N/A	N/A	N/A	
Required Riprap Size:	**VH**	**L**	**H**	**Fig. 9-38 or Fig. 9-36**
d_{50} (in):	**18**	**9**	**15**	
Expansion Factor, $1/(2\tan\theta)$:	1.00	3.00	2.00	Read from Fig. 9-35 or 9-36
θ:	0.46	0.17	0.24	
Erosive Soils?	Yes	Yes	Yes	
Area of Flow, A_t (ft^2):	6.09	1.45	3.82	$A_t=Q/V$
Length of Protection, L_p (ft):	12.2	4.8	13.1	L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	9.0	6.0	9.0	Min L=3D or 3H
Max Length (ft)	30.0	20.0	30.0	Max L=10D or 10H
Min Bottom Width, T (ft):	14.3	3.6	9.4	$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	**13.0**	**6.0**	**14.0**	
Design Width (ft)	**14.3**	**3.6**	**9.4**	
Riprap Depth (in)	**36**	**18**	**30**	Depth=2(d_{50})
Type II Bedding Depth (in)*	8	6	8	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)	36.0	36.0		Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

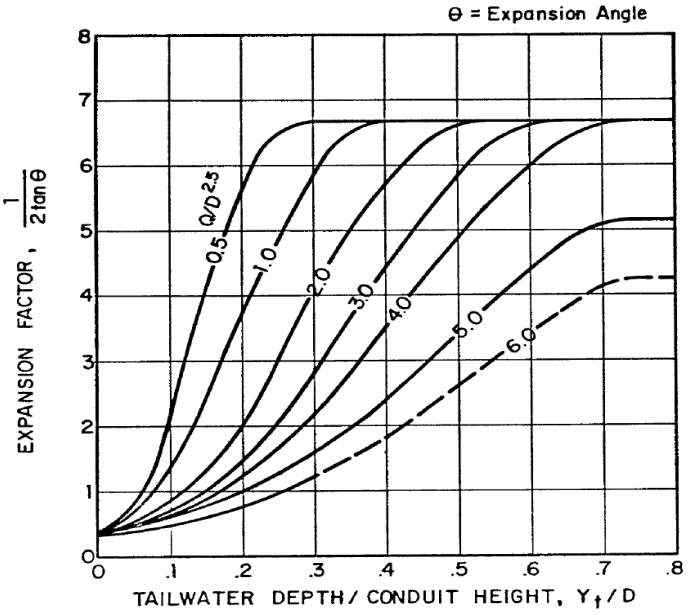


Figure 9-35. Expansion factor for circular conduits

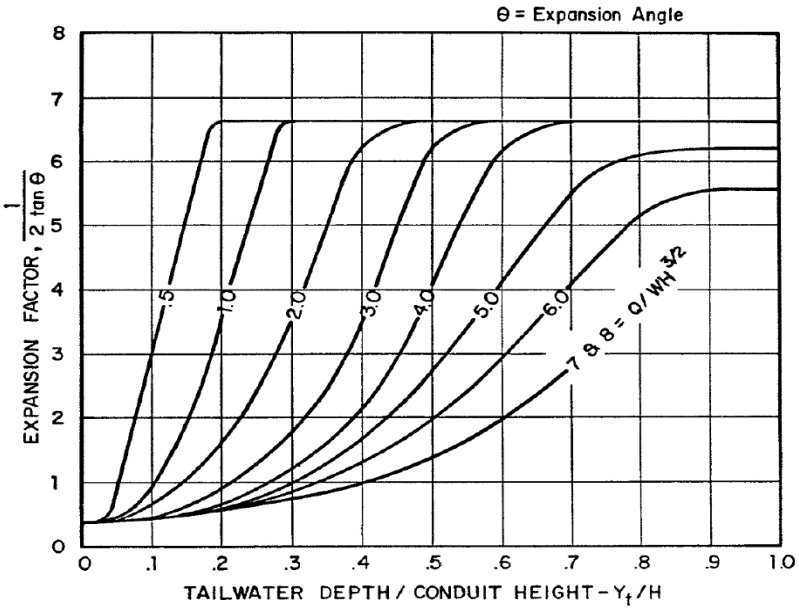


Figure 9-36. Expansion factor for rectangular conduits

APPENDIX D

EXCERPTS FROM REFERENCED MATERIAL

November 13, 2025

JR Engineering, LLC
7200 South Alton Way, Suite C400
Centennial, Colorado, 80112

Attention: Kevin Rohrbough, P.E.
Client Manager

Subject: Updated Preliminary Geotechnical Investigation and
Slope Stability Evaluation
Ridgegate – Mesa Tops Road Alignment
Douglas County, Colorado
Project No. DN52,378.000-115-L2

CTL|Thompson performed a Preliminary Geotechnical Investigation for the proposed road alignment for Cabela Drive within the Ridgegate – Mesa Tops development in Lone Tree, Colorado (Project No. DN52,378.000-115-R1; report dated March 12, 2025). We have been requested to review proposed grading plans and perform slope stability evaluation for the proposed road alignment. The purpose of our evaluation was to assess slope stability for the existing slopes relative to planned cuts and fills for the Mesa Tops Road Alignment. This letter is based on our understanding of the planned development, previous investigations, and our experience. The discussions and criteria presented in this letter are intended for planning purposes only. This letter has been revised to address comments from the City of Lone Tree from their SB25-0014 – Hillcamp Drive Filing No. 1 – 2nd Review dated September 5, 2025.

PREVIOUS INVESTIGATIONS

CTL|Thompson performed a Preliminary Geotechnical Investigation within the Ridgegate Mesa Tops development under our Project No. DN52,036-115-R1 and presented our results in a report dated November 20, 2023. We drilled and sampled 19 widely-spaced exploratory borings. We encountered sandy clay and clayey sand over claystone and sandstone bedrock. Bedrock was very hard and practical drill rig refusal was encountered in nine borings at depths of 12 to 21 feet below existing grades. The primary geotechnical concerns identified were expansive clay and claystone and potentially unstable slopes.

We subsequently performed a Preliminary Geotechnical Investigation for the proposed road alignment under our Project No. DN52,036-115-R1 and presented results in a report dated March 12, 2025. The purpose of the investigation was to determine the type of subgrade soils present at the site, evaluate pavement support characteristics, and provide preliminary pavement design alternatives. We drilled and sampled six exploratory borings along the road alignment. We encountered sandy clay and clean to clayey sand underlain by weathered and comparatively unweathered claystone bedrock. Data from our previous investigations was considered in preparation of this report.

RESULTS OF SLOPE STABILTY ANALYSIS

Cross-Section	Factor of Safety		
	Existing	Interim*	Proposed
A	2.4	1.2	2.0
B (Left to Right)	2.6	0.9	2.1
B (Right to Left)	1.4	1.1	2.4
C	1.6	1.0	1.6
D	2.0	-	2.1
E	2.3	-	2.3

*Slope Stability for the interim cases was performed on benched cut slopes. The FOS values of less than 1.0 for the interim cases were for failure slopes through the vertical benches, and were not representative of the global stability of the slope. Bench heights of less than 4 feet will likely be required for some areas.

Landslides and Debris Flow

As part of our evaluation, we reviewed the 2018 Landslide Inventory and Susceptibility Map of Douglas County, Colorado[3] and the 2018 Debris Flow Susceptibility Map of Douglas County, Colorado[4]. Excerpts of these maps are shown below in Photos 2 and 3, respectively. There are limitations associated with map scaling and scope of the investigation; however, the potential for landslides and debris flows indicated on these maps generally agree with site observations from this investigation. Mapped hazard areas of landslide and debris flows within the subject site are presented on Fig. 5.

The landslide map indicates there are potential landslide deposits and landslide hazard areas present along the proposed road development and to the northwest of the site. We are aware of post-construction slope failures on nearby sites. As discussed previously, slope stability analyses imply existing and proposed slopes are stable. Addition of water to the subsurface from precipitation or irrigation reduces relative stability and may initiate slope failures. Surface drainage should be designed, constructed, and maintained to provide rapid removal of surface runoff.

Additionally, the debris flow map indicates debris flow hazard areas are present within the drainages on-site. The topography of the site encourages water to flow from higher elevations, through these drainage pathways, towards lower lying areas. In large precipitation events, erosion and mud or debris flows can occur through these pathways. The Civil Engineer should evaluate drainage basins present on the site slopes and design surface drainage structures that will reduce the risk of debris flows.

[3] Lindsey, Kassandra, "Landslide Inventory and Susceptibility for Douglas County, Colorado," Colorado Geological Survey, (Open File Report, OF-18-07), 2018.
[4] McCoy, Kevin M., F. Scot Fitzgerald, Matthew L. Morgan, and Karen A. Berry. "Debris Flow Susceptibility Map of Douglas County, Colorado," Colorado Geological Survey (Open File Report, OF-18-08), 2018.

steep slopes. Sliding can result along sloping interfaces between new fill and existing ground. An effective way to deal with this issue is to bench slopes steeper than about 20 percent prior to fill placement as shown on Fig. 6. Addition of water to the subsurface from precipitation or landscape irrigation will likely reduce relative stability and may initiate slope failures. Surface drainage should be designed, constructed, and maintained to provide rapid removal of surface runoff.

Nearmap DEM Change Detection

Change detection analysis was performed across the site to identify areas that have recently experienced vertical ground movement. We utilized Digital Elevation Model data (DEM) produced by Nearmap for the analysis. The data sets were created using photogrammetry from airborne vehicles. Heights, or elevations, of points/objects are calculated based off the vehicles internal GPS data and the parallax effect. The DEMs used to compare elevation changes were obtained in August 2018 and August 2023. The DEMs' horizontal spatial reference is the Colorado Central NAD83 system, and the vertical spatial reference is the NAVD88 system. The elevation data from the more recent DEM was subtracted from that of the older DEM, resulting in a new data set that illustrates a decrease in elevation as a positive value.

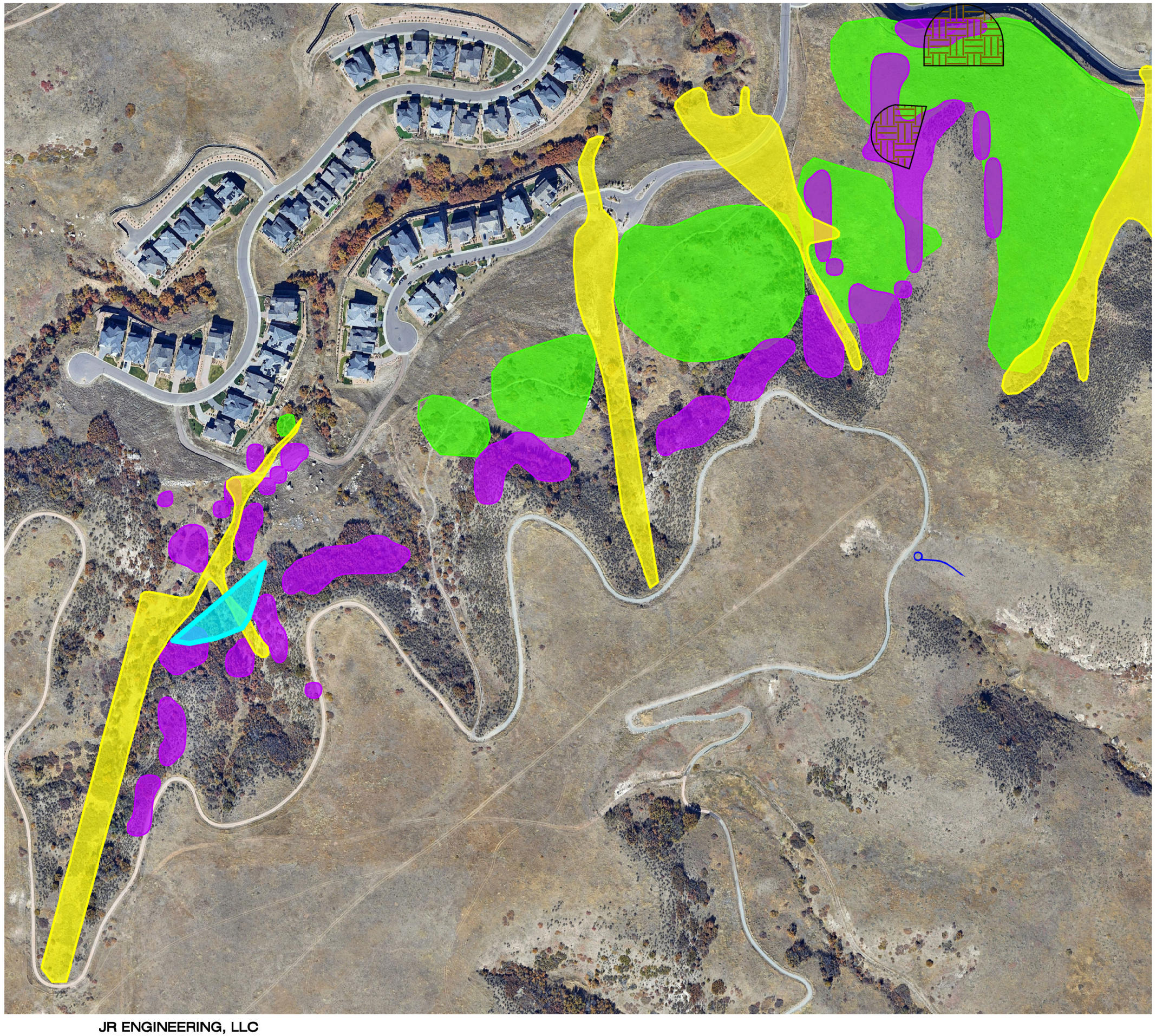
After our analysis, a site visit was made to investigate areas with measured elevation drops since visual obstructions can skew the data. Locations were removed from consideration based on ground surface morphology and vegetation cover. The results of our analysis are presented in Fig. 5. The areas indicated on Fig. 5 are areas with measured elevation drops of up to about 19 feet. It is unknown if the elevation drops in these locations are the result of slope failure, erosion, or man-made excavations or grade changes. No conclusive observations were made in our review of historical photos.

Erosion and Flooding

There are many drainages present throughout the site near the proposed road alignment. The topography of the site encourages water to flow from the higher elevations, through the drainage pathways, towards the lower lying areas. During peak precipitation events, some accumulation of surface sheet flow in gullies and drainages is expected. Development will increase the number of impervious surfaces and change established drainage paths, which can lead to drainage problems and erosion if surface water flow is not adequately designed. Slopes will require erosion control during and after construction. Re-vegetation or other erosion control measures should be employed to control erosion. We identified two main debris flow channels near the central and eastern portions of the proposed road alignment near TH-4 and TH-6 (Fig. 5). The flow should be diverted away from the proposed alignment in these areas. A sub-fill drain is recommended along the bottom of existing drainages where more than about fifteen feet of site grading fill is planned or in existing drainages that are expected to have periodic flow of collected surface water (Fig. 7).

Expansive Clay and Claystone

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are referred to as expansive soils.



LEGEND:

- INDICATES AREA OF OBSERVED SITE GRADE DISTURBANCE [SEE NEARMAP DEM CHANGE DETECTION SECTION IN REPORT]
- INDICATES AREA OF DEBRIS FLOW HAZARD, AS MAPPED ON SUSCEPTIBILITY MAPPED BY CGS (OF-18-08)AND BASED ON FIELD OBSERVATIONS
- INDICATES POTENTIAL LANDSLIDE DEPOSIT, INVENTORY MAPPED BY CGS (OF-18-07)
- INDICATES AREA OF LANDSLIDE HAZARD, SUSCEPTIBILITY MAPPED BY CGS (OF-18-07)
- INDICATES AREA OF MAPPED LANDSLIDE DEPOSITS (MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP 1-770-A)
- INDICATES MAPPED LOCATION OF SPRING OR SEEPAGE AT THE GROUND SURFACE (MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP 1-770-A)

JR ENGINEERING, LLC
MESA TOPS ROAD ALIGNMENT
CTL|T Project No. DN52,378-115-L2

Geologic Hazards Fig. 5

Calibre

RIDGEGATE – SECTION 22, FILING NO. 1

PHASE III DRAINAGE REPORT

JANUARY 2017

For:
Century Communities
8390 E. Crescent Parkway, Suite 650
Greenwood Village, CO 80111

City of Lone Tree Review & Approval Is With Respect To General Conformance With City Standards. Responsibility For The Design Remains With The Professional(s) Submitting And Stamping The Document(s).

CITY OF LONE TREE
PUBLIC WORKS DEPARTMENT
APPROVED
BY GA Wells DATE FEB 08 2017

Calibre Engineering, Inc. 9090 S Ridgeline Blvd, Suite 105 Highlands Ranch, CO 80129 (303) 730-9434 www.calibre-engineering.com

Outfall 1 (DP 1)

- Basins OS1.1 and OS1.2 are primarily undeveloped basins, with possibility of future rural residential use and a road. These basins contain an upper reach of Cottonwood Creek. Runoff generated in these basins follows an existing drainage channel to a proposed culvert at DP 1.1. The culvert outfalls to the main Cottonwood Creek Channel at DP 1. During the major event, inlet controlled flow will occur at this culvert, attenuating the flow to the Cottonwood Creek Channel.

Outfall 2 (DP 2)

- Basin OS2.1-OS2.3 are primarily undeveloped basins, with possible future rural residential land use and road. Runoff generated in these basins follows an existing drainage channel to a proposed depressed Type-D inlet at DP 2.1. The culvert outfalls to the main Cottonwood Creek Channel at DP 2.

Outfall 3 (DP 3)

- Runoff from Basins OS3.1 and Basins A1-A2.2 is captured in a proposed storm system which outfalls to Basin OS3.2 at DP 3.4.
    - Basin OS3.1 is an undeveloped basin. Runoff generated in this basin is routed via a lined channel (SmartDitch or equivalent) to a low point at DP 3.1, where runoff is captured by an FES.
    - Basin A1 is a developed basin. Runoff generated in this basin is routed via curb and gutter to a Type-R inlet in sump at DP 3.2.
    - Basins A2.1 and A2.2 are developed basins. Runoff generated in these basins is captured at DP 3.3 by a Type-R inlet in sump.
- Basin OS3.2 is a large offsite basin containing an upper reach of Cottonwood Creek Channel. Runoff from this basin and Basins A1-A2.2 and Basin OS3.1 reaches a proposed culvert at DP 3.4, which outfalls to the main Cottonwood Creek Channel at DP 3. During the major event, inlet controlled flow will occur at this culvert, attenuating the flow to the Cottonwood Creek Channel.
- Basin A3 contains the back of lots. Runoff generated in this basin is routed via grass swales to landscape inlets in sump. Collected runoff is conveyed by a drain system along the back of the lots, which outfalls to the main channel at DP 3.5.

Outfall 4 (DP 4)

- Basins OS4.1 and OS4.2 are undeveloped basins. Runoff generated in these basins follows an existing drainage channel and proposed swale to a proposed culvert at DP 4.1. The culvert outfalls to the main Cottonwood Creek Channel at DP 4.
- Basin B1 is a developed basin. Runoff generated in this basin is routed via curb and gutter to a Type-R inlet in sump at DP 4.2 on the north side of Viewside Way. Another Type-R inlet on the south side of Viewside Way captures nuisance flows on this side of the street, although it does not capture substantial flows during the minor or major event. These inlets outfall to the proposed culvert utilized by Basins OS4.1 and OS4.2.

III. STORM DRAINAGE CRITERIA

A. Regulations:

- Criteria used in the development of this Phase III Drainage Report include:
  - The Douglas County Storm Drainage Design and Technical Criteria Manual
  - The Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual was also used as a reference and guide for criteria

B. Drainage Studies, Outfall Systems Plans, Site Constraints

- The site is discussed but not included within:
  - Flood Hazard Area Delineation, Cottonwood Creek by Muller Engineering Company Inc., August 2011
  - "Cottonwood Creek (Downstream of Lincoln Avenue) Outfall Systems Plan" by Muller Engineering Company, August 2010.
- Existing drainage reports for the site and surrounding areas include:
  - Master Drainage Plan for Ridgegate – Cottonwood Creek Drainage Basin by Merrick & Company, dated January 2012.
  - Phase III Drainage Report for Tract O Access Road (Cottonwood Creek Flow Control Structure) Rampart Range Metropolitan District No. 1, Merrick & Company, April 2012.

Compliance with these studies is further discussed in Section IV.

C. Hydrology

- Peak storm runoff for the developed basins was determined using the Rational Formula: Q=CIA.
- The Colorado Urban Hydrograph Procedure (CUHP_v1.4.4) was used in conjunction with SWMM 5.1 to determine the runoff for the master basins (including offsite basins upstream of the site), and routing within Cottonwood Creek.
- Rainfall intensities were taken from Figure 6-1, Zone 1, of the *Douglas County Storm Drainage Design and Technical Criteria Manual*.
- The 5-year storm was analyzed as the minor event.
- The 100-year storm was analyzed as the major event.
- There are no detention facilities on site. However, attenuated flow is expected behind the culverts/storm lines at DP 1, DP 3, and DP4 during the major event. The stored volume was calculated using SWMM 5.1. See Appendix C.

- For large upstream basins, rational method is not an appropriate method to estimate runoff. To calculate pipe/inlet capacities, runoff calculated with CUHP for the entire corresponding major basin will be used. For example, for the system discharging at DP 4, Q_{100} used at DP4.1 will be 30.6 cfs. This is the Q100 from the CUHP basin 4, which corresponds to basins B1, B2, OS4.1, and OS4.2. For this reason, the estimated runoff at design points in the SWMM model will be lower than the Rational method calculations and Hydraflow calculations.
- Runoff to area inlets was determined by calculating the total runoff in the basin and dividing by the number of lots in that basin.
- See Appendix B for hydrologic calculations.

D. Hydraulics

- All of the streets contained within the site are local streets.
- For the minor storm event, runoff may spread to back of sidewalk (mountable curb with attached sidewalk) / curb (for vertical curb) or to the crown of the street, whichever is less.
- For the major storm event, the depth of water at the flowline shall not exceed 12 inches or the depth up to the point where the water is no *longer* contained within the public road right-of-way, whichever is less.
- There are three street sections, which are described below. Section numbers (shown in parenthesis) correspond to the summary table which follows.
  - 42’ R.O.W.-R.O.W., superelevated, with mountable curb and attached walk on the lower side of the street (1). The other side of the street will vertical curb with no walk.
  - 42’ R.O.W-R.O.W., crowned, with mountable curb and attached walk on the lower side of the street (2). There will be a transition to vertical curb at inlet locations (3). The other side of the street will not have walk, and will have mountable curb in front of lots (4) and vertical curb otherwise (5).
  - 46’ R.O.W-R.O.W., crowned, with vertical curb (6).
- Maximum flow depths at flowline are:

Maximum Allowable Depth at Flowline		
Section	**Minor Event**	**Major Event**
1	4.96”	5.46”
2	5.12”	5.46”
3	5.12”	7.56”
4	4.00”	4.98”
5	5.12”	7.08”
6	4.64”	8.28”

- Street and inlet capacities were evaluated with the UDFCD’s UD-Inlet_v4.03 spreadsheet. See Appendix C for hydraulic calculations.

- Hydraulic grade lines were calculated using Bentley Hydraflow Storm Sewers v10.40. Hydraulic Grade Lines for the minor event will be within the pipe. Hydraulic Grade Lines for major event flows will be a minimum of 1' below the proposed surface at the storm system structures.
- EPA SWMM 5.1 was used to model the hydraulics within Cottonwood Creek.
- Bentley FlowMaster V8.1 was used to calculate the swale capacities.
- UD-Culvert_v3.05 was used to calculate the head vs. capacity for the culverts at DPs 1, 3, and 4.
- Hydraflow Express Extension for Autodesk Autocad Civil 3d was used to calculate the depth of flow during overtopping of the road at DPs 1,3, and 4 during an emergency condition where the culverts are completely plugged. To do this, a circular weir with the radius set to the vertical curve radius of the road was used.

IV. EXISTING STORMWATER CONVEYANCE OR STORAGE FACILITIES

A. Existing Stormwater Conveyance Facilities

Storm sewers

- There are two existing 5' Type R inlets, one on either side of Bluffside Drive, at DP 10.1 and DP 10.2. These inlets outfall to an existing storm system in Cabela Dr. (See Appendix E for excerpts from reports). A comparison of the previous design flows and current design flows are presented below:

Contributing Runoff to Cabela St. Storm System					
Tract O Drainage Report			Current		
DP	Basin	Q_{100} (cfs)	DP	Basin	Q_{100} (cfs)
0	A2	2.3	7.2*	D1*	1.4
1	A1	14.5	7.1	OS7	- **
2	B	1.7	10.1	F1	4.9
3	C	3.7	10.2	F2	7.2
	Total	**22.2**		**Total**	**13.5**

* Q_{100} presented is the overflow from DP 7.2 to the existing inlet identified at DP 0 in the *Tract O Drainage Report*. See Appendix E, pg. E5 for previous report inlet calculations.

**Because the previous Basins A1, A2, and a portion of Basin C (current Basins OS7, D1, and D2) are now being conveyed directly to the Cottonwood Creek Channel, the total piped flow to the existing system in Cabela Drive is reduced.

Cottonwood Creek

- The site currently drains via the unimproved Cottonwood Creek. The site outfalls to an existing 48" RCP at current DP 9. This RCP outfalls to the "Cottonwood Creek Flow Control Structure" as identified in the *Tract O Drainage Report*.
- The SWMM model produced in the *Pond 311 Drainage Report* is the most recent. This model identifies storage unit "P" as the Cottonwood Creek Flow Control Structure. This

WATER QUALITY FOR CALIBRE SITE PROVIDED DOWNSTREAM, FUTURE ROADWAY AREA AND IMPERVIOUSNESS TAKEN INTO ACCOUNT

point had a maximum inflow of 412.38 cfs in the major event. The current design for Ridgegate – Section 22, Filing No. 1 will restrict runoff reaching DP 9 to 325.17 cfs.

B. Existing Stormwater Storage Facilities

- There are no existing stormwater storage facilities onsite. Ponding to 6093.58' within Cottonwood Creek channel behind the 48" RCP at DP 9 was expected with the *Tract O Drainage Report*. (Note that with this report, proposed ponding at DP 9 = 6092.60').
- There is the existing Full Spectrum Detention facility, Pond 311, east of Ridgegate Parkway. This will provide detention and water quality for the site (See Appendix E for excerpts from Pond 311 Drainage Report).

V. PROPOSED STORMWATER CONVEYANCE OR STORAGE FACILITIES

A. Proposed Stormwater Conveyance Facilities

- The proposed drainage will follow historic flow patterns as closely as possible.

Storm Sewers

- Offsite basins are routed via existing drainage channels, grass swales, and lined channels to low points, where runoff is conveyed via proposed storm lines underneath the proposed roads to the main Cottonwood Creek Channel.
- Runoff generated by developed areas will be routed via curb and gutter or rear-yard swales to inlets or FES. The lines will outfall to the main channel utilizing the same storm lines as the delineated offsite basins.
- The back-of-wall drainage lines will be private and will be privately maintained. These systems will consist of 12"-18" smooth-interior pipes, connected by 12" Nyloplast Drain Basin with 12" Nyloplast standard grate inlet (or approved equivalent).
- Two separate runoff calculations were used to size the back-of-lot drainage systems.
  - To size the storm lines in the back-of-lot and back-of-wall systems, runoff calculated by rational method for drainage basins A3, B2, C5, and E was divided by the number of lots in that basin to determine the inflow to each inlet in each of those basins. Those inlet inflows were input to each landscape inlet within the Hydraflow model used to size the storm lines.
  - To size the inlet grates, a separate and more conservative flow calculation was used. The runoff for an individual lot was determined using the rational method. Lot 30 was used as representative lot and represents the most conservative condition (shortest initial time of concentration, and 1% slope in the swale.) The individual runoff was determined to be 1.0 cfs (Appendix C, pg. C29). 12" Nyloplast dome grates and drain basins will be used, with a required ponding depth of 3". This head will be provided by depressing each landscape inlet 3".

- All proposed storm systems will be public except for:
  - Back-of-wall and back-of-lot drain lines with associated inlets.
  - 24" Trapezoidal lined swales (SmartDitch or equivalent).
- Public infrastructure includes storm system within the street, proposed culverts, and outlet works.

Swales

- 24" Trapezoidal lined swales (SmartDitch or equivalent) are proposed along the back of walls in Basin OS3.1 and OS5. See Appendix C for hydraulic calculations.
- Triangular swales protected with turf reinforcement mats (TRM) are proposed at various locations through the site. A manning's n of 0.025 was used for the day-one installed condition, and n=0.030 was used for the fully vegetated condition. See Appendix A for locations of swales, and Appendix C pgs C83 and C87-C210 for hydraulic calculations.

Cottonwood Creek

- The unimproved Cottonwood Creek will be utilized to convey the runoff from the Ridgegate – Section 22, Filing No. 1 site to the outfall at DP 9. To achieve pre-development flows within the channel during the major event, runoff in upstream channels will be attenuated by a 36" culvert at DP 1, 30" culvert at DP 3, and an 18" RCP at DP 4.

  A SWMM model for the system/network was produced to ensure that the current design is consistent with the model provided with the *Pond 311 Drainage Report* (the most recent for Cottonwood Creek). The results are presented below:

Pond 311 Report		Current Report	
Design Point	Maximum Inflow (cfs)	Design Point	Maximum Inflow (cfs)
J2	111.68	J2	110.61
J3	232.7	J3	202.83
15F	261.61	15F1.2	230.90
15G	296.86	15G	291.59
P	412.38	P	325.17

- The proposed peak runoff rates during the 100-year event are compared at the design points presented in the table above for current model and that presented in the *Pond 311 Drainage Report*.
- The proposed runoff at all compared nodes is lower than the runoffs expected in the *Pond 311 Drainage Report*. The current design is not anticipated to negatively impact the channel.
- See appendix A for current SWMM exhibit, Appendix C for current SWMM model output, and Appendix E for SWMM Model output from *Tract O Drainage Report*.

B. Proposed Stormwater Storage Facilities

- Detention and water quality for Ridgegate – Section 22, Filing No. 1 are provided for in Pond 311. The current proposed land use is consistent with that anticipated in the *Pond 311 Drainage Report*, therefore no improvements to Pond 311 are proposed with the construction of this filing.
- There are no proposed detention facilities on site. Attenuation is expected at the culverts at DPs 1, 3, 4, and 9. See Appendix C for the SWMM model results, and Appendix A for the drainage exhibits showing the extents of ponding anticipated.

VI. WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

A. Non-structural Best Management Practices

- Discussion of non-structural Best Management Practices is included in a separate stormwater management plan.

B. Structural Best Management Practices

- Discussion of structural Best Management Practices is included in a separate stormwater management plan.

VII. FLOODPLAIN MODIFICATIONS

A. Major Drainageway – Undesignated Floodplain

- No part of the project is anticipated to be in an undesignated floodplain.

B. Major Drainageway – Designated Floodplain

- The site is out of the floodplain as designated by FEMA Map Number 08035C0044F (See Appendix A), as well as the floodplain designated in the FHADs.

VIII. POTENTIAL PERMITTING REQUIREMENTS

- A GESC permit will be required before commencement of construction.
- There are wetlands present onsite, but they will not be disturbed with development. No wetlands permit will be required.
- There will be no additional permitting requirements at this time.

IX. SUMMARY

- The proposed drainage plan is in general conformance with Douglas County Storm Drainage Standards and City of Lone Tree Standards.
- A variance is requested to the criteria set in *Douglas County Drainage Manual*, Section 9.8.1, requiring piped flows velocities < 18 fps. Velocities in the 100-year event in the 30" RCP culvert at DP 3 are calculated as 19.91 fps. Changes to the pipe to reduce velocities are not practical at this location; the pipe is sized to restrict flows within downstream Cottonwood Creek to allowable levels per the *Pond 311 Report*, and invert elevations are set to existing channel grades.

Summary of flows for the 100-year event are as follows:

- The runoff to the storm system in Cabela Drive will be reduced by **8.7 cfs** in the major event. The runoff reaching the existing 10' inlet on the south side of Cabela Drive, west of Bluffside Drive will be reduced by **0.9 cfs**.
- The maximum inflow reaching DP 9 at the Cottonwood Creek Flow Control Structure was calculated to be **412.38 cfs** in the *Pond 311 Drainage Report*. By attenuating runoff behind the culverts at DPs 1, 3, and 4 in the major event, the anticipated inflow at DP 9 in the current model is **325.17 cfs**.
- The expected inflows at the compared nodes within the portion of Cottonwood Creek contained within the site are less than those expected with the *Pond 311 Drainage Report*. It is proposed that the main portion of Cottonwood Creek remain unimproved.

X. LIST OF REFERENCES

1. *Douglas County Storm Drainage Design and Technical Criteria*, amended July 8, 2008.

2. *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3*. Urban Drainage and Flood Control District, January 2016

3. *Flood Hazard Area Delineation, Cottonwood Creek,* Muller Engineering Company Inc., *August 2011,*

4. *Cottonwood Creek (Downstream of Lincoln Avenue) Outfall Systems Plan,* Muller Engineering Company, August 2010.

5. *Master Drainage Plan for Ridgegate – Cottonwood Creek Drainage Basin by Merrick & Company*, dated January 2012.

6. *Phase III Drainage Report for Tract O Access Road (Cottonwood Creek Flow Control Structure) Rampart Range Metropolitan District No. 1*, Merrick & Company, April 2012.

7. *Phase III Drainage Report for Detention Pond 311 Retrofit Rampart Range Metropolitan District No. 1, Merrick & Company, December 2013.*

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*NOTE PERCENT IMPERVIOUS VALUES USED PER LAND TYPE ARE OUTDATED ACCORDING TO MARCH 2024 UPDATE TO MHFD CRITERIA MANUAL VOLUME 1 CHAPTER 6

COMPOSITE 'C' FACTORS

LOCATION: City of Lonetree DATE : 1/24/2017

BASIN DESIGNATION	UNDEV/LAWN	SINGLE FAMILY	RURAL SF	WALK	PAVED	TOTAL	SOIL TYPE	UNDEV/LAWN			SINGLE FAMILY			RURAL SF			WALK			PAVED			COMP. C FACTOR		
								%I	5 YR	100 YR	%I	5 YR	100 YR	%I	5 YR	100 YR	%I	5 YR	100 YR	%I	5 YR	100 YR	%I	5 YR	100 YR
OS1.1	0.98					0.98	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
OS1.2	25.75		16.65		1.88	44.28	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	12.9	0.16	0.57
Outfall 1	**26.73**		**16.65**		**1.88**	**45.26**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**12.7**	**0.16**	**0.57**
OS2.1	0.86					0.86	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
OS2.2	12.91		2.39		0.17	15.47	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	5.9	0.10	0.53
OS2.3	1.33					1.33	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
Outfall 2	**15.09**		**2.39**		**0.17**	**17.65**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**5.4**	**0.10**	**0.53**
OS3.1	6.21					6.21	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
A1	1.72	0.25		0.11	0.49	2.56	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	28.5	0.30	0.64
A2.1	0.40	0.13		0.05	0.53	1.11	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	57.7	0.55	0.77
A2.2	0.10	0.20			0.30	0.60	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	65.3	0.62	0.80
OS3.2	88.88		10.67			99.56	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	3.9	0.09	0.53
A3		1.30				1.30	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	45.0	0.44	0.71
Outfall 3	**97.31**	**1.87**	**10.67**	**0.15**	**1.32**	**111.32**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**5.7**	**0.10**	**0.53**
OS4.1	3.16				0.32	3.48	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	11.0	0.15	0.56
OS4.2	14.22				0.31	14.53	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	4.1	0.09	0.53
B1	1.34	0.81			0.77	2.92	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	39.7	0.40	0.69
B2		2.33				2.33	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	45.0	0.44	0.71
Outfall 4	**18.72**	**3.14**			**1.40**	**23.27**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**13.7**	**0.17**	**0.57**
OS5	7.51					7.51	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
C1.1	1.77				0.30	2.07	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	16.0	0.19	0.58
C1.2	0.36	0.76				1.12	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	31.2	0.32	0.65
C2	0.66	0.37		0.05	0.47	1.56	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	45.0	0.44	0.71
C3	1.05				0.12	1.17	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	11.8	0.15	0.56
C4	0.10	0.35		0.11	0.42	0.98	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	69.3	0.66	0.82
C5	0.33	2.36				2.69	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	39.8	0.40	0.69
Outfall 5	**11.79**	**3.84**		**0.16**	**1.31**	**17.10**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**20.0**	**0.23**	**0.60**
OS6.1	6.87					6.87	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
OS6.2	9.86					9.86	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
OS6.3	2.11					2.11	C	2	0.07	0.52	45	0.44	0.71	20	0.23	0.60	90	0.84	0.91	100	0.92	0.96	2.0	0.07	0.52
Outfall 6	**18.84**					**18.84**	**C**	**2**	**0.07**	**0.52**	**45**	**0.44**	**0.71**	**20**	**0.23**	**0.60**	**90**	**0.84**	**0.91**	**100**	**0.92**	**0.96**	**2.0**	**0.07**	**0.52**

Site-specific conditions may vary from the representative values presented in this chapter. The engineer is responsible for assuring that the selected imperviousness values represent the imperviousness of the catchment or the proposed development. During master planning or in early stages of design, select imperviousness values that are unlikely to be exceeded as final design plans are developed to avoid the need to increase the size of infrastructure during later design stages.

TABLE 6-2. RECOMMENDED IMPERVIOUSNESS BY LAND USE

LAND USE/DENSITY	IMPERVIOUSNESS
Residential	
Single-family Housing (SFH) – Rural (0 – 3 du/ac)	35%
SFH – Low & Medium-density (3 – 5 du/ac)	55%
SFH – High-density (5 - 20 du/ac)	65%
Manufactured Housing (>= 10 du/ac)	65%
Multi-family Housing (MFH) – Medium-density (5 – 20 du/ac)	65%
MFH – High-density MFH (>20 du/ac)	70%
Commercial	
Commercial – Low-density	65%
Commercial – Medium- to High-density	80%
Commercial – Urban Core	90%
Industrial/Institutional	
Schools	55%
Office/institutional	65%
Industrial Areas	75%
Solar Fields, Gravel Cover[1,2]	60%
Solar Fields, Grass Cover[1,2]	45%
Parks and Open Space	
Open Space, Undisturbed Native Grasses	5%
Community Parks	25%
Neighborhood Parks	15%
Golf Courses	30%
Cemeteries	25%

Note: Recommended imperviousness values shown in the table are the minimum imperviousness values for a specific land use. It is the engineer's responsibility to select imperviousness values that appropriately reflect the actual density of the proposed development.

[1] Use these values at the master planning scale or when the specific layout of panels is not known. Use values from the surface type (Table 6-3) at the site planning and design stage when panel width, panel spacing, and panel orientation relative to contours are known.

[2] Assumes 1:1 ratio of panels to aisles. See MHFD's technical memorandum regarding *Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values* for additional information on procedures to reflect other impervious areas such as roads and pads that may be part of a solar field and layouts with wider inter-panel spacing.

TABLE 6-3. RECOMMENDED IMPERVIOUSNESS BY SURFACE TYPES

SURFACE TYPES		IMPERVIOUSNESS
Roadways and Paved Streets		95%
Concrete Driveways and Walks		95%
Roofs		95%
Gravel	No Traffic (Pedestrian Use)	40%
	Low-traffic Areas (Maintenance Paths and Substations)	60%
	High-traffic Areas (Roadways and Parking)	80%
Disturbed Soil (Including Lawns, Managed/Active Turf, Landscaped Areas with Water-Wise Vegetation, and Uncompacted Gravel/Mulch Planting Beds)		20%
Undisturbed or Decompacted Soil (Native Grasses and Open Space Areas)		5%
Artificial Turfs[1]	Landscape Applications (without Subgrade Drainage Layer)	25% – 45%
	Sport Fields (with Underdrain Pipe System)	60% – 80%
Water Surfaces (Lakes/Reservoirs/Irrigation Ponds)		100%
Solar Fields[2]	Grass Cover (Varies with Panel Orientation Relative to Ground Contours)	10% – 45%
	Gravel Cover (Varies with Panel Orientation Relative to Ground Contours)	50% – 75%
Historic Flow Analysis, Greenbelts, Agricultural		5%
Newly Graded Areas		65%
Stormwater Control Measures[3]	Retention Ponds & Constructed Wetland Ponds	100%
	Rooftop Systems – Blue Roofs	95%
	Rooftop Systems – Green Roofs (extensive)	65%
	Rooftop Systems – Green Roofs (intensive)	50%
	Permeable Pavement – CGP/PGP/RGP	55%
	Permeable Pavement – PICP	45%
	Extended Detention Basins	25%
	Receiving Pervious Areas (incl. Grass Buffers & Grass Swales)	20%
	Bioretention & Sand Filters	10%

[1] Consult with the manufacturer to get a recommended value.

[2] Assumes 1:1 ratio of panels to aisles. See MHFD's technical memorandum regarding *Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values* for additional information on procedures for determining percent imperviousness based on panel width, panel spacing, and panel orientation relative to ground contours and how to reflect other impervious areas such as roads and pads that may be part of a solar field and layouts with wider inter-panel spacing.

[3] See MHFD's technical memorandum regarding *Evaluation of Percent Imperviousness for Stormwater Control Measures* for background information.

Calibre

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

SF-3 MIN

DESIGN STORM: 5-YEAR DEVELOPED

MAS

KLH

LOCATION: Ridgegate Section 22 - Filing 1 FINAL City of Lonetree 1/24/2017

		DIRECT RUNOFF							TOTAL RUNOFF					REMARKS
STRUCTURE	DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	SUM AREA	SUM Tc (min.)	I (in./hr.)	SUM CA	TOTAL Q (cfs)	
FES-1	1.1	OS1.1	0.98	0.02	15	0.02	3.23	0.1						OS1.1
FES-1	1.1	OS1.2	44.28	0.12	21	5.10	2.72	13.9	45.26	21.3	2.72	5.11	13.9	OS1.1+OS1.2
	1	Outfall 1							45.26	21	2.72	5.11	13.9	
FES-15	2.1	OS2.1	0.86	0.02	14	0.02	3.39	0.1						OS2.1
IN-9	2.1	OS2.2	15.47	0.05	19	0.81	2.92	2.4	17.65	18.7	2.92	0.85	2.5	OS2.1-OS2.3
FES-15	2.1	OS2.3	1.33	0.02	16	0.02	3.20	0.1						OS2.3
	2	Outfall 2							17.65	19	2.92	0.85	2.5	
FES-15	3.1	OS3.1	6.21	0.02	19	0.11	2.93	0.3						OS3.1
IN-1	3.2	A1	2.56	0.25	13	0.65	3.45	2.2						A1
IN-2	3.3	A2.1	1.11	0.51	8	0.57	4.11	2.3						A2.1
IN-2	3.3	A2.2	0.60	0.58	7	0.35	4.38	1.5	1.71	8.5	4.11	0.92	3.8	A2.1+A2.2
FES-12	3.4	OS3.2	99.56	0.03	38	3.48	1.94	6.8	10.47	38.0	1.94	5.16	10.0	A1-A2.2+OS3.1+OS3.2
Landscape Inlets	3.5	A3	1.30	0.40	10	0.52	3.94	2.0						A3
	3	Outfall 3							111.32	38	1.94	5.68	11.0	

Calibre

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

SF-3 MIN

DESIGN STORM: 5-YEAR DEVELOPED

MAS

KLH

LOCATION: Ridgegate Section 22 - Filing 1 FINAL City of Lonetree 1/24/2017

		DIRECT RUNOFF							TOTAL RUNOFF					REMARKS
STRUCTURE	DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	SUM AREA	SUM Tc (min.)	I (in./hr.)	SUM CA	TOTAL Q (cfs)	
FES-17	4.1	OS4.1	3.48	0.10	18	0.34	2.97	1.0						OS4.1
FES-17	4.1	OS4.2	14.53	0.04	21	0.53	2.78	1.5	18.01	20.5	2.78	0.87	2.4	OS4.1+OS4.2
IN-3	4.2	B1	2.92	0.35	13	1.03	3.50	3.6						B1
Landscape Inlets	4.3	B2	2.33	0.40	16	0.94	3.19	3.0						B2
	4	Outfall 4							23.27	21	2.78	2.84	7.9	
FES-16	5.1	OS5	7.51	0.02	18	0.13	3.01	0.4						OS5
IN-6	5.2	C1.1	2.07	0.14	17	0.30	3.05	0.9						C1.1
FES-14	5.3	C1.2	1.12	0.28	11	0.31	3.72	1.2						C1.2
IN-4	5.4	C2	1.56	0.40	6	0.62	4.53	2.8						C2
IN-4	5.5	C3	1.17	0.10	13	0.12	3.45	0.4	2.72	13.2	3.45	0.75	2.6	C2+C3
IN-5	5.6	C4	0.98	0.62	8	0.60	4.17	2.5						C4
Landscape Inlets	5.7	C5	2.69	0.35	15	0.95	3.29	3.1						C5
	5	Outfall 5							17.10	18	3.01	3.04	9.2	

Calibre

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

DESIGN STORM: 100-YEAR DEVELOPED

SF-3 MAJ

MAS
KLH

LOCATION: Ridgegate Section 22 - Filing 1 FINAL City of Lonetree 1/24/2017

		DIRECT RUNOFF							TOTAL RUNOFF					REMARKS
STRUCTURE	DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	SUM AREA	SUM Tc (min.)	I (in./hr.)	SUM CA	Total Q (cfs)	
FES-1	1.1	OS1.1	0.98	0.52	15	0.51	5.87	3.0						OS1.1
FES-1	1.1	OS1.2	44.28	0.57	21	25.07	4.94	123.9	-	-	-	-	82.6 (2)	OS1.1+OS1.2
	1	Outfall 1							45.26	-	-	-	82.6 (2)	
FES-15	2.1	OS2.1	0.86	0.52	14	0.45	6.16	2.7						OS2.1
IN-9	2.1	OS2.2	15.47	0.53	19	8.26	5.30	43.8	-	-	-	-	28.5 (2)	OS2.1-OS2.3
FES-15	2.1	OS2.3	1.33	0.52	16	0.69	5.81	4.0						OS2.3
	2	Outfall 2							17.65	-	-	-	28.5 (2)	
FES-15	3.1	OS3.1	6.21	0.52	19	3.21	5.32	17.1						OS3.1
IN-1	3.2	A1	2.56	0.64	13	1.63	6.27	10.2						A1
IN-2	3.3	A2.1	1.11	0.77	8	0.85	7.48	6.4						A2.1
IN-2	3.3	A2.2	0.60	0.80	7	0.48	7.97	3.8	1.71	8.5	7.48	1.33	10.0	A2.1+A2.2
FES-12	3.4	OS3.2	99.56	0.53	38	52.34	3.54	185.1	-	-	-	-	197.8 (2)	A1-A2.2+OS3.1+OS3.2
Landscape Inlets	3.5	A3	1.30	0.71	10	0.92	7.16	6.6						A3
	3	Outfall 3							111.32	-	-	-	197.8 (2)	

Calibre

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

DESIGN STORM: 100-YEAR DEVELOPED

SF-3 MAJ

MAS
KLH
1/24/2017

LOCATION: Ridgegate Section 22 - Filing 1 FINAL City of Lonetree

		DIRECT RUNOFF							TOTAL RUNOFF					REMARKS
STRUCTURE	DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	SUM AREA	SUM Tc (min.)	I (in./hr.)	SUM CA	Total Q (cfs)	
FES-17	4.1	OS4.1	3.48	0.56	18	1.94	5.41	10.5						OS4.1
FES-17	4.1	OS4.2	14.53	0.53	21	7.65	5.05	38.6	-	-	-	-	47.0 [2]	OS4.1+OS4.2
IN-3	4.2	B1	2.92	0.69	13	2.01	6.36	12.8						B1
Landscape Inlets	4.3	B2	2.33	0.71	16	1.66	5.80	9.6						B2
	4	Outfall 4							23.27	-	-	-	47.0 [3]	
FES-16	5.1	OS5	7.51	0.52	18	3.88	5.48	21.3						OS5
IN-6	5.2	C1.1	2.07	0.58	17	1.20	5.54	6.6						C1.1
FES-14	5.3	C1.2	1.12	0.65	11	0.73	6.76	4.9						C1.2
IN-4	5.4	C2	1.56	0.71	6	1.11	8.23	9.1						C2
IN-4	5.5	C3	1.17	0.56	13	0.66	6.27	4.1	2.72	13.2	6.27	1.76	11.0	C2+C3
IN-5	5.6	C4	0.98	0.82	8	0.80	7.58	6.1						C4
Landscape Inlets	5.7	C5	2.69	0.69	15	1.85	5.98	11.1						C5
	5	Outfall 5							17.10	-	-	-	32.8 [2]	

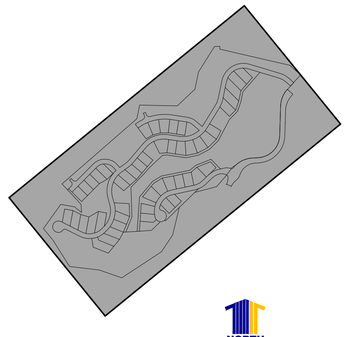
RIPRAP PROTECTION TABLE

DESIGN PT.	TYPE		LENGTH & WIDTH(FT)	DEPTH (FT)
DP 1	VL	L.T. Basin	20	1
DP 2	L	L.T. Basin	15	1.5
DP 3	L	L.T. Basin	20	1.5
DP 3.4 (outlet)	VL	L.T. Basin	15	1
DP 4	VL	L.T. Basin	15	1
DP 5	VL	L.T. Basin	20	1
DP 6	VL	L.T. Basin	15	1
DP 7	L	Pad	15	1.5
DP 8	L	Pad	15	1.5

SUMMARY RUNOFF TABLE

DESIGN PT.	BASIN	AREA	ROUTED Q_5	ROUTED Q_{100}
		(ACRES)	(CFS)	(CFS)
1.1	OS1.1	0.98	0.1	3.0
	OS1.2	44.3	13.9	82.6 *
2.1	OS2.1	0.86	0.1	2.7
	OS2.2	15.5	2.5	28.5 *
	OS2.3	1.33	0.1	4.0
3.1	OS3.1	6.21	0.3	17.1
3.2	A1	2.56	2.2	10.2
3.3	A2.1	1.11	2.3	6.4
	A2.2	0.60	3.8	10.0
3.4	OS3.2	99.6	10.0	197.8 *
3.5	A3	1.30	2.0	6.6
4.1	OS4.1	3.48	1.0	10.5
	OS4.2	14.53	2.4	47.0 *
4.2	B1	2.92	3.6	12.8
4.3	B2	2.33	3.0	9.6
5.1	OS5	7.51	0.4	21.3
5.2	C1.1	2.07	0.9	6.6
5.3	C1.2	1.12	1.2	4.9
5.4	C2	1.56	2.8	9.1
5.5	C3	1.17	2.6	11.0
5.6	C4	0.98	2.5	6.1
5.7	C5	2.69	3.1	11.1
6.1	OS6.1	6.87	0.3	17.2
	OS6.2	9.86	0.8	30.6 *
	OS6.3	2.11	0.1	6.4
7.1	OS7	4.55	0.8	13.7
7.2	D1	0.61	1.7	4.0
7.3	D2	0.59	1.3	3.5
8.1	OS8	4.09	0.4	11.2
8.2	E	1.21	2.1	6.8
9	CH	5.29	30.4	321.0 *
10.1	F1	0.84	1.6	4.9
10.2	F2	1.00	2.2	7.2

* Runoff values taken from SWMM model



NORTH

KEYMAP

LEGEND

- PROPOSED MAJOR CONTOUR — 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR — 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM DRAIN PIPE
- PROPOSED STORM DRAIN INLET
- PROPOSED RIPRAP PAD
- PROPOSED SWALE
- PROPERTY LINE
- DIRECTIONAL FLOW ARROW
- BASIN LINE
- 100-YR PONDING EXTENTS
- EMERGENCY OVERFLOW ARROW
- DESIGN POINT
- PROPOSED BASIN LABEL
- AREA (AC.) — A1 (1.00 | .40 | .60): BASIN DESIGNATION; MINOR RUNOFF COEF.; MAJOR RUNOFF COEF.

UNCC
CALL BEFORE YOU DIG
811
OR
1-800-922-1987
Utility Notification Center of Colorado

City of Lone Tree

Date

These construction plans have been reviewed by the City of Lone Tree for street and drainage improvements only.

Engineering Division Acceptance Block

DATE	REVISION DESCRIPTION
6	
5	
4	
3	
2	
1	

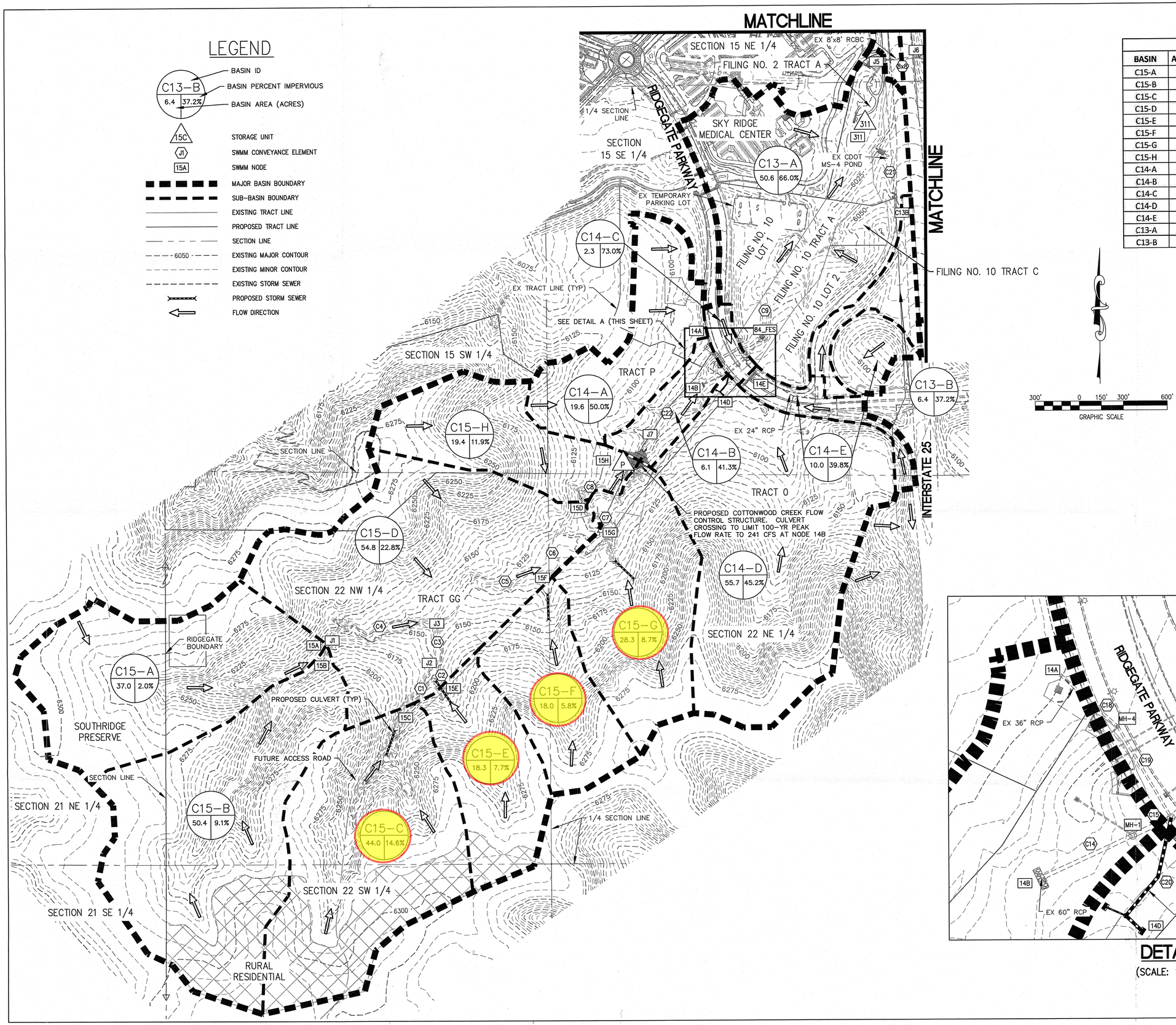
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Job Number:
Prepared For: CENTURY
Designer: KLH | Drafter: MAS | Checked: TAJ
1 inch = 1 ft. Horizontal

Calibre Engineering, Inc.
9090 South Ridgeline Boulevard, Suite 105
Highlands Ranch, CO 80129 (303) 730-0434
www.calibre-engineering.com
Construction Management Civil Engineering Surveying

RIDGEGATE - SECTION 22, FILING 1
PHASE III DRAINAGE REPORT
PROPOSED DRAINAGE PLAN

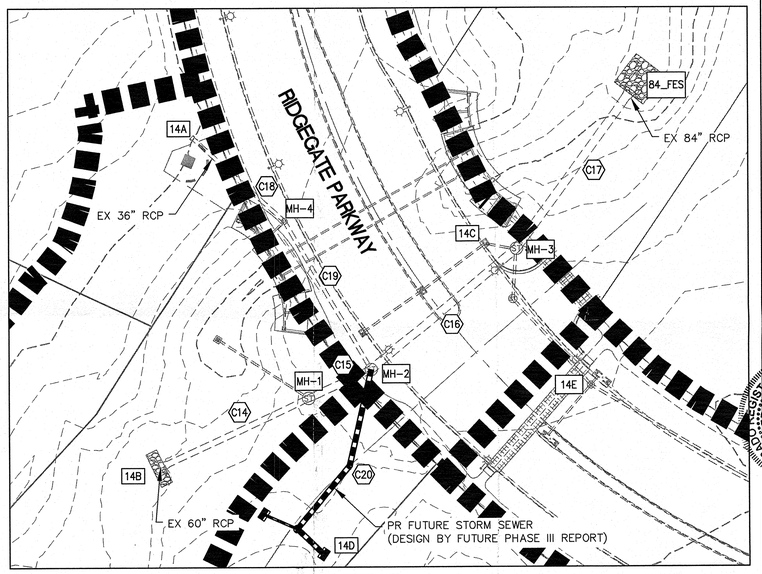
Sheet DR2 2 of 2
Date JANUARY 24, 2017

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XREFS: W-Wetlands-RECVD, W-Wetlands, X-20PDR, 10PUT, 10KMDR, 10EPN, 10EUT, 10PPN, 10BASE,



BASIN SUMMARY TABLE			
BASIN	AREA (ACRES)	% IMPERVIOUS	Q_{100} (CFS)
C15-A	37.0	2.0	52.7
C15-B	50.4	9.1	70.6
C15-C	44.0	14.6	81.9
C15-D	54.8	22.8	91.1
C15-E	18.3	7.7	30.4
C15-F	18.0	5.8	30.0
C15-G	28.3	8.7	58.9
C15-H	19.4	11.9	27.7
C14-A	19.6	50.0	60.4
C14-B	6.1	41.3	17.0
C14-C	2.3	73.0	10.1
C14-D	55.7	45.2	224.6
C14-E	10.0	39.8	30.2
C13-A	50.6	66.0	198.0
C13-B	6.4	37.2	14.5

SWMM SUMMARY			
SWMM CONVEYANCE ELEMENT	CONVEYANCE ELEMENT TYPE	LOCATED WITHIN BASIN	Q_{100} (CFS)
C1	CHANNEL	C15-D	81.9
C2	CHANNEL	C15-D	30.4
C3	CHANNEL	C15-D	111.7
C4	CHANNEL	C15-D	124.5
C5	CHANNEL	C15-D	232.7
C6	CHANNEL	C15-D	261.3
C7	CHANNEL	C14-B	314.9
C8	CHANNEL	C15-H	404.7
C9	CHANNEL	C13-A	470.1
C14	60" RCP	C14-B	240.7
C16	84" RCP	C14-C	434.9
C17	84" RCP	C13-A	473.6
C18	36" RCP	C14-C	62.4
C19	36" RCP	C14-C	61.1
C20	48" RCP	C14-D	217.6
C21	CHANNEL	C13-A	14.6
C22	CHANNEL	C14-B	236.5
8x8	8'x8' RCBC	C13-A	340.7



DETAIL A
(SCALE: 1" = 60')

CALL UNCC
TWO WORKING DAYS
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1-800-922-1987
UTILITY NOTIFICATION CENTER OF COLORADO

MERRICK & COMPANY

THE WAY WE VISION EXCEPTIONAL WORK CHARTERED IN AN APPROACH OF WORK PROVIDED BY MERRICK AND COMPANY FOR A SPECIFIED PROJECT OR PURPOSE. ANY REUSE OF THE DRAWINGS AND SPECIFICATIONS WITHOUT THE WRITTEN CONSENT OF MERRICK AND COMPANY FOR THE SPECIFIC PROJECT OR PURPOSE SHALL BE AT THE USER'S SOLE RISK AND WITHOUT LIABILITY OR LEGAL EXPOSURE TO MERRICK AND COMPANY.

RAMPART RANGE
METRO DISTRICT
NO. 1

8390 E. CRESCENT PARKWAY, SUITE 500
GREENWOOD VILLAGE, COLORADO 80111
PH: 303-779-4525/FAX: 303-773-2050

REVISIONS:				
REV	REVISION DESCRIPTION	DATE:	CHANGED BY:	CHECKED BY: APPROVED BY:

		DATE:
DESIGN BY:	CDB	1/25/12
DRAWN BY:	CDB	1/25/12
CHECKED BY:	BQR	1/25/12
APPROVED BY:	KLL	1/25/12

COTTONWOOD CREEK
MASTER DRAINAGE PLAN

DEVELOPED DRAINAGE MAP
WEST OF I-25

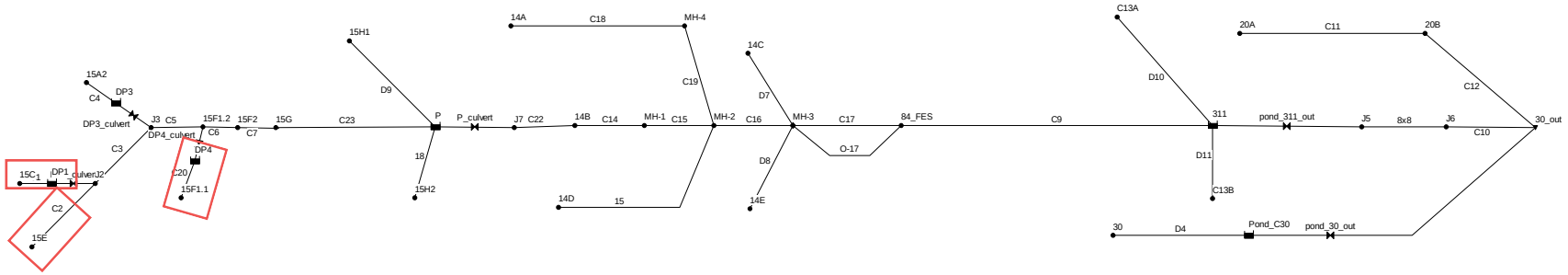
COLORADO REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER D. BOWSER
Colorado Professional Engineer #19366
For and on Behalf of
Merrick & Company
Merrick & Company Job No. 18015087

JOB NO: 65117247
DATE: 1/25/12
SHEET 02 OF 03

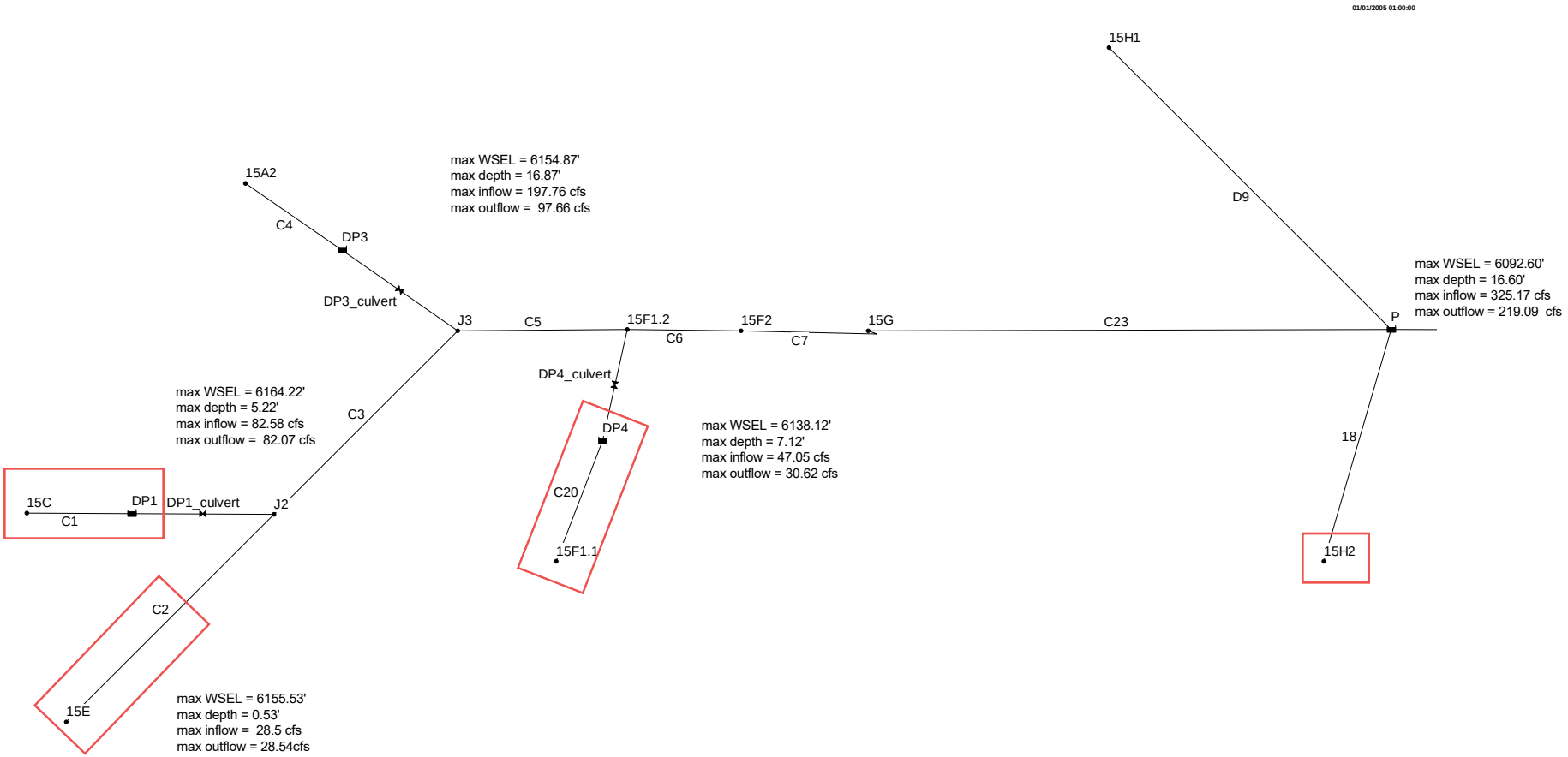
Q:\DEN\Projects\65Z7-01-RRMD Overall\Design\2011-01 Cottonwood Creek Master\Drainage\Basin Maps\Drainage Map - Developed.dwg, Layout1, 1/26/2012 4:55:51 PM, 1:1

COTTONWOOD CREEK MASTER: 100-YEAR DEVELOPED

01/01/2005 01:00:00



COTTONWOOD CREEK MASTER: 100-YEAR DEVELOPED

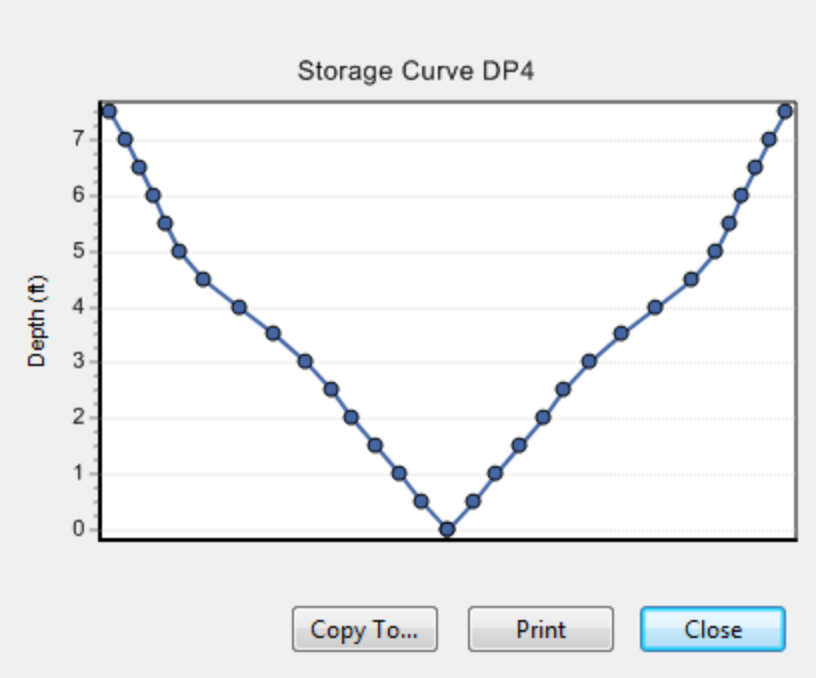


****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
14A	JUNCTION	115.40	115.40	0	00:40	1.8	1.8	0.000
14B	JUNCTION	18.73	221.69	0	01:30	0.343	11.9	0.000
14C	JUNCTION	0.00	0.00	0	00:00	0	0	0.000
14D	JUNCTION	160.17	160.17	0	00:45	3.34	3.34	0.000
14E	JUNCTION	36.68	36.68	0	00:45	0.773	0.773	0.000
15C	JUNCTION	82.58	82.58	0	00:45	2.07	2.07	0.000
15E	JUNCTION	28.49	28.49	0	00:50	0.77	0.77	0.000
15F1.2	JUNCTION	0.00	230.90	0	00:55	0	8.77	0.000
15G	JUNCTION	30.64	291.59	0	00:55	0.802	10.4	0.000
15H1	JUNCTION	11.20	11.20	0	00:45	0.241	0.241	0.000
20A	JUNCTION	25.52	25.52	0	00:40	0.447	0.447	0.000
20B	JUNCTION	31.36	55.90	0	00:45	0.788	1.23	0.000
30	JUNCTION	458.44	458.44	0	00:40	6.34	6.34	0.000
84_FES	JUNCTION	0.00	440.90	0	00:50	0	17.7	0.000
C13A	JUNCTION	167.39	167.39	0	00:45	2.86	2.86	0.000
C13B	JUNCTION	20.18	20.18	0	00:50	0.542	0.542	0.000
J2	JUNCTION	0.00	110.61	0	00:50	0	2.82	0.000
J3	JUNCTION	0.00	202.83	0	00:50	0	7.7	0.000
J5	JUNCTION	0.00	391.36	0	01:20	0	21.1	0.000
J6	JUNCTION	0.00	391.73	0	01:20	0	21.1	0.000
J7	JUNCTION	0.00	219.09	0	01:35	0	11.6	0.000
MH-1	JUNCTION	0.00	221.70	0	01:30	0	11.9	0.000
MH-2	JUNCTION	0.00	406.11	0	00:50	0	16.9	0.000
MH-4	JUNCTION	0.00	80.51	0	00:40	0	1.64	-0.000
15H2	JUNCTION	13.53	13.53	0	00:40	0.272	0.272	0.000
15F2	JUNCTION	32.81	261.96	0	00:55	0.822	9.6	0.000
15A2	JUNCTION	197.76	197.76	0	00:50	4.87	4.87	0.000
15F1.1	JUNCTION	47.05	47.05	0	00:45	1.07	1.07	0.000
30_out	OUTFALL	0.00	474.24	0	01:15	0	28.6	0.000
MH-3	DIVIDER	0.00	440.74	0	00:50	0	17.7	0.000
311	STORAGE	0.00	595.03	0	00:50	0	21.1	0.068
P	STORAGE	13.69	325.17	0	00:55	0.695	11.6	-0.005
Pond_C30	STORAGE	0.00	458.44	0	00:40	0	6.34	0.092
DP3	STORAGE	0.00	197.76	0	00:50	0	4.87	-0.177
DP1	STORAGE	0.00	82.58	0	00:45	0	2.07	1.065
DP4	STORAGE	0.00	47.05	0	00:45	0	1.07	-0.300

gal

FROM CALIBRE REPORT - USED FOR JR SWMM MODEL



Curve Name

DP4

Description

	Depth (ft)	Area (ft2)
1	0	0.01
2	0.5	67.70
3	1	252.35
4	1.5	557.76
5	2	984.39
6	2.5	1470.04
7	3	2171.89
8	3.5	3282.54
9	4	4642.87
10	4.5	6398.94
11	5	7769.58

View... Load... Save... OK Cancel Help

Curve Name

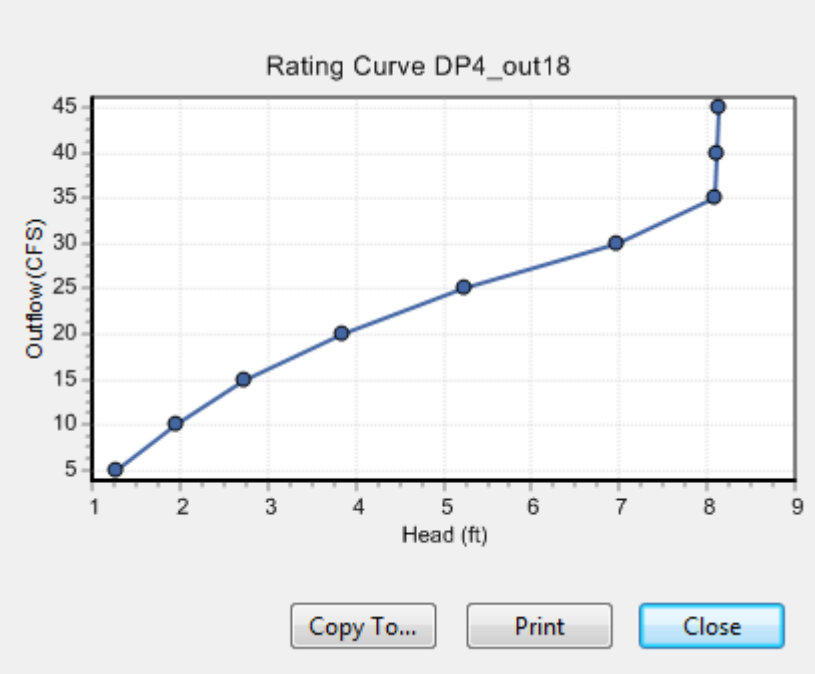
DP4

Description

	Depth (ft)	Area (ft2)
12	5.5	8532.80
13	6	9333.43
14	6.5	10188.80
15	7	11146.66
16	7.5	12272.63
17		
18		
19		
20		
21		
22		

View... Load... Save... OK Cancel Help

FROM CALIBRE REPORT - USED FOR JR SWMM MODEL



Curve Name

DP4_out18

Description

18" RCP at DP4

	Head (ft)	Outflow (CFS)
1	1.28	5
2	1.96	10
3	2.74	15
4	3.84	20
5	5.25	25
6	6.98	30
7	8.09	35
8	8.11	40
9	8.14	45
10		
11		

View...

Load...

Save...

OK

Cancel

Help

MODIFIED BASINS

RURAL RESIDENTIAL

100-YR PONDING WSEL = 6154.87

100-YR PONDING WSEL = 6164.22

100-YR PONDING WSEL = 6138.12

100-YR PONDING WSEL = 6092.60

1	45.3	.16 / .57
2	17.7	.10 / .53
3	111.3	.10 / .53
4	23.3	.17 / .57
5	17.1	.23 / .60
6	18.8	.07 / .52
7	5.8	.21 / .59
8	5.29	.16 / .56
9	16.0	.09 / .53

DP1, DP3, DP4, J2, J3, C2, C3, C5, C6, C7, C23, P, 15A2, 15C, 15E, 15F1.1, 15F1.2, 15F2, 15G, 15H1, 15H2

KEYMAP

LEGEND

- PROPOSED MAJOR CONTOUR — 5250
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR — 5250
- EXISTING MINOR CONTOUR
- PROPOSED STORM DRAIN PIPE
- PROPOSED STORM DRAIN INLET
- PROPOSED RIPRAP PAD
- PROPOSED SWALE
- PROPERTY LINE
- DIRECTIONAL FLOW ARROW
- BASIN LINE
- 100-YR PONDING EXTENTS
- EMERGENCY OVERFLOW ARROW
- DESIGN POINT
- PROPOSED BASIN LABEL — A1 — AREA (AC.) 1.00 — .40 MINOR RUNOFF COEF. — .60 MAJOR RUNOFF COEF. — BASIN DESIGNATION
- 1J SWMM NODE
- P STORAGE UNIT
- C1 SWMM CONVEYANCE ELEMENT

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811
OR
1-800-922-1987
Utility Notification Center of Colorado

City of Lone Tree

Date

These construction plans have been reviewed by the City of Lone Tree for street and drainage improvements only.

Engineering Division Acceptance Block

DATE	REVISION DESCRIPTION
	6
	5
	4
	3
	2
	1

Drawing Name: X-PDR.dwg
Job Number:
Prepared For: CENTURY
HORIZONTAL SCALE: 1"=200' (0, 100, 200, 400)
Designer: KLH | Drafter: MAS | Checked: TAJ

Calibre Engineering, Inc.
9090 South Ridgeline Boulevard, Suite 105
Highlands Ranch, CO 80129 (303) 730-0434
www.calibre-engineering.com
Construction Management Civil Engineering Surveying

RIDGEGATE - SECTION 22, FILING 1
PHASE III DRAINAGE REPORT
SWMM MAP

Sheet DR1 — 1 of 2
Date JANUARY 24, 2017

PATH: P:\CENTURY RG TGG\CADD\EXHIBITS\X-PDR.DWG
PLOTTED BY: MEGAN SAWYER PLOT DATE: 1/24/2017 8:48 AM
XREFS: W-Wetlands-RECVD, W-Wetlands, X-20PDR, 10PUT, 10KMDR, 10EPN, 10EUT, 10PPN, 10BASE,

FROM CALIBRE REPORT

EXCESS URBAN RUNOFF CONTROL (FULL-SPECTRUM) DETENTION SIZING

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN

Basin ID: POND 311 - EURV

* User input data shown in blue.

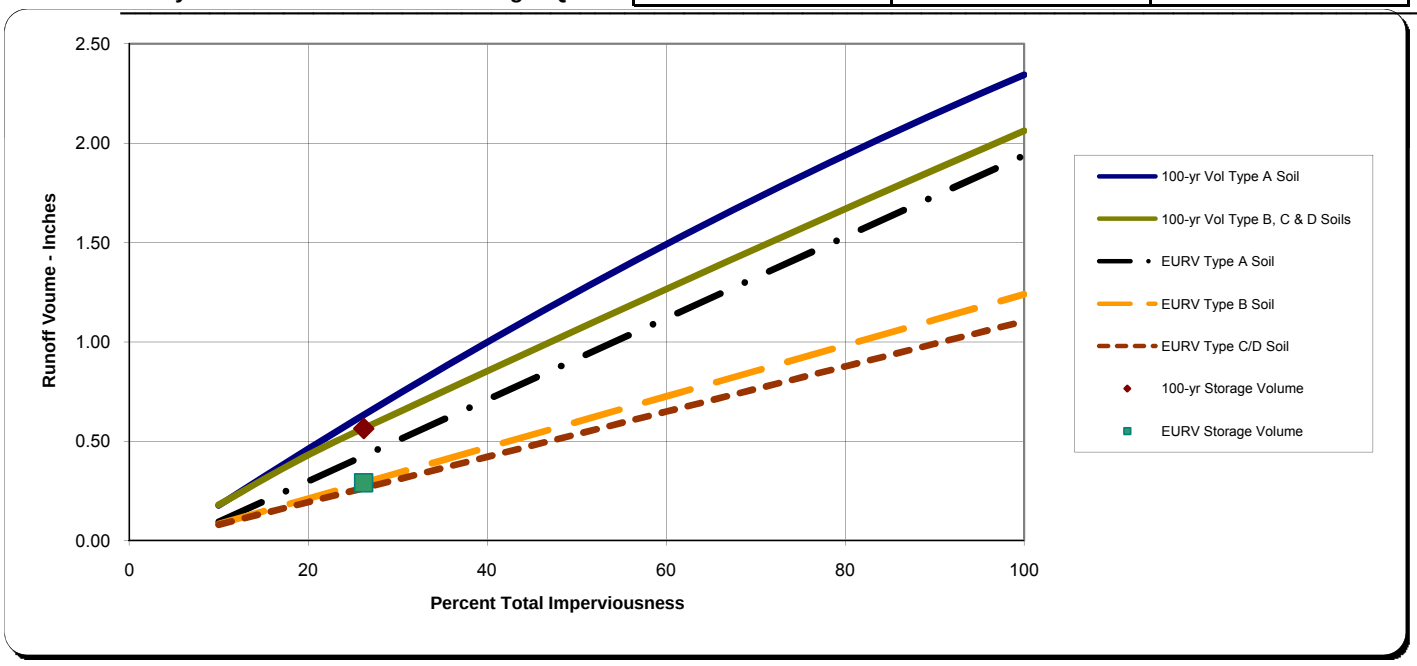
Area of Watershed (acres)	420.90
Subwatershed Imperviousness	26.2%
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0
Effective Imperviousness[1]	26.2%

Hydrologic Soil Type	Percentage of Area	Area (acres)
Type A		0.0
Type B		0.0
Type C or D	100.0%	420.9

Note: Pond 311 will provide EURV only, 100-year detention is not necessary since the 100-year developed peak flow rate at I-25 is less than the 100-year historical release rate at I-25. Pond 311 will require some additional storage volume beyond the EURV volume to increase the discharge through the outlet structure. The additional volume will be a function of the outlet structure properties.

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		Decay Coefficient--α
Initial--f_i	Final--fo	
3	0.5	0.0018

	Detention Volumes [2,5]		
	(watershed inches)	(acre-feet)	Maximum Allowable Release Rate, cfs[3]
Excess Urban Runoff Volume[4]	0.29	10.20	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	0.56	19.75	420.90



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

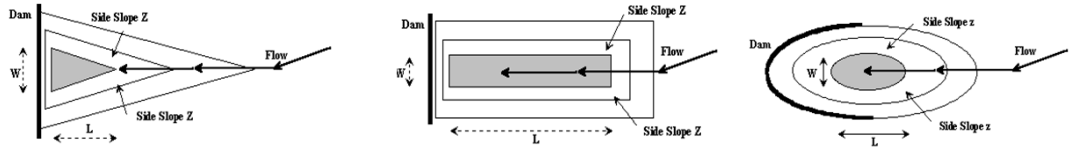
4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

FROM CALIBRE REPORT

STAGE-STORAGE SIZING FOR POLYGONAL, ELLIPTICAL, OR IRREGULAR PONDS

Project: PHASE III DRAINAGE REPORT FOR POND 311 RETROFIT
Basin ID: POND 311 - STAGE-STORAGE



Design Information (Input):

Width of Pond Bottom, W =		ft
Length of Pond Bottom, L =		ft
Dam Side-slope (H:V), Z_d =		ft/ft

Check Pond Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle		OR…
Circle / Ellipse		OR…
Irregular	X	(Use Overide values in cells G32:G52)

Note: 100-year detention volume determined from SWMM Model

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
~~Storage Requirement from Sheet 'Full Spectrum':~~	~~10.20~~	~~10.75~~	~~acre-ft.~~

Labels for WQCV, Minor, & Major Storage Stages (input)	Stage ft (input)	Side Slope (H:V) ft/ft Below El.	Pond Width at Stage ft (output)	Pond Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
M.P. WSE	5997.20	(input)				574		0.013	0.00	
	5998.00		0.00	0.00		649	489	0.015	0.01	
	5999.00		0.00	0.00		2605	2,116	0.060	0.05	
	6000.00		0.00	0.00		16021	11,429	0.368	0.26	
	6001.00		0.00	0.00		26286	32,583	0.603	0.75	
	6002.00		0.00	0.00		59606	75,529	1.368	1.73	
	6003.00		0.00	0.00		82383	146,523	1.891	3.36	
	6004.00		0.00	0.00		100547	237,988	2.308	5.46	
	6005.00		0.00	0.00		108788	342,656	2.497	7.87	
	6006.00		0.00	0.00		116792	455,446	2.681	10.46	
	6007.00		0.00	0.00		125616	576,650	2.884	13.24	
	6008.00		0.00	0.00		133586	706,251	3.067	16.21	
	6009.00		0.00	0.00		141534	843,811	3.249	19.37	
	6010.00		0.00	0.00		141534	985,345	3.249	22.62	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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							#N/A		#N/A	
							#N/A		#N/A	

EURV of 10.20 ac-ft achieved at elevation 6005.90 (by interpolation).

FROM CALIBRE REPORT

PROJECT: PHASE III DRAINAGE REPORT FOR POND 311 RETROFIT
PROJECT NO. 03016838

POND 311 WQ PLATE CALCULATOR

NOTE: Shaded cells represent user input data. Other cells calculated from orifice equation.

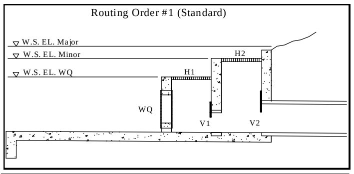
Diameter of holes, D =	1.625	in.
Number of holes per row, N =	1	
Vertical distance between rows, h =	4	in.
Orifice discharge coefficient	0.6	
Total open area at each row, A_o =	0.014	ft^2

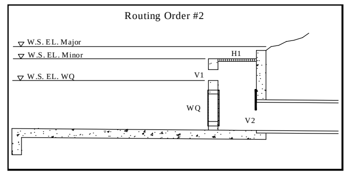
Stage (ft)	Central Elevations of Rows of Holes in feet																					Total Flow (cfs)
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	
	5997.20	5997.53	5997.87	5998.20	5998.53	5998.87	5999.20	5999.53	5999.87	6000.20	6000.53	6000.87	6001.20	6001.53	6001.87	6002.20	6002.53	6002.87	6003.20	6003.53	6003.87	6004.20	
	Collection Capacity for Each Row of Holes (cfs)																					
5997.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
5998.00	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.13**
5999.00	0.09	0.08	0.07	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.39**
6000.00	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.71**
6001.00	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.10**
6002.00	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.54**
6003.00	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.03	0.00	0.00	0.00	0.00	**2.02**
6004.00	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.03	0.00	**2.55**
6005.00	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	**3.05**
6006.00	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11	0.10	0.09	**3.43**
6007.00	0.22	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.12	0.12	**3.77**
6008.00	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	**4.08**
6009.00	0.24	0.23	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	**4.36**
6010.00	0.25	0.24	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	**4.62**

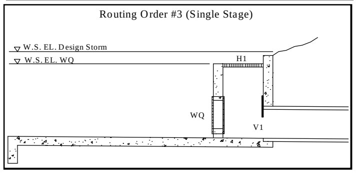
FROM CALIBRE REPORT

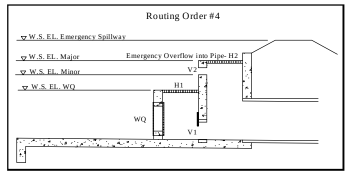
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN
Basin ID: POND 311 REDESIGN









Current Routing Order is #3

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =			28.00		inches
OR							
Rectangular Opening:	Width in Feet	W =	6.75				ft.
	Length (Height for Vertical)	L or H =	12.00				ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	67		100		%
	Orifice Coefficient	C_o =	0.60		0.60		
	Weir Coefficient	C_w =	3.33				
	Orifice Elevation (Bottom for Vertical)	E_o =	6005.90		5,994.46		ft.

Calculation of Collection Capacity:

		#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Net Opening Area (after Trash Rack Reduction)	A_o =	54.27		4.28		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =	33.05	ft.			
OPTIONAL: User-Overide Weir Length	L_w =		ft.			
Top Elevation of Vertical Orifice Opening, Top =				5996.79		ft.
Center Elevation of Vertical Orifice Opening, Cen =				5995.63		ft.

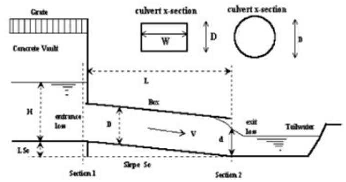
Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	5997.20	#N/A	0.00	0.00	0.00	0.00	25.83	0.00	**#N/A**	
	5998.00	#N/A	0.00	0.00	0.00	0.00	31.72	0.00	**#N/A**	
	5999.00	#N/A	0.00	0.00	0.00	0.00	37.82	0.00	**#N/A**	
	6000.00	#N/A	0.00	0.00	0.00	0.00	43.06	0.00	**#N/A**	
	6001.00	#N/A	0.00	0.00	0.00	0.00	47.73	0.00	**#N/A**	
	6002.00	#N/A	0.00	0.00	0.00	0.00	51.98	0.00	**#N/A**	
	6003.00	#N/A	0.00	0.00	0.00	0.00	55.91	0.00	**#N/A**	
	6004.00	#N/A	0.00	0.00	0.00	0.00	59.58	0.00	**#N/A**	
	6005.00	#N/A	0.00	0.00	0.00	0.00	63.04	0.00	**#N/A**	
	6006.00	#N/A	3.48	82.63	0.00	0.00	66.31	0.00	**#N/A**	
	6007.00	#N/A	126.95	274.06	0.00	0.00	69.44	0.00	**#N/A**	
	6008.00	#N/A	334.87	378.67	0.00	0.00	72.42	0.00	**#N/A**	
	6009.00	#N/A	600.61	460.08	0.00	0.00	75.29	0.00	**#N/A**	
	6010.00	#N/A	913.54	529.11	0.00	0.00	78.06	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	

FROM CALIBRE REPORT

STAGE-DISCHARGE SIZING OF THE OUTLET CULVERT (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN
Basin ID: POND 311 REDESIGN



Design Information (Input):

Circular Culvert: Barrel Diameter in Inches	D =	72	inches
Circular Culvert: Inlet Edge Type (choose from pull-down list)		Square End with Headwall	
OR:		**OR:**	
Box Culvert: Barrel Height (Rise) in Feet	Height (Rise) =		ft.
Box Culvert: Barrel Width (Span) in Feet	Width (Span) =		ft.
Box Culvert: Inlet Edge Type (choose from pull-down list)		1.5 : 1 Bevel w/ 90 Deg. Headwall	
Number of Barrels	No =	1	
Inlet Elevation at Culvert Invert	I_{elev} =	5994.46	ft. elev.
Outlet Elevation at Culvert Invert	O_{elev} =	5994.05	ft. elev.
Culvert Length in Feet	L =	111.8	ft.
Manning's Roughness	n =	0.0130	
Bend Loss Coefficient	K_b =	0.00	
Exit Loss Coefficient	K_x =	1.00	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.50
Friction Loss Coefficient	K_f =	0.32
Sum of All Loss Coefficients	K_s =	1.82
Orifice Inlet Condition Coefficient	C_d =	0.85
Minimum Energy Condition Coefficient	KE_{low} =	-0.0031

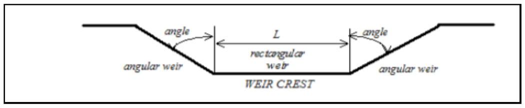
Calculations of Culvert Capacity (output):

Water Surface Elevation From Sheet "Pond" (ft., linked)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Flowrate Into Culvert From Sheet "Outlet" (cfs, linked)	Controlling Culvert Flowrate cfs (output)	Inlet equation used:
5997.20		55.70	1.00	**#N/A**	**#N/A**	min. energy equation
5998.00		86.21	38.60	**#N/A**	**#N/A**	regression equation
5999.00		128.91	100.90	**#N/A**	**#N/A**	regression equation
6000.00		177.11	151.60	**#N/A**	**#N/A**	regression equation
6001.00		224.01	189.60	**#N/A**	**#N/A**	regression equation
6002.00		265.91	227.30	**#N/A**	**#N/A**	regression equation
6003.00		302.51	259.80	**#N/A**	**#N/A**	regression equation
6004.00		334.91	289.00	**#N/A**	**#N/A**	regression equation
6005.00		364.11	315.70	**#N/A**	**#N/A**	regression equation
6006.00		390.81	340.50	**#N/A**	**#N/A**	regression equation
6007.00		415.71	366.40	**#N/A**	**#N/A**	regression equation
6008.00		439.01	388.30	**#N/A**	**#N/A**	regression equation
6009.00		461.11	411.10	**#N/A**	**#N/A**	regression equation
6010.00		482.21	431.00	**#N/A**	**#N/A**	regression equation
				#N/A		
				#N/A		
				#N/A		
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FROM CALIBRE REPORT

STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN
Basin ID: POND 311 - BYPASS CHANNEL



Design Information (input):

Bottom Length of Weir	L =	10.00	feet
Angle of Side Slope Weir	Angle =	0.00	degrees
Elev. for Weir Crest	EL. Crest =	6006.00	feet
Coef. for Rectangular Weir	C_w =	3.33	
Coef. for Trapezoidal Weir	C_t =	3.33	

Calculation of Spillway Capacity (output):

Water Surface Elevation ft. (linked)	Rect. Weir Flowrate cfs (output)	Triangle Weir Flowrate cfs (output)	Total Spillway Release cfs (output)	Total Pond Release cfs (output)
5997.20	0.00	0.00	0.00	#N/A
5998.00	0.00	0.00	0.00	#N/A
5999.00	0.00	0.00	0.00	#N/A
6000.00	0.00	0.00	0.00	#N/A
6001.00	0.00	0.00	0.00	#N/A
6002.00	0.00	0.00	0.00	#N/A
6003.00	0.00	0.00	0.00	#N/A
6004.00	0.00	0.00	0.00	#N/A
6005.00	0.00	0.00	0.00	#N/A
6006.00	0.00	0.00	0.00	#N/A
6007.00	33.30	0.00	33.30	#N/A
6008.00	94.19	0.00	94.19	#N/A
6009.00	173.03	0.00	173.03	#N/A
6010.00	266.40	0.00	266.40	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A

FROM CALIBRE REPORT

PROJECT: COTTONWOOD CREEK MASTER DRAINAGE PLAN
PROJECT NO. 03016838

Pond 311 Final Stage-Discharge

Water Surface Elevation (ft)	Total WQCV Flow (cfs)	#1 Horiz. Weir Flow (cfs)	#1 Horiz. Orifice Flow (cfs)	#1 Vert. Collection Capacity (cfs)	Outlet Structure Collection Capacity (cfs)	Culvert Inlet-Control Flowrate (cfs)	Culvert Outlet-Control Flowrate (cfs)	Total Discharge from Outlet Structure (cfs)	Discharge from Bypass Channel (cfs)	Total Discharge from Pond 311 (cfs)
5997.20	0.00	0.00	0.00	25.83	0.00	55.70	1.00	0.00	0.00	**0.00**
5998.00	0.13	0.00	0.00	31.72	0.13	86.21	38.60	0.13	0.00	**0.13**
5999.00	0.39	0.00	0.00	37.82	0.39	128.91	100.90	0.39	0.00	**0.39**
6000.00	0.71	0.00	0.00	43.06	0.71	177.11	151.60	0.71	0.00	**0.71**
6001.00	1.10	0.00	0.00	47.73	1.10	224.01	189.60	1.10	0.00	**1.10**
6002.00	1.54	0.00	0.00	51.98	1.54	265.91	227.30	1.54	0.00	**1.54**
6003.00	2.02	0.00	0.00	55.91	2.02	302.51	259.80	2.02	0.00	**2.02**
6004.00	2.55	0.00	0.00	59.58	2.55	334.91	289.00	2.55	0.00	**2.55**
6005.00	3.05	0.00	0.00	63.04	3.05	364.11	315.70	3.05	0.00	**3.05**
6006.00	3.43	3.48	82.63	66.31	6.91	390.81	340.50	6.91	0.00	**6.91**
6007.00	3.77	126.95	274.06	69.44	69.44	415.71	366.40	69.44	33.30	**102.74**
6008.00	4.08	334.87	378.67	72.42	72.42	439.01	388.30	72.42	94.19	**166.61**
6009.00	4.36	600.61	460.08	75.29	75.29	461.11	411.10	75.29	173.03	**248.32**
6010.00	4.62	913.54	529.11	78.06	78.06	482.21	431.00	78.06	266.40	**344.46**

NOTE: THIS SPREADSHEET USED TO COMBINE FLOWS FROM POND 311 - WQ PLATE FLOW CALCULATOR AS WELL AS FLOW RATES FROM UD-DETENTION_2.2 SPREADSHEET FOR POND 311. THE TOTAL DISCHARGE COLUMN REPRESENTS THE ULTIMATE STAGE-DISCHARGE FROM POND 311.

FROM CALIBRE REPORT

PROJECT: PHASE III DRAINAGE REPORT FOR POND 311 RETROFIT
PROJECT NO. 03016838

POND 311 - DEPTH AND VOLUME OUTPUTS FROM SWMM

NOTE: The numbers below are from the SWMM Model, "COTTONWOOD CREEK 100-YR DEVELOPED" and represent the relationship between pond depth and volume per hour for retro-fitted Pond 311

Hours	Depth (ft)	Volume (ft^3)
1	12.0	869,106
2	12.2	898,087
3	10.5	663,056
4	8.9	462,388
5	8.7	437,813
6	8.5	416,677
7	8.3	397,749
8	8.2	380,949
9	8.0	366,097
10	7.9	352,990
11	7.8	341,437
12	7.7	330,567
13	7.6	319,876
14	7.5	309,363
15	7.4	299,026
16	7.3	288,865
17	7.2	278,877
18	7.1	269,060
19	7.0	259,414
20	6.9	249,935
21	6.8	240,624
22	6.7	231,479
23	6.6	222,509
24	6.6	213,711
25	6.5	205,087
26	6.4	196,635
27	6.3	188,356
28	6.2	180,248
29	6.1	172,310
30	6.0	164,544
31	5.9	156,947
32	5.8	149,520

Hours	Depth (ft)	Volume (ft^3)
33	5.8	142,258
34	5.7	135,151
35	5.6	128,198
36	5.5	121,398
37	5.4	114,753
38	5.3	108,263
39	5.2	101,930
40	5.1	95,753
41	5.0	89,733
42	4.9	83,872
43	4.8	78,171
44	4.8	72,628
45	4.7	67,236
46	4.6	61,997
47	4.5	56,918
48	4.4	52,003
49	4.2	47,259
50	4.1	42,697
51	4.0	38,326
52	3.9	34,162
53	3.7	30,220
54	3.6	26,493
55	3.4	22,979
56	3.3	19,680
57	3.1	16,599
58	2.9	13,737
59	2.8	11,095
60	2.6	8,656
61	2.4	6,418
62	2.2	4,402
63	2.0	2,656
64	1.5	1,318

Hours	Depth (ft)	Volume (ft^3)
65	0.8	515
66	0.3	192
67	0.1	70
68	0.0	25
69	0.0	9
70	0.0	3
71	0.0	1
72	0.0	0
73	0.0	0
74	0.0	0
75	0.0	0
76	0.0	0

EXCESS URBAN RUNOFF CONTROL (FULL-SPECTRUM) DETENTION SIZING

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN

Basin ID: POND C30

* User input data shown in blue.

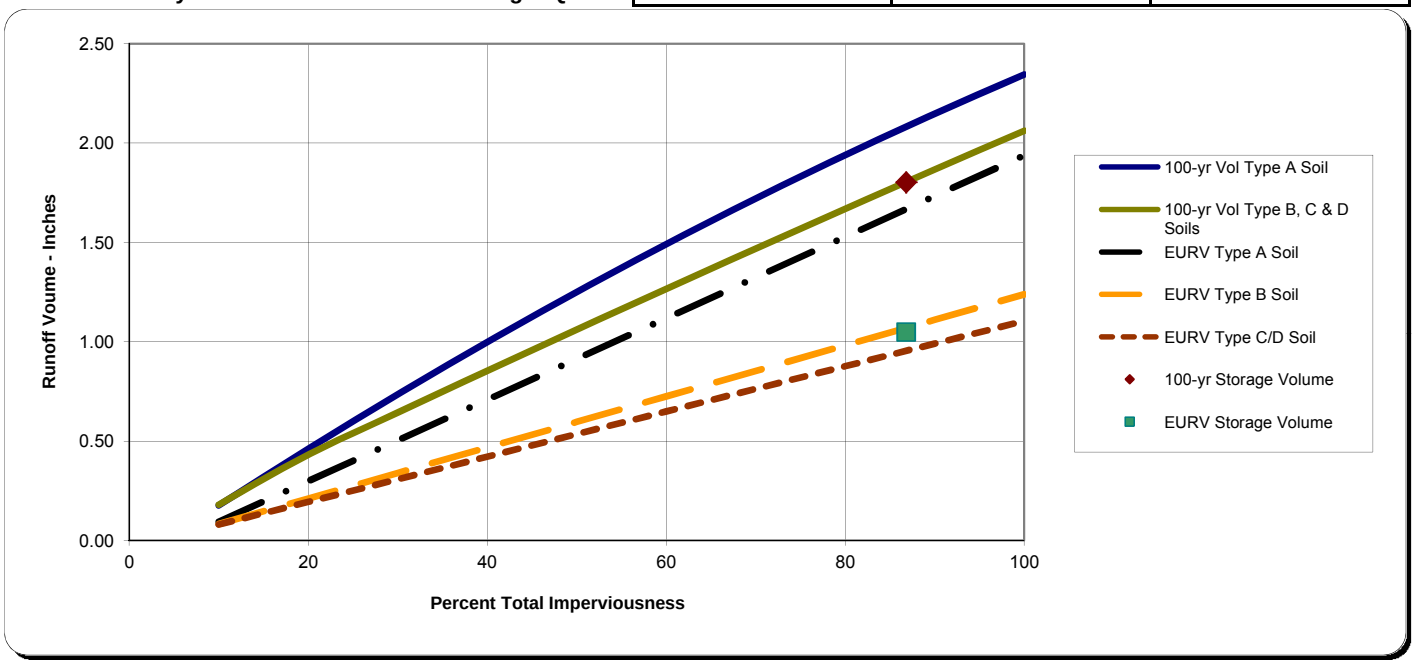
Area of Watershed (acres)	91.40	
Subwatershed Imperviousness	86.8%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	86.8%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A		0.0
Type B		0.0
Type C or D	100.0%	91.4

Note: Pond C30 will provide off-channel EURV only, 100-year detention is not necessary since the 100-year developed peak flow rate at Lincoln Avenue west channel is less than the 100-year historical release rate at the Lincoln Avenue west channel. Pond C30 will require some additional storage volume beyond the EURV volume to create the necessary head to increase the discharge through the outlet structure or provide the necessary bypass flow. The additional volume will be a function of the outlet structure properties.

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--fo**	
3	0.5	0.0018

Detention Volumes [2,5]		**Maximum Allowable Release Rate, cfs**[3]
(watershed inches)	**(acre-feet)**	
Excess Urban Runoff Volume[4]	1.05	7.99	Design Oulet to Empty EURV in 72 Hours
~~**100-year Detention Volume Including WQCV**~~ [5]	~~1.80~~	~~13.74~~	~~91.40~~



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

FROM CALIBRE REPORT

EXCESS URBAN RUNOFF CONTROL (FULL-SPECTRUM) DETENTION SIZING

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN

Basin ID: POND C40

* User input data shown in blue.

Area of Watershed (acres)	154.9	
Subwatershed Imperviousness	92.2%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	92.2%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A		0.0
Type B		0.0
Type C or D	100.0%	154.9

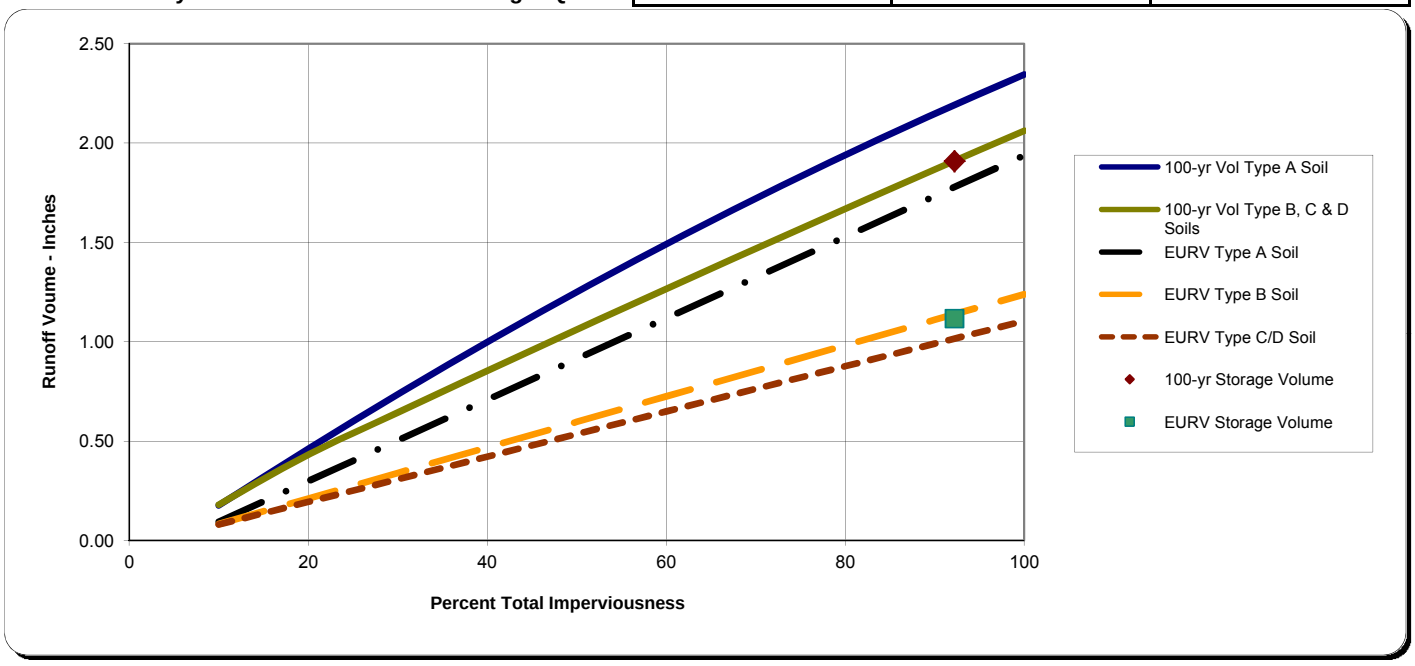
Note: 100-year detention volume determined from SWMM Model

100-YR + WQCV (pg. D-10) = TOTAL POND VOLUME

20.41 + 5.43 = 25.84 AC-FT

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--fo**	
3	0.5	0.0018

	Detention Volumes [2,5]		**Maximum Allowable Release Rate, cfs**[3]
	(watershed inches)	**(acre-feet)**	
Excess Urban Runoff Volume[4]	1.12	14.42	Design Oulet to Empty EURV in 72 Hours
~~**100-year Detention Volume Including WQCV**~~ [5]	~~1.91~~	~~24.65~~	~~154.90~~



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN
Basin ID: POND C40

WQCV Design Volume (Input):

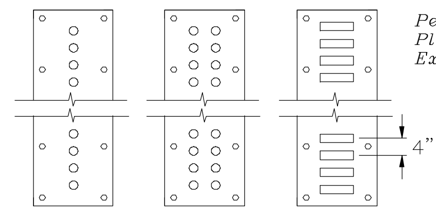
Catchment Imperviousness, I_a = 92.2 percent
Catchment Area, A = 154.9 acres
Depth at WQCV outlet above lowest perforation, H = inches
Vertical distance between rows, h = inches
Number of rows, NL =
Orifice discharge coefficient, C_o =

Diameter of holes, D = in.
Number of holes per row, N =
OR
Height of slot, H = in.
Width of slot, W = in.

Time to Drain the Pond = hours

Outlet Design Information (Output):

Water Quality Capture Volume (1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)), WQCV = 0.421 watershed inches
Water Quality Capture Volume (WQCV) = 5.43 acre-feet
Design Volume (WQCV / 12 * Area * 1.2) Vol = 6.52 acre-feet
Recommended maximum outlet area per row (based on 4" vertical spacing of rows), Ao = N/A square inches
Total opening area at each row based on user-input above, Ao = 0.00 square inches
Total opening area at each row based on user-input above, Ao = 0.000 square feet



Perforated Plate Examples

Calculation of Collection Capacity:

Note: This spreadsheet used to determine the WQCV to be added to the 100-year detention volume per Douglas County Standards.

Pond C40 WQCV = 5.43 ac-ft

Stage ft (input)	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Σ Flow
	Central Elevations of Rows of Holes in feet																		
	Collection Capacity for Each Row of Holes in cfs																		
																			#N/A
																			#N/A
																			#N/A
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FROM CALIBRE REPORT

FROM CALIBRE REPORT

EXCESS URBAN RUNOFF CONTROL (FULL-SPECTRUM) DETENTION SIZING

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN

Basin ID: POND C50

* User input data shown in blue.

Area of Watershed (acres)	54.1	
Subwatershed Imperviousness	86.2%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	86.2%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A		0.0
Type B		0.0
Type C or D	100.0%	54.1

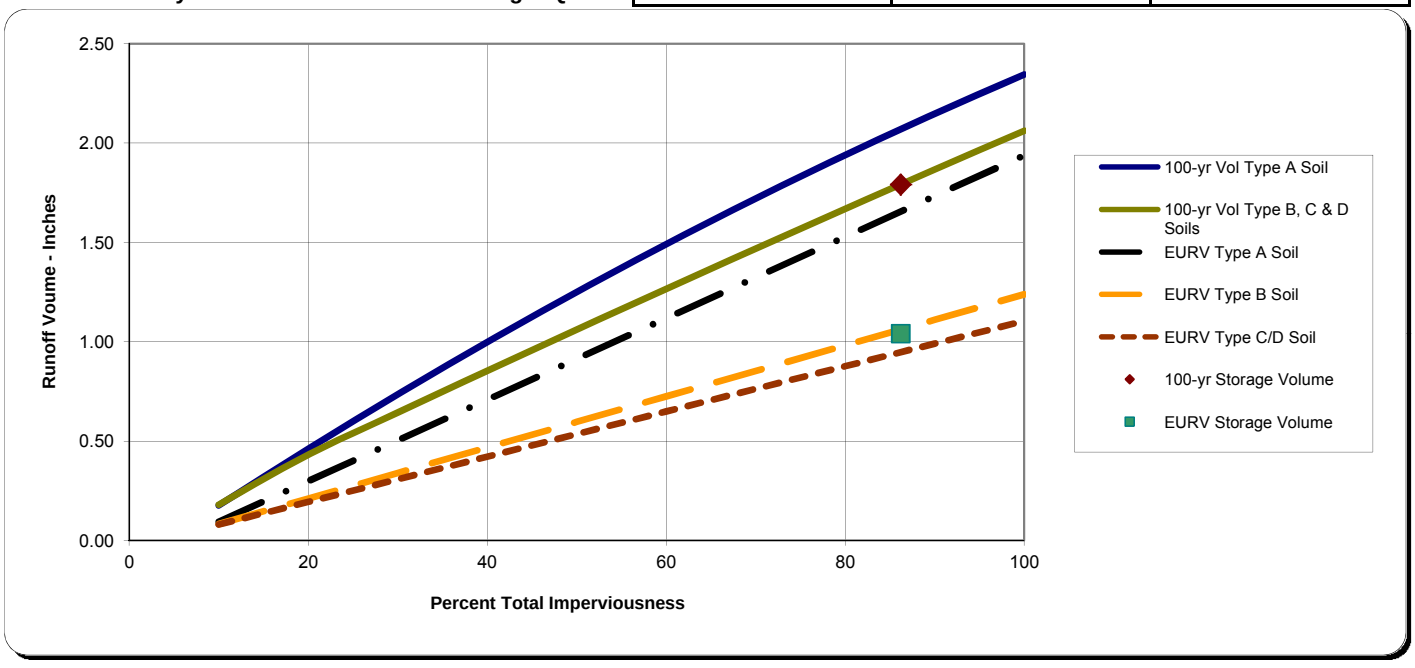
Note: 100-year detention volume determined from SWMM Model

100-YR + WQCV (pg. D-12) = TOTAL POND VOLUME

7.04 + 1.67 = 8.71 AC-FT

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--fo**	
3	0.5	0.0018

	Detention Volumes [2,5]		**Maximum Allowable Release Rate, cfs[3]**
	(watershed inches)	**(acre-feet)**	
Excess Urban Runoff Volume[4]	1.04	4.70	Design Oulet to Empty EURV in 72 Hours
~~**100-year Detention Volume Including WQCV [5]**~~	~~1.79~~	~~8.08~~	~~54.10~~



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

4) EURV approximates the difference between developed and pre-developed runoff volume.

5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

FROM CALIBRE REPORT

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: COTTONWOOD CREEK MASTER DRAINAGE PLAN
Basin ID: POND C50

WQCV Design Volume (Input):

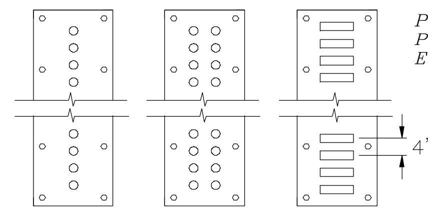
Catchment Imperviousness, I_a = 86.2 percent
Catchment Area, A = 54.1 acres
Depth at WQCV outlet above lowest perforation, H = inches
Vertical distance between rows, h = inches
Number of rows, NL =
Orifice discharge coefficient, C_o =

Diameter of holes, D = in.
Number of holes per row, N =
OR
Height of slot, H = in.
Width of slot, W = in.

Time to Drain the Pond = hours

Outlet Design Information (Output):

Water Quality Capture Volume (1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)), WQCV = 0.371 watershed inches
Water Quality Capture Volume (WQCV) = 1.67 acre-feet
Design Volume (WQCV / 12 * Area * 1.2) Vol = 2.01 acre-feet
Recommended maximum outlet area per row (based on 4" vertical spacing of rows), Ao = N/A square inches
Total opening area at each row based on user-input above, Ao = 0.00 square inches
Total opening area at each row based on user-input above, Ao = 0.000 square feet



Perforated Plate Examples

Calculation of Collection Capacity:

Note: This spreadsheet used to determine the WQCV to be added to the 100-year detention volume per Douglas County Standards.

Pond C50 WQCV = 1.67 ac-ft

Stage ft (input)	Central Elevations of Rows of Holes in feet																		Σ Flow
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	
	Collection Capacity for Each Row of Holes in cfs																		
																			#N/A
																			#N/A
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FROM CALIBRE REPORT

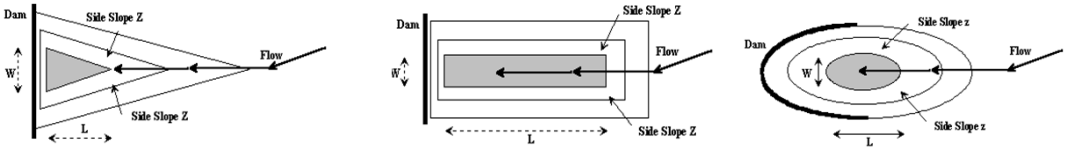
APPENDIX E – COTTONWOOD CREEK FLOW CONTROL STRUCTURE (CCFCS) CALCULATIONS

A 48" culvert was initially analyzed in the SWMM model to determine the release rate at the CCFCS. The 48" culvert discharge created a higher discharge than the allowable peak inflow at the RidgeGate Parkway storm sewer system main pipe. A restrictor plate was analyzed on the upstream end of the CCFCS. The restrictor plate reduced the discharge from the CCFCS to 236.5 cfs and created a peak inflow at the RidgeGate Parkway storm sewer system main pipe to 240.8 cfs. Therefore, the CCFCS will consist of a 48" culvert with a restrictor plate on the upstream end of the culvert.

STAGE-STORAGE SIZING FOR POLYGONAL, ELLIPTICAL, OR IRREGULAR PONDS

Project: 03016838

Basin ID: COTTONWOOD CREEK FLOW CONTROL STRUCTURE STAGE-STORAGE



Design Information (Input):

Width of Pond Bottom, W =		ft
Length of Pond Bottom, L =		ft
Dam Side-slope (H:V), Z_d =		ft/ft

Check Pond Shape

Right Triangle		OR…
Isosceles Triangle		OR…
Rectangle		OR…
Circle / Ellipse		OR…
Irregular	X	(Use Overide values in cells G32:G52)

Stage-Storage Relationship:

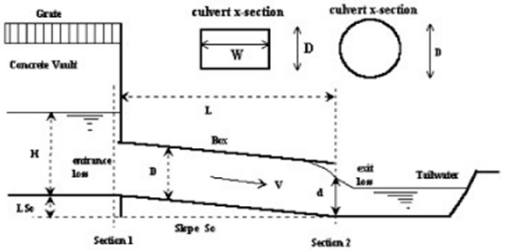
	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':			acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Stage ft (input)	Side Slope (H:V) ft/ft Below El.	Pond Width at Stage ft (output)	Pond Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	6071.57	(input)				0		0.000	0.00	
	6072.00		0.00	0.00		0	0	0.000	0.00	
	6073.00		0.00	0.00		483	242	0.011	0.01	
	6074.00		0.00	0.00		1326	1,146	0.030	0.03	
	6075.00		0.00	0.00		2823	3,221	0.065	0.07	
	6076.00		0.00	0.00		4346	6,805	0.100	0.16	
	6077.00		0.00	0.00		5567	11,762	0.128	0.27	
	6078.00		0.00	0.00		7263	18,177	0.167	0.42	
	6079.00		0.00	0.00		8917	26,267	0.205	0.60	
	6080.00		0.00	0.00		11390	36,420	0.261	0.84	
	6081.00		0.00	0.00		13222	48,726	0.304	1.12	
	6082.00		0.00	0.00		17404	64,039	0.400	1.47	
	6083.00		0.00	0.00		20191	82,837	0.464	1.90	
	6084.00		0.00	0.00		24295	105,080	0.558	2.41	
	6085.00		0.00	0.00		27102	130,778	0.622	3.00	
	6086.00		0.00	0.00		30649	159,654	0.704	3.67	
	6087.00		0.00	0.00		34174	192,065	0.785	4.41	
	6088.00		0.00	0.00		39795	229,050	0.914	5.26	
	6089.00		0.00	0.00		43510	270,702	0.999	6.21	
	6090.00		0.00	0.00		48278	316,596	1.108	7.27	
	6091.00		0.00	0.00		52804	367,137	1.212	8.43	
	6092.00		0.00	0.00		59791	423,435	1.373	9.72	
	6093.00		0.00	0.00		67508	487,084	1.550	11.18	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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							#N/A		#N/A	

FROM CALIBRE REPORT

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: 03016838
Basin ID: COTTONWOOD CREEK FLOW CONTROL STRUCTURE



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	48.00	inches
	Inlet Edge Type (choose from pull-down list)		Square End with Headwall	
OR:			**OR:**	
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
	Barrel Width (Span) in Feet	Width (Span) =		ft.
	Inlet Edge Type (choose from pull-down list)		1 : 1 Bevel w/ Headwall	
	Number of Barrels	No =	1	
	Inlet Elevation at Culvert Invert	Inlet Elev =	6071.57	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	6065.21	ft. elev.
	Culvert Length in Feet	L =	268.12	ft.
	Manning's Roughness	n =	0.0150	
	Bend Loss Coefficient	K_b =	0.00	
	Exit Loss Coefficient	K_x =	1.00	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.50
Friction Loss Coefficient	K_f =	1.75
Sum of All Loss Coefficients	K_s =	3.25
Orifice Inlet Condition Coefficient	C_d =	0.86
Minimum Energy Condition Coefficient	KE_{low} =	-0.6400

Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used: (output)
6071.57		0.00	0.00	**0.00**	No flow (WS < inlet)
6072.00	6065.30	1.50	88.69	**1.50**	min. energy equation
6073.00	6065.61	18.16	100.29	**18.16**	min. energy equation
6074.00	6065.80	33.59	110.75	**33.59**	regression equation
6075.00	6066.05	58.30	121.08	**58.30**	regression equation
6076.00	6066.28	83.91	129.94	**83.91**	regression equation
6077.00	6066.46	105.47	138.29	**105.47**	regression equation
6078.00	6066.60	123.30	146.69	**123.30**	regression equation
6079.00	6066.72	138.62	154.20	**138.62**	regression equation
6080.00	6066.82	152.25	161.78	**152.25**	regression equation
6081.00	6066.91	164.66	168.68	**164.66**	regression equation
6082.00	6066.99	176.19	175.63	**175.63**	regression equation
6083.00	6067.04	187.02	182.32	**182.32**	regression equation
6084.00	6067.08	197.06	188.53	**188.53**	orifice equation
6085.00	6067.13	206.29	194.77	**194.77**	orifice equation
6086.00	6067.17	215.12	200.82	**200.82**	orifice equation
6087.00	6067.21	223.61	206.69	**206.69**	orifice equation
6088.00	6067.25	231.78	212.41	**212.41**	orifice equation
6089.00	6067.29	239.68	217.81	**217.81**	orifice equation
6090.00	6067.32	247.32	223.24	**223.24**	orifice equation
6091.00	6067.36	254.74	228.53	**228.53**	orifice equation
6092.00	6067.39	261.94	233.71	**233.71**	orifice equation
6093.00	6067.43	268.96	238.78	**238.78**	orifice equation
				0.00	
				0.00	
				0.00	
				0.00	
				0.00	
				0.00	
				0.00	

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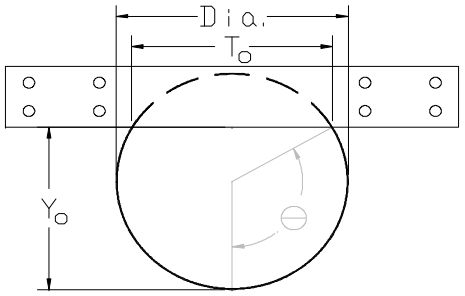
RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

FROM CALIBRE REPORT

Project: 03016838

Basin ID: COTTONWOOD CREEK FLOW CONTROL STRUCTURE

Note: The Q value and the water surface elevation at design depth on this page is based on a static water surface elevation and was an estimate of the discharge required at the CCFCS to obtain the maximum allowable flow at the main storm sewer pipe at the RidgeGate Parkway storm sewer system. Data from this sheet appears on Sheet E-5 to create a stage-discharge through the restrictor plate. The restrictor plate stage-discharge curve was then combined with the culvert stage-discharge to create the final stage-discharge from the CCFCS.

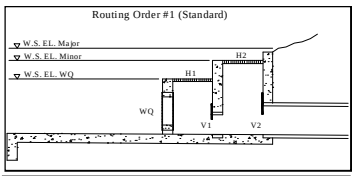


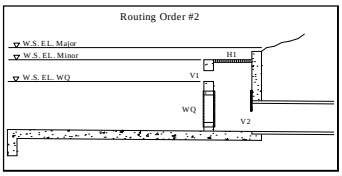
		#1 Vertical Orifice	
Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)			
Water Surface Elevation at Design Depth	Elev: WS =	6,092.60	feet
Pipe/Vertical Orifice Entrance Invert Elevation	Elev: Invert =	6,071.57	feet
Required Peak Flow through Orifice at Design Depth	Q =	235.00	cfs
Pipe/Vertical Orifice Diameter (inches)	Dia =	48.0	inches
Orifice Coefficient	C_o =	0.60	
Full-flow Capacity (Calculated)			
Full-flow area	Af =	12.57	sq ft
Half Central Angle in Radians	Theta =	3.14	rad
Full-flow capacity	Qf =	264.0	cfs
	Percent of Design Flow =	112%	
Calculation of Orifice Flow Condition			
Half Central Angle (0<Theta<3.1416)	Theta =	2.28	rad
Flow area	A_o =	11.09	sq ft
Top width of Orifice (inches)	T_o =	36.49	inches
Height from Invert of Orifice to Bottom of Plate (feet)	Y_o =	3.30	feet
Elevation of Bottom of Plate	Elev Plate Bottom Edge =	6,074.87	feet
Resultant Peak Flow Through Orifice at Design Depth	Q_o =	235.0	cfs
Width of Equivalent Rectangular Vertical Orifice	**Equivalent Width =**	**3.36**	**feet**
Centroid Elevation of Equivalent Rectangular Vertical Orifice	**Equiv. Centroid El. =**	**6,073.22**	**feet**

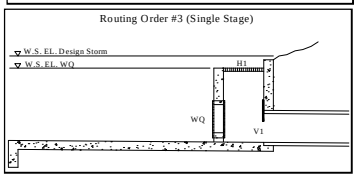
FROM CALIBRE REPORT

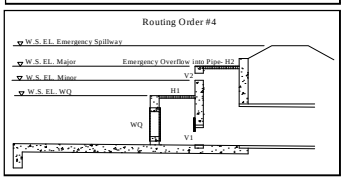
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: 18015087 RRMD
Basin ID: TRACT P EMBANKMENT CULVERT









Current Routing Order is #5

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =					inches
OR							
Rectangular Opening:	Width in Feet	W =			3.36		ft.
	Length (Height for Vertical)	L or H =			3.30		ft.
	Percentage of Open Area After Trash Rack Reduction	% open =			100		%
	Orifice Coefficient	C_o =			0.60		
	Weir Coefficient	C_w =					
	Orifice Elevation (Bottom for Vertical)	E_o =			6,071.57		ft.

Calculation of Collection Capacity:

Net Opening Area (after Trash Rack Reduction)	A_o =			11.09		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =			ft.		
OPTIONAL: User-Overide Weir Length	L_w =			ft.		
Top Elevation of Vertical Orifice Opening, Top =				6074.87		ft.
Center Elevation of Vertical Orifice Opening, Cen =				6073.22		ft.

Routing 5: Water flows separately through WQCV plate, #1 horizontal opening, #2 horizontal opening, #1 vertical opening, and #2 vertical opening. The sum of all four will be applied to culvert sheet.

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	6071.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	
	6072.00	0.00	0.00	0.00	0.00	0.00	3.23	0.00	**3.23**	
	6073.00	0.00	0.00	0.00	0.00	0.00	19.57	0.00	**19.57**	
	6074.00	0.00	0.00	0.00	0.00	0.00	43.34	0.00	**43.34**	
	6075.00	0.00	0.00	0.00	0.00	0.00	71.24	0.00	**71.24**	
	6076.00	0.00	0.00	0.00	0.00	0.00	89.03	0.00	**89.03**	
	6077.00	0.00	0.00	0.00	0.00	0.00	103.82	0.00	**103.82**	
	6078.00	0.00	0.00	0.00	0.00	0.00	116.75	0.00	**116.75**	
	6079.00	0.00	0.00	0.00	0.00	0.00	128.38	0.00	**128.38**	
	6080.00	0.00	0.00	0.00	0.00	0.00	139.04	0.00	**139.04**	
	6081.00	0.00	0.00	0.00	0.00	0.00	148.94	0.00	**148.94**	
	6082.00	0.00	0.00	0.00	0.00	0.00	158.22	0.00	**158.22**	
	6083.00	0.00	0.00	0.00	0.00	0.00	166.99	0.00	**166.99**	
	6084.00	0.00	0.00	0.00	0.00	0.00	175.32	0.00	**175.32**	
	6085.00	0.00	0.00	0.00	0.00	0.00	183.27	0.00	**183.27**	
	6086.00	0.00	0.00	0.00	0.00	0.00	190.89	0.00	**190.89**	
	6087.00	0.00	0.00	0.00	0.00	0.00	198.22	0.00	**198.22**	
	6088.00	0.00	0.00	0.00	0.00	0.00	205.29	0.00	**205.29**	
	6089.00	0.00	0.00	0.00	0.00	0.00	212.12	0.00	**212.12**	
	6090.00	0.00	0.00	0.00	0.00	0.00	218.74	0.00	**218.74**	
	6091.00	0.00	0.00	0.00	0.00	0.00	225.16	0.00	**225.16**	
	6092.00	0.00	0.00	0.00	0.00	0.00	231.41	0.00	**231.41**	
	6093.00	0.00	0.00	0.00	0.00	0.00	237.49	0.00	**237.49**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	

Stage-discharge curve based on restrictor plate geometry.

FROM CALIBRE REPORT

PROJECT: COTTONWOOD CREEK MASTER DRAINAGE PLAN
PROJECT NO. 03016838

COTTONWOOD CREEK FLOW CONTROL STRUCTURE
FINAL STAGE-DISCHARGE

STAGE (ft)	CONTROLLING CULVERT FLOW RATE (cfs)	RESTRICTOR PLATE DISCHARGE (cfs)	FINAL DISCHARGE (cfs)
6071.57	0.00	0.00	0.00
6072.00	1.50	3.23	1.50
6073.00	18.16	19.57	18.16
6074.00	33.59	43.34	33.59
6075.00	58.30	71.24	58.30
6076.00	83.91	89.03	83.91
6077.00	105.47	103.82	103.82
6078.00	123.30	116.75	116.75
6079.00	138.62	128.38	128.38
6080.00	152.25	139.04	139.04
6081.00	164.66	148.94	148.94
6082.00	175.63	158.22	158.22
6083.00	182.32	166.99	166.99
6084.00	188.53	175.32	175.32
6085.00	194.77	183.27	183.27
6086.00	200.82	190.89	190.89
6087.00	206.69	198.22	198.22
6088.00	212.41	205.29	205.29
6089.00	217.81	212.12	212.12
6090.00	223.24	218.74	218.74
6091.00	228.53	225.16	225.16
6092.00	233.71	231.41	231.41
6093.00	238.78	237.49	237.49

MERRICK POND 311 REPORT EXCERPTS FROM CALIBRE REPORT

PHASE III DRAINAGE REPORT
FOR
TRACT O ACCESS ROAD
(COTTONWOOD CREEK FLOW CONTROL STRUCTURE)
RAMPART RANGE METROPOLITAN DISTRICT NO. 1

April 2012

Prepared For:

Rampart Range Metropolitan District No. 1
8390 E. Crescent Parkway, Suite 500
Greenwood Village, CO 80111
Phone: (303) 779-4525
Fax: (303) 773-2050

Prepared By:

Carson Besgrove, PE

Reviewed By:

4/19/12

Kenneth Lee Linhardt, PE No. 19366
Senior Project Manager

Merrick Job No. 65117247

MERRICK & COMPANY

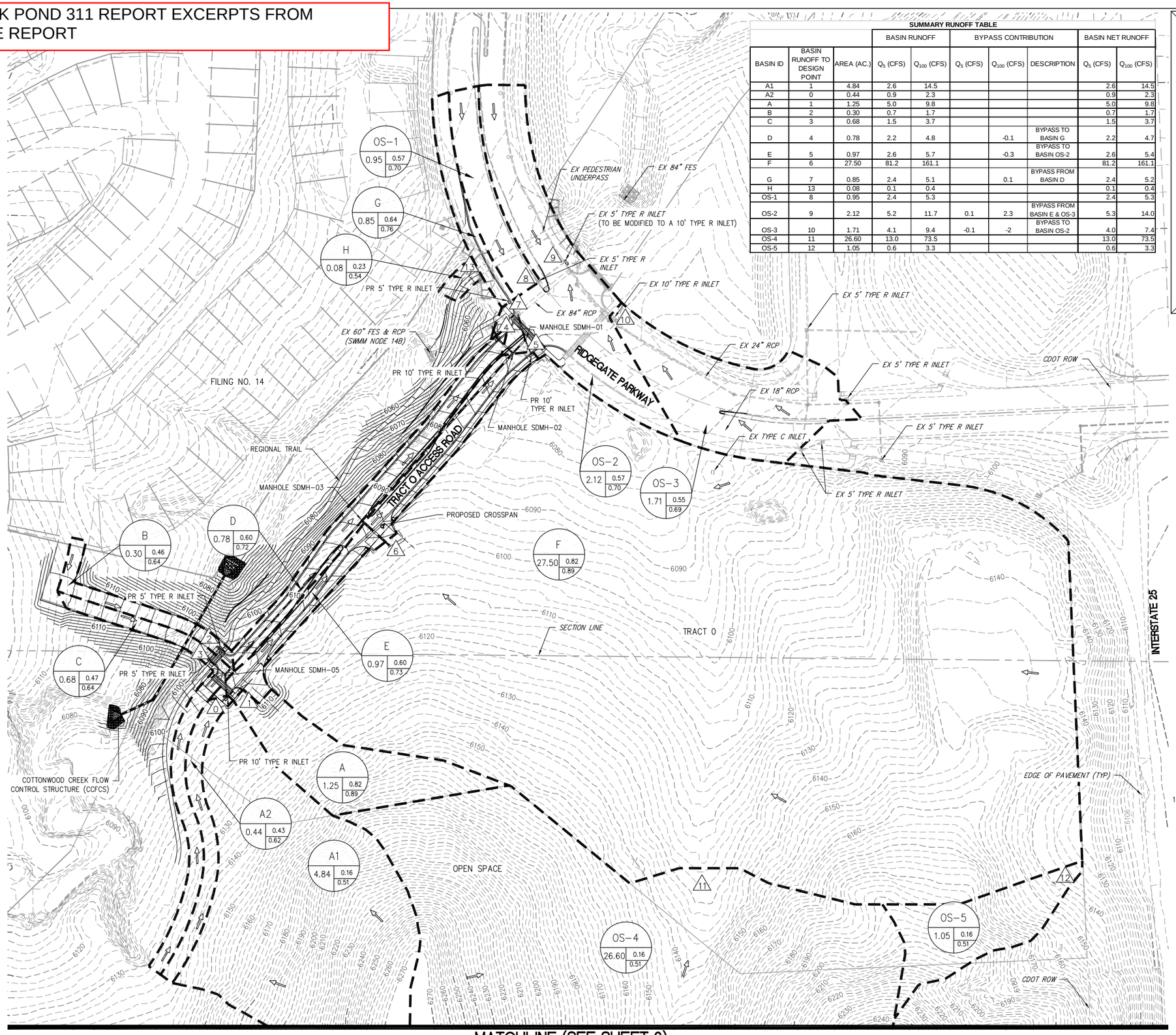
2450 South Peoria Street
Aurora, CO 80014-5472
Phone: (303) 751-0741
Fax (303) 752-4451

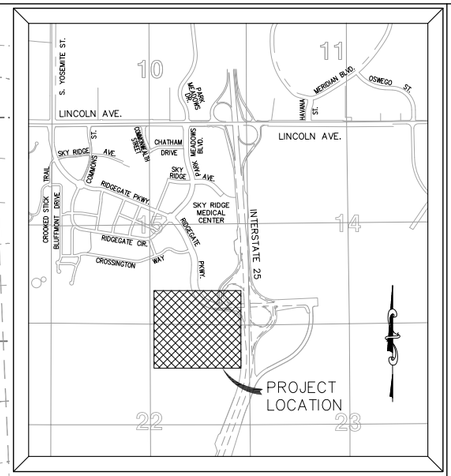
CITY OF LONE TREE
PUBLIC WORKS DEPART
APPROVE
BY
DATE APR 25 2012

MERRICK POND 311 REPORT EXCERPTS FROM CALIBRE REPORT

SUMMARY RUNOFF TABLE

BASIN ID	BASIN RUNOFF TO DESIGN POINT	AREA (AC.)	BASIN RUNOFF Q_5 (CFS)	BASIN RUNOFF Q_{100} (CFS)	BYPASS CONTRIBUTION Q_5 (CFS)	BYPASS CONTRIBUTION Q_{100} (CFS)	BYPASS CONTRIBUTION DESCRIPTION	BASIN NET RUNOFF Q_5 (CFS)	BASIN NET RUNOFF Q_{100} (CFS)
A1	1	4.84	2.6	14.5				2.6	14.5
A2	0	0.44	0.9	2.3				0.9	2.3
A	1	1.25	5.0	9.8				5.0	9.8
B	2	0.30	0.7	1.7				0.7	1.7
C	3	0.68	1.5	3.7				1.5	3.7
D	4	0.78	2.2	4.8		-0.1	BYPASS TO BASIN G	2.2	4.7
E	5	0.97	2.6	5.7		-0.3	BYPASS TO BASIN OS-2	2.6	5.4
F	6	27.50	81.2	161.1				81.2	161.1
G	7	0.85	2.4	5.1		0.1	BYPASS FROM BASIN D	2.4	5.2
H	13	0.08	0.1	0.4				0.1	0.4
OS-1	8	0.95	2.4	5.3				2.4	5.3
OS-2	9	2.12	5.2	11.7	0.1	2.3	BYPASS FROM BASIN E & OS-3	5.3	14.0
OS-3	10	1.71	4.1	9.4	-0.1	-2	BYPASS TO BASIN OS-2	4.0	7.4
OS-4	11	26.60	13.0	73.5				13.0	73.5
OS-5	12	1.05	0.6	3.3				0.6	3.3





VICINITY MAP

SCALE: 1" = 2000'

LEGEND

- OS-1 / 22.70 / 0.72 / 0.81 — BASIN DESIGNATION; BASIN AREA (ACRES); 5-YR RUNOFF COEFFICIENT; 100-YR RUNOFF COEFFICIENT
- 22 — DESIGN POINT
- DIRECTIONAL FLOW ARROWS
- DRAINAGE BASIN BOUNDARY
- EXISTING RIGHT-OF-WAY
- EXISTING PROPERTY LINE
- EXISTING EASEMENT
- 5985 — EXISTING MAJOR CONTOUR
- 5986 — EXISTING MINOR CONTOUR
- EXISTING INLET, STORM SEWER, & MANHOLE
- PROPOSED INLET, STORM SEWER, & MANHOLE
- 5985 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
0	0.9	2.3
1	18.4	91.5
2	0.7	1.7
3	2.2	5.3
4	2.2	4.8
5	2.6	5.7
6	73.1	147.0
7	2.4	5.1
8	2.4	5.3
9	5.2	11.7
10	4.1	9.4
11	13.0	73.5
12	0.6	3.3

Note: Design Point flows represent total flow at Design Point in the storm sewer pipe.

100' 0 50' 100' 200'

GRAPHIC SCALE

PRELIMINARY NOT FOR CONSTRUCTION

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UTILITY NOTIFICATION CENTER OF COLORADO

MERRICK & COMPANY

RAMPART RANGE METRO DISTRICT NO. 1

8390 E. CRESCENT PARKWAY, SUITE 500
GREENWOOD VILLAGE, COLORADO 80111
PH: 303-779-4525/FAX: 303-773-2050

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REV:	REVISION DESCRIPTION:	DATE:	DRAWN BY:	CHECKED BY:	APPROVED BY:

		DATE:
DESIGN BY:	COB	2/14/12
DRAWN BY:	COB	2/14/12
CHECKED BY:	BCR	2/14/12
APPROVED BY:	KLL	2/14/12

TRACT O ACCESS ROAD

DEVELOPED DRAINAGE MAP (NORTH)

REGISTERED PROFESSIONAL ENGINEER — KENNETH L. LEE LINK — 19366 — COLORADO

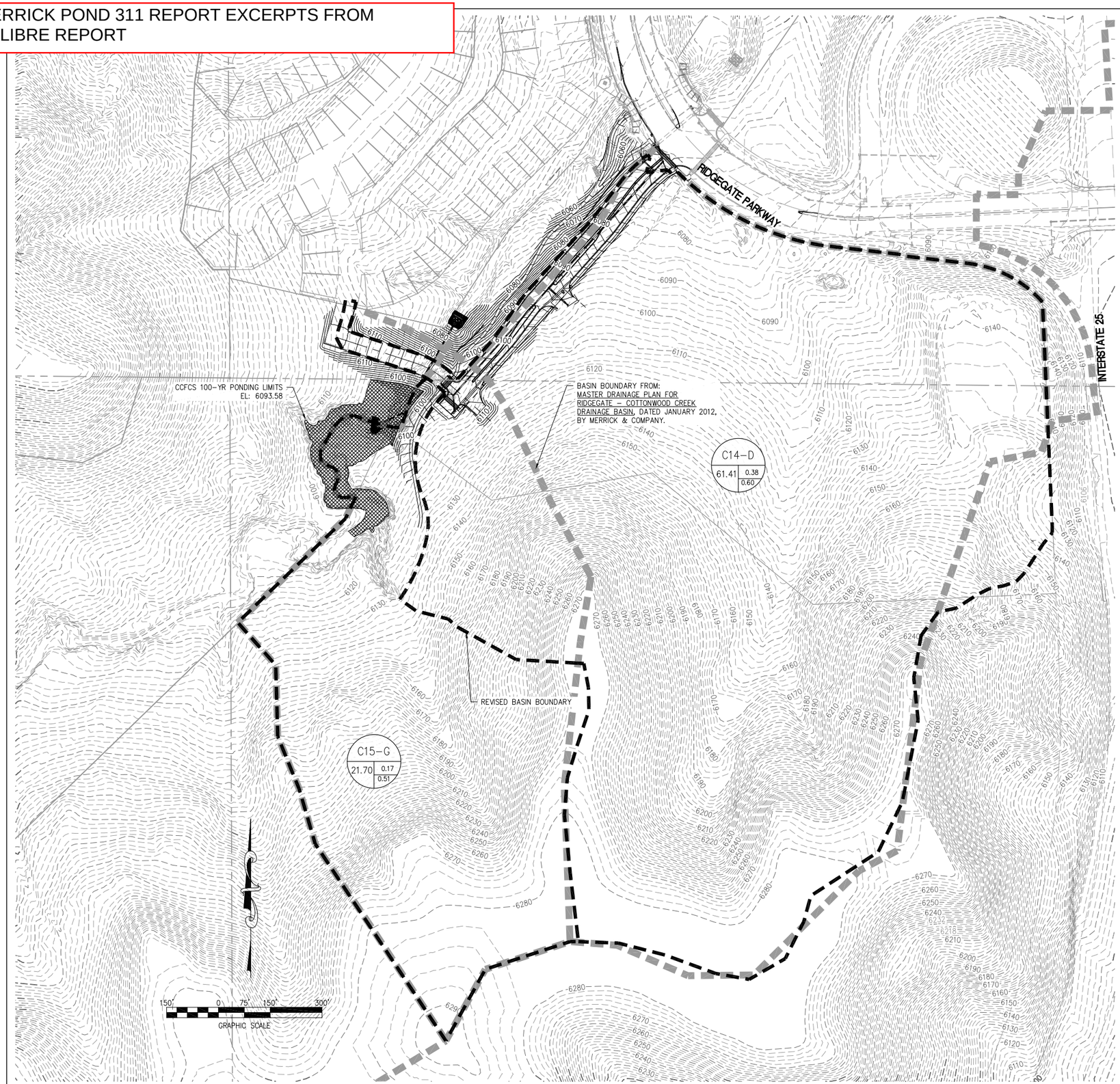
Kenneth L. Link, PE
Colorado License No. 19366
Engineering Professional
For and on Behalf of
Merrick & Company

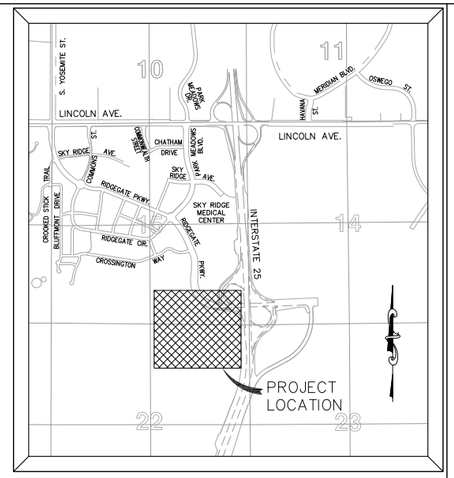
Merrick & Company Job No. 65117247

JOB NO: 65117247
DATE: 4/9/12
SHEET: 1 OF 2

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MERRICK POND 311 REPORT EXCERPTS FROM CALIBRE REPORT





VICINITY MAP

SCALE: 1" = 2000'

LEGEND

- BASIN DESIGNATION
- BASIN AREA (ACRES)
- 5-YR RUNOFF COEFFICIENT
- 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- DIRECTIONAL FLOW ARROWS
- DRAINAGE BASIN BOUNDARY
- EXISTING RIGHT-OF-WAY
- EXISTING PROPERTY LINE
- EXISTING EASEMENT
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING INLET, STORM SEWER, & MANHOLE
- PROPOSED INLET, STORM SEWER, & MANHOLE
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

Developed Composite C-Factor and Impervious Analysis

C_{CD} =	$K_{CD} + (0.858*i^3 - 0.786*i^2 + 0.774*i + 0.04)$			(UDFCD Formula RO-7)			
K_{CD} =	0	2-yr		(UDFCD Table RO-4)			
	(-0.10*i + 0.11)	5-yr					
	(-0.18*i + 0.21)	10-yr					
	(-0.39*i + 0.46)	100-yr					
Basin	**Land Use**	**Area (acres)**	**I (%)**	**C2**	**C5**	**C10**	**C100**
Basin C15-G	Open Space	21.30	2				
	Streets, Paved	0.40	100				
	Total Area	**21.70**	**3.8%**	**0.07**	**0.17**	**0.27**	**0.51**
Basin	**Land Use**	**Area (acres)**	**I (%)**	**C2**	**C5**	**C10**	**C100**
Basin C14-D	Streets Paved	2.10	100				
	Commercial Area	28.75	95				
	Drives and Walks	0.10	90				
	Boulevard/Landscaping	0.97	2				
	Open Space	32.49	2				
	Total Area	**64.41**	**46.8%**	**0.32**	**0.38**	**0.44**	**0.60**

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RAMPART RANGE
METRO DISTRICT
NO. 1

8390 E. CRESCENT PARKWAY, SUITE 500
GREENWOOD VILLAGE, COLORADO 80111
PH: 303-779-4525/FAX: 303-773-2050

REVISIONS:						
REV:	REVISION DESCRIPTION:	DATE:	DRAWN BY:	CHECKED BY:	APPROVED BY:	

	DATE:
DESIGN BY:	CCB 2/14/12
DRAWN BY:	CCB 2/14/12
CHECKED BY:	BKR 2/14/12
APPROVED BY:	KLL

TRACT O ACCESS ROAD

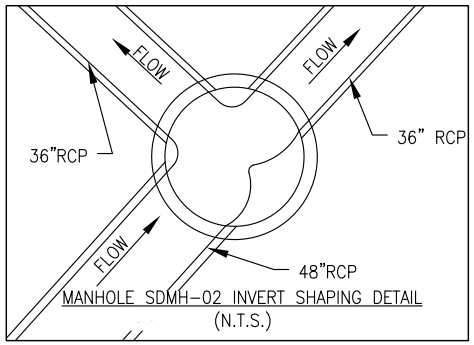
MASTER DRAINAGE PLAN
BASIN REVISIONS

KENNETH L. LINDQUIST
COLORADO REGISTERED 19366 PROFESSIONAL ENGINEER
Colorado Registered Professional Engineer No. 19366
For and On Behalf of
Merrick & Company

Merrick & Company Job No. 65117247

JOB NO: 65117247
DATE: 4/9/12
SHEET: 1 OF 1

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MANHOLE SDMH-02 INVERT SHAPING DETAIL
(N.T.S.)

(N.T.S.)

DISCHARGE FROM: RIDGEGATE SECTION 15, FILING NO. 14, PHASE III DRAINAGE REPORT, DATED FEBRUARY 2011, BY CALIBRE.
Q5=38.1 CFS
Q100=67.8 CFS
(FLOW RATES FROM HYDRAFLOW STORM SEWERS EXTENSION MODEL, LINE NO. 17)

DP 9
Q5=7.6 CFS
Q100=17.0 CFS

DP 8
Q5=2.4 CFS
Q100=5.3 CFS

DP 7
INLET FLOW:
Q5=2.4 CFS
Q100=5.2 CFS
PIPE FLOW:
Q5=40.5 CFS
Q100=73.0 CFS

DP 10
Q5=4.0 CFS
Q100=7.4 CFS

EXISTING STORM SEWER (TYP)

DISCHARGE FROM REVISED SWMM MODEL FROM: MASTER DRAINAGE PLAN FOR RIDGEGATE – COTTONWOOD CREEK DRAINAGE BASIN, DATED JANUARY 2012, BY MERRICK & COMPANY.
Q5=104.3 CFS
Q100=241.0 CFS
(FLOW RATES FROM SWMM MODELS, NODE 14B, MAXIMUM TOTAL INFLOW)

SEE TRACT O ACCESS ROAD STORM SEWER NETWORK MODEL NO. 2 FOR OUTLET PIPE INFORMATION

DISCHARGE FROM: RIDGEGATE PARKWAY INTERCHANGE AND I-25 WIDENING FINAL HYDRAULICS & HYDROLOGY REPORT V.2, DATED JULY 2003, BY PBS&J.
Q5=11.0 CFS
Q100=28.9 CFS
(FLOW RATES FROM STORMCAD MODEL, PIPE P-13)

DP 5
Q5=2.6 CFS
Q100=5.7 CFS

RIDGEGATE PARKWAY

SDMH-01
Q5=42.1+2.6=44.7 CFS
Q100=112.3+5.7=118.0 CFS

SDMH-02
NOTE: THIS MANHOLE HAS TWO OUTLET PIPES AT THE SAME INVERT ELEVATION.
THEREFORE, FLOW RATES ARE DIVIDED BY 2.
Q5=84.1/2=42.1 CFS
Q100=224.5/2=112.3 CFS

PROPOSED STORM SEWER (TYP)

SDMH-03
Q5=84.1 CFS
Q100=224.5 CFS

TRACT O ACCESS ROAD

DP 6
Q5=73.1 CFS
Q100=147.0 CFS

DP 2
Q5=0.7 CFS
Q100=1.7 CFS

DP 3
Q5=2.2 CFS
Q100=5.3 CFS

DP 1
Q5=18.4 CFS
Q100=91.5 CFS

SDMH-05
Q5=19.7 CFS
Q100=94.7 CFS

TRACT O ACCESS ROAD STORM SEWER NETWORK MODEL NO. 1

NOTE:
THE FLOW RATES LISTED ARE FROM STANDARD FORM SF-3 FROM APPENDIX B. THE FLOW RATES LISTED ACCOUNT FOR ALL BYPASS FLOW RATES AND REPRESENT THE FLOW WITHIN THE PIPE.

MODEL RIM ELEVATIONS = FL OF INLETS OR RIM OF MANHOLE STRUCTURES.

(18) – LINE NUMBER

MERRICK POND 311
REPORT EXCERPTS FROM
CALIBRE REPORT

Q:\DEN\Projects\5087-01-RRMD Overall\Design\2012-02 Tract O\Drainage\Hydraulics\Sewer\District 3 Access Road Sewer Model - 1.dwg, Tract O Access Road, 4/18/2012 5:26:00 PM, 1:1

MERRICK POND 311 REPORT EXCERPTS FROM CALIBRE REPORT

PHASE III DRAINAGE REPORT
FOR
DETENTION POND 311 RETROFIT
RAMPART RANGE METROPOLITAN DISTRICT NO. 1

December 2013

Prepared For:

Rampart Range Metropolitan District No. 1
6399 S. Fiddler's Green Circle, Suite #1
Greenwood Village, CO 80111-4974
Phone: (303) 779-4525
Fax: (303) 773-2050

Prepared By:

Carson Besgrove, PE

Reviewed By:

COLORADO REGISTERED PROFESSIONAL ENGINEER
KENNETH LEE LINHARDT
19366

Kenneth Lee Linhardt, PE No. 19366 2/17/14
Senior Project Manager

Merrick Job No. 65117773

MERRICK & COMPANY

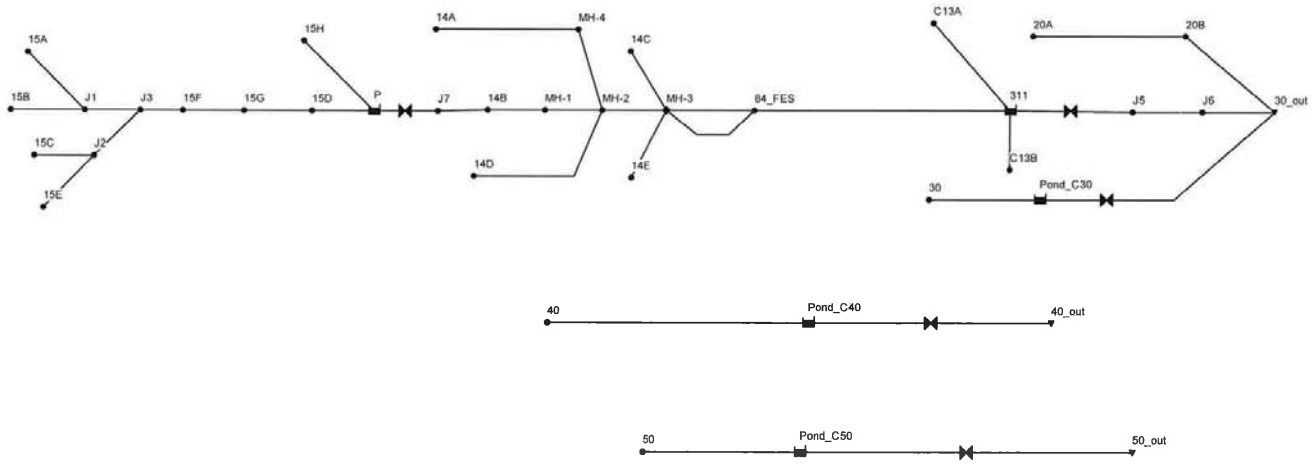
5970 Greenwood Plaza Blvd
Greenwood Village, Colorado 80111
Phone: (303) 751-0741
Fax (303) 752-4451

City of Lone Tree Review & Approval Is With Respect To General Conformance With City Standards. Responsibility For The Design Remains With The Professional(s) Submitting And Stamping The Document(s).

CITY OF LONE TREE
PUBLIC WORKS DEPARTMENT
APPROVED
BY GA Weeks DATE FEB 27 2014

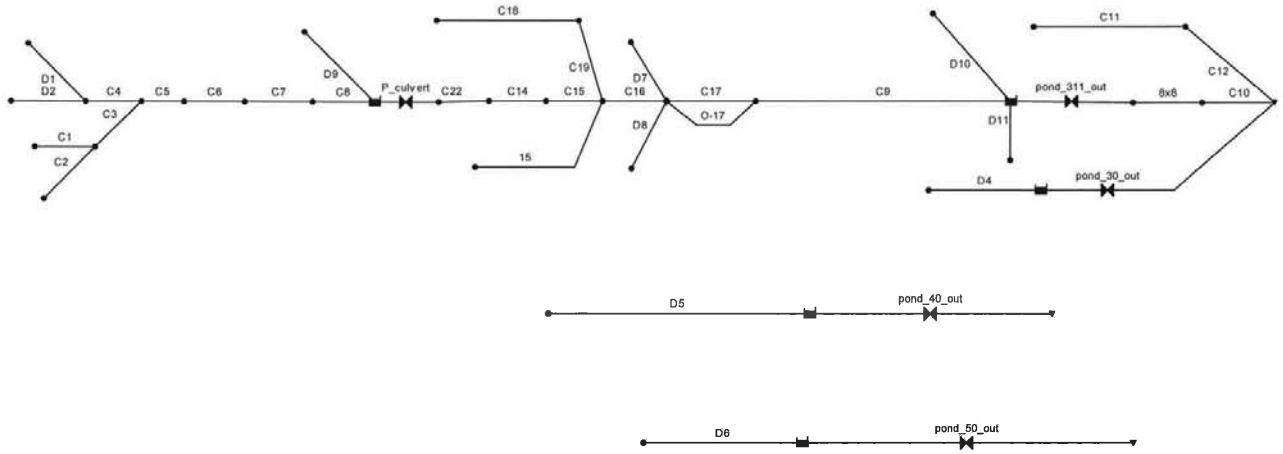
SWMM NODE MAP

01/01/2005 01:00:00



SWMM LINK MAP

01/01/2005 01:00:00



COTTONWOOD CRK 100-YEAR DEVELOPED

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------

COTTONWOOD CREEK MASTER: 100-YEAR DEVELOPED

************************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
************************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ JAN-01-2005 00:00:00
Ending Date .............. JAN-05-2005 23:30:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Routing Time Step ........ 30.00 sec


WARNING 08: elevation drop exceeds length for Conduit D10

**************************        Volume         Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............       133.484         43.498
External Inflow ..........         0.000          0.000
External Outflow .........       133.608         43.538
Internal Outflow .........         0.000          0.000
Storage Losses ...........         0.000          0.000
Initial Stored Volume ....         0.000          0.000
Final Stored Volume ......         0.000          0.000
Continuity Error (%) .....        -0.093


*********************************
Highest Flow Instability Indexes
*********************************
Link C22 (3)
Link C14 (3)
Link P_culvert (3)
Link 15 (2)
Link C16 (2)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.01


******************
Node Depth Summary
```

COTTONWOOD CRK 100-YEAR DEVELOPED

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
14A	JUNCTION	0.02	1.94	6066.48	0 00:40
14B	JUNCTION	0.06	3.18	6053.73	0 01:24
14C	JUNCTION	0.00	0.00	6065.00	0 00:00
14D	JUNCTION	0.03	2.70	6045.70	0 00:40
14E	JUNCTION	0.00	0.00	6070.00	0 00:00
15A	JUNCTION	0.00	0.00	6160.00	0 00:00
15B	JUNCTION	0.00	0.00	6160.00	0 00:00
15C	JUNCTION	0.01	1.13	6156.13	0 00:40
15D	JUNCTION	0.04	3.36	6083.36	0 00:52
15E	JUNCTION	0.01	0.55	6155.55	0 00:45
15F	JUNCTION	0.03	2.31	6112.31	0 00:51
15G	JUNCTION	0.03	2.46	6090.46	0 00:51
15H	JUNCTION	0.00	0.00	6125.00	0 00:00
20A	JUNCTION	0.00	0.62	5985.62	0 00:35
20B	JUNCTION	0.01	0.80	5960.80	0 00:40
30	JUNCTION	0.00	0.00	5948.00	0 00:00
40	JUNCTION	0.00	0.00	5944.00	0 00:00
50	JUNCTION	0.00	0.00	5962.00	0 00:00
84_FES	JUNCTION	0.08	4.77	6042.14	0 00:49
C13A	JUNCTION	0.00	0.00	0.00	0 00:00
C13B	JUNCTION	0.00	0.00	6060.00	0 00:00
J1	JUNCTION	0.02	1.56	6156.56	0 00:50
J2	JUNCTION	0.02	1.42	6141.42	0 00:45
J3	JUNCTION	0.03	2.31	6132.31	0 00:49
J5	JUNCTION	0.11	3.60	5997.65	0 01:21
J6	JUNCTION	0.12	3.60	5995.60	0 01:22
J7	JUNCTION	0.04	2.24	6069.24	0 01:30
MH-1	JUNCTION	5.02	8.14	6050.50	0 01:24
MH-2	JUNCTION	17.76	19.77	6061.31	0 00:36
MH-4	JUNCTION	0.12	2.08	6064.25	0 00:35
30_out	OUTFALL	0.11	2.70	5936.38	0 01:25
40_out	OUTFALL	0.00	0.00	5932.72	0 00:00
50_out	OUTFALL	0.00	0.00	5953.00	0 00:00
MH-3	DIVIDER	0.47	4.77	6043.92	0 00:49
311	STORAGE	2.47	12.02	6009.35	0 01:21
P	STORAGE	0.27	19.03	6093.53	0 01:30
Pond_C30	STORAGE	3.35	9.86	5944.86	0 01:20
Pond_C40	STORAGE	0.51	7.42	5950.42	0 01:05
Pond_C50	STORAGE	0.46	6.79	5961.79	0 01:10

Pond 311 100-year WSE=6009.35

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
14A	JUNCTION	60.41	60.41	0 00:40	1.130	1.130
14B	JUNCTION	19.31	240.37	0 01:24	0.354	12.313
14C	JUNCTION	0.00	0.00	0 00:00	0.000	0.000
14D	JUNCTION	159.46	159.46	0 00:40	3.347	3.347
14E	JUNCTION	36.37	36.37	0 00:40	0.773	0.773
15A	JUNCTION	52.70	52.70	0 00:50	1.574	1.574
15B	JUNCTION	70.60	70.60	0 00:50	2.255	2.255
15C	JUNCTION	81.92	81.92	0 00:40	2.042	2.042
15D	JUNCTION	91.05	386.29	0 00:52	2.690	11.110
15E	JUNCTION	30.37	30.37	0 00:45	0.810	0.810
15F	JUNCTION	30.00	261.61	0 00:51	0.786	7.481
15G	JUNCTION	36.95	296.86	0 00:51	0.935	8.420
15H	JUNCTION	26.21	26.21	0 00:50	0.847	0.847

COTTONWOOD CRK 100-YEAR DEVELOPED

20A	JUNCTION	25.32	25.32	0	00:35	0.447	0.447
20B	JUNCTION	30.92	56.11	0	00:40	0.788	1.235
30	JUNCTION	458.22	458.22	0	00:35	6.338	6.338
40	JUNCTION	785.87	785.87	0	00:35	11.345	11.345
50	JUNCTION	272.38	272.38	0	00:35	3.638	3.638
84_FES	JUNCTION	0.00	437.63	0	00:49	0.000	17.548
C13A	JUNCTION	166.82	166.82	0	00:40	2.853	2.853
C13B	JUNCTION	19.94	19.94	0	00:45	0.542	0.542
J1	JUNCTION	0.00	123.30	0	00:50	0.000	3.829
J2	JUNCTION	0.00	111.68	0	00:45	0.000	2.853
J3	JUNCTION	0.00	232.70	0	00:49	0.000	6.690
J5	JUNCTION	0.00	391.03	0	01:21	0.000	20.948
J6	JUNCTION	0.00	391.02	0	01:22	0.000	20.948
J7	JUNCTION	0.00	236.38	0	01:30	0.000	11.958
MH-1	JUNCTION	0.00	240.34	0	01:24	0.000	12.310
MH-2	JUNCTION	0.00	404.03	0	00:49	0.000	16.784
MH-4	JUNCTION	0.00	62.44	0	00:35	0.000	1.130
30_out	OUTFALL	0.00	475.42	0	01:14	0.000	28.550
40_out	OUTFALL	0.00	214.00	0	00:43	0.000	11.349
50_out	OUTFALL	0.00	54.00	0	00:39	0.000	3.636
MH-3	DIVIDER	0.00	438.20	0	00:49	0.000	17.553
311	STORAGE	0.00	588.78	0	00:49	0.000	20.960
P	STORAGE	0.00	412.38	0	00:53	0.000	11.958
Pond_C30	STORAGE	0.00	458.22	0	00:35	0.000	6.338
Pond_C40	STORAGE	0.00	785.87	0	00:35	0.000	11.345
Pond_C50	STORAGE	0.00	272.38	0	00:35	0.000	3.638

Pond 311 100-year
Peak Inflow=588.8 cfs

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
14C	JUNCTION	119.51	0.000	0.000
14E	JUNCTION	119.51	0.000	0.000
15A	JUNCTION	119.51	0.000	0.000
15B	JUNCTION	119.51	0.000	0.000
15H	JUNCTION	119.51	0.000	0.000
30	JUNCTION	119.51	0.000	0.000
40	JUNCTION	119.51	0.000	0.000
50	JUNCTION	119.51	0.000	0.000
C13A	JUNCTION	119.51	0.000	0.000
C13B	JUNCTION	119.51	0.000	0.000
311	STORAGE	30.27	7.021	0.649
P	STORAGE	2.09	15.034	2.466
Pond_C30	STORAGE	119.51	9.860	2.640
Pond_C40	STORAGE	119.51	7.420	0.330
Pond_C50	STORAGE	119.51	6.788	0.212

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS

COTTONWOOD CRK 100-YEAR DEVELOPED

311	73.352	8	0	796.421	89	0	01:21	391.03
P	4.503	1	0	432.380	70	0	01:30	236.38
Pond_C30	123.303	12	0	669.930	63	0	01:20	58.85
Pond_C40	47.800	5	0	878.902	94	0	01:05	214.00
Pond_C50	14.916	5	0	308.695	96	0	01:09	54.00

Pond 311 100-year peak discharge=391.0 cfs

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
30_out	73.97	11.99	475.42	28.550
40_out	74.95	4.71	214.00	11.349
50_out	44.15	2.56	54.00	3.636
System	64.36	19.26	743.42	43.535

Maximum flow at the western channel less than the "Plan 100-year Release Rate" of 524 cfs identified in the MDP-12

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
15	CONDUIT	160.48	0	00:40	17.70	0.80	0.68
8x8	CONDUIT	391.02	0	01:22	13.58	0.43	0.45
C1	CONDUIT	81.92	0	00:44	6.43	0.05	0.23
C10	CONDUIT	390.95	0	01:25	8.04	0.28	0.54
C11	CONDUIT	25.32	0	00:39	6.09	0.01	0.12
C12	CONDUIT	56.07	0	00:40	9.46	0.02	0.16
C14	CONDUIT	240.34	0	01:24	18.27	0.73	0.64
C15	CONDUIT	240.33	0	01:24	14.68	0.61	0.56
C16	CONDUIT	403.99	0	00:49	16.30	0.70	0.61
C17	CONDUIT	437.63	0	00:49	15.71	0.81	0.68
C18	CONDUIT	62.44	0	00:35	12.77	0.78	0.65
C19	CONDUIT	61.10	0	00:36	12.18	0.80	0.68
C2	CONDUIT	30.37	0	00:49	5.72	0.01	0.11
C22	CONDUIT	236.38	0	01:31	7.15	0.18	0.45
C3	CONDUIT	111.65	0	00:45	6.47	0.08	0.28
C4	CONDUIT	124.46	0	00:55	6.35	0.09	0.31
C5	CONDUIT	232.65	0	00:51	6.82	0.20	0.46
C6	CONDUIT	261.32	0	00:51	7.78	0.19	0.45
C7	CONDUIT	296.80	0	00:52	7.84	0.22	0.49
C8	CONDUIT	386.17	0	00:53	6.39	0.69	0.84
C9	CONDUIT	435.59	0	00:50	7.82	0.38	0.64
D1	DUMMY	52.70	0	00:50			
D10	DUMMY	166.82	0	00:40			
D11	DUMMY	19.94	0	00:45			
D2	DUMMY	70.60	0	00:50			
D4	DUMMY	458.22	0	00:35			
D5	DUMMY	785.87	0	00:35			
D6	DUMMY	272.38	0	00:35			
D7	DUMMY	0.00	0	00:00			
D8	DUMMY	36.37	0	00:40			
D9	DUMMY	26.21	0	00:50			
O-17	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
P_culvert	DUMMY	236.38	0	01:30			
pond_30_out	DUMMY	58.85	0	01:20			
pond_311_out	DUMMY	391.03	0	01:21			
pond_40_out	DUMMY	214.00	0	00:43			
pond_50_out	DUMMY	54.00	0	00:39			

COTTONWOOD CRK 100-YEAR DEVELOPED

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
D1	0.01	0.01	0.01	119.51	0.01
D10	0.01	0.01	0.01	119.51	0.01
D11	0.01	0.01	0.01	119.51	0.01
D2	0.01	0.01	0.01	119.51	0.01
D4	0.01	0.01	0.01	119.51	0.01
D5	0.01	0.01	0.01	119.51	0.01
D6	0.01	0.01	0.01	119.51	0.01
D7	0.01	0.01	0.01	119.51	0.01
D8	0.01	0.01	0.01	119.51	0.01
D9	0.01	0.01	0.01	119.51	0.01

Analysis begun on: Tue Dec 10 14:21:55 2013
Analysis ended on: Tue Dec 10 14:21:55 2013
Total elapsed time: < 1 sec

structure. The T-Base manhole shall be constructed per Douglas County Standard Detail SD-6. Horizontal or vertical alignment changes using a three piece elbow or bend in conjunction with a T-Base may be considered through the variance process for very large pipes where the base structure for a Box Base or Type P manhole would be excessively large.

3. Type "P" Manhole. This manhole is appropriate for 30 degree and 45 degree deflections (horizontal alignment changes) where the use of a box base manhole would result in excessive dimensions. The Type "P" Manhole shall be constructed per Douglas County Standard Detail SD-10.
4. Special Junction Structures. Special junction structures may have to be designed when pipe sizes and alignment changes exceed those that can be accommodated by standard manhole types.

9.7.4 Steps and Platforms. Steps are required in all manholes exceeding 3.5-feet in height and shall be in accordance with AASHTO M 199. The Occupational Health and Safety Administration has specific standards for fixed ladders used to ascend heights exceeding 20-feet. Cages and/or landing platforms may be required to satisfy these requirements in excessively deep manhole structures. It is the design engineer's responsibility to ensure that the appropriate measures are designed and construction details are developed and included in the construction drawings, as needed to comply with the Occupational Health and Safety Administration standards. When landing platforms are proposed, consideration shall be given to the potential maintenance activities and the expected loadings on the platforms.

9.7.5 Drop Manholes. The drop within a manhole from the upstream to downstream pipe invert should normally not exceed 1-foot. There are cases when a drop larger than 1-foot may be necessary to avoid a utility conflict, reduce the slope of the downstream pipe, or to account for the energy losses in the manhole. Drops that exceed 1-foot will be evaluated on a case-by-case basis and additional analysis may be required. The details referenced in Section 9.7.3 for the Box Base and Type P manholes do not accommodate a significant elevation difference between the pipes entering and exiting the manhole, therefore use of these manholes would require a special design.

9.7.6 Energy Dissipation in Manholes for Small Storm Drainage Outfalls. Small storm drainage outfalls are defined as outfall systems that have a design flow rate of 20 cubic feet per second or less at the outlet point into a drainageway or detention pond. Small storm drainage outfall systems are commonly proposed to drain cul-de-sacs or other small tributary areas. In many cases, a relatively steep slope is required for the pipe to outlet into an adjacent drainageway or detention pond. In the design of these systems, manholes will be allowed to have drops to a maximum of 4.5-feet in order to provide energy dissipation within the system. In order for a manhole to qualify as an energy dissipation structure upstream of the storm sewer outlet, the minor storm flow must have sufficient velocity to impact the opposite side of the manhole. These minimum velocities, based on the drop height, are provided in Figure 9-1. The information provided in Figure 9-1 is based on the use of a 4-foot manhole (inside diameter). The use of a 4-foot

manhole is acceptable and required when proposed for the purposes of energy dissipation in small outfall systems.

9.7.7 Manhole Shaping. All manholes shall be constructed with fill concrete to the top of the highest crown of the highest top of pipe entering or exiting the manhole. The shaping shall match the pipe section below pipe springline and consist of vertical walls above pipe springline. This shaping significantly reduces manhole losses. The appropriate loss coefficient can be determined using Figure ST-8 and Table ST-9 in Volume 1 of the *UDFCD Manual* for full shaping. Douglas County Standard Detail SD-6, provides construction details for channelization in slab base and box base manholes.

9.7.8 Other Design Considerations. The following design criteria shall also be met:

- The elevation of the pipe crowns shall be matched when the downstream pipe is larger than the upstream pipe. This will minimize the backwater effects on the upstream pipe.
- The invert of a manhole shall be constructed with a slope between the upstream and downstream pipes. The slope shall be the average of the upstream and downstream pipe slopes or based on a fall of 0.1-foot through the manhole.
- It is critical that gutter pans, curb heads, and any other problematic locations be avoided when determining the horizontal placement of manholes.

9.8 Hydraulic Design

Once the layout of the storm sewer system is determined, the peak flows in the system must be calculated followed by a hydraulic analysis to determine pipe capacity and size. The pipe size shall not decrease moving downstream (even if the capacity is available due to increased slope, etc.) in order to reduce clogging potential.

9.8.1 Allowable Storm Sewer Velocity and Slope. The allowable storm sewer velocity is dependent on many factors, including the type of pipe, the acceptable water level during the pipe design life, proposed flow conditions (open channel versus pressure flows), and the type and quality of construction of joints, manholes, and junctions.

1. Maximum velocity. In consideration of the above factors, the maximum velocity in all storm sewers shall be limited to 18-fps.
2. Minimum velocity. The need to maintain a self-cleaning storm sewer system is recognized as a goal to minimize the costs for maintenance of storm sewer facilities. Sediment deposits, once established, are generally difficult to remove even with pressure cleaning equipment. A minimum velocity of 4-fps is required when the storm sewer conveys runoff from frequently occurring storm events. Assuming that the pipe has been designed to near full flow, a flow depth equal to 25-percent of the pipe diameter and the corresponding flow rate shall be used to check the minimum velocity. If the pipe is not designed to flow near full, a flow depth equal to 25-percent of the design flow

2. Step 2 Pipe Capacity. In the major storm event it is acceptable to have a surcharge in the system. Therefore Manning's equation is not applicable for those pipes which are under pressure flow conditions. There may be cases where the major storm event does not result in a surcharge of the system. In these pipes the capacity can be calculated using Manning's equation, as described in Section 9.8.2.

3. Step 3 Hydraulic and Energy Grade Lines. Hydraulic grade line calculations for the storm sewer system shall be provided for the major storm event. The major storm energy grade line must not rise past the elevation 1-foot below the final grade along the storm sewer system. When a storm sewer is flowing under a pressure flow condition, the energy and hydraulic grade lines shall be calculated using the pressure-momentum theory. The capacity calculations generally proceed from the storm sewer outlet upstream, accounting for all energy losses. These losses are added to the energy grade line and accumulate to the upstream end of the storm sewer. The hydraulic grade line is then determined by subtracting the velocity head from the energy grade line at each change in the energy grade line slope. Refer to Section 4.4 in the Streets/Inlets/Storm Sewers chapter of Volume 1 of the *UDFCD Manual* as a guideline for completing hydraulic grade line and energy grade line calculations. The procedure described in the *UDFCD Manual* is based on the FHWA HEC-22 publication. All of the losses through a storm sewer system (at bends, junctions, transitions, entrances, and exits) are based upon coefficients recommended in the *UDFCD Manual*.

9.8.4 Computer Programs. It is recommended that a computer program be used for the design or as a calculation "check" of a storm sewer system. NeoUDSewer is the software created to supplement the *UDFCD Manual* and is an approved computer program for storm sewer analysis in the County. NeoUDSewer is a powerful tool which can calculate rainfall and runoff using the Rational Method and then size a circular storm sewer based on Manning's equation. Example 6.13 in the Streets/Inlets/Storm Sewers chapter of the *UDFCD Manual* is an example of sample project input and the resulting output from NeoUDSewer.

If an alternate computer program (i.e., StormCAD) is used, a calibration model based on Example 6.13 in the *UDFCD Manual* must be completed and provided to the County. This calibration model is generated by completing an analysis of Example 6.13 with the alternate computer model. The results of this alternate model must be comparable to the results from the NeoUDSewer analysis. It is not necessary to calibrate the hydrologic analysis as shown in Example 6.13; rather, the design engineer may input the peak flow directly to obtain a comparison of the resulting hydraulic and energy grade lines through the example system. The goal of this model calibration is to verify that the loss coefficients and other system assumptions used in the alternate computer program are equivalent to the methodology applied by NeoUDSewer, which is accepted by the County.

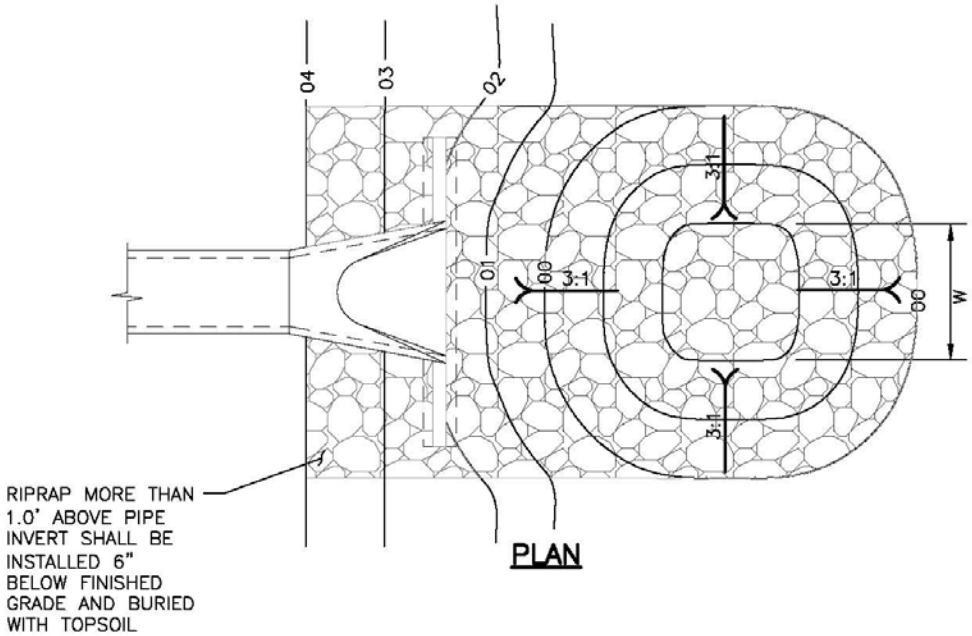
TABLE 10-1
EROSION PROTECTION AT CONDUIT OUTLETS

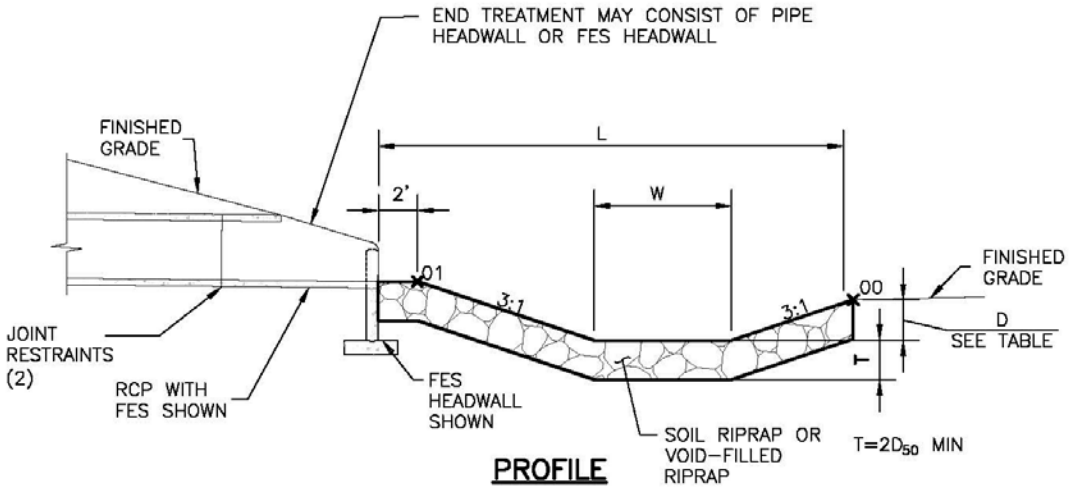
Erosion Protection Guidelines	UDFCD Manual Section	Use For	Do Not Use For
1. Riprap Lining (Section 10.3.1)	Section 7.0 of Major Drainage, Volume 1	· Receiving channel on same line and grade · Storm sewer and culvert outlets · Velocities from 0-15 fps · High tailwater · Fish passage	· Velocities above 15 fps · Wetland channels
2. Low Tailwater Stilling Basin (Section 10.3.2)	Section 3.4 of Hydraulic Structures, Volume 2	· Storm sewer and culvert outlets · Velocities from 0-15 fps · Low tailwater	· Velocities above 15 fps · Confined receiving area · Major drainage Areas where standing water is unacceptable
3. Concrete Impact Stilling Basin (Section 10.3.3)	Section 3.2 of Hydraulic Structures, Volume 2	· Storm sewer outlets · Velocities over 15 fps · Low tailwater	· In-line culvert outlets · High visibility areas
4. Concrete Baffle Chute (Section 10.3.4)	Section 3.3 of Hydraulic Structures, Volume 2	· Storm sewer outlets · Velocities over 5 fps · Low tailwater · Degrading channel	· In-line culvert outlets · High debris potential · High visibility areas
5. Drop Structures	Section 2.0 of Hydraulic Structures, Volume 2	· Wetland channels · Low rise box culverts or small diameter pipes where plugging is possible	· Confined receiving area · Fish passage

Final design criteria is available in the *UDFCD Manuals*

10.2.2 Selecting Type of Erosion Protection. Riprap protection downstream of culverts is considered for most situations where moderate outlet hydraulics govern. It is highly recommended that the designer use a low tailwater basin when a storm sewer enters a drainageway at an approximate right angle, and drop structures or riprap lining for in-line culvert outlets on major drainageways. The County strongly suggests drop structures or riprap lining for in-line culvert outlets on major drainageways.

Steep, high velocity conduits may be modified by providing a drop in a manhole and designing a larger diameter, flatter slope pipe from the manhole to the channel. This technique may also be used to reduce outlet velocities and the corresponding extents of riprap erosion protection. The use of drop manholes for this technique is discussed in Section 9.7.6.



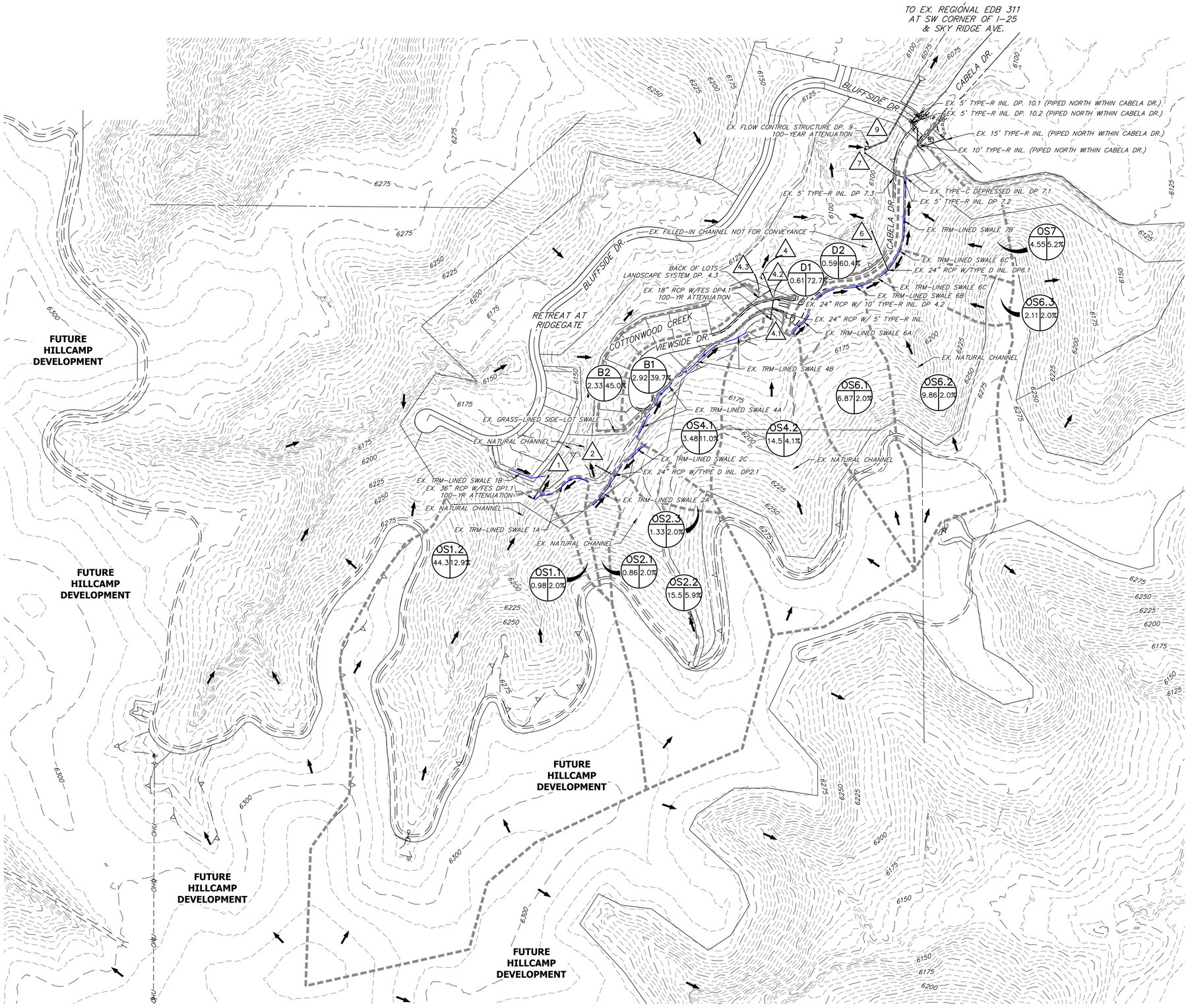


PIPE SIZE OR BOX HEIGHT	D	W*	L
18" – 24"	1'–0"	4'	15'
30" – 36"	1'–6"	6'	20'
42" – 48"	2'–0"	7'	24'
54" – 60"	2'–6"	8'	28'
66" – 72"	3'–0"	9'	32'

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

Figure 9-37. Low tailwater riprap basin

APPENDIX E
DRAINAGE MAPS



LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSION CONT. (INDEX)
- DEPRESSION CONT. (INTER)
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- DRAINAGE BASIN
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %)
- DESIGN POINT IDENTIFIER
- FLOW DIRECTION ARROW

NOTES:

1. DRAINAGE BASIN AREA AND IMPERVIOUS VALUES TAKEN FROM THE RIDGEGATE – SECTION 22, FILING NO.1 PHASE III DRAINAGE REPORT, DATED JANUARY 2017, BY CALIBRE ENGINEERING (RETREAT AT RIDGEGATE REPORT) AND ACCOUNT FOR THE PROPOSED CABELA DRIVE IMPERVIOUSNESS.
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2. SEE THE RETREAT AT RIDGEGATE REPORT FOR MORE INFORMATION.

200 100 0 200 400
ORIGINAL SCALE: 1" = 200'

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SUITE 300
GREENWOOD VILLAGE, CO 80111
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3	3RD COLT SUBMITTAL	KJR	11/20/25
4	4TH COLT SUBMITTAL	KJR	3/27/26

H-SCALE	1"=200'
V-SCALE	N/A
DATE	03/2026
DESIGNED BY	KR
DRAWN BY	BP
CHECKED BY	

HILLCAMP TRAIL

EXISTING DRAINAGE MAPS

EX OVERALL DRAINAGE MAP

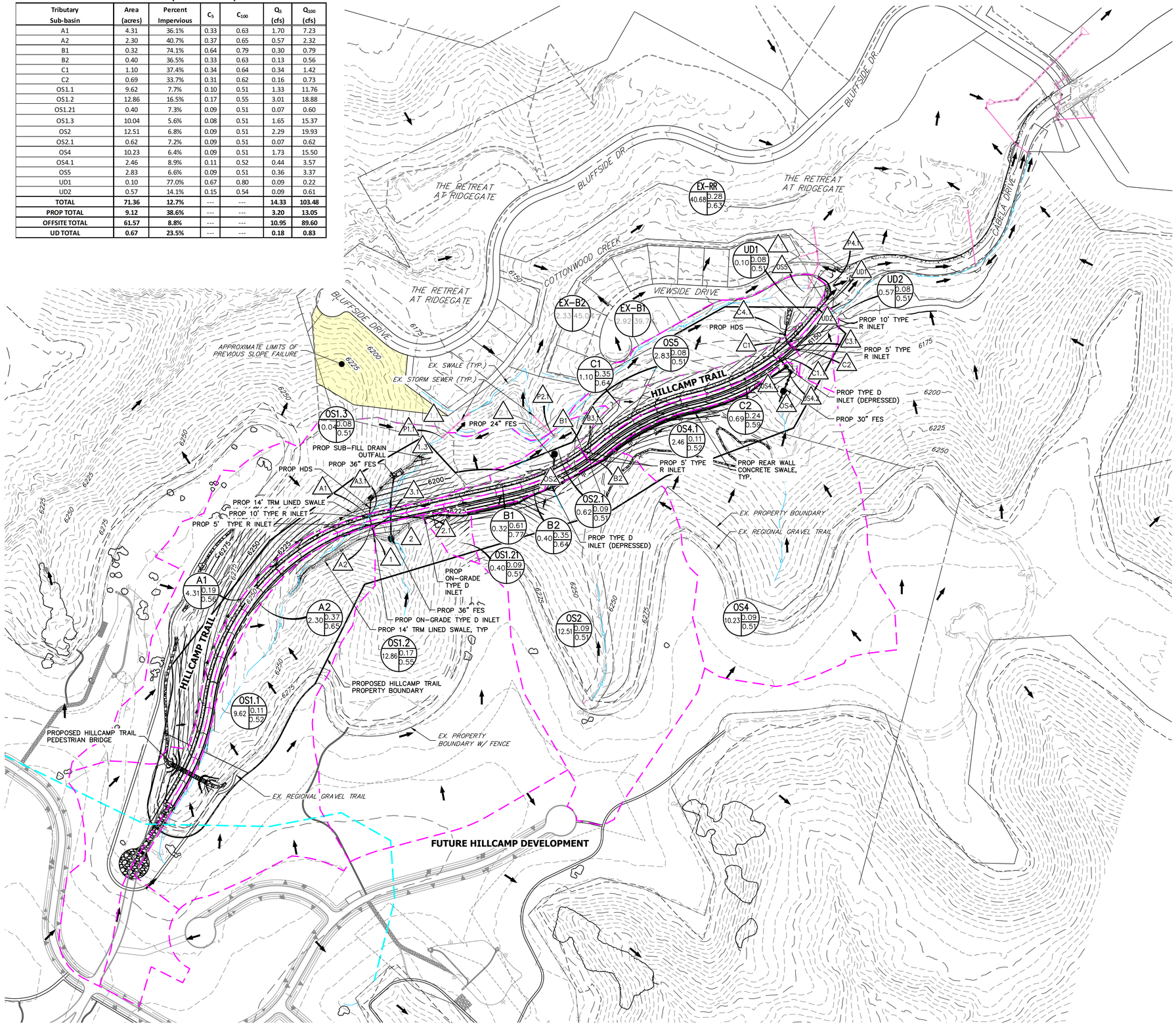
SHEET 1 OF 1

JOB NO. 15950.18

C:\Users\PosseyB\OneDrive - JR Engineering\15950\12\project files\15950118 cabela drive\Drawings\sheet drawings\15950118 Cabela Drive Drainage Maps\2025-10-24 15950118 Hillcamp Trail Drive Existing Overall Drainage Map.dwg, EX Overall Drainage Map, 3/27/2026 11:19:59 AM, poseyb

SUB-BASIN SUMMARY TABLE (CUHP-SWMM)

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A1	4.31	36.1%	0.33	0.63	1.70	7.23
A2	2.30	40.7%	0.37	0.65	0.57	2.32
B1	0.32	74.1%	0.64	0.79	0.30	0.79
B2	0.40	36.5%	0.33	0.63	0.13	0.56
C1	1.10	37.4%	0.34	0.64	0.34	1.42
C2	0.69	33.7%	0.31	0.62	0.16	0.73
OS1.1	9.62	7.7%	0.10	0.51	1.33	11.76
OS1.2	12.86	16.5%	0.17	0.55	3.01	18.88
OS1.21	0.40	7.3%	0.09	0.51	0.07	0.60
OS1.3	10.04	5.6%	0.08	0.51	1.65	15.37
OS2	12.51	6.8%	0.09	0.51	2.29	19.93
OS2.1	0.62	7.2%	0.09	0.51	0.07	0.62
OS4	10.23	6.4%	0.09	0.51	1.73	15.50
OS4.1	2.46	8.9%	0.11	0.52	0.44	3.57
OS5	2.83	6.6%	0.09	0.51	0.36	3.37
UD1	0.10	77.0%	0.67	0.80	0.09	0.22
UD2	0.57	14.1%	0.15	0.54	0.09	0.61
TOTAL	**71.36**	**12.7%**	---	---	**14.33**	**103.48**
PROP TOTAL	**9.12**	**38.6%**	---	---	**3.20**	**13.05**
OFFSITE TOTAL	**61.57**	**8.8%**	---	---	**10.95**	**89.60**
UD TOTAL	**0.67**	**23.5%**	---	---	**0.18**	**0.83**



PROP DESIGN POINT TABLE (CUHP-SWMM)

Design Point	Q_5 (cfs)	Q_{100} (cfs)
A1	1.70	7.23
A2	0.57	2.32
A3.1 / HDS-A1	1.70	7.23
1	1.33	11.76
2	3.01	18.88
2.1	0.07	0.60
3.1	3.96	30.43
1.3	1.65	15.37
P1.1	7.76	53.84
OS2	2.29	19.93
OS2.1	0.07	0.62
P2.1	2.36	20.55
B1	0.30	0.79
B2	0.13	0.56
B3.1	0.43	1.31
OS4	1.73	15.50
OS4.1	0.44	3.57
OS4.2	1.73	15.69
C1.1	2.63	21.02
C2	0.16	0.73
C3.1	2.79	21.68
C1	0.34	1.42
C4.1 / HDS C1	2.64	19.09
P4.1	3.47	25.93

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (# / ## / #)
- FLOW DIRECTION ARROW
- PROPOSED JR DESIGN POINT (4.1)

NOTES:

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150 75 0 150 300

ORIGINAL SCALE: 1" = 150'

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4	4TH COLT SUBMITTAL	K.JR	3/27/26
5	5TH COLT SUBMITTAL	K.JR	7/21/26
6	6TH COLT SUBMITTAL	K.JR	9/8/26

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DATE	09/2026
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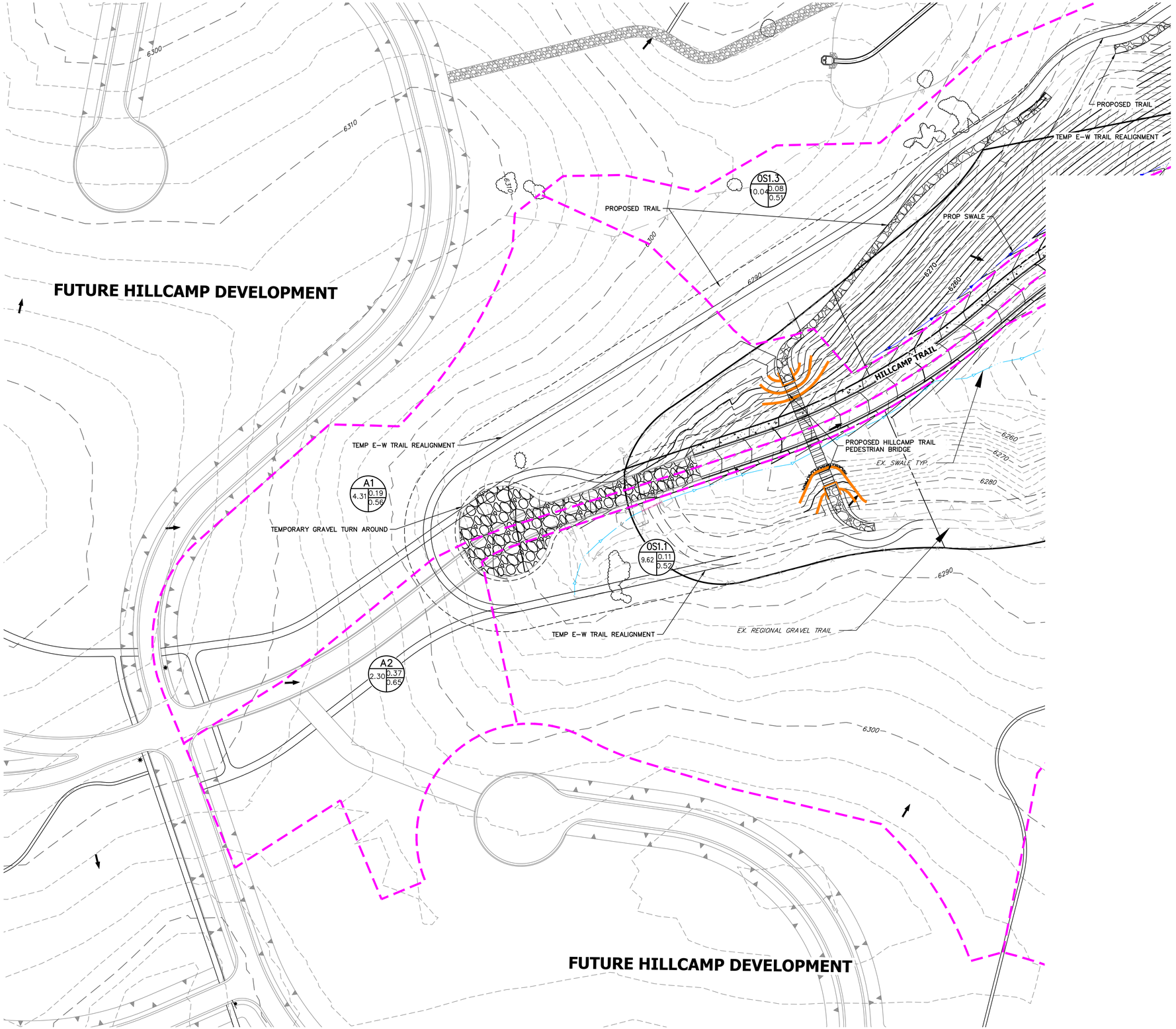
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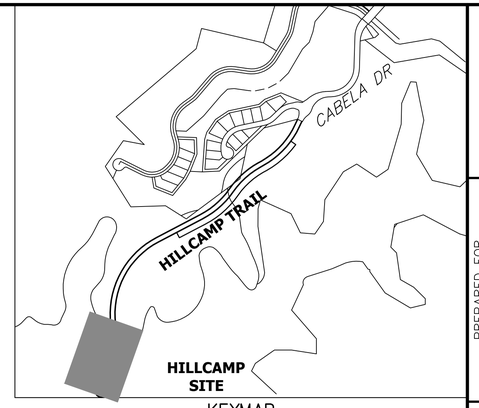
PROPOSED DRAINAGE MAPS

DR-01

SHEET 1 OF 6

JOB NO. 15950.18





KEYMAP
SCALE: 1" = 600'

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB–BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (# / ## / #)
- FLOW DIRECTION ARROW
- PROPOSED JR DESIGN POINT (4.1)

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50 25 0 50 100
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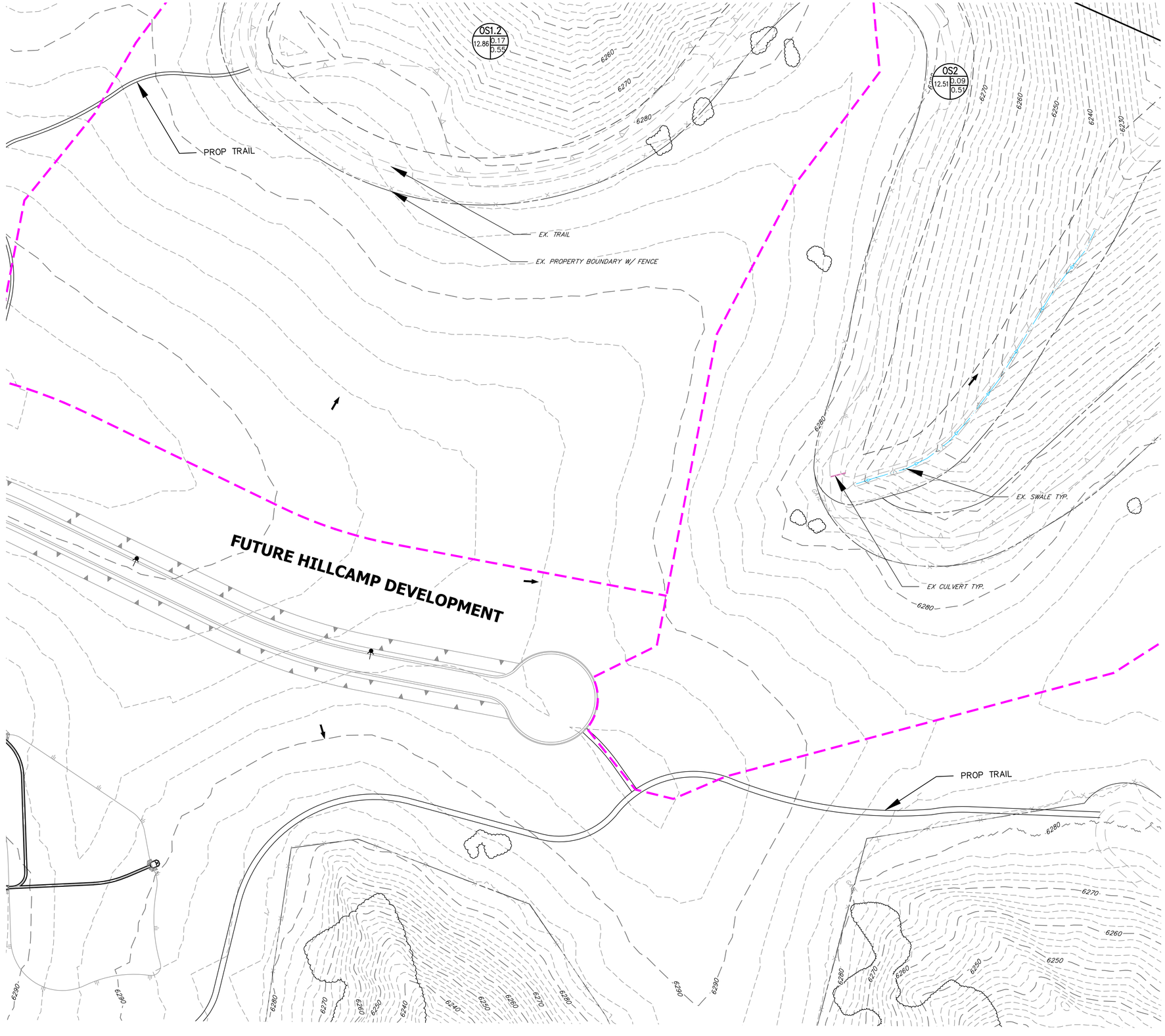
No.	REVISION	BY	DATE
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2	2ND COLT SUBMITTAL	KJR	8/15/25
3	3RD COLT SUBMITTAL	KJR	11/20/25
4	4TH COLT SUBMITTAL	KJR	3/27/26
5	5TH COLT SUBMITTAL	KJR	7/21/26
6	6TH COLT SUBMITTAL	KJR	9/8/26

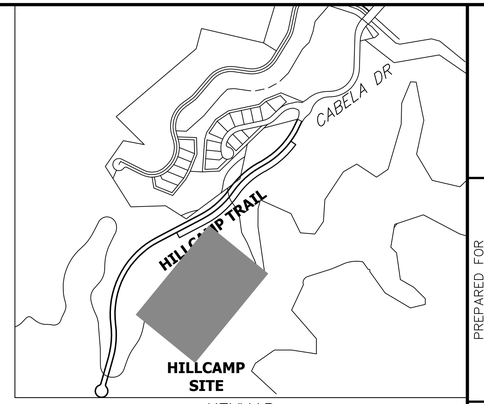
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V–SCALE	N/A
DATE	09/2026
DESIGNED BY	BP
DRAWN BY	BP
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HILLCAMP TRAIL
PROPOSED DRAINAGE MAPS

DR–02

SHEET 2 OF 6
JOB NO. 15950.18





KEYMAP
SCALE: 1" = 600'

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (# / ## / #)
- FLOW DIRECTION ARROW
- PROPOSED JR DESIGN POINT (4.1)

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5	5TH COLT SUBMITTAL	KJR	7/21/26
6	6TH COLT SUBMITTAL	KJR	9/8/26

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V-SCALE	N/A
DATE	09/2026
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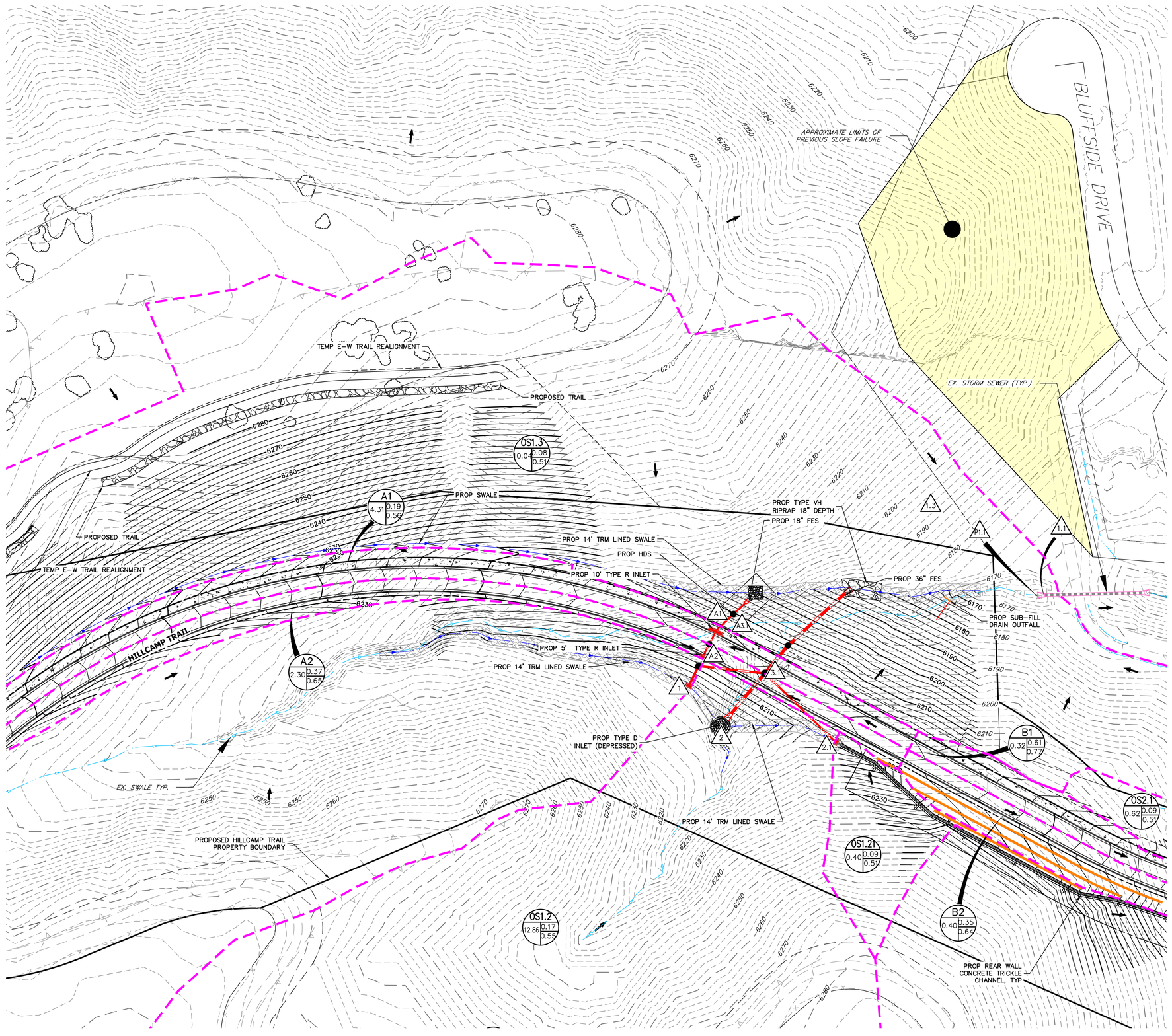
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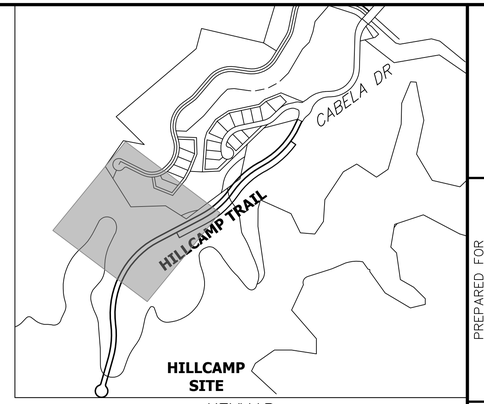
PROPOSED DRAINAGE MAPS

DR-03

SHEET 3 OF 6

JOB NO. 15950.18





KEYMAP
SCALE: 1" = 600'

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (# / #.## / #)
- FLOW DIRECTION ARROW
- PROPOSED JR DESIGN POINT (4.1)

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50 25 0 50 100
ORIGINAL SCALE: 1" = 50'

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2001 16TH STREET
SUITE 1700
DENVER, CO 80202
PHONE: 303-779-5710

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No.	REVISION	BY	DATE
1	1ST COLT SUBMITTAL	KJR	3/20/25
2	2ND COLT SUBMITTAL	KJR	8/15/25
3	3RD COLT SUBMITTAL	KJR	11/20/25
4	4TH COLT SUBMITTAL	KJR	3/27/26
5	5TH COLT SUBMITTAL	KJR	7/21/26
6	6TH COLT SUBMITTAL	KJR	9/8/26

H-SCALE	1"=50'
V-SCALE	N/A
DATE	09/2026
DESIGNED BY	BP
DRAWN BY	BP
CHECKED BY	

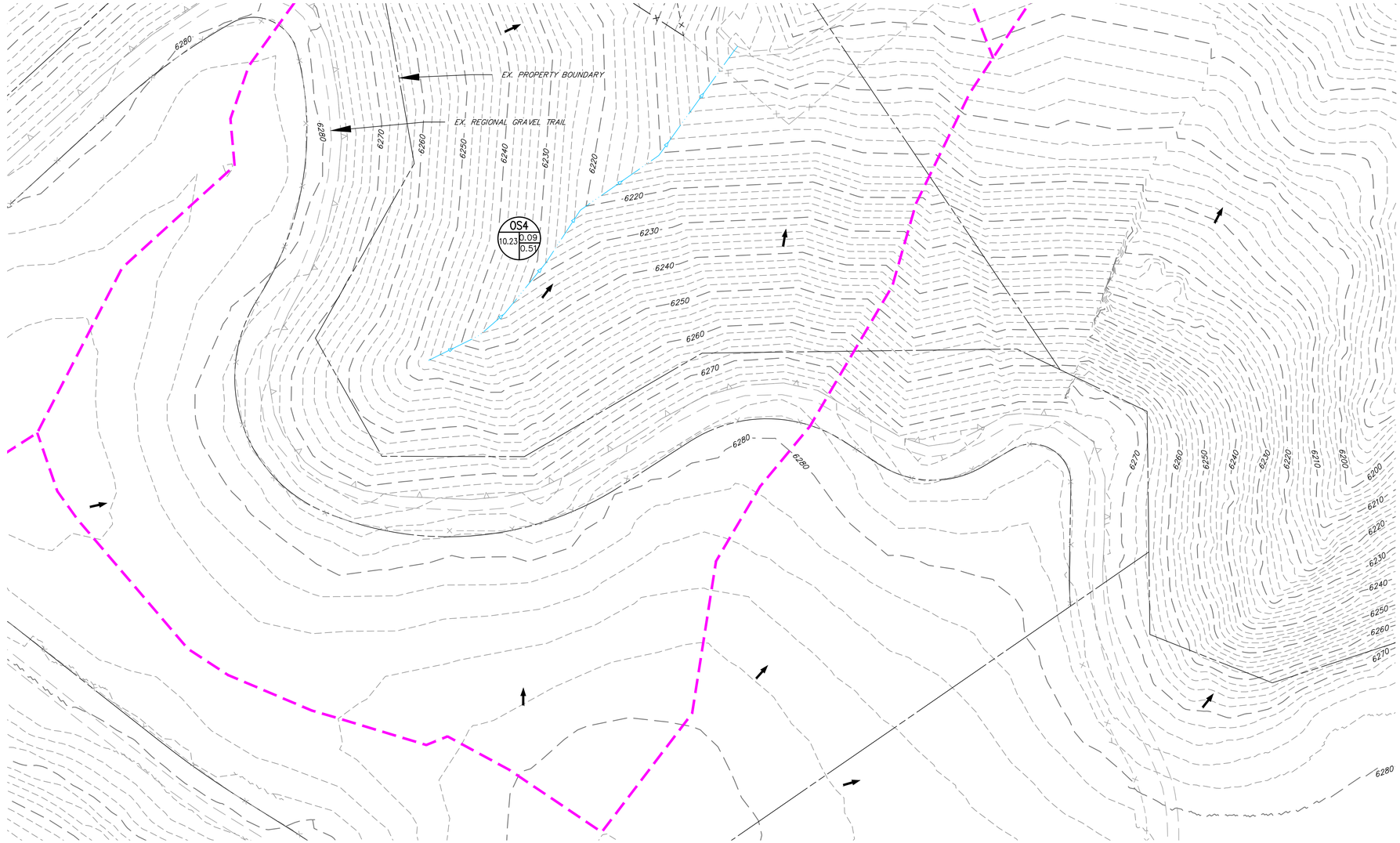
HILLCAMP TRAIL

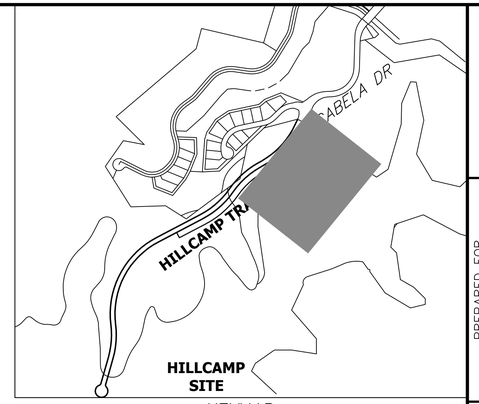
PROPOSED DRAINAGE MAPS

DR-04

SHEET 4 OF 6

JOB NO. 15950.18





KEYMAP
SCALE: 1" = 600'

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (#, ##, #)
- FLOW DIRECTION ARROW
- PROPOSED JR DESIGN POINT (4.1)

NOTES:

1. DRAINAGE BASIN AREA AND IMPERVIOUS VALUES TAKEN FROM THE RIDGEGATE – SECTION 22, FILING NO.1 PHASE III DRAINAGE REPORT, DATED JANUARY 2017, BY CALIBRE ENGINEERING (RETREAT AT RIDGEGATE REPORT) AND ACCOUNT FOR THE PROPOSED CABELA DRIVE IMPERVIOUSNESS.
2. ALL EXISTING DRAINAGE INFRASTRUCTURE DOWNSTREAM OF THE PROPOSED IMPROVEMENTS IS DESIGNED TO ACCOUNT FOR THE PROPOSED CABELA DRIVE IMPROVEMENTS PER THE "RIDGEGATE – SECTION 22, FILING NO.1 PHASE III" DRAINAGE REPORT, DATED JANUARY 2017, BY CALIBRE ENGINEERING (RETREAT AT RIDGEGATE REPORT).
3. SEE THE RETREAT AT RIDGEGATE REPORT FOR MORE INFORMATION.

50 25 0 50 100
ORIGINAL SCALE: 1" = 50'

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6	6TH COLT SUBMITTAL	K.JR	9/8/26

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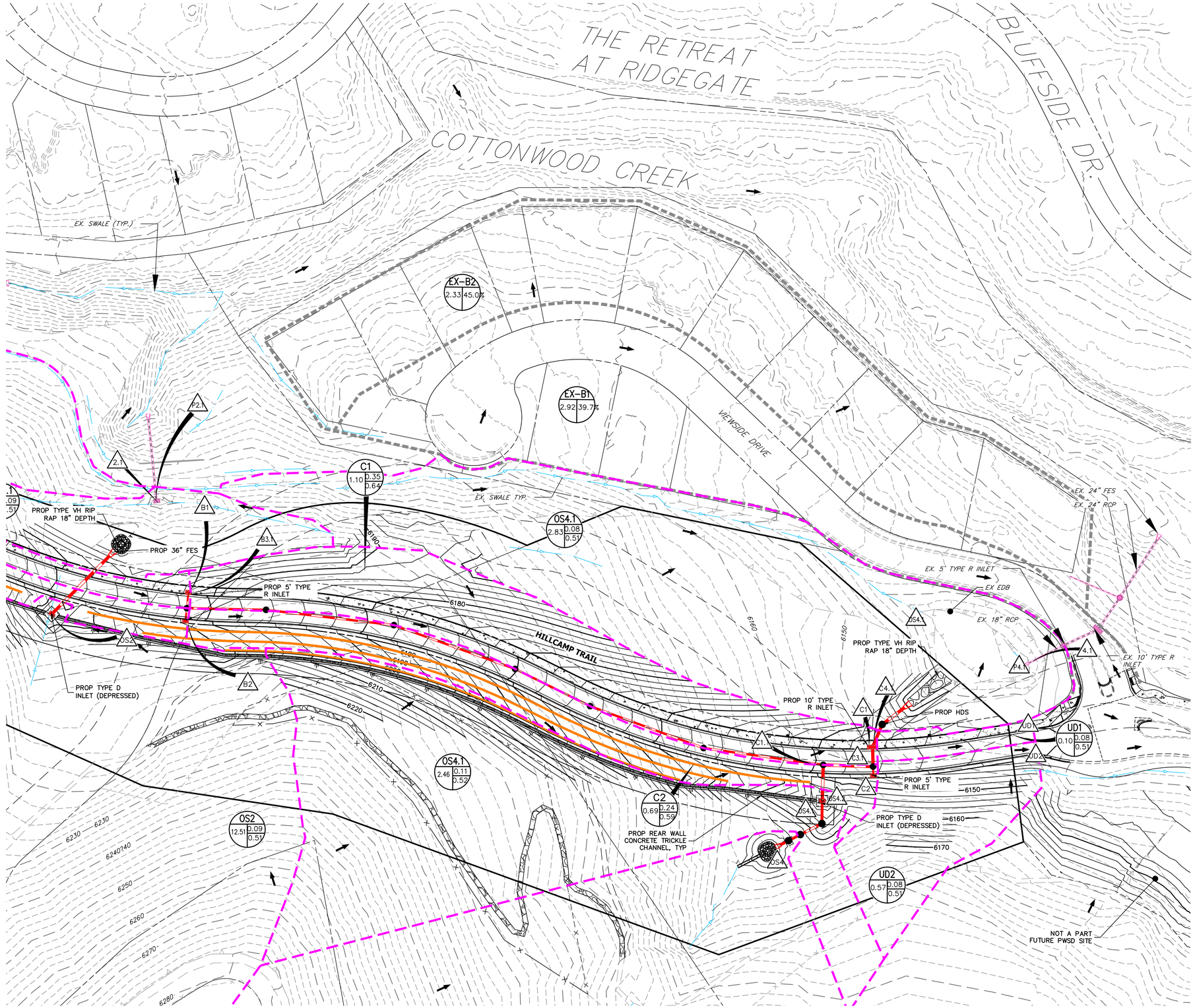
HILLCAMP TRAIL

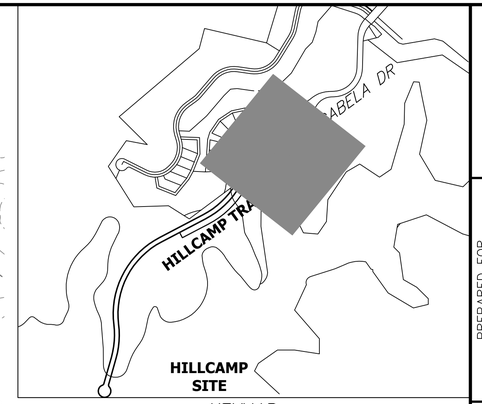
PROPOSED DRAINAGE MAPS

DR-05

SHEET 5 OF 6

JOB NO. 15950.18





KEYMAP
SCALE: 1" = 600'

LEGEND

EXISTING

- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- FLOW DIRECTION ARROW
- EXISTING RETREAT AT RIDGEGATE DESIGN POINT (4.1)

PROPOSED

- RIGHT OF WAY
- INDEX CONTOUR (6100)
- INTERMEDIATE CONTOUR
- SWALE/WATERWAY FLOWLINE
- STORM DRAIN
- RETAINING WALL
- CENTER LINE
- DRAINAGE SUB-BASIN
- BASIN DESIGNATION (ACRES, IMP. %) (#, ##, #)
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V-SCALE	N/A
DATE	09/2026
DESIGNED BY	BP
DRAWN BY	BP
CHECKED BY	

HILLCAMP TRAIL

PROPOSED DRAINAGE MAPS

DR-06

SHEET 6 OF 6

JOB NO. 15950.18