PHASE III DRAINAGE REPORT

FOR

QuikTrip Castle Pines #4266
NWC of Castle Pines Parkway & South Havana Street, Castle Pines, CO

Prepared for:

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Kimley»Horn

Project #: 096888058
Prepared: July 10, 2026
Resubmitted: October 6, 2026

CERTIFICATION

ENGINEER'S CERTIFICATION STATEMENT

This report and plan for the Phase III drainage design of QuikTrip Castle Pines #4266 was prepared by me (or under my direct supervision) in accordance with the provisions of Douglas County Drainage 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.

SIGNATURE: _____

Jessica McCallum, CO P.E. No. 59054 Date

DEVELOPER'S CERTIFICATION STATEMENT

QuikTrip Corporation hereby certifies that the drainage facilities for QuikTrip Castle Pines #4266 shall be constructed according to the design presented in this report. I understand that Douglas County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and Douglas County reviews drainage plans pursuant to Colorado Revised Statues, Title 30, Article 28; but cannot, on behalf of QuikTrip Corporation, guarantee that final drainage design review will absolve QuikTrip Corporation and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

QuikTrip Corporation _____

Name of Developer

_____

Authorized Signature Date

_____

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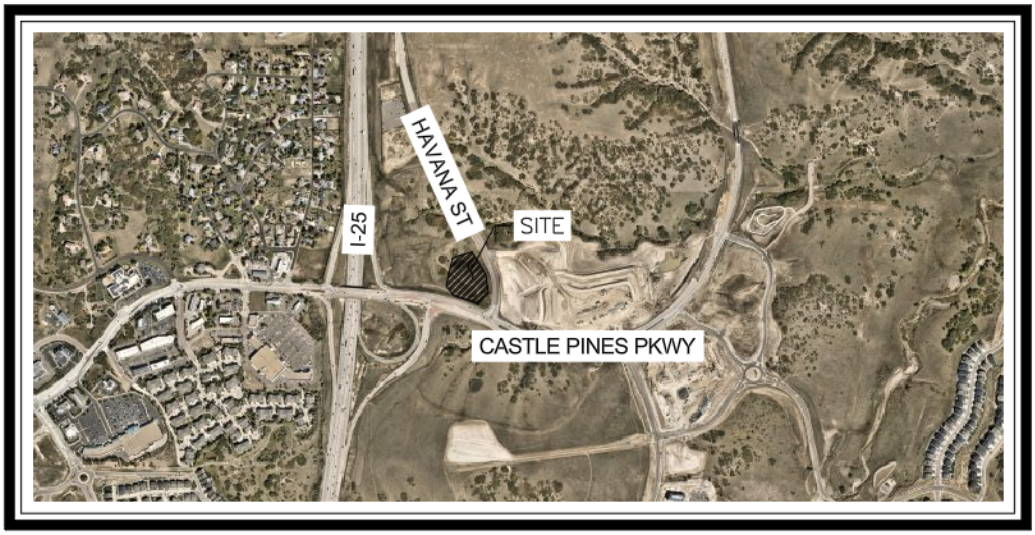
GENERAL LOCATION AND DESCRIPTION

SITE LOCATION

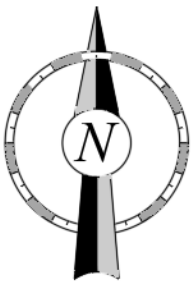
The purpose of this report is to outline the Phase III Drainage Report for QuikTrip Castle Pines #4266 located on Lot 1 of the Canyonside Subdivision Filing No. 4 (the "Property"), City of Castle Pines (the "City"), Douglas County (the "County"), Colorado. The Property is located within the northwest ¼ of Section 2 and the northeast ¼ of Section 3, Township 7 South, Range 67 West of the 6th PM.

The adjacent zoning land uses and roadways to the Property are listed below:

- North of Site: Proposed South Havana Street, Lot 2 Canyonside Subdivision Filing No. 4, PD (The Canyons)
- West of Site: Vacant land, PD (The Canyons), Existing South Havana Street
- East of Site: Proposed South Havana Street, Lot 3 Canyonside Subdivision Filing No. 4, PD (The Canyons)
- South of Site: Castle Pines Parkway



Vicinity Map
Not to Scale



DESCRIPTION OF PROPERTY

The proposed Property consists of the construction of an approximately 6,445-gross square-foot QuikTrip convenience store with fuel pumps and canopy, parking lot, utilities, and landscaping (the "Site"). The Site is 3.536 acres in size. The disturbed area of the Site is 4.15 acres. A future car wash will also be constructed in a later phase on the north side of the Site.

The Site is currently undeveloped, and existing ground cover is non-existent due to overlot grading operations. Existing South Havana Street is in the process of being relocated, and this is needed for the creation of the Site. Proposed grades (grades at the time of Site construction start) for the Site per the approved plat range from 2% to 25%.

NRCS soil data is available for this Site (see **Appendix A**), and the onsite soils are USCS Hydrologic Soil Group C. Group C soils have a slow rate of water transmission and a slow rate of infiltration when thoroughly wet. This site specifically is comprised of Fondis-Kutch association and Fondis clay loam.

The Site is tributary to Parkway Tributary which is part of the Newlin Gulch Watershed. Newlin Gulch Major Drainageway eventually outfalls to Reuter-Hess Reservoir.

The Flood Insurance Rate Map (FIRM) 08035C0180G effective date September 4, 2020, by FEMA, indicates that the Site is located in Zone X (outside of the 500-year flood plain). This panel is included in the **Appendix A**.

There are no major irrigation canals or ditches within the Site.

The Property generally slopes from southwest to northeast to a Type C inlet with the stormwater outfall eventually being EDB Pond B before outfalling to existing vacant land on the east side of proposed South Havana Street into Parkway Tributary.

The proposed land use is commercial.

EXISTING MAJOR DRAINAGE BASIN CONDITIONS

The Property is within Newlin Gulch Watershed.

MASTER DEVELOPMENT DRAINAGE PLAN

Per the Phase III Drainage Report for Canyonside Filing No. 4 – Phase 1, City of Castle Pines, Colorado prepared by Terracina Design dated March 21, 2005 (the "Master Study"), the runoff is directed to a proposed Type C inlet (Design Point B05) located south of relocated South Havana Street and a 30-inch RCP. Per the Master Study, the anticipated outfall for this Property is the extended detention basin (EDB Pond B) located directly northwest of the Site. The proposed EDB Pond B will route runoff via the proposed RCP (Design Point B) to the ultimate outfall for the Site of Parkway Tributary (Design Point 5). Reference **Appendix E** for supporting excerpts from the Master Study.

DRAINAGE BASINS AND SUB-BASINS

MAJOR DRAINAGE BASINS

The Property is within the Newlin Gulch Watershed. Per the Newlin Gulch Major Drainageway Plan prepared by Muller Engineering Company, Inc. dated October 2015, Newlin Gulch originates in the City of Castle Pines along I-25. The creek flows northeast through areas of Castle Pines, unincorporated Douglas County, and the Town of Parker before emptying into Cherry Creek near Challenger Park in the Town of Parker. The major drainage basin consists of rangeland and open space, high density city center, residential uses, commercial uses, undeveloped parcels, and subdivisions.

Drainage facilities downstream of the Site have been designed by others and are approved for construction, including the extended detention basin, EDB Pond B, located directly northwest of the Property. Reference **Appendix E** for vicinity map indicating watershed limits and downstream proposed extended detention basin, EDB Pond B.

There are off-site flows that affect the Property. Portions of vacant land along the west property line and pervious area within the Castle Pines Parkway right-of-way flow northeast onto the Property. An area of proposed sidewalk, landscaping, and the proposed right-in only access by others flows west onto the Property. The proposed full access to the Site on the north side of the Property and a portion of proposed relocated South Havana Street flows southwest onto the Property.

MINOR DRAINAGE BASINS

The developed runoff from the Property will generally be collected by means of private roof drains and storm sewer inlets located in the paved driveways within each delineated basin area. The runoff collected from each basin and the roof system of the proposed building will be conveyed to the private and public storm sewer systems and outfall to the proposed extended detention pond, EDB Pond B, northwest of the Site. The ultimate outfall is the proposed private 42-inch RCP, located east of proposed South Havana Street, discharging into a Type H soil riprap to Parkway Tributary.

There are no major irrigation facilities within the Site. There are off-site flows that affect the Site in fully developed conditions. Proposed infrastructure has been designed to include these off-site flows.

DRAINAGE DESIGN CRITERIA

REGULATIONS

The proposed storm facilities and drainage design follow the Douglas County Storm Drainage Design and Technical Criteria Manual (the “CRITERIA”) and the Mile High Flood Control District Urban Storm Drainage Criteria Manual (the “MANUAL”). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding onsite drainage patterns is provided in the Stormwater Conveyance Facilities Section.

DRAINAGE STUDIES

The Master Study provides updated calculations for the downstream detention basin EDB Pond B and the tributary area to this pond. The proposed drainage facilities for the Site are designed to follow the historic flow patterns of the Property as well as the intent of the original storm water design for the overall development. This Phase III Drainage Report is in general compliance with the Master Study.

The Master Study weighted average imperviousness for the Site area, sub-basin B05 (F), is 90.4%. The proposed Site has a weighted imperviousness of 63.8%, which is less than the impervious value for the Site area per the Master Study.

The Master Study proposed runoff coefficients for the Site area, sub-basin B05 (F), are 0.78 and 0.85 for the 5-year and 100-year, respectively. The proposed Site runoff coefficients are 0.55 and 0.74 for the 5-year and 100-year respectively. This shows compliance with the Master Study.

The Master Study proposed runoff flows for the Site area, sub-basin B05 (F), are 15.18 cfs and 30.39 cfs for the 5-year and 100-year, respectively. The proposed Site runoff flows are 10.32 cfs and 24.87 cfs for the 5-year and 100-year respectively. This shows compliance with the Master Study.

Applicable portions of the Master Study are included in the **Appendix E** for reference.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Chapter 6 of the CRITERIA. Table 6-1 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. The 1-hour point rainfall values per the CRITERIA used to calculate intensity were 1.43 inches for the 5-year and 2.60 inches for the 100-year. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-5 of the MANUAL by calculating weighted impervious values for each specific site basin. The calculated runoff coefficients per the MANUAL are provided in **Appendix B**. The 100-year detention and water quality capture volume are provided in the downstream detention pond EDB Pond B. Based upon this approach, we feel that the drainage design provided for the Site is conservative and in keeping with the zoning and historic drainage concept for the area.

HYDRAULIC CRITERIA

The proposed drainage facilities will be designed in accordance with the CRITERIA and MANUAL. Hydraulic calculations were computed using StormCAD and the Standard Step method and summarized in the **Appendix C**. On-site runoff is routed to the proposed detention pond via proposed 30” RCP storm sewer northeast of the property.

Inlet capacity calculations are provided in the **Appendix C** for the calculated 5-year and 100-year flows routed to the proposed inlets on site. The capacity of each inlet is adequate for the 100-year developed flows for each sub-basin.

WATER QUALITY ENHANCEMENT

Water quality enhancement for the Site will be provided by the downstream extended detention basin (EDB Pond B). EDB Pond B is designed to slowly release the WQCV to allow for settling of sediment, improving the water quality of the effluent leaving the facilities. The water quality capture volume for the Site is provided in the proposed extended detention basin, EDB Pond B. The Site also implements landscaping throughout to help reduce the imperviousness on site.

STORMWATER MANAGEMENT FACILITY DESIGN

STORMWATER CONVEYANCE FACILITIES

The Property has been divided into 19 sub-basins, A1-A8, C, R1, R2, OS1, OS2, and OF1-OF6. The runoff generated on the building and canopy roof areas, sub-basins R1 and R2, is collected and conveyed via a private roof drain system which outfalls to the proposed private storm sewer system. Sub-basins A1-A8, C, OS1, and OS2 are all on-site areas draining to on-site proposed inlets or the proposed EDB Pond B by others. A proposed drainage exhibit is provided in **Appendix D**. Off-site flows will affect the site under proposed conditions, but the proposed private storm sewer system and EDB Pond B are equipped to handle these flows, as they were already accounted for with the Master Study.

Sub-Basin A1

Sub-basin A1 is 0.05 acres and consists of the proposed north portion of the Site with asphalt pavement drive aisles, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 10’ Type R Curb Inlet at Design Point A1 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A1 is 0.20 cfs for the 5-year event and 0.40 cfs for the 100-year event.

Sub-Basin A2

Sub-basin A2 is 0.18 acres and consists of the proposed northeast portion of the Site with asphalt pavement drive aisles, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5’ Type R Curb Inlet at Design Point A2 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A2 is 0.52 cfs for the 5-year event and 1.15 cfs for the 100-year event.

Sub-Basin A3

Sub-basin A3 is 0.16 acres and consists of the proposed east portion of the Site with a portion of the proposed right-in only access by others, asphalt pavement drive aisles, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5’ Type R Curb Inlet at Design Point A3 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A3 is 0.49 cfs for the 5-year event and 1.04 cfs for the 100-year event.

Sub-Basin A4

Sub-basin A4 is 0.96 acres and consists of the proposed southeast portion of the Site with asphalt pavement drive aisles, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private Denver No. 16 Combination Inlet at Design Point A4 into the

private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A4 is 1.90 cfs for the 5-year event and 4.86 cfs for the 100-year event.

Sub-Basin A5
Sub-basin A5 is 0.32 acres and consists of the proposed south portion of the Site with asphalt pavement drive aisles, retaining walls, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A5 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A5 is 0.64 cfs for the 5-year event and 1.65 cfs for the 100-year event.

Sub-Basin A6
Sub-basin A6 is 0.18 acres and consists of the proposed west portion of the Site with asphalt pavement drive aisles, retaining walls, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A6 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A6 is 0.63 cfs for the 5-year event and 1.31 cfs for the 100-year event.

Sub-Basin A7
Sub-basin A7 is 0.19 acres and consists of the proposed west portion of the Site with asphalt pavement drive aisles, retaining walls, trash enclosures, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A7 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A7 is 0.45 cfs for the 5-year event and 1.21 cfs for the 100-year event.

Sub-Basin A8
Sub-basin A8 is 0.13 acres and consists of the proposed central portion of the Site with asphalt pavement drive aisles, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A8 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A8 is 0.47 cfs for the 5-year event and 0.96 cfs for the 100-year event.

Sub-Basin C
Sub-basin C is 0.67 acres and consists of the proposed north portion of the Site that will become a car wash in the future. The runoff developed within this sub-basin is collected via a private 10' Type R Curb Inlet at Design Point A1 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin A1 is 2.65 cfs for the 5-year event and 5.17 cfs for the 100-year event.

Sub-Basin R1
Sub-basin R1 is 0.16 acres and consists of the rooftop of the proposed building. The runoff developed within this sub-basin is collected via a private building roof drain. The roof drain discharges to the private storm sewer system at Design Point R which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin R1 is 0.62 cfs for the 5-year event and 1.21 cfs for the 100-year event.

Sub-Basin R2
Sub-basin R2 is 0.12 acres and consists of the roof of the proposed fuel canopy. The runoff developed within this sub-basin is collected via a private canopy roof drain. The roof drain discharges to the private storm sewer system at Design Point R which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin R2 is 0.46 cfs for the 5-year event and 0.90 cfs for the 100-year event.

Sub-Basin OS1
Sub-basin OS1 is 0.34 acres and consists of the proposed north portion of the Site with landscaping. The runoff developed within this sub-basin flows directly to the proposed extended detention basin by others, EDB Pond B, at Design Point B for water quality and detention and to the public 10' Type R Curb Inlet proposed by others within S Havana Street. The developed direct runoff from sub-basin OS1 is 0.25 cfs for the 5-year event and 1.29 cfs for the 100-year event. It is not practical to collect runoff in this area due to the existing topography and the proximity to EDB Pond B and proposed S Havana Street right-of-way. The sub-basin is also composed only of proposed landscaping. The proposed flow patterns follow existing conditions proposed with the relocation of S Havana Street.

Sub-Basin OS2
Sub-basin OS2 is 0.02 acres and consists of the proposed east portion of the Site with landscaping. The runoff developed within this sub-basin is collected via a public 10' Type R Curb Inlet at Design Point B09 into the public storm sewer system by others which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OS2 is 0.02 cfs for the 5-year event and 0.09 cfs for the 100-year event. It is not practical to collect runoff in this limited area due to the existing topography and the proximity to proposed S Havana Street right-of-way. The sub-basin is also composed only of proposed landscaping.

Sub-Basin OF1
Sub-basin OF1 is 0.16 acres and consists of an off-site area northeast of the Site with the asphalt pavement full access to the Site, a portion of S Havana Street, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 10' Type R Curb Inlet at Design Point A1 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OF1 is 0.50 cfs for the 5-year event and 1.10 cfs for the 100-year event.

Sub-Basin OF2
Sub-basin OF2 is 0.04 acres and consists of an off-site area east of the Site with the asphalt pavement right-in access to the Site, sidewalk, and landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A3 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OF2 is 0.11 cfs for the 5-year event and 0.27 cfs for the 100-year event.

Sub-Basin OF3
Sub-basin OF3 is 0.09 acres and consists of an off-site area southeast of the Site with landscaping. The runoff developed within this sub-basin is collected via a private Denver No. 16 Inlet at Design Point A4 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The

developed direct runoff from sub-basin OF3 is 0.08 cfs for the 5-year event and 0.43 cfs for the 100-year event.

Sub-Basin OF4
Sub-basin OF4 is 0.10 acres and consists of an off-site area south of the Site with landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A5 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OF4 is 0.10 cfs for the 5-year event and 0.50 cfs for the 100-year event.

Sub-Basin OF5
Sub-basin OF5 is 0.21 acres and consists of an off-site area southwest of the Site with landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A7 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OF5 is 0.19 cfs for the 5-year event and 1.00 cfs for the 100-year event.

Sub-Basin OF6
Sub-basin OF6 is 0.07 acres and consists of an off-site area west of the Site with landscaping. The runoff developed within this sub-basin is collected via a private 5' Type R Curb Inlet at Design Point A1 into the private storm sewer system which ultimately outfalls to the proposed extended detention basin by others, EDB Pond B, for water quality and detention. The developed direct runoff from sub-basin OF6 is 0.07 cfs for the 5-year event and 0.34 cfs for the 100-year event.

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	C5	C100
A1	A1	0.05	0.20	0.40	0.73	0.83
A2	A2	0.18	0.52	1.15	0.66	0.80
A3	A3	0.16	0.49	1.04	0.70	0.82
A4	A4	0.96	1.90	4.86	0.51	0.72
A5	A5	0.32	0.64	1.65	0.51	0.72
A6	A6	0.18	0.63	1.31	0.72	0.83
A7	A7	0.19	0.45	1.21	0.47	0.70
A8	A8	0.13	0.47	0.96	0.76	0.85
A1	C	0.67	2.65	5.17	0.81	0.87
R	R1	0.16	0.62	1.21	0.81	0.87
R	R2	0.12	0.46	0.90	0.81	0.87
B	OS1	0.34	0.25	1.29	0.20	0.57
B09	OS2	0.02	0.02	0.09	0.20	0.57
A1	OF1	0.16	0.50	1.10	0.66	0.80
A3	OF2	0.04	0.11	0.27	0.53	0.73
A4	OF3	0.09	0.08	0.43	0.20	0.57
A5	OF4	0.10	0.10	0.50	0.20	0.57
A7	OF5	0.21	0.19	1.00	0.20	0.57
A1	OF6	0.07	0.07	0.34	0.20	0.57
Total		**4.15**	**10.32**	**24.87**	**0.55**	**0.74**

STORMWATER STORAGE FACILITIES

The Master Study provides detention pond calculations, outfall conditions, and maintenance requirements for the proposed extended detention basin EDB Pond B located northwest of the Property that provides water quality and detention for the Site. On-site runoff is captured via a proposed private storm sewer system that ties into the proposed public 30” RCP storm sewer (by others) located east of the property which directs flows to EDB Pond B.

MASTER STUDY COMPLIANCE

Since the Site is in compliance with the Master Study, the detention pond by others was designed to have the capacity for the proposed Site.

SEDIMENT AND EROSION CONTROL CONCEPT

Structural practices consist of vehicle tracking control at the construction access entrance, inlet protection, and silt fence. These measures will be installed before earthwork activities begin and supplemented by additional controls during construction. Vehicle tracking control will limit tracking of mud onto adjacent streets. Silt fence will trap sediment from leaving the Site. The storm sewer system will be protected by inlet protection for area, on-grade or curb inlets as well as curb socks. The contractor will also implement street sweeping and operational measures for dust mitigation to mitigate the transfer of off-site as implemented by the GESC plans.

FLOODPLAIN MODIFICATION

There are no floodplain modifications proposed with this Site.

ADDITIONAL PERMITTING REQUIREMENTS

There are no additional permitting requirements proposed with this Site.

CONCLUSIONS

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for QuikTrip Castle Pines #4266 located on Lot 1 of the Canyonside Subdivision Filing No. 4 conforms to Douglas County Storm Drainage Design and Technical Criteria Manual and the Mile High Flood Control District Urban Storm Drainage Criteria Manual. Additionally, the drainage design is in general conformance with the Master Study.

VARIANCES

There are no variances proposed with this Site.

REFERENCES

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

2. Mile High Flood District Urban Storm Drainage Criteria Manual (MHFD USDCM), Vol. 1, September 1969, partially updated March 2024.

3. Mile High Flood District Urban Storm Drainage Criteria Manual (MHFD USDCM), Vol. 2, September 1969, updated January 2016.

4. Mile High Flood District Urban Storm Drainage Criteria Manual (MHFD USDCM), Vol. 3, September 1992, partially updated March 2024.

5. Flood Insurance Rate Map, City of Castle Pines and Douglas County Unincorporated Areas, Colorado, Map Number 08035C0180G, Effective Date September 4, 2020, prepared by the Federal Emergency Management Agency (FEMA).

6. Phase III Drainage Report for Canyonside Filing No. 4 – Phase 1, City of Castle Pines, Colorado, dated March 21, 2025, by Terracina Design (the “Master Study”)

7. Newlin Gulch Major Drainageway Plan prepared by Muller Engineering Company, Inc., dated October 2015.

APPENDIX

A – SOILS MAPS AND FEMA PANEL

Hydrologic Soil Group—Castle Rock Area, Colorado

Map Scale: 1:1,910 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 18, Aug 29, 2025

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

Date(s) aerial images were photographed: 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FoD	Fondis clay loam, 3 to 9 percent slopes	C	1.6	8.7%
Fu	Fondis-Kutch association	C	17.1	91.3%
Totals for Area of Interest			**18.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

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

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Rating Options

Aggregation Method: Dominant Condition

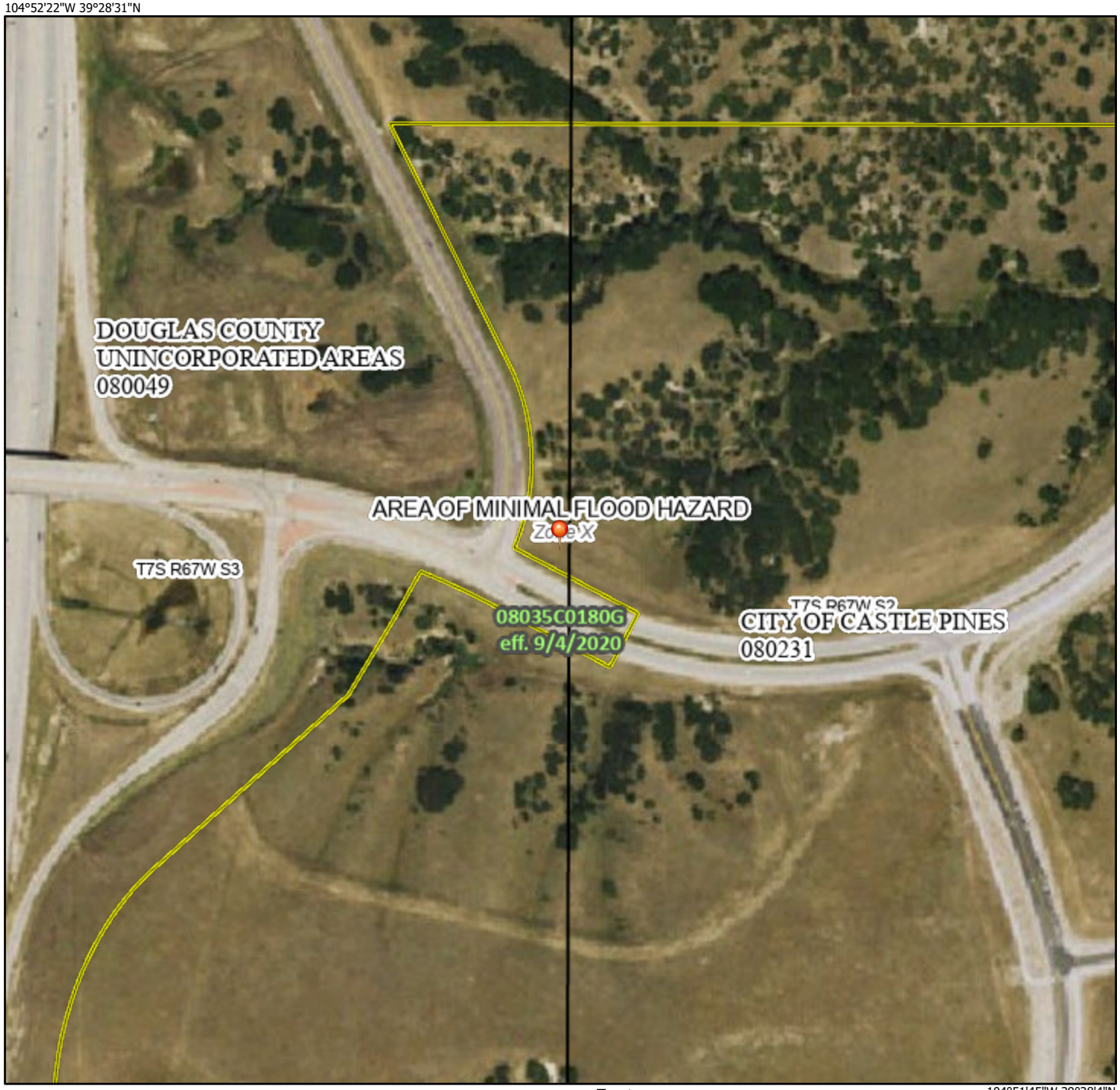
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°52'22"W 39°28'31"N



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

1:6,000

104°51'45"W 39°28'4"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
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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 7/7/2025 at 9:41 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.

B – HYDROLOGIC CALCULATIONS

Zone 1 includes the area from the Douglas/Elbert County line west to the base of the foothills. **Zone 2** includes the area from the base of the foothills west to the South Platte River drainage basin line. **Zone 3** includes the area from the South Platte River drainage basin line west to the Douglas/Jefferson County line.

TABLE 6-1
1-HOUR POINT RAINFALL VALUES FOR DOUGLAS COUNTY (INCHES)

	2- YR	5-YR	10-YR	50-YR	100-YR
ZONE 1	1.06	1.43	1.66	2.26	2.60
ZONE 2	0.98	1.32	1.53	2.07	2.34
ZONE 3	0.72	1.05	1.26	1.78	2.05

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.06	1.43	1.66	2.6

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
A1	2,388	0.05	0	95%	0.79	0.81	0.83	0.87	294	20%	0.14	0.20	0.28	0.57	2,094	95%	0.79	0.81	0.83	0.87	85.8%	0.71	0.73	0.76	0.83
A2	7,862	0.18	0	95%	0.79	0.81	0.83	0.87	1,897	20%	0.14	0.20	0.28	0.57	5,965	95%	0.79	0.81	0.83	0.87	76.9%	0.63	0.66	0.70	0.80
A3	6,890	0.16	0	95%	0.79	0.81	0.83	0.87	1,249	20%	0.14	0.20	0.28	0.57	5,641	95%	0.79	0.81	0.83	0.87	81.4%	0.67	0.70	0.73	0.82
A4	41,972	0.96	0	95%	0.79	0.81	0.83	0.87	20,304	20%	0.14	0.20	0.28	0.57	21,668	95%	0.79	0.81	0.83	0.87	58.7%	0.47	0.51	0.56	0.72
A5	13,815	0.32	0	95%	0.79	0.81	0.83	0.87	6,785	20%	0.14	0.20	0.28	0.57	7,030	95%	0.79	0.81	0.83	0.87	58.2%	0.47	0.51	0.56	0.72
A6	7,895	0.18	0	95%	0.79	0.81	0.83	0.87	1,158	20%	0.14	0.20	0.28	0.57	6,737	95%	0.79	0.81	0.83	0.87	84.0%	0.69	0.72	0.75	0.83
A7	8,483	0.19	0	95%	0.79	0.81	0.83	0.87	4,644	20%	0.14	0.20	0.28	0.57	3,839	95%	0.79	0.81	0.83	0.87	53.9%	0.43	0.47	0.53	0.70
A8	5,575	0.13	0	95%	0.79	0.81	0.83	0.87	418	20%	0.14	0.20	0.28	0.57	5,157	95%	0.79	0.81	0.83	0.87	89.4%	0.74	0.76	0.79	0.85
C	29,343	0.67	-	95%	0.79	0.81	0.83	0.87	-	20%	0.14	0.20	0.28	0.57	-	95%	0.79	0.81	0.83	0.87	90.0%	0.79	0.81	0.83	0.87
R1	6,849	0.16	6,849	95%	0.79	0.81	0.83	0.87	0	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	95.0%	0.79	0.81	0.83	0.87
R2	5,152	0.12	5,152	95%	0.79	0.81	0.83	0.87	0	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	95.0%	0.79	0.81	0.83	0.87
OS1	14,809	0.34	0	95%	0.79	0.81	0.83	0.87	14,809	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
OS2	985	0.02	0	95%	0.79	0.81	0.83	0.87	985	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
OF1	6,809	0.16	0	95%	0.79	0.81	0.83	0.87	1,707	20%	0.14	0.20	0.28	0.57	5,102	95%	0.79	0.81	0.83	0.87	76.2%	0.62	0.66	0.69	0.80
OF2	1,901	0.04	0	95%	0.79	0.81	0.83	0.87	859	20%	0.14	0.20	0.28	0.57	1,042	95%	0.79	0.81	0.83	0.87	61.1%	0.49	0.53	0.58	0.73
OF3	3,759	0.09	0	95%	0.79	0.81	0.83	0.87	3,759	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
OF4	4,341	0.10	0	95%	0.79	0.81	0.83	0.87	4,341	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
OF5	9,108	0.21	0	95%	0.79	0.81	0.83	0.87	9,108	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
OF6	2,997	0.07	0	95%	0.79	0.81	0.83	0.87	2,997	20%	0.14	0.20	0.28	0.57	0	95%	0.79	0.81	0.83	0.87	20.0%	0.14	0.20	0.28	0.57
TOTAL	180,933	4.15	12,001	95%	0.79	0.81	0.83	0.87	75,314	20%	0.14	0.20	0.28	0.57	93,618	95%	0.79	0.81	0.83	0.87	63.8%	0.52	0.55	0.60	0.74

QuikTrip - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00
Grassed Waterway	15.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
A1	A1	2,388	0.05	0.73	42	4.2%	2.7	49	2.3%	20.00	3.0	0.3	5.0	91	10.5	5.0
A2	A2	7,862	0.18	0.66	79	1.5%	6.2	140	1.8%	20.00	2.7	0.9	7.1	219	11.2	7.1
A3	A3	6,890	0.16	0.70	100	1.3%	6.8	13	1.9%	20.00	2.8	0.1	6.9	113	10.6	6.9
A4	A4	41,972	0.96	0.51	100	1.9%	8.7	205	1.2%	20.00	2.2	1.5	10.2	305	11.7	10.2
A5	A5	13,815	0.32	0.51	100	1.7%	9.0	65	1.4%	20.00	2.4	0.5	9.5	165	10.9	9.5
A6	A6	7,895	0.18	0.72	100	2.4%	5.2	0	0.0%	20.00	0.0	0.0	5.2	100	10.6	5.2
A7	A7	8,483	0.19	0.47	100	25.0%	3.9	76	1.3%	20.00	2.3	0.6	5.0	176	11.0	5.0
A8	A8	5,575	0.13	0.76	40	1.3%	3.6	103	1.0%	20.00	2.0	0.9	5.0	143	10.8	5.0
A1	C	29,343	0.67	0.81	100	5.4%	3.0	157	2.0%	20.00	2.8	0.9	5.0	257	11.4	5.0
R	R1	6,849	0.16	0.81	70	1.0%	4.5	0	0.0%	20.00	0.0	0.0	5.0	70	10.4	5.0
R	R2	5,152	0.12	0.81	100	1.0%	5.3	0	0.0%	20.00	0.0	0.0	5.3	100	10.6	5.3
B	OS1	14,809	0.34	0.20	93	2.8%	11.3	0	0.0%	7.00	0.0	0.0	11.3	93	10.5	10.5

QuikTrip - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient					
Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
B09	OS2	985	0.02	0.20	61	1.7%	10.7	0	0.0%	7.00	0.0	0.0	10.7	61	10.3	10.3
A1	OF1	6,809	0.16	0.66	23	2.5%	2.9	59	1.8%	20.00	2.7	0.4	5.0	82	10.5	5.0
A3	OF2	1,901	0.04	0.53	86	4.3%	5.9	0	0.0%	20.00	0.0	0.0	5.9	86	10.5	5.9
A4	OF3	3,759	0.09	0.20	20	25.0%	2.5	0	0.0%	7.00	0.0	0.0	5.0	20	10.1	5.0
A5	OF4	4,341	0.10	0.20	20	25.0%	2.5	0	0.0%	7.00	0.0	0.0	5.0	20	10.1	5.0
A7	OF5	9,108	0.21	0.20	100	25.0%	5.7	8	25.0%	7.00	3.5	0.0	5.7	108	10.6	5.7
A1	OF6	2,997	0.07	0.20	26	25.0%	2.9	0	0.0%	7.00	0.0	0.0	5.0	26	10.1	5.0

QuikTrip - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	NOTES
A1	A1	0.05	0.73	5.0	0.04	4.85	0.20	5.0	0.70	4.85	3.41	DP A1 cumulative runoff
A2	A2	0.18	0.66	7.1	0.12	4.38	0.52					
A3	A3	0.16	0.70	6.9	0.11	4.42	0.49	6.9	0.13	4.42	0.59	DP A3 cumulative runoff
A4	A4	0.96	0.51	10.2	0.49	3.83	1.90	10.2	0.51	3.83	1.96	DP A4 cumulative runoff
A5	A5	0.32	0.51	9.5	0.16	3.95	0.64	9.5	0.18	3.95	0.72	DP A5 cumulative runoff
A6	A6	0.18	0.72	5.2	0.13	4.80	0.63					
A7	A7	0.19	0.47	5.0	0.09	4.85	0.45	5.7	0.13	4.67	0.63	DP A7 cumulative runoff
A8	A8	0.13	0.76	5.0	0.10	4.85	0.47					
A1	C	0.67	0.81	5.0	0.55	4.85	2.65					
R	R1	0.16	0.81	5.0	0.13	4.85	0.62	5.3	0.22	4.78	1.06	DP R cumulative runoff
R	R2	0.12	0.81	5.3	0.10	4.78	0.46					
B	OS1	0.34	0.20	10.5	0.07	3.68	0.25					

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Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	NOTES
B09	OS2	0.02	0.20	10.3	0.00	3.77	0.02					
A1	OF1	0.16	0.66	5.0	0.10	4.85	0.50					
A3	OF2	0.04	0.53	5.9	0.02	4.63	0.11					
A4	OF3	0.09	0.20	5.0	0.02	4.85	0.08					
A5	OF4	0.10	0.20	5.0	0.02	4.85	0.10					
A7	OF5	0.21	0.20	5.7	0.04	4.67	0.19					
A1	OF6	0.07	0.20	5.0	0.01	4.85	0.07					

QuikTrip - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	NOTES
A1	A1	0.05	0.83	5.0	0.05	8.82	0.40	5.0	0.80	8.82	7.01	DP A1 cumulative runoff
A2	A2	0.18	0.80	7.1	0.14	7.97	1.15					
A3	A3	0.16	0.82	6.9	0.13	8.04	1.04	6.9	0.16	8.04	1.30	DP A3 cumulative runoff
A4	A4	0.96	0.72	10.2	0.70	6.97	4.86	10.2	0.75	6.97	5.20	DP A4 cumulative runoff
A5	A5	0.32	0.72	9.5	0.23	7.19	1.65	9.5	0.29	7.19	2.05	DP A5 cumulative runoff
A6	A6	0.18	0.83	5.2	0.15	8.73	1.31					
A7	A7	0.19	0.70	5.0	0.14	8.82	1.21	5.7	0.26	8.49	2.17	DP A7 cumulative runoff
A8	A8	0.13	0.85	5.0	0.11	8.82	0.96					
A1	C	0.67	0.87	5.0	0.59	8.82	5.17					
R	R1	0.16	0.87	5.0	0.14	8.82	1.21	5.3	0.24	8.68	2.09	DP R cumulative runoff
R	R2	0.12	0.87	5.3	0.10	8.68	0.90					
B	OS1	0.34	0.57	10.5	0.19	6.69	1.29					

QuikTrip - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

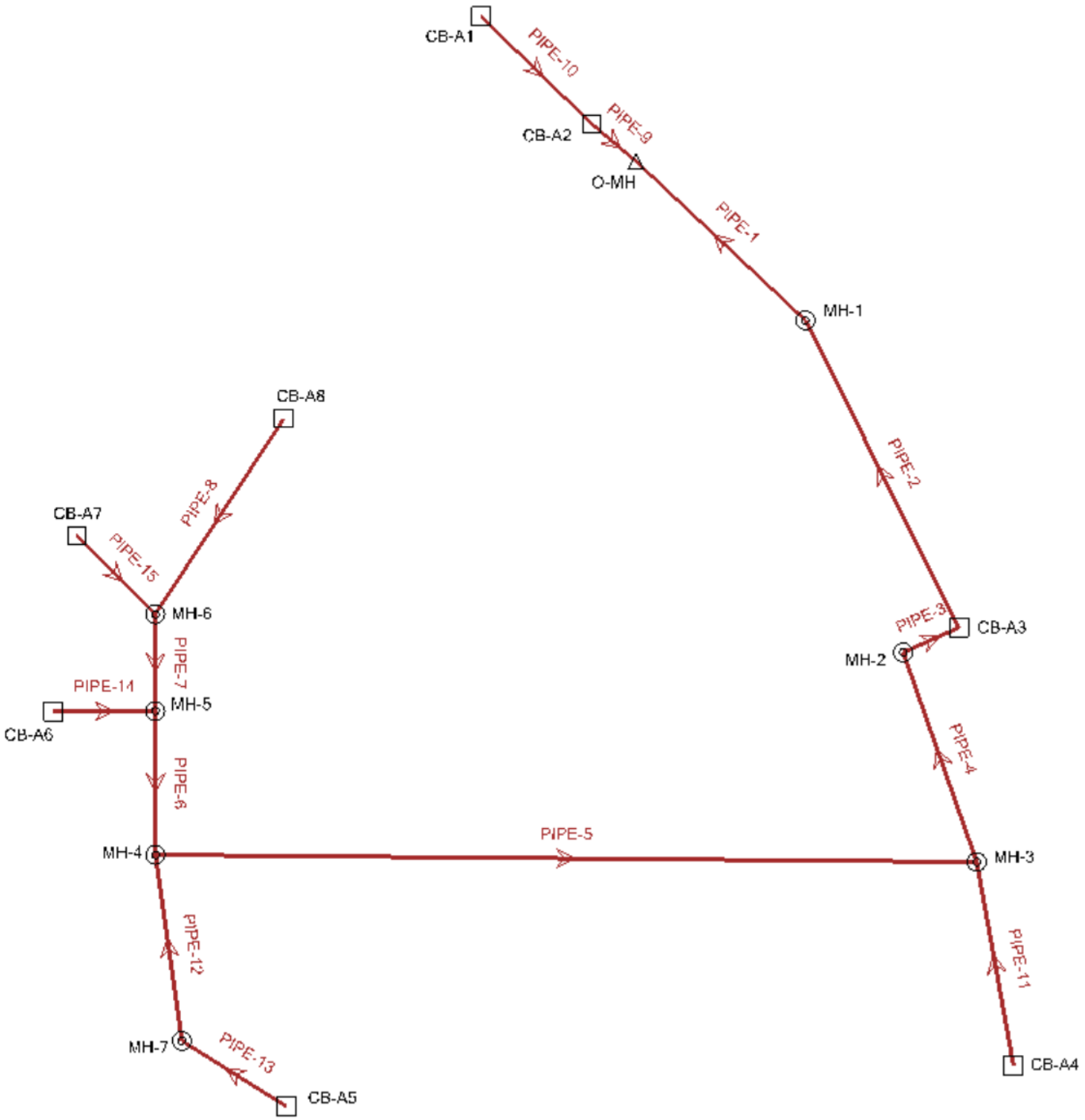
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
B09	OS2	0.02	0.57	10.3	0.01	6.85	0.09					
A1	OF1	0.16	0.80	5.0	0.12	8.82	1.10					
A3	OF2	0.04	0.73	5.9	0.03	8.42	0.27					
A4	OF3	0.09	0.57	5.0	0.05	8.82	0.43					
A5	OF4	0.10	0.57	5.0	0.06	8.82	0.50					
A7	OF5	0.21	0.57	5.7	0.12	8.49	1.00					
A1	OF6	0.07	0.57	5.0	0.04	8.82	0.34					

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	C5	C100
A1	A1	0.05	0.20	0.40	0.73	0.83
A2	A2	0.18	0.52	1.15	0.66	0.80
A3	A3	0.16	0.49	1.04	0.70	0.82
A4	A4	0.96	1.90	4.86	0.51	0.72
A5	A5	0.32	0.64	1.65	0.51	0.72
A6	A6	0.18	0.63	1.31	0.72	0.83
A7	A7	0.19	0.45	1.21	0.47	0.70
A8	A8	0.13	0.47	0.96	0.76	0.85
A1	C	0.67	2.65	5.17	0.81	0.87
R	R1	0.16	0.62	1.21	0.81	0.87
R	R2	0.12	0.46	0.90	0.81	0.87
B	OS1	0.34	0.25	1.29	0.20	0.57
B09	OS2	0.02	0.02	0.09	0.20	0.57
A1	OF1	0.16	0.50	1.10	0.66	0.80
A3	OF2	0.04	0.11	0.27	0.53	0.73
A4	OF3	0.09	0.08	0.43	0.20	0.57
A5	OF4	0.10	0.10	0.50	0.20	0.57
A7	OF5	0.21	0.19	1.00	0.20	0.57
A1	OF6	0.07	0.07	0.34	0.20	0.57
Total		4.15	10.32	24.87	0.55	0.74

C – HYDRAULIC CALCULATIONS

StormCAD Layout



5-YR
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
CB-A1	3.42	6,348.47	6,345.68	6,345.67	6,345.91	6,345.90	0.050	0.01
CB-A2	3.94	6,349.75	6,345.64	6,345.64	6,345.75	6,345.75	0.050	0.01
CB-A3	6.14	6,352.09	6,346.81	6,346.42	6,346.92	6,346.72	1.320	0.39
CB-A8	0.47	6,351.95	6,349.30	6,349.29	6,349.39	6,349.38	0.050	0.00
CB-A7	0.64	6,352.29	6,349.65	6,349.64	6,349.77	6,349.76	0.050	0.01
CB-A6	0.63	6,351.19	6,349.07	6,349.06	6,349.09	6,349.09	0.050	0.00
CB-A5	0.74	6,351.11	6,348.94	6,348.93	6,349.07	6,349.06	0.050	0.01
CB-A4	1.98	6,349.95	6,347.45	6,347.45	6,347.50	6,347.50	0.050	0.00

5-YR
FlexTable: Conduit Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE-15	CB-A7	MH-6	35.6	0.007	6,349.31	6,349.06	12.0	0.010	0.64	3.65	3.88	16.5
PIPE-7	MH-6	MH-5	31.1	0.005	6,348.56	6,348.40	18.0	0.010	1.11	3.68	9.80	11.3
PIPE-8	CB-A8	MH-6	75.1	0.005	6,349.04	6,348.66	18.0	0.010	0.47	2.84	9.71	4.8
PIPE-13	CB-A5	MH-7	39.5	0.005	6,348.57	6,348.37	12.0	0.010	0.74	3.38	3.30	22.4
PIPE-12	MH-7	MH-4	60.3	0.005	6,348.27	6,347.97	12.0	0.010	0.74	3.36	3.27	22.6
PIPE-3	MH-2	CB-A3	19.5	0.005	6,345.80	6,345.70	30.0	0.010	5.54	5.54	38.18	14.5
PIPE-2	CB-A3	MH-1	110.1	0.005	6,345.60	6,345.05	30.0	0.010	6.14	5.65	37.68	16.3
PIPE-1	MH-1	O-MH	74.5	0.005	6,344.95	6,344.58	30.0	0.010	6.14	5.64	37.56	16.3
PIPE-6	MH-5	MH-4	46.1	0.005	6,348.30	6,348.07	18.0	0.010	1.74	4.14	9.65	18.0
PIPE-14	CB-A6	MH-5	32.7	0.005	6,348.57	6,348.40	18.0	0.010	0.63	3.13	9.85	6.4
PIPE-4	MH-3	MH-2	71.2	0.005	6,346.26	6,345.90	30.0	0.010	5.54	5.51	37.91	14.6
PIPE-5	MH-4	MH-3	263.2	0.005	6,347.67	6,346.36	24.0	0.010	2.48	4.45	20.75	12.0
PIPE-11	CB-A4	MH-3	66.3	0.005	6,346.69	6,346.36	24.0	0.010	1.98	4.16	20.74	9.5
PIPE-9	CB-A2	O-MH	18.5	0.005	6,344.67	6,344.58	24.0	0.010	3.94	5.04	20.50	19.2
PIPE-10	CB-A1	CB-A2	49.4	0.005	6,345.02	6,344.77	24.0	0.010	3.42	4.91	20.92	16.4

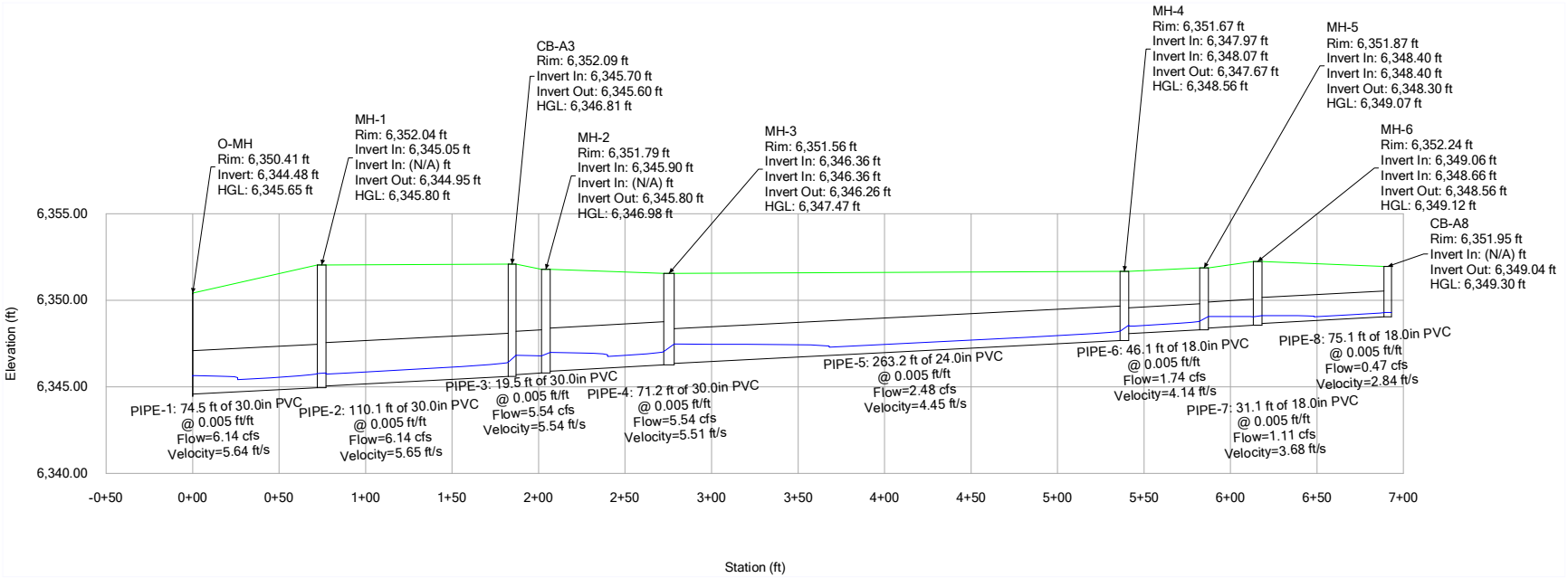
5-YR
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH-6	1.11	6,349.12	6,349.05	6,349.13	6,349.13	0.900	0.07
MH-7	0.74	6,348.69	6,348.63	6,348.87	6,348.76	0.470	0.06
MH-1	6.14	6,345.80	6,345.77	6,346.30	6,346.07	0.100	0.03
MH-5	1.74	6,349.07	6,348.80	6,349.10	6,348.98	1.520	0.28
MH-2	5.54	6,346.98	6,346.79	6,347.10	6,346.94	1.320	0.19
MH-4	2.48	6,348.56	6,348.22	6,348.83	6,348.41	1.770	0.35
MH-3	5.54	6,347.47	6,347.04	6,347.48	6,347.32	1.520	0.43

5-YR
FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Energy Grade Line (ft)	System Additional Flow (cfs)
O-MH	6,350.41	6,344.48	10.08	User Defined Tailwater	6,345.65	6,345.65	6,345.65	9.00

5-YR
Profile Report
Engineering Profile - STORM 1 (QT4266.stsw)

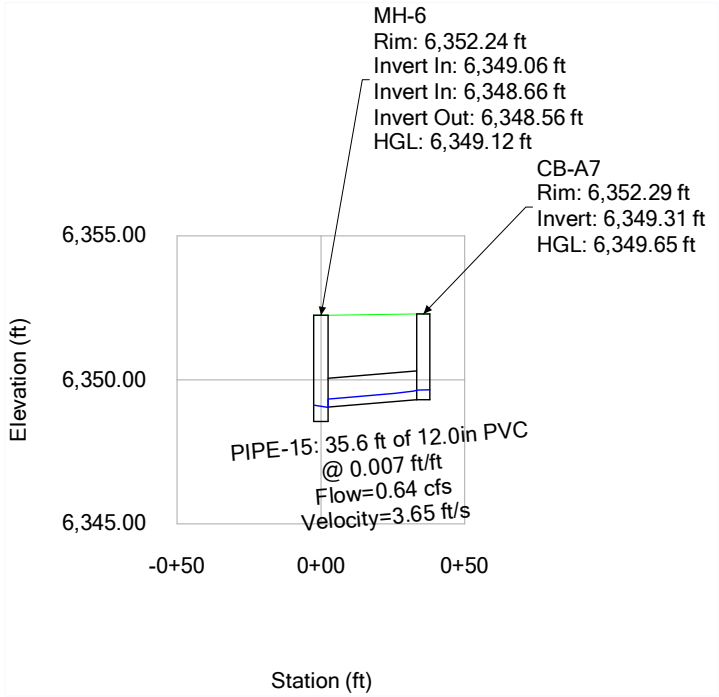


LEGEND

HGL:

PROPOSED GRADE:

5-YR
Profile Report
Engineering Profile - STORM 2 (QT4266.stsw)

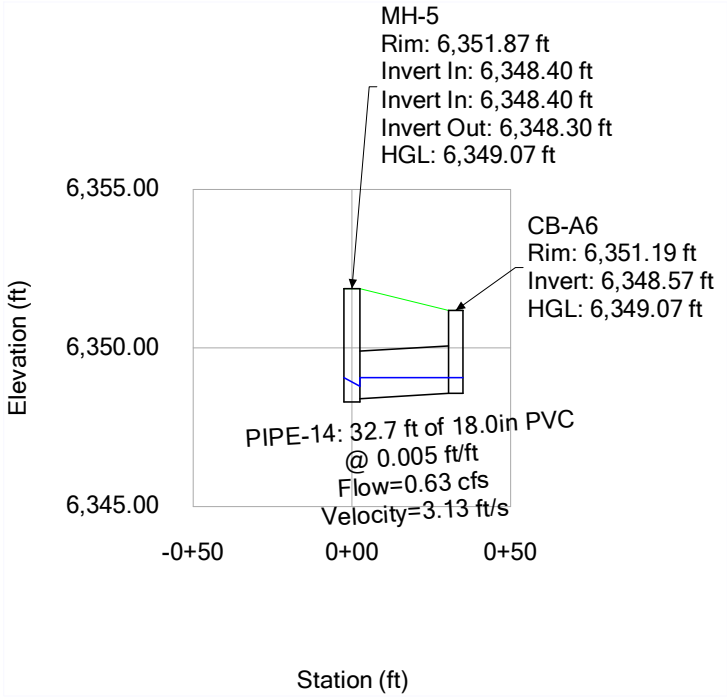


LEGEND

HGL:

PROPOSED GRADE:

5-YR
Profile Report
Engineering Profile - STORM 3 (QT4266.stsw)

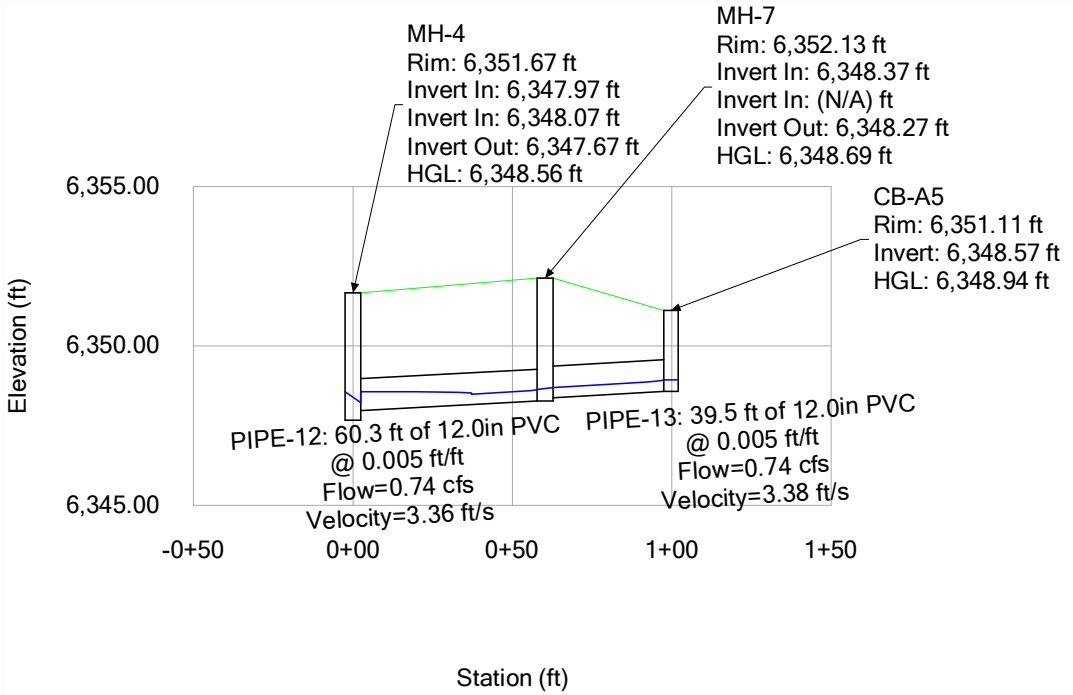


LEGEND

HGL:

PROPOSED GRADE:

5-YR
Profile Report
Engineering Profile - STORM 4 (QT4266.stsw)

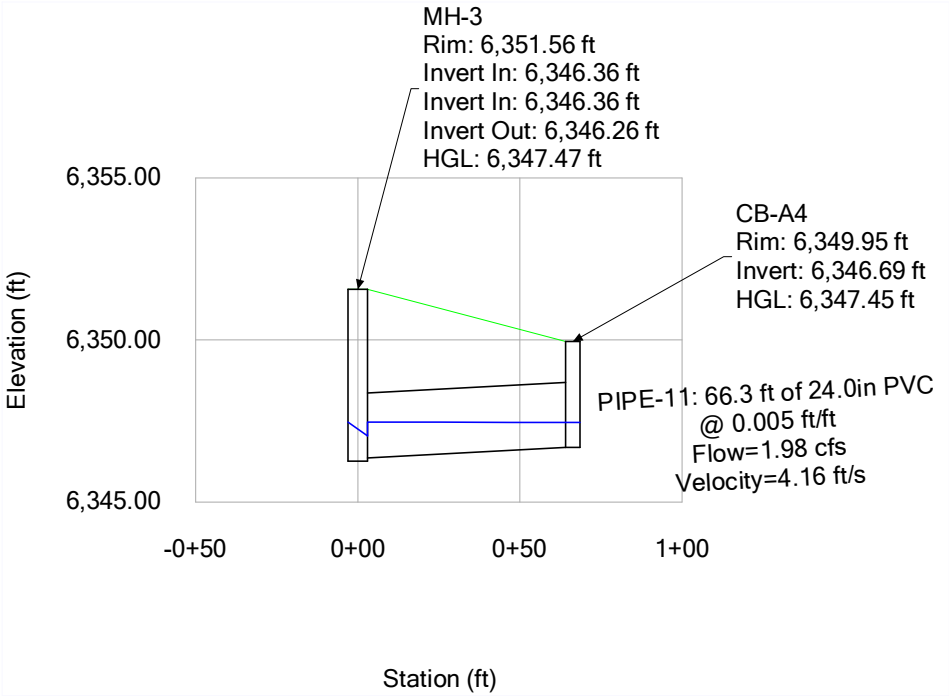


LEGEND

HGL:

PROPOSED GRADE:

5-YR
Profile Report
Engineering Profile - STORM 5 (QT4266.stsw)

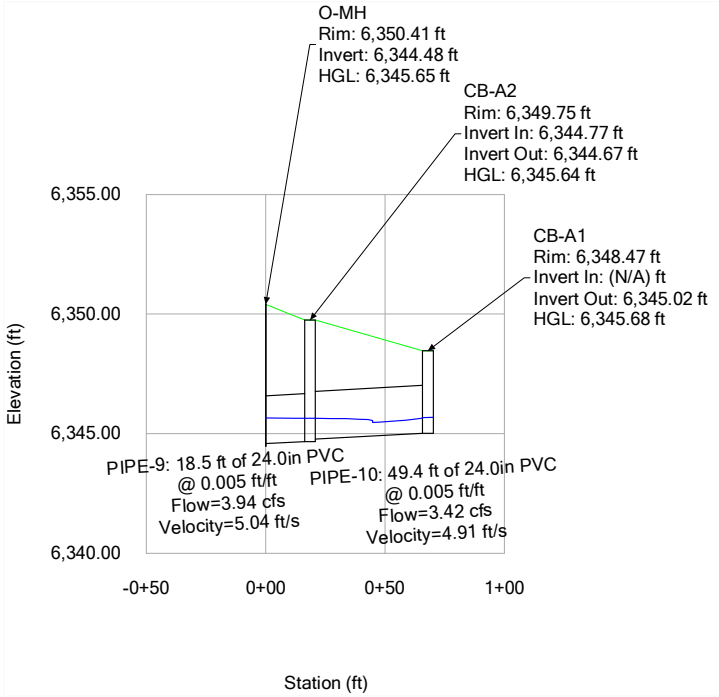


LEGEND

HGL:

PROPOSED GRADE:

5-YR
Profile Report
Engineering Profile - STORM 6 (QT4266.stsw)



LEGEND

HGL:

PROPOSED GRADE:

100-YR
FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Elevation (Ground) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
CB-A1	7.01	6,348.47	6,346.97	6,346.97	6,347.05	6,347.04	0.050	0.00
CB-A2	8.16	6,349.75	6,346.94	6,346.93	6,347.02	6,347.04	0.050	0.01
CB-A3	15.34	6,352.09	6,347.62	6,346.92	6,347.81	6,347.45	1.320	0.70
CB-A8	0.96	6,351.95	6,349.68	6,349.67	6,349.70	6,349.70	0.050	0.00
CB-A7	2.21	6,352.29	6,349.96	6,349.95	6,350.23	6,350.22	0.050	0.01
CB-A6	1.31	6,351.19	6,349.60	6,349.60	6,349.62	6,349.62	0.050	0.00
CB-A5	2.15	6,351.11	6,349.46	6,349.45	6,349.59	6,349.58	0.050	0.01
CB-A4	5.29	6,349.95	6,348.29	6,348.28	6,348.35	6,348.34	0.050	0.00

100-YR
FlexTable: Conduit Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE-15	CB-A7	MH-6	35.6	0.007	6,349.31	6,349.06	12.0	0.010	2.21	5.10	3.88	56.9
PIPE-7	MH-6	MH-5	31.1	0.005	6,348.56	6,348.40	18.0	0.010	3.17	4.95	9.80	32.3
PIPE-8	CB-A8	MH-6	75.1	0.005	6,349.04	6,348.66	18.0	0.010	0.96	3.50	9.71	9.9
PIPE-13	CB-A5	MH-7	39.5	0.005	6,348.57	6,348.37	12.0	0.010	2.15	4.47	3.30	65.2
PIPE-12	MH-7	MH-4	60.3	0.005	6,348.27	6,347.97	12.0	0.010	2.15	2.74	3.27	65.8
PIPE-3	MH-2	CB-A3	19.5	0.005	6,345.80	6,345.70	30.0	0.010	14.03	7.18	38.18	36.7
PIPE-2	CB-A3	MH-1	110.1	0.005	6,345.60	6,345.05	30.0	0.010	15.34	7.28	37.68	40.7
PIPE-1	MH-1	O-MH	74.5	0.005	6,344.95	6,344.58	30.0	0.010	15.34	7.27	37.56	40.8
PIPE-6	MH-5	MH-4	46.1	0.005	6,348.30	6,348.07	18.0	0.010	4.48	5.36	9.65	46.4
PIPE-14	CB-A6	MH-5	32.7	0.005	6,348.57	6,348.40	18.0	0.010	1.31	3.87	9.85	13.3
PIPE-4	MH-3	MH-2	71.2	0.005	6,346.26	6,345.90	30.0	0.010	14.03	7.14	37.91	37.0
PIPE-5	MH-4	MH-3	263.2	0.005	6,347.67	6,346.36	24.0	0.010	6.63	5.87	20.75	32.0
PIPE-11	CB-A4	MH-3	66.3	0.005	6,346.69	6,346.36	24.0	0.010	5.29	5.52	20.74	25.5
PIPE-9	CB-A2	O-MH	18.5	0.005	6,344.67	6,344.58	24.0	0.010	8.16	2.60	20.50	39.8
PIPE-10	CB-A1	CB-A2	49.4	0.005	6,345.02	6,344.77	24.0	0.010	7.01	6.00	20.92	33.5

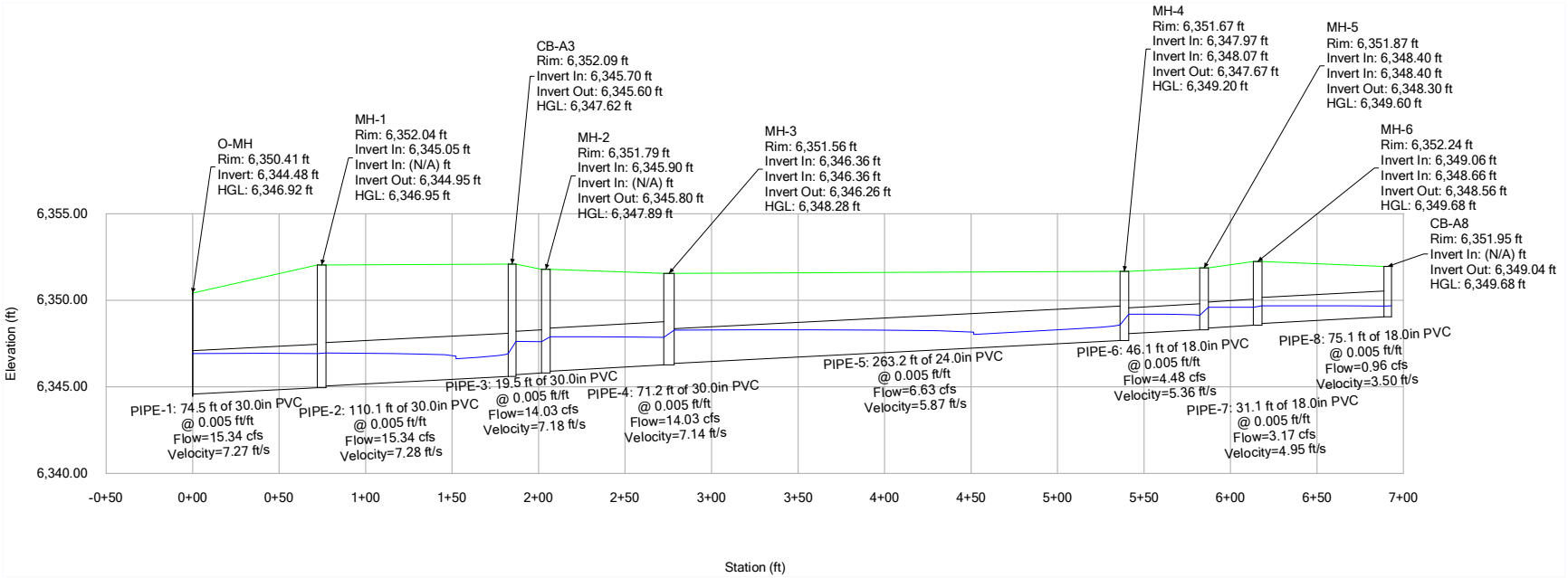
100-YR
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH-6	3.17	6,349.68	6,349.60	6,350.08	6,349.69	0.900	0.08
MH-7	2.15	6,349.39	6,349.33	6,349.50	6,349.45	0.470	0.05
MH-1	15.34	6,346.95	6,346.93	6,347.18	6,347.14	0.100	0.02
MH-5	4.48	6,349.60	6,349.13	6,349.67	6,349.44	1.520	0.47
MH-2	14.03	6,347.89	6,347.61	6,348.06	6,347.82	1.320	0.28
MH-4	6.63	6,349.20	6,348.58	6,349.35	6,348.93	1.770	0.62
MH-3	14.03	6,348.28	6,347.85	6,348.32	6,348.13	1.520	0.43

100-YR
FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Energy Grade Line (ft)	System Additional Flow (cfs)
O-MH	6,350.41	6,344.48	23.50	User Defined Tailwater	6,346.92	6,346.92	6,346.92	21.39

100-YR
Profile Report
Engineering Profile - STORM 1 (QT4266.stsw)

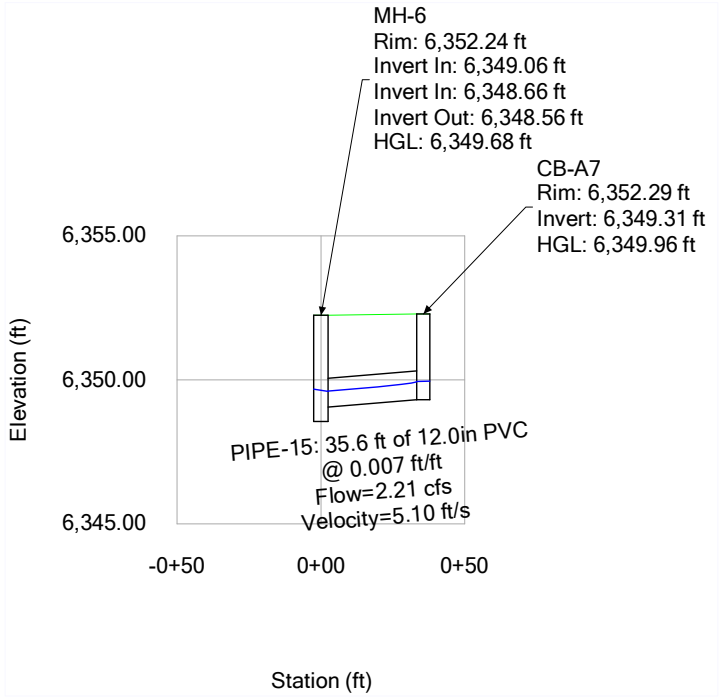


LEGEND

HGL:

PROPOSED GRADE:

100-YR
Profile Report
Engineering Profile - STORM 2 (QT4266.stsw)

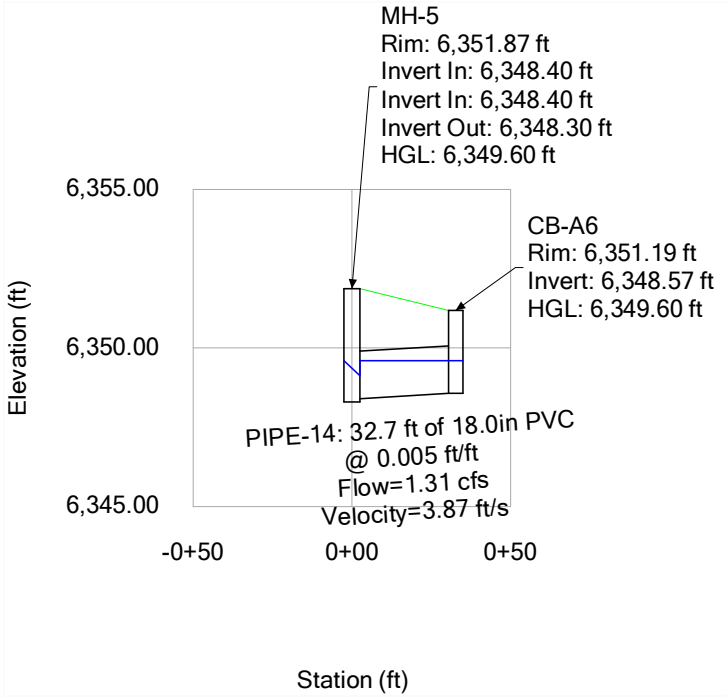


LEGEND

HGL:

PROPOSED GRADE:

100-YR
Profile Report
Engineering Profile - STORM 3 (QT4266.stsw)

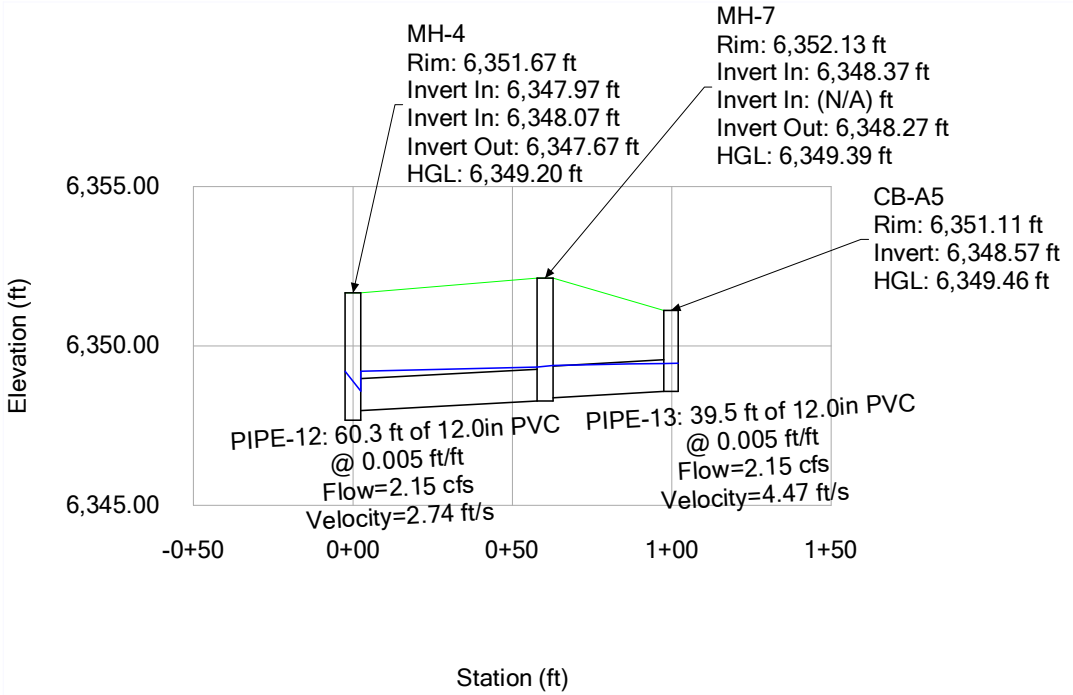


LEGEND

HGL:

PROPOSED GRADE:

100-YR
Profile Report
Engineering Profile - STORM 4 (QT4266.stsw)

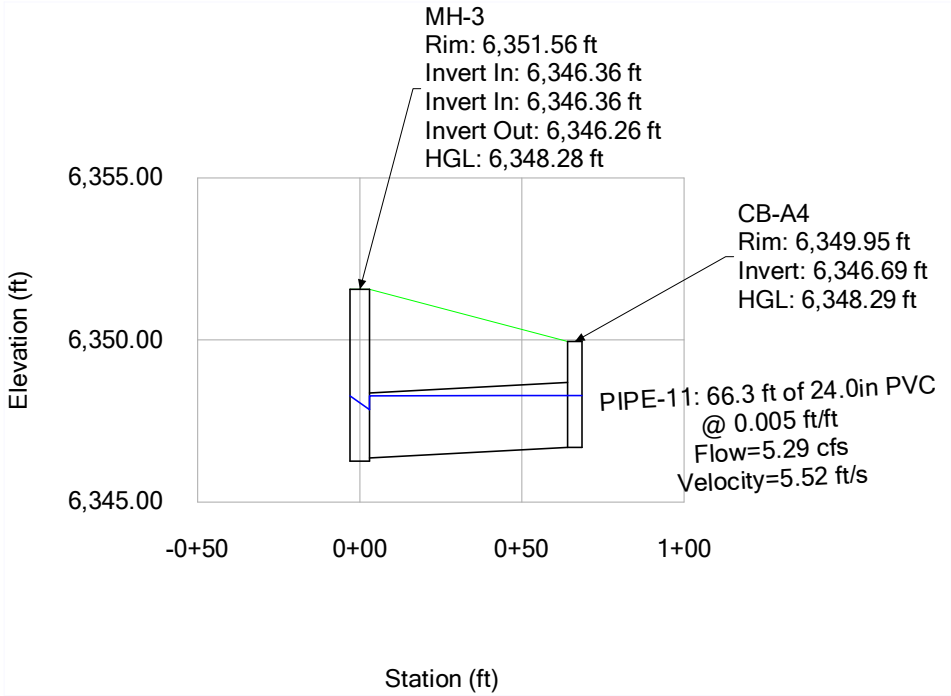


LEGEND

HGL:

PROPOSED GRADE:

100-YR
Profile Report
Engineering Profile - STORM 5 (QT4266.stsw)

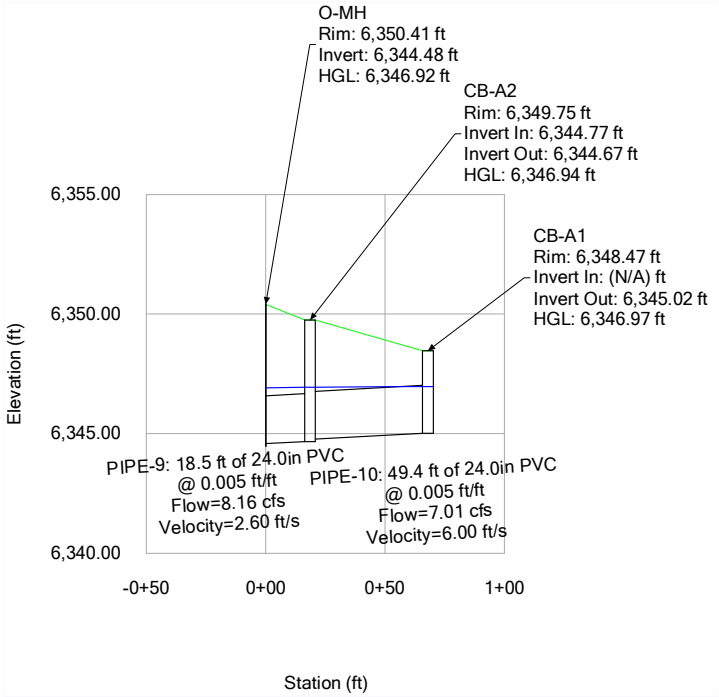


LEGEND

HGL:

PROPOSED GRADE:

100-YR
Profile Report
Engineering Profile - STORM 6 (QT4266.stsw)



LEGEND

HGL:

PROPOSED GRADE:

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: QuikTrip 4266 Castle Pines
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	Inlet A1	Inlet A2
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening
Number of Inlet Units	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	3.41	0.52
Major Peak Flow, Q (cfs)	7.01	1.15

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

Receive Bypass Flow from:		
Bypass Flow Description (Optional):		
Minor Bypass Flow Received, Q_b (cfs)		
Major Bypass Flow Received, Q_b (cfs)		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	3.41	0.52
Major Total Design Peak Flow, Q (cfs)	7.01	1.15
Minor Inlet Interception Capacity, Q_a (cfs)	7.28	0.52
Major Inlet Interception Capacity, Q_a (cfs)	7.28	1.15
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	0.00
Major Flow Bypassed Downstream, Qb (cfs)	N/A	0.00
Minor Flow Capture Percentage, C%	100%	100%
Major Flow Capture Percentage, C%	100%	100%

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

'roject: QuikTrip 4266 Castle Pines
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	Inlet A3	Inlet A4
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening
Number of Inlet Units	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	0.59	1.96
Major Peak Flow, Q (cfs)	1.30	5.20

Bypass (Carry-Over) Flow from Upstream bypass flows to be linked.

Receive Bypass Flow from:		
Bypass Flow Description (Optional):		
Minor Bypass Flow Received, Q_b (cfs)		
Major Bypass Flow Received, Q_b (cfs)		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.59	1.96
Major Total Design Peak Flow, Q (cfs)	1.30	5.20
Minor Inlet Interception Capacity, Q_a (cfs)	1.31	5.74
Major Inlet Interception Capacity, Q_a (cfs)	1.31	5.74
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Minor Flow Capture Percentage, C%	100%	100%
Major Flow Capture Percentage, C%	100%	100%

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project:	QuikTrip 4266 Castle Pines
Minor:	5-year
Major:	100-year

Worksheet Protected

INLET NAME	Inlet A5	Inlet A6
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening
Number of Inlet Units	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	0.72	0.63
Major Peak Flow, Q (cfs)	2.05	1.31

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:		
Bypass Flow Description (Optional):		
Minor Bypass Flow Received, Q_b (cfs)		
Major Bypass Flow Received, Q_b (cfs)		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.72	0.63
Major Total Design Peak Flow, Q (cfs)	2.05	1.31
Minor Inlet Interception Capacity, Q_a (cfs)	2.99	2.82
Major Inlet Interception Capacity, Q_a (cfs)	2.99	2.82
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Minor Flow Capture Percentage, C%	100%	100%
Major Flow Capture Percentage, C%	100%	100%

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project:	QuikTrip 4266 Castle Pines
Minor:	5-year
Major:	100-year

Worksheet Protected

INLET NAME	Inlet A7	Inlet A8
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening
Number of Inlet Units	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	0.63	0.47
Major Peak Flow, Q (cfs)	2.17	0.96

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:		
Bypass Flow Description (Optional):		
Minor Bypass Flow Received, Q_b (cfs)		
Major Bypass Flow Received, Q_b (cfs)		

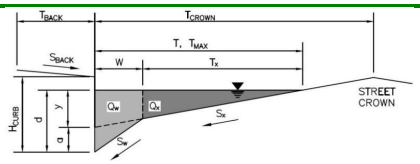
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.63	0.47
Major Total Design Peak Flow, Q (cfs)	2.17	0.96
Minor Inlet Interception Capacity, Q_a (cfs)	2.18	1.25
Major Inlet Interception Capacity, Q_a (cfs)	2.18	1.25
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A
Minor Flow Capture Percentage, C%	100%	100%
Major Flow Capture Percentage, 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: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A1



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.029	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	

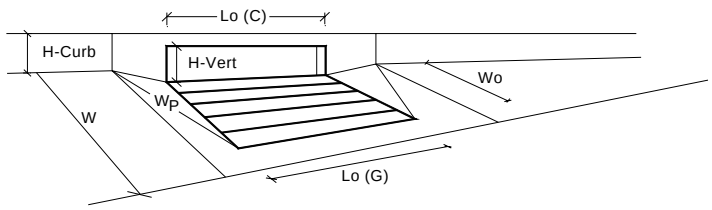
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	13.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)

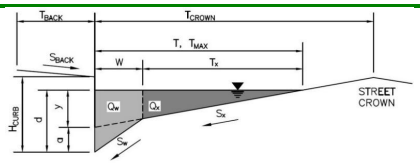


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.4	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) =	10.00	10.00	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 =	1.50	1.50	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	
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} =	0.33	0.33	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} =	0.90	0.90	
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 =	7.3	7.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.4	7.0	cfs

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

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

Project: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.030	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 =	0.032	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

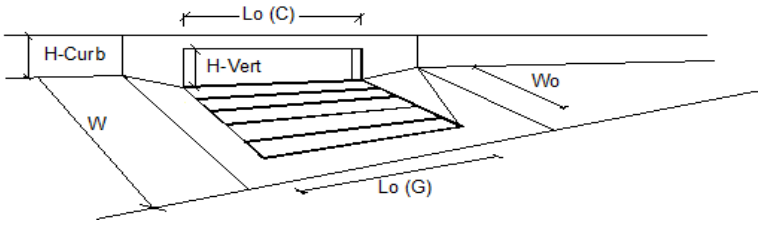
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	6.0	6.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	2.7	2.7	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.52 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.15 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)

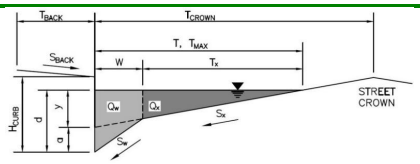


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit 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	
Total Inlet Interception Capacity	Q_a =	0.5	1.1	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: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A3



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.011	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	

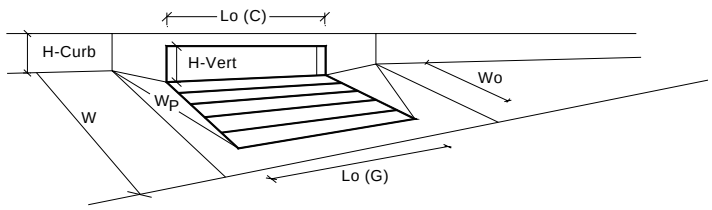
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



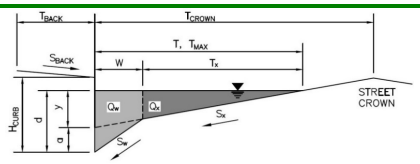
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.2	3.2	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 =	1.50	1.50	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	
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} =	0.14	0.14	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} =	0.96	0.96	
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 =	1.3	1.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.3	cfs

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

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

Project: QuikTrip 4266 Castle Pines

Inlet ID: Inlet A4



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

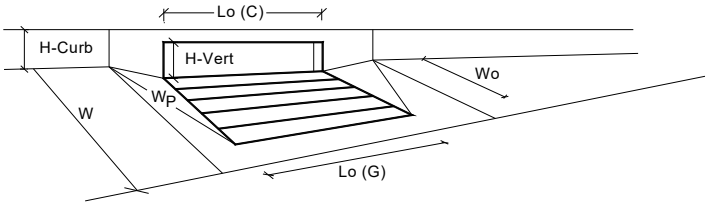
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)

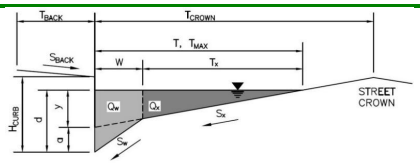


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.52	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.94	0.94	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**5.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.0	5.2	cfs

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

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

Project: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A5



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.029	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	

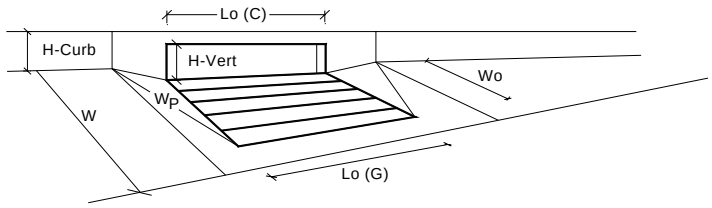
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



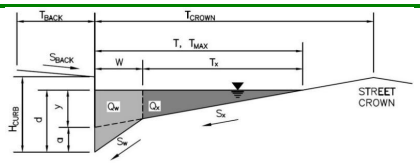
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	4.4	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 =	1.50	1.50	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	
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} =	0.24	0.24	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} =	1.00	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 =	3.0	3.0	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.7	2.1	cfs

MHFD-Inlet, Version 6.00 (August 2025)

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

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

Project: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A6



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.036	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	

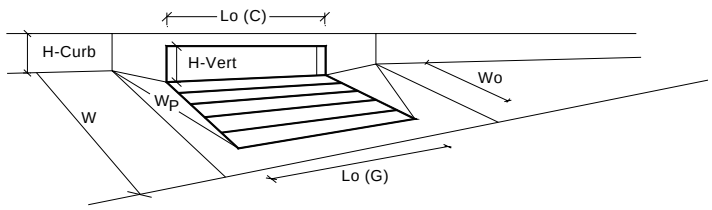
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	8.0	8.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)

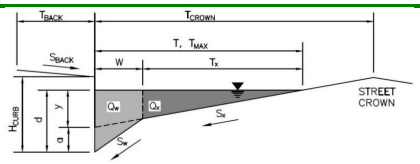


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	4.3	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 =	1.50	1.50	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	
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} =	0.23	0.23	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} =	1.00	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 =	2.8	2.8	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.3	cfs

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

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

Project: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A7



Gutter Geometry:

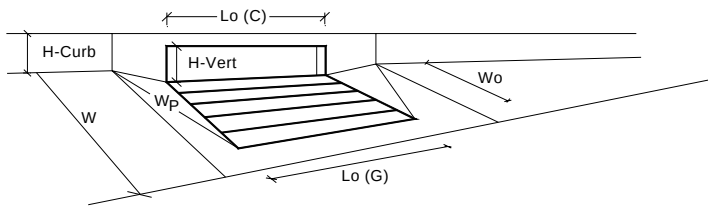
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.5	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.018	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} =	12.5	12.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		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 6.00 (August 2025)



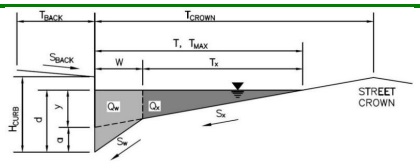
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.9	3.9	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 =	1.50	1.50	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	
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} =	0.20	0.20	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} =	1.00	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 =	2.2	2.2	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	2.2	cfs

MHFD-Inlet, Version 6.00 (August 2025)

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

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

Project: QuikTrip 4266 Castle Pines
Inlet ID: Inlet A8



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	1.50	ft
Street Transverse Slope	S_X =	0.040	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	

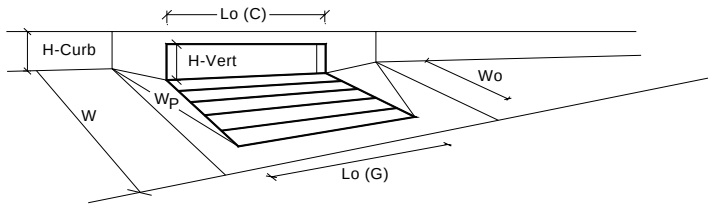
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	5.0	5.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	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 =	3.2	3.2	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 =	1.50	1.50	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	
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} =	0.14	0.14	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} =	0.95	0.95	
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	1.2	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.5	1.0	cfs

INLET PICTURES

CDOT Type R Curb Opening

Denver No. 14 Curb Opening

Colorado Springs D-10-R

CDOT/Denver 13 Valley Grate

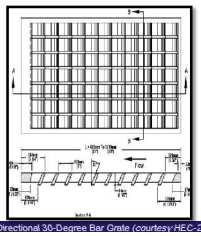
CDOT/Denver 13 Combination

Denver No. 16 Combination

Wheat Ridge Combination Inlet

Denver No. 16 Valley Grate

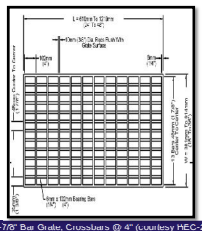
Directional Cast Vane Grate

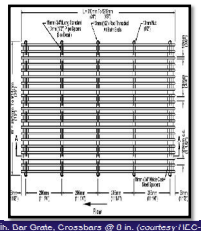

Directional 30-Degree Bar Grate (courtesy HEC-22)

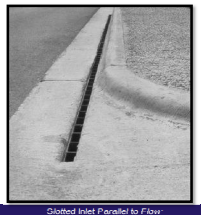
Directional 45-Degree Bar Grate

Reticuline Riveted Grate

1-7/8" Bar Grate, Crossbars @ 8"


1-7/8" Bar Grate, Crossbars @ 4" (courtesy HEC-22)


1-1/8 in. Bar Grate, Crossbars @ 8 in. (courtesy HEC-22)


Slotted Inlet Parallel to Flow

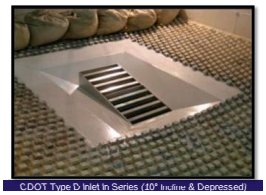
CDOT Type C Grate (Close Mesh)

CDOT Type C Grate

CDOT Type C Inlet

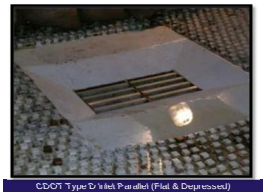
CDOT Type C Inlet in Depression

CDOT Type D Inlet In Series (Flat & Depressed)


CDOT Type D Inlet In Series (10° Incline & Depressed)

CDOT Type D Inlet In Series (20° Incline & Depressed)

CDOT Type D Inlet In Series (30° Incline & Depressed)

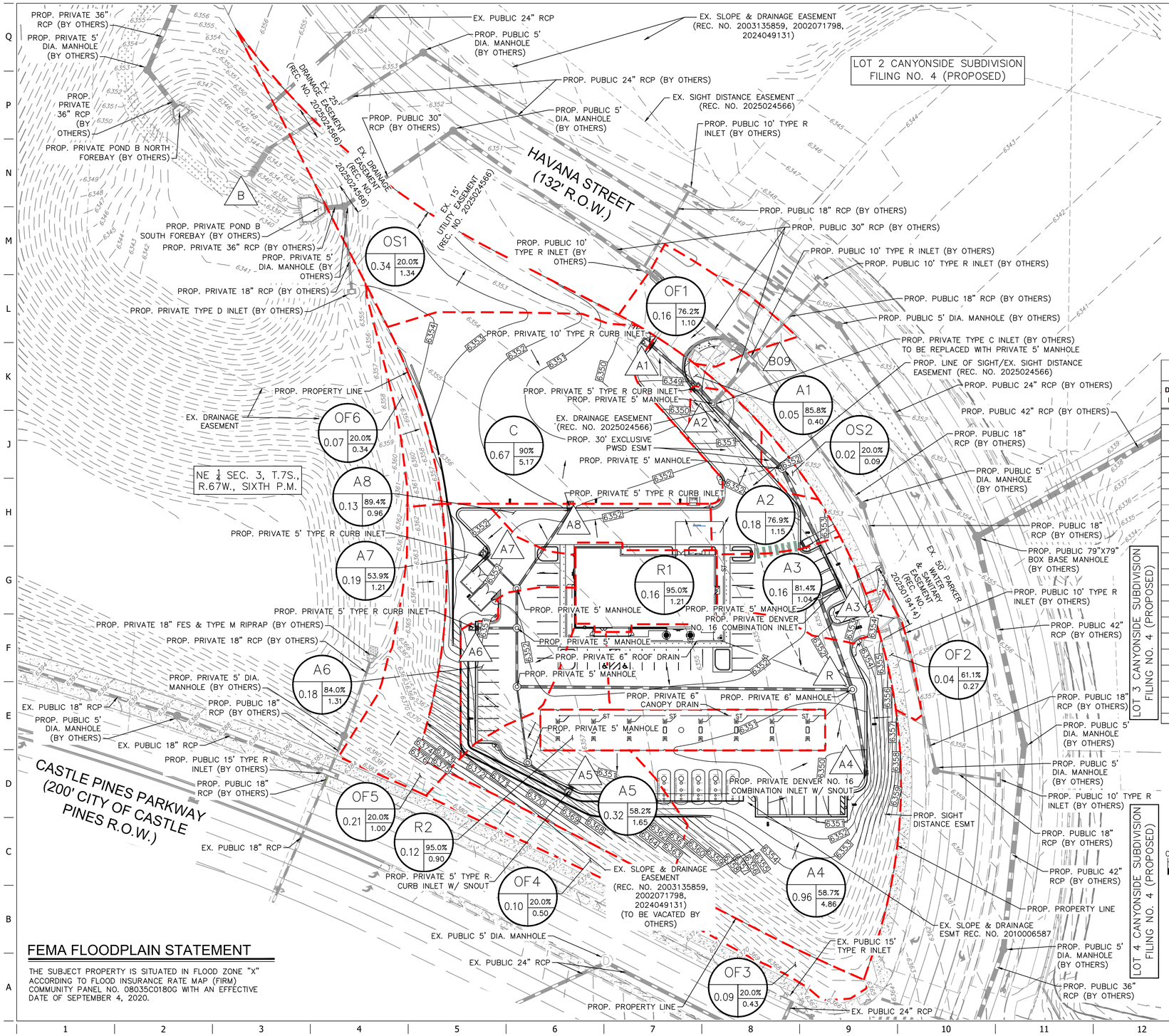

CDOT Type D Inlet Parallel (Flat & Depressed)

CDOT Type D Inlet Parallel (10° Incline & Depressed)

CDOT Type D Inlet Parallel (20° Incline & Depressed)

CDOT Type D Inlet Parallel (30° Incline & Depressed)

D – DRAINAGE MAP EXHIBIT



LEGEND

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

= DESIGN POINT

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

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	C5	C100
A1	A1	0.05	0.20	0.40	0.73	0.83
A2	A2	0.18	0.52	1.15	0.66	0.80
A3	A3	0.16	0.49	1.04	0.70	0.82
A4	A4	0.96	1.90	4.86	0.51	0.72
A5	A5	0.32	0.64	1.65	0.51	0.72
A6	A6	0.18	0.63	1.31	0.72	0.83
A7	A7	0.19	0.45	1.21	0.47	0.70
A8	A8	0.13	0.47	0.96	0.76	0.85
A1	C	0.67	2.65	5.17	0.81	0.87
R	R1	0.16	0.62	1.21	0.81	0.87
R	R2	0.12	0.46	0.90	0.81	0.87
B	OS1	0.34	0.25	1.29	0.20	0.57
B09	OS2	0.02	0.02	0.09	0.20	0.57
A1	OF1	0.16	0.50	1.10	0.66	0.80
A3	OF2	0.04	0.11	0.27	0.53	0.73
A4	OF3	0.09	0.08	0.43	0.20	0.57
A5	OF4	0.10	0.10	0.50	0.20	0.57
A7	OF5	0.21	0.19	1.00	0.20	0.57
A1	OF6	0.07	0.07	0.34	0.20	0.57
Total		4.15	10.32	24.87	0.55	0.74

FEMA FLOODPLAIN STATEMENT

THE SUBJECT PROPERTY IS SITUATED IN FLOOD ZONE "X" ACCORDING TO FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY PANEL NO. 08035C0180G WITH AN EFFECTIVE DATE OF SEPTEMBER 4, 2020.

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

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

CITY DEVELOPMENT REVIEW ENGINEER

DATE

THESE CONSTRUCTION DRAWINGS HAVE BEEN REVIEWED BY THE CITY OF CASTLE PINES FOR STREET AND DRAINAGE, GRADING, EROSION, AND SEDIMENT CONTROL IMPROVEMENTS ONLY.

PUBLIC WORKS ACCEPTANCE BLOCK

PROJECT NO.:096888056

Kimley»Horn
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2 North Nevada Avenue, Suite 900
Colorado Springs, CO 80903 (719) 453-0180

QuikTrip No. 4266

CASTLE PINES PARKWAY AND HAVANA STREET
CASTLE PINES, CO USA
CANYONSIDE SUBDIVISION FILING NO. 4, LOT 1

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PROTOTYPE: P-125 (08/15/2025)
DIVISION:
VERSION: 001
DESIGNED BY:
DRAWN BY:
REVIEWED BY:

REV	DATE	DESCRIPTION
	3/12/26	1ST SUBMITTAL
	7/23/26	2ND SUBMITTAL

ORIGINAL ISSUE DATE:

SHEET TITLE:
(C122) POST DEVELOPED DRAINAGE MAP

SHEET NUMBER:
16

E – MASTER DRAINAGE STUDIES

PHASE III DRAINAGE REPORT

FOR

Canyonside Filing 4 – Phase 1
City of Castle Pines, Colorado

Prepared for:

North Canyons Development Company
3033 E. 1st Avenue, Suite 725
Denver, CO 80206
Contact: Skyler Hager
Phone: 720-737-5221

Prepared by:

Terracina Design
10200 E. Girard Ave., Suite A-314
Denver, CO 80231
Contact: David Bacci, PE
Phone: 303-632-8867

March 21, 2025

Engineer's Statement:

I affirm that this report and plan for the Phase III drainage design of Canyonside Filing 4 – Phase 1, was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Castle Pines Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Castle Pines does not and will not assume liability for drainage facilities designed by others.

David Bacci, P.E., CFM
Colorado Professional Engineer
License #42104

Owner/Developer's Statement:

North Canyons Development Company hereby certifies that the drainage facilities for Canyonside Filing 4 – Phase 1, will be constructed according to the design presented in this report. I understand that The City of Castle Pines does not and will not assume liability for the drainage facilities designed and/or certified by my engineer. The City of Castle Pines reviews drainage plans pursuant to Colorado Revised Statutes Title 30, Article 28; but cannot, on behalf of Canyonside Filing 4 – Phase 1, guarantee that final drainage design review will absolve North Canyons Development Company and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

North Canyons Development Company

Skyler Hager

Printed Name

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

This Phase III Drainage Report provides remediation for changes in the drainage patterns resulting from the construction of the major infrastructure components for Canyonside Filing 4 – Phase 1, from here on known as "Site". The Site is currently undeveloped and future development will include commercial lots, open space, re-alignment of S Havana St, and utility infrastructure.

Canyonside Filing 4 is bound to the east and south by Castle Pines Pkwy (formerly Hess Rd), Freshfields Inc. property to the north, and Interstate 25 to the west. It is located within Section 2 and 3, Township 7 South, Range 67 West of the 6th Principal Meridian, City of Castle Pines, Colorado. Parcel 1 was platted with the Canyons Superblock Plat No. 2, reception No. 2018040799, and will consist of a portion of the Castle Pines Parkway Right-of-Way between the current Interstate 25 on-ramp and the Canyon Forge Dr intersection. A vicinity map for the Site can be found in Appendix A.

B. Description of Property

The Site is approximately 200 acres of undeveloped land, and according to the approved PD Amendment 2, the land use is mixed use and open space. The Site has been previously included in The Canyons, Preliminary Plan No. 2. Soils located throughout the Site are primarily Fondis Clay Loam (FoD), Fondis-Kutch association (Fu), and Hilly gravelly land (HG). These soil types are a part of the Type C and D hydrologic soil groups. A soils map has been provided and can be found in Appendix A. A geological investigation was performed by CTL Thompson and summarized in a report named "Geological and Preliminary Geotechnical investigation – Soil Suitability Report; The Canyons PA-1, PA-2, and PA-3; Southeast of I-25 and Hess Road, Castle Pines, Colorado dated August 16, 2018 (Ref. B). CTL also completed a letter which evaluated the suitability of fill placement on Planning Area 1 dated January 6, 2022. These reports states there were no geological hazards identified on Site.

There is one major drainageway throughout the Site. Parkway Tributary runs west to east along the center of the Site. Parkway tributary eventually merges into Newlin Gulch which outfalls into Reuter-Hess reservoir. No modifications or improvements to the floodplain are proposed with the development of the Site to Parkway Tributary. The Site drainage will not be impacted by any irrigation facilities.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The existing drainage patterns within the major basin will generally follow the historic patterns. The development lies within the Newlin Gulch Basin. Newlin Gulch extends to the southwest under Interstate 25 where the Lagae Ranch Development discharges into the basin at historic flows and will not affect our Site. The runoff going to and from CDOT pond 3 was not assessed in this analysis because it discharges directly into Parkway Tributary and will not impact the runoff going through the Site. Once the overland discharge from the Extended Detention Basins (EDB) reach Parkway Tributary, the flows will be conveyed through Newlin Gulch, to Reuter-Hess Reservoir, to Cherry Creek, and eventually they will become a part of the South Platte River.

B-Basins will drain northwest towards EDB Pond B which will release to Parkway Tributary through an outfall pipe to the northeast below S Havana St. C-Basins will drain east towards existing EDB Pond C which will release to Parkway Tributary through an existing outfall pipe to the south. Existing basin XP1 drains north towards EDB CDOT Pond 1 which releases to the east through an outfall pipe below Interstate 25 on-ramp to an open channel. Runoff from this channel is currently conveyed to a pipe south of Castle Pines Parkway which ultimately discharges to the northeast to Parkway Tributary. With the proposed site improvements, the runoff will remain in the subsurface drainage system instead of discharging into the open channel, and it will ultimately be conveyed to Parkway Tributary via the subsurface drainage system. See Appendix E for the existing and proposed drainage maps.

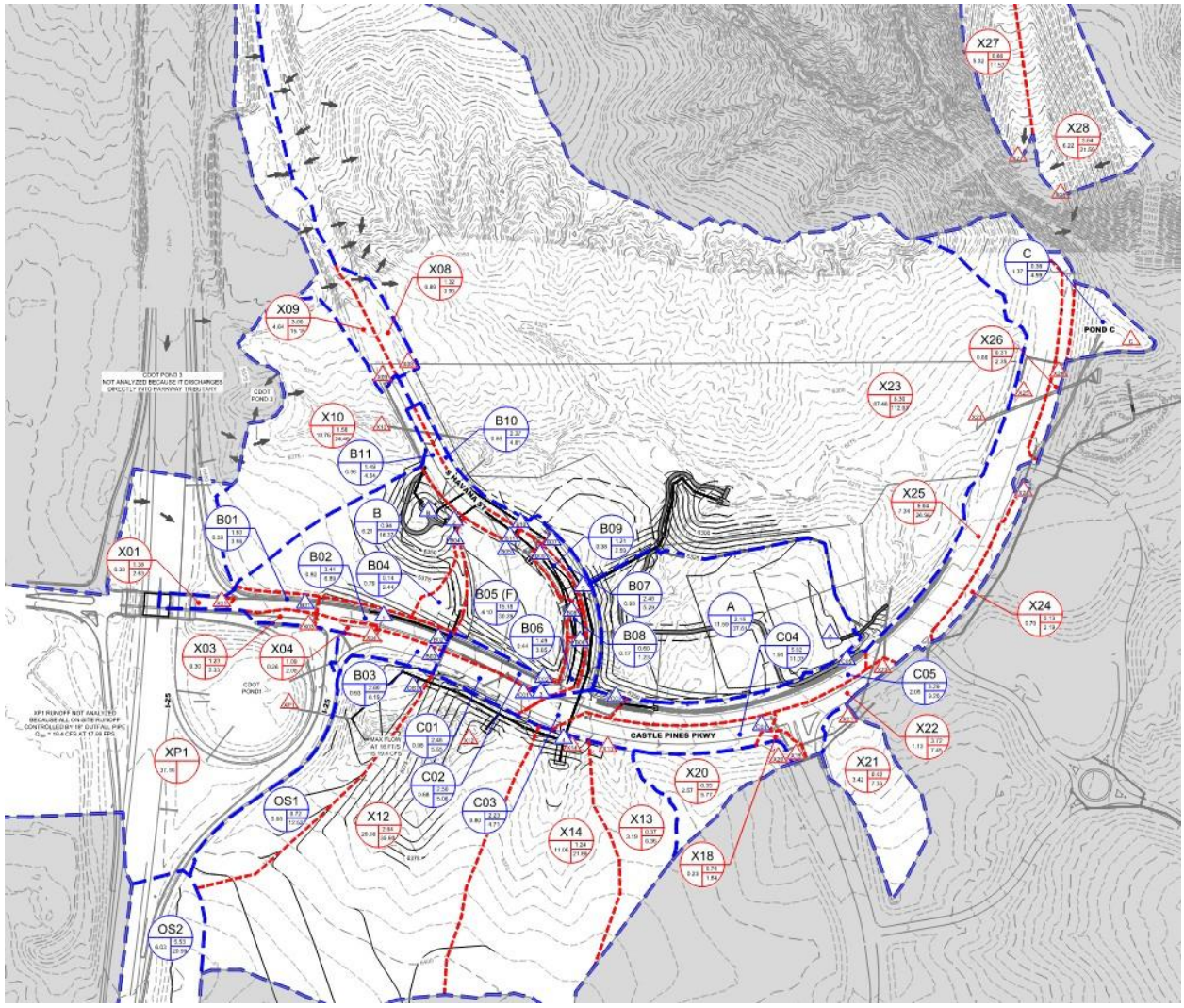

Figure 1: Overall Proposed Drainage Map. See Appendix E for existing and proposed drainage maps.

The Site does not fall within a floodplain, as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel 08035C0180G. A FIRM map can be found in Appendix A.

Basin B04
Basin B04 is 0.79 acres comprised of open space, which was basin X07 and a portion of basin XP2. This basin was delineated from the existing basins because the proposed swale within this basin prevents the runoff from flowing into the rest of basin X07. Runoff generated within the basin will drain north via a grass-lined swale to an in-series, depressed Type D Inlet at Design Point B04. This Type D inlet has a maximum allowable head of one foot, but only 0.62 feet of head is required to capture all the flows going to this inlet, as seen in Appendix B. The captured runoff will be conveyed north via the proposed subsurface system to Design Point 2 and ultimately discharged into proposed EDB Pond B. Bypass runoff will be received by basin B.

Basin B05
Basin B05 is 4.10 acres comprised of open space that has been graded as a flat pad for a future commercial site, which was basin X07 and a portion of basin X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Basin B05 was assessed for both the interim and final conditions in the rational method calculations found in Appendix A. Runoff generated within the basin will drain northeast to a sump Type C Inlet at Design Point B05. This Type C inlet has a maximum allowable head of 2 feet, but only 0.56 feet of head is required to capture all the flows going to this inlet, as seen in Appendix B. The captured runoff will be conveyed northeast via the proposed subsurface system to Design Point B09 and ultimately discharged into proposed EDB Pond B. If the inlet were to get clogged, runoff would overtop the crown of South Havana Street to basin B10 and ultimately to Parkway Tributary.

Basin B06
Basin B06 is 0.44 acres comprised of arterial roadways, which was portions of basins X15, X16, and X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain north to an on-grade Type R Inlet at Design Point B06. The captured runoff will be conveyed northwest via the proposed subsurface system to Design Point B08 and ultimately discharged into proposed EDB Pond B. Basin B06 will receive bypass runoff from basin C02, and basin B06's bypassed runoff will be received by basin B08.

Basin B07
Basin B07 is 0.93 acres comprised of arterial roadways, which was portions of basins X16 and X23. This sub-basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain northwest to an on-grade Type R Inlet at Design Point B07. The captured runoff will be conveyed southwest via the proposed subsurface system to Design Point B09 and ultimately discharged into proposed EDB Pond B. Bypass runoff will be received by basin B10.

Basin B08
Basin B08 is 0.17 acres comprised of arterial roadways, which was a portion of basin X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain north to an on-grade Type R Inlet at Design Point B08. The captured runoff will be conveyed northwest via the proposed subsurface system to Design Point B09 and ultimately discharged into proposed EDB Pond B. Basin B08 will receive bypass runoff from basin B06, and basin B08's bypassed runoff will be received by basin B05.

Basin B09
Basin B09 is 0.38 acres comprised of arterial roadways, which was a portion of basin X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain northwest to an on-grade Type R Inlet at Design Point B09. The captured runoff will be conveyed northwest via the proposed subsurface system to Design Point B11 and ultimately discharged into proposed EDB Pond B. Bypass runoff will be received by basin B05.

Basin B10
Basin B10 is 0.68 acres comprised of arterial roadways, which was a portion of basin X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain southeast to a sump Type R Inlet at Design Point B10. The captured runoff will be conveyed southwest via the proposed subsurface system to Design Point B11 and ultimately discharged into proposed EDB Pond B. Basin B10 will receive bypass runoff from basin B07, and basin B10 should not bypass any runoff. If the inlet were to get clogged, runoff would discharge to the north ultimately to Parkway Tributary.

Basin B11
Basin B11 is 0.96 acres comprised of arterial roadways, which was portions of basins X07, X10, and X23. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain southeast to a sump Type R Inlet at Design Point B11. The captured runoff will be conveyed northwest via the proposed subsurface system to Design Point 2 and ultimately discharged into proposed EDB Pond B. Basin B11 should not bypass any runoff; however, if the inlet were to get clogged, runoff would overtop the crown of S Havana St to basin B10 and ultimately discharge to Parkway Tributary.

Basin B
Basin B is 6.21 acres comprised of open space for proposed EDB Pond B, which was basin XP2 and portions of basins X07 and X10. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain northeast towards the outlet structure of EDB Pond B. The pond B outlet structure will convey flows to the east via proposed subsurface system to Design Point 5, and the flows will ultimately be released into Parkway Tributary. The table below summarizes the hydraulic results of EDB Pond B for a 100 and 500-yr storm event when the outlet structure is 50% and 99% clogged, and these calculations can be found in Appendix C.

Condition	Storage Volume (ac-ft)	Ponding Depth (ft)
50% Clogged 100-yr storm	2.413	8.63
50% Clogged 500-yr storm	3.171	9.92
99% Clogged 100-yr storm	3.537	10.48
99% Clogged 500-yr storm	4.487	11.79

There are several safeguards included in the design of this pond because this pond was designed without a spillway. For one thing, the pond has been designed to ultimately store up to 6.685 acre-feet at 14.33 feet deep. Furthermore, the pond has been designed to have an emergency overflow weir in addition to the pond's outlet structure. This emergency overflow weir was designed to have a front edge height that is 8 inches higher than the 100-year max ponding depth of Pond B at 99% clogged (11.14 feet from the top of the micropool). This emergency overflow weir will be able to capture two times pond B's 100-year inflow under 1.41 feet of head, which amounts to 1.78 feet of freeboard. Pond B does not need a spillway since it won't overflow at 99% clogged in the 500-year storm and since it has an emergency overflow weir to help capture the flows from any storm greater than the 100-year storm.

Basin C01

Basin C01 is 0.98 acres comprised of arterial roadways, which was basin X11 and portions of basins X12 and X19 in the existing drainage map. This basin was delineated from the existing basins because the road grading is changing to drain to the median and there is a sidewalk being installed on the south side of Castle Pines Parkway, resulting in a larger basin than X11. Runoff generated within the basin will drain east to an on-grade Type R Inlet at Design Point C01. The captured runoff will be conveyed north via the proposed subsurface system to Design Point 3 and ultimately discharged into existing EDB Pond C (within basin C). Basin C01 will receive bypass runoff from basin B03, and basin C01's bypassed runoff will be received by basin C03.

Basin C02

Basin C02 is 0.68 acres comprised of arterial roadways, which was basin X15 and a portion of basin X07. This basin was delineated from the existing basins because the grading and flow pattern for this area changed with the relocation of South Havana Street. Runoff generated within the basin will drain east to an existing on-grade Type R Inlet at Design Point C02. The captured runoff will be conveyed south via the proposed subsurface system to Design Point 3 and ultimately discharged into existing EDB Pond C. Basin C02 will receive bypass runoff from basin B02, and basin C02's bypassed runoff will be received by basin B06.

Basin C03

Basin C03 is 0.80 acres comprised of arterial roadways, which was basin X16 and portions of basins X12, X14, X19, and X23 in the existing drainage map. This basin was delineated from the existing basins because the road grading is changing to drain to the north with the relocation of South Havana Street and there is a sidewalk being installed on the south side of Castle Pines Parkway, resulting in a larger basin than X16. Runoff generated within the basin will drain east to an on-grade Type R Inlet at Design Point C03. The captured runoff will be conveyed east via the existing riprap-lined swale to Design Point C05 and ultimately discharged into existing EDB Pond C. Basin C03 will receive bypass runoff from basin C01, and basin C03's bypassed runoff will be received by basin C05.

Basin C04

Basin C04 is 1.91 acres comprised of arterial roadways, which was basin X19 and portions of basins X13, X14, and X20 in the existing drainage map. This basin was delineated from the existing basins because there is a sidewalk being installed on the south side of Castle Pines Parkway, resulting in a larger basin than X19. Runoff generated within the basin will drain east to a depressed Type D Inlet at Design Point C04. The captured runoff will be conveyed northeast via the existing subsurface system and the existing riprap-lined swale along Castle Pines Pkwy to Design Point C05 and ultimately discharged into existing EDB

III. DRAINAGE DESIGN CRITERIA

A. Regulations

This Phase III Drainage Report is in accordance with the Douglas County Storm Drainage Design and Technical Criteria Manual (Ref. D), adopted by the City of Castle Pines, and the Mile High Flood District (MHFD) Storm Drainage Criteria Manual (Ref. E, F, G). These manuals were used as a basis of design for the Site. The drainage design also complies with the Cherry Creek Basin Water Quality Authority (CCBWQA) regulations (Ref. A). All EDBs have been designed in accordance with regulation 72 of CCBWQA to provide adequate WQCV for the entire Site. All applicable figures, tables, and graphs from these manuals have been included in Appendix D. The report will analyze the minor (5-year) and major (100-year) storm events.

B. Drainage Studies, Master Plans, Site Constraints

The existing storm infrastructure within Castle Pines Parkway R.O.W. was designed based on the "Final Drainage Report for the West Phase of the Douglas County Hess Road Extension Project" by Muller Engineering Company dated February 10, 2010 (Ref. H). The aforementioned report anticipated The Site's development. The Pond C outlet structure has been sized for the ultimate buildout of Castle Pines Parkway according to the Hess Road Extension Project Drainage Report found in Appendix D. The outlet structure of Pond C will not be modified during Canyonside Filing 4 because the improvements were anticipated in the previously approved drainage report.

The area to the south of Castle Pines Parkway and to the east of Canyonside Boulevard was previously analyzed in the Phase III Drainage Report for Canyonside Filing 2 (Ref. C), and the drainage map from this report can be found in Appendix D. The improvements proposed in this project will not impact the final conditions of the basins previously analyzed in the aforemented drainage report. This report has been written as a standalone report that conforms to the calculations presented in References C and H.

C. Hydrology

All the proposed minor drainage basins within The Project are less than 160 acres; therefore, the rational method can be used in determining the flow rates for the Site. The sub-basins were delineated based on the existing and proposed topography developed for the project. Impervious calculations were based on the values from the Mile High Flood District's Street Drainage Criteria Manual Volume 1, which can be found in Appendix D. Basin B05 was assessed under both the interim and final conditions in the rational method calculations found in Appendix A. Flow rates for each basin can be found in Appendix A.

The intensity-frequency curves used in the rational method calculations were taken from the Douglas County Storm Drainage Design and Technical Criteria Manual. All drainage facilities were analyzed and designed for both the minor (5-year) and major (100-year) storm events. Time of concentration calculations were used to determine the rainfall intensity, and these calculations can also be found in Appendix A.

D. Hydraulics

Hydraulic calculations for EDB sizing were based on MHFD design spreadsheets and can be found in Appendix C. Pond B will utilized a emergency overflow weir in addition to the outlet structure. Hydraflow Express was used to assess the hydraulics of this emergency overflow weir because it will function as an area inlet, and these calculations can be found in Appendix C. This emergency overflow weir was designed to have a front edge height that is 8 inches higher than the 100-year max ponding depth of Pond B at 99% clogged (11.14 feet from the top of the micropool). This emergency overflow weir will be able to capture two times pond B's 100-year inflow under 1.41 feet of head, which amounts to 1.78 feet of freeboard.

Street and inlet capacity design were performed and based on Chapter 8 of the City's Drainage Criteria and design spreadsheets provided by the MHFD, which can be found in Appendix B. Area inlet calculations were performed using the Hydraflow Express add-on for the Civil3D program, and the results can be found in Appendix B. The inlet calculation for basin B05 was based on the interim conditions because additional storm infrastructure will be required when Lot 1 is developed as a commercial site. Riprap calculations were performed based on the design spreadsheets provided by the MHFD, and these calculations can also be found in Appendix B.

Hydraulic calculations for swale capacity, swale velocity, and area inlet capacities were performed using the Hydraflow Express add-on for the Civil3D program. Hydraflow Express uses the Manning's equation to compute flow at a known depth or a depth at a known flow. Hydraflow Express was also used to calculate the flow going through the XP1 outfall pipe based on its size and slope and the maximum flow velocities of 18 feet per second for the major storm and 15 feet per second for the minor storm. All results from these calculations can be found in Appendix B.

Hydraulic grade lines and storm pipe capacities were designed and modeled using StormCAD. StormCAD uses the routed hydrograph method and the Manning's equation to compute the hydraulic grade line throughout a pipe network. Basin B05 was assessed as a fully developed commercial site in the StormCAD model. See Appendix B for the StormCAD Output Tables.

E. Water Quality Enhancement

Water quality measures have been included with designs of forebays for the proposed EDB's, and the forebay calculations can be found in Appendix C. The ponds in the developed area were designed as EDB's which incorporated structures that release flows for the water quality capture volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year storm event.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

Low Impact Development (LID) practices and strategies have been applied to the comprehensive land planning and engineering design approach to managing stormwater runoff. The primary objective of the Project is the preservation of the natural features of the property by arranging the development to minimize site grading, impacts to existing vegetation and wetlands, as well as providing large open space areas. The drainage design will generally maintain the historic drainage patterns and release rates for the Site. The EDB's on Site have been located to minimize subsurface systems and control the developed discharge prior to entering the established waterways thus reducing the impact to Parkway Tributary.

Runoff will be captured by 5-foot, 10-foot, and 15-foot Type R inlets at on-grade and in sump locations, along with Type C & D inlets for area drains. The runoff will then be conveyed via a subsurface system toward the proposed EDBs. The EDBs will discharge less than historical rates via a pipe from the outlet structure to Parkway Tributary.

B. Stormwater Storage Facilities

The Site will utilize one proposed EDB (Pond B) and an existing EDB (Pond C) for water quality and detention storage. The basins were designed as EDB's (WQCV, EURV, 100-year), and will be released below historic rates per the criteria. EDB's and 100-year detention pond volumes were calculated using the MHFD detention basin design workbook (MHFD-Detention, Version 4.06, July 2022). A copy of the output file for the ponds has been included in Appendix C.

Proposed EDB Pond B was designed to have two forebays to improve the pond's water quality. Forebay calculations can be found in Appendix C. The existing grading and outlet structure design of EDB pond C will support the proposed basin delineation and stormwater drainage system because the proposed improvements were anticipated in the Hess Road Extension Project. Excerpts from the "Final Drainage Report for the West Phase of the Douglas County Hess Road Extension Project" by Muller Engineering dated February 5, 2010 and the "Canyonside Filing 4 - Phase 1 Drainage Report" can be found in Appendix D.

The design of the EDB's is compliant with the Colorado Revised Statute 37-92-602 (8) pertaining to stormwater and detention facilities. The applicable MHFD spreadsheet and calculations are in Appendix C. In addition, per the new statute, the maximum micropool volume will be no greater than 1% of the 100-year volume including water quality.

C. Water Quality Enhancement Control Measures

Water quality measures have been included in the design of the proposed EDB's. The basins have been designed to incorporate a structure that releases flows for the water quality capture volume (WQCV), excess urban runoff volume (EURV), and the 100-year storm event. The design of these structures has been provided in Appendix C. The Pond C outlet structure has been sized for the ultimate buildout of Castle Pines Parkway according to the Hess Road Extension Project Drainage Report found in Appendix D. The original watershed area and imperviousness was maintained with the improvements from this project, so the pond does not need to be modified.

D. Floodplain Modification

This project is not adjacent to a FEMA floodplain, see Appendix A for FEMA map 08035C0180G.

E. Additional Permitting Requirements

The drainage design of The Project adheres to the requirements of Section 404 of the Clean Water Act, Section 106 of the National Historic Preservation Act of 1966 and the Endangered Species Act. Additionally, the drainage design conforms to all applicable local, state, and federal requirements for drainage design and stormwater discharge.

V. CONCLUSIONS

A. Compliance with Standards

The drainage design for the Site conforms to the Douglas County Storm Drainage Design and Technical Criteria Manual, the adopted criteria for The City of Castle Pines and the Mile High Flood Districts' Drainage Criteria Manual where applicable. The report outlines the required design and construction of offline extended detention basins within each sub-basin. The report conforms to the Cherry Creek Reservoir Control Regulation No. 72.

B. Variances

There is one variance being requested for the project concerning Pond B being built without a spillway. The pond was designed without a spillway because the proposed grading and site layout would require the spillway to be pointed towards South Havana Street, and if flows were directed that way, they would pond in the low spots of the adjacent developments. Instead of an emergency spillway, the pond has been designed to have 1 foot of freeboard during the 500-year storm event while the outlet structure is 99% clogged. Furthermore, an emergency overflow weir was included in the design of the pond to capture any flows that exceed the 100-year storm's max ponding depth. This overflow weir can fully capture the 100-year storm inflows into the pond while maintaining over a foot of freeboard.

C. Drainage Concept

The rational method was used to determine the developed runoff values for the minor drainage basins throughout the Site. These basins were delineated based on the natural Site topography and the developed Site plan. The proposed extended detention basins were sized for a 100-yr storm and will release below historic rates. The storm sewer system will be designed to capture the minor (5-year) and major (100-year) storm events.

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Project Name: Canyonside Filing 4 - Proposed Basins
Prepared By: JNS

Percent Impervious Calculations

Basin Id	Design Point	Total Basin Area	Historic Area	Paved Street Area	Commercial Area	Gravel Area	Weighted % Impervious
			2%	100%	90%	40%	
A	A	11.59	11.59				2.0%
B	B	6.21	6.21				2.0%
B01	B01	0.59	0.12	0.46			79.2%
B02	B02	0.92	0.10	0.82			88.8%
B03	B03	0.93	0.24	0.69			74.9%
B04	B04	0.79	0.79				2.0%
B05 (I)	B05 (I)	4.10	3.93	0.17			6.0%
B05 (F)	B05 (F)	4.10		0.17	3.93		90.4%
B06	B06	0.44	0.06	0.38			86.7%
B07	B07	0.93	0.19	0.74			80.0%
B08	B08	0.17	0.02	0.15			87.8%
B09	B09	0.38	0.08	0.30			80.3%
B10	B10	0.68	0.08	0.60			88.2%
B11	B11	0.96	0.55	0.41			44.3%
C	C	1.37	1.31			0.06	3.7%
C01	C01	0.98	0.29	0.70			71.4%
C02	C02	0.68	0.08	0.60			88.8%
C03	C03	0.80	0.15	0.65			81.6%
C04	C04	1.91	0.47	1.45			76.0%
C05	C05	2.05	1.03	1.02			50.7%
OS1	OS1	5.88	5.88				2.0%
OS2	OS2	6.03	4.22	1.82			31.5%
X01	X01	0.33		0.33			100.0%
X03	X03	0.30		0.30			100.0%
X04	X04	0.26		0.26			100.0%
X08	X08	0.89	0.49	0.39			45.3%
X09	X09	4.64	3.75	0.89			20.7%
X10	X10	10.76	10.67	0.09			2.8%
X12	X12	20.06	20.06				2.0%
X13	X13	3.19	3.19				2.0%
X14	X14	11.06	11.06				2.0%
X18	X18	0.23	0.05	0.18			79.1%
X20	X20	2.57	2.56	0.01			2.5%
X21	X21	3.42	3.42				2.0%
X22	X22	1.13	0.11	1.01			90.3%
X23	X23	87.48	85.63	1.67		0.18	3.9%
X24	X24	0.70	0.70				2.0%
X25	X25	7.24	5.18	2.06			29.8%
X26	X26	0.88	0.80	0.08			11.1%
X27	X27	5.32	5.32				2.0%
X28	X28	6.22	5.31	0.91			16.3%
XP1	XP1	19.84	12.09	7.75			40.3%

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Project Name: Canyonside Filing 4 - Proposed Basins
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Runoff Coefficent (C)

Runoff Coefficient calculations based on MHFD Volume 1: Chapter 6, Table 6-4 equations

Basin Id	Weighted % Impervious	i	Soil Type	Soil Type	Basin Area	Runoff Coefficients, C		Weighted Coefficients, C	
						5-Year	100-Year	5-Year	100-Year
A	2.0%	0.02	A	0.00	11.59	0.01	0.13	0.05	0.49
			B	0.00		0.01	0.44		
			C/D	11.59		0.05	0.49		
B	2.0%	0.02	A	0.00	6.21	0.01	0.13	0.05	0.49
			B	0.00		0.01	0.44		
			C/D	6.21		0.05	0.49		
B01	79.2%	0.79	A	0.00	0.59	0.64	0.73	0.68	0.81
			B	0.00		0.67	0.80		
			C/D	0.59		0.68	0.81		
B02	88.8%	0.89	A	0.00	0.92	0.74	0.80	0.76	0.85
			B	0.00		0.76	0.84		
			C/D	0.92		0.76	0.85		
B03	74.9%	0.75	A	0.00	0.93	0.59	0.69	0.65	0.79
			B	0.00		0.63	0.78		
			C/D	0.93		0.65	0.79		
B04	2.0%	0.02	A	0.00	0.79	0.01	0.13	0.05	0.49
			B	0.00		0.01	0.44		
			C/D	0.79		0.05	0.49		
B05 (I)	6.0%	0.06	A	0.00	4.10	0.02	0.16	0.08	0.51
			B	0.00		0.04	0.45		
			C/D	4.10		0.08	0.51		
B05 (F)	90.4%	0.90	A	0.00	4.10	0.76	0.82	0.78	0.85
			B	0.00		0.77	0.85		
			C/D	4.10		0.78	0.85		
B06	86.7%	0.87	A	0.00	0.44	0.72	0.79	0.75	0.84
			B	0.00		0.74	0.83		
			C/D	0.44		0.75	0.84		
B07	80.0%	0.80	A	0.00	0.93	0.65	0.73	0.69	0.81
			B	0.00		0.67	0.80		
			C/D	0.93		0.69	0.81		
B08	87.8%	0.88	A	0.00	0.17	0.73	0.80	0.76	0.84
			B	0.00		0.75	0.84		
			C/D	0.17		0.76	0.84		
B09	80.3%	0.80	A	0.00	0.38	0.65	0.74	0.69	0.81
			B	0.00		0.68	0.80		
			C/D	0.38		0.69	0.81		
B10	88.2%	0.88	A	0.00	0.68	0.73	0.80	0.76	0.85
			B	0.00		0.75	0.84		
			C/D	0.68		0.76	0.85		
B11	44.3%	0.44	A	0.00	0.96	0.30	0.46	0.40	0.67
			B	0.00		0.35	0.63		
			C/D	0.96		0.40	0.67		
C	3.7%	0.04	A	0.00	1.37	0.01	0.14	0.07	0.50
			B	0.00		0.02	0.44		
			C/D	1.37		0.07	0.50		
C01	71.4%	0.71	A	0.00	0.98	0.56	0.67	0.62	0.78
			B	0.00		0.60	0.76		
			C/D	0.98		0.62	0.78		
C02	88.8%	0.89	A	0.00	0.68	0.74	0.80	0.76	0.85
			B	0.00		0.76	0.84		
			C/D	0.68		0.76	0.85		
C03	81.6%	0.82	A	0.00	0.80	0.66	0.75	0.70	0.82
			B	0.00		0.69	0.81		
			C/D	0.80		0.70	0.82		
C04	76.0%	0.76	A	0.00	1.91	0.61	0.70	0.66	0.80
			B	0.00		0.64	0.78		
			C/D	1.91		0.66	0.80		
C05	50.7%	0.51	A	0.00	2.05	0.36	0.51	0.45	0.69
			B	0.00		0.41	0.66		
			C/D	2.05		0.45	0.69		
OS1	2.0%	0.02	A	0.00	5.88	0.01	0.13	0.05	0.49
			B	0.00		0.01	0.44		
			C/D	5.88		0.05	0.49		
OS2	31.5%	0.32	A	0.00	6.03	0.20	0.36	0.29	0.61
			B	0.00		0.24	0.57		
			C/D	6.03		0.29	0.61		
X01	100.0%	1.00	A	0.00	0.33	0.86	0.89	0.86	0.89
			B	0.00		0.86	0.90		
			C/D	0.33		0.86	0.89		

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Project Name: Canyonside Filing 4 - Proposed Basins
Prepared By: JNS

Time of Concentration Calculations (T_C)

Sub-Basin Data			Initial or Overland Flow Time				Channelized Flow Time				T_c Check (Urbanized Basins)					
Basin Id	Basin Area	C(5)	Length (ft)	Elev Change	Slope (%)	T_i (min)	Length (ft)	Elev Change	Slope (%)	NRCS Coeff. K	Velocity (FPS)	T_t (min)	Comp. T_c	Percent Imperv.	MHFD Eq. 6.5	$Final\ T_c$ (min)
A	11.59	0.05	79	16	20.6	6.19	860	14	1.7	20.0	2.59	5.5	11.7	2.0%	37.6	11.7
B	6.21	0.05	300	25	8.2	16.38	523	50	9.5	15.0	4.62	1.9	18.3	2.0%	28.7	18.3
B01	0.59	0.68	126	4	3.5	5.54	233	7	3.0	20.0	3.44	1.1	6.7	79.2%	13.7	6.7
B02	0.92	0.76	69	4	5.3	2.91	470	18	3.9	20.0	3.94	2.0	4.9	88.8%	12.8	5.0
B03	0.93	0.65	87	4	5.1	4.44	324	13	3.9	20.0	3.95	1.4	5.8	74.9%	14.7	5.8
B04	0.79	0.05	187	20	10.8	11.80	311	18	5.7	15.0	3.59	1.4	13.2	2.0%	28.0	13.2
B05 (I)	4.10	0.08	79	12	14.6	6.74	446	6	1.4	20.0	2.35	3.2	9.9	6.0%	31.4	9.9
B05 (F)	4.10	0.78	79	12	14.6	2.15	446	6	1.4	20.0	2.35	3.2	5.3	90.4%	13.6	5.3
B06	0.44	0.75	177	8	4.4	5.23	177	4	2.0	20.0	2.82	1.0	6.3	86.7%	12.2	6.3
B07	0.93	0.69	159	6	3.5	6.15	646	12	1.9	20.0	2.73	3.9	10.1	80.0%	16.3	10.1
B08	0.17	0.76	115	2	2.1	5.21	12	0	2.8	20.0	3.33	0.1	5.3	87.8%	11.1	5.3
B09	0.38	0.69	77	2	2.8	4.59	207	4	1.9	20.0	2.72	1.3	5.9	80.3%	13.6	5.9
B10	0.68	0.76	43	1	2.7	2.93	577	13	2.3	20.0	3.05	3.2	6.1	88.2%	14.0	6.1
B11	0.96	0.40	45	1	2.5	6.26	618	13	2.1	20.0	2.91	3.5	9.8	44.3%	23.1	9.8
C	1.37	0.07	138	28	20.0	8.16	163	5	3.4	15.0	2.75	1.0	9.1	3.7%	26.9	9.1
C01	0.98	0.62	111	1	2.0	7.25	355	15	4.2	20.0	4.09	1.4	8.7	71.4%	15.4	8.7
C02	0.68	0.76	79	3	4.1	3.38	354	14	4.0	20.0	4.02	1.5	4.8	88.8%	12.3	5.0
C03	0.80	0.70	289	7	2.6	8.91	134	5	3.7	20.0	3.85	0.6	9.5	81.6%	12.7	9.5
C04	1.91	0.66	141	5	3.9	6.05	729	26	3.6	20.0	3.78	3.2	9.3	76.0%	16.4	9.3
C05	2.05	0.45	125	5	4.2	8.17	916	32	3.5	20.0	3.76	4.1	12.2	50.7%	22.4	12.2
OS1	5.88	0.05	300	13	4.3	20.20	904	19	2.1	15.0	2.18	6.9	27.1	2.0%	36.8	27.1
OS2	6.03	0.29	126	4	3.3	11.07	920	20	2.2	20.0	2.94	5.2	16.3	31.5%	28.4	16.3
X01	0.33	0.86	89	2	2.3	3.18	212	2	1.0	20.0	2.03	1.7	4.9	100.0%	10.5	5.0
X03	0.30	0.86	63	2	3.9	2.25	223	7	3.1	20.0	3.52	1.1	3.3	100.0%	9.9	5.0
X04	0.26	0.86	67	3	4.4	2.22	197	8	4.1	20.0	4.06	0.8	3.0	100.0%	9.7	5.0
X08	0.89	0.41	182	10	5.3	9.74	322	9	2.8	20.0	3.37	1.6	11.3	45.3%	20.4	11.3
X09	4.64	0.20	29	1	3.1	6.00	1856	46	2.5	20.0	3.14	9.9	15.9	20.7%	39.1	15.9
X10	10.76	0.06	283	22	7.8	16.07	732	62	8.4	5.0	1.45	8.4	24.5	2.8%	30.0	24.5
X12	20.06	0.05	300	5	1.8	26.90	1308	58	4.4	5.0	1.05	20.7	47.6	2.0%	36.8	36.8
X13	3.19	0.05	300	8	2.6	23.91	656	40	6.1	5.0	1.24	8.9	32.8	2.0%	30.4	30.4
X14	11.06	0.05	300	10	3.3	22.22	789	49	6.2	5.0	1.25	10.5	32.7	2.0%	31.3	31.3
X18	0.23	0.68	23	0	2.0	2.88	90	2	2.2	20.0	2.97	0.5	3.4	79.1%	13.1	5.0
X20	2.57	0.06	300	17	5.5	18.59	476	30	6.3	5.0	1.25	6.3	24.9	2.5%	29.0	24.9
X21	3.42	0.05	300	12	3.9	20.93	483	35	7.4	5.0	1.36	5.9	26.9	2.0%	28.9	26.9
X22	1.13	0.78	300	10	3.4	6.78	202	7	3.4	20.0	3.67	0.9	7.7	90.3%	11.5	7.7
X23	87.48	0.07	300	2	2.0	25.69	4071	150	3.7	5.0	0.96	70.7	96.4	3.9%	62.4	62.4
X24	0.70	0.05	91	6	6.8	9.62	624	29	4.6	15.0	3.22	3.2	12.8	2.0%	30.9	12.8
X25	7.24	0.28	116	7	6.0	8.85	1170	46	3.9	20.0	3.97	4.9	13.8	29.8%	28.4	13.8
X26	0.88	0.13	134	0	2.0	16.17	349	3	0.9	15.0	1.39	4.2	20.4	11.1%	30.1	20.4
X27	5.32	0.05	272	11	4.2	19.43	1533	56	3.6	20.0	3.82	6.7	26.1	2.0%	40.1	26.1
X28	6.22	0.17	98	6	6.2	9.12	1068	56	5.2	20.0	4.57	3.9	13.0	16.3%	30.1	13.0
XP1	19.84	0.37	67	1	2.0	8.62	873	26	3.0	20.0	3.47	4.2	12.8	40.3%	24.9	12.8

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Project Name: Canyonside Filing 4 - Proposed Basins
Prepared By: JNS

Peak Runoff Rational Method (5-Year Storm)

			Rainfall Depth-Duration-Frequency (1-hr) =				1.43
Design Point	Basin ID	Basin Area (Ac)	Runoff Coeff (5-Year)	T_c (min)	C X A	I (in/hr)	Q (cfs)
A	A	11.59	0.05	11.7	0.60	3.63	2.16
B	B	6.21	0.05	18.3	0.32	2.95	0.94
B01	B01	0.59	0.68	6.7	0.40	4.46	1.80
B02	B02	0.92	0.76	5.0	0.70	4.85	3.41
B03	B03	0.93	0.65	5.8	0.60	4.65	2.80
B04	B04	0.79	0.05	13.2	0.04	3.44	0.14
B05 (I)	B05 (I)	4.10	0.08	9.9	0.34	3.88	1.34
B05 (F)	B05 (F)	4.10	0.78	5.3	3.18	4.77	15.18
B06	B06	0.44	0.75	6.3	0.33	4.55	1.49
B07	B07	0.93	0.69	10.1	0.64	3.85	2.48
B08	B08	0.17	0.76	5.3	0.13	4.78	0.60
B09	B09	0.38	0.69	5.9	0.26	4.64	1.21
B10	B10	0.68	0.76	6.1	0.52	4.59	2.37
B11	B11	0.96	0.40	9.8	0.38	3.90	1.49
C	C	1.37	0.07	9.1	0.09	4.00	0.36
C01	C01	0.98	0.62	8.7	0.61	4.08	2.48
C02	C02	0.68	0.76	5.0	0.52	4.85	2.50
C03	C03	0.80	0.70	9.5	0.56	3.95	2.23
C04	C04	1.91	0.66	9.3	1.26	3.98	5.02
C05	C05	2.05	0.45	12.2	0.93	3.56	3.29
OS1	OS1	5.88	0.05	27.1	0.30	2.38	0.72
OS2	OS2	6.03	0.29	16.3	1.77	3.12	5.53
X01	X01	0.33	0.86	5.0	0.28	4.85	1.38
X03	X03	0.30	0.86	5.0	0.25	4.85	1.23
X04	X04	0.26	0.86	5.0	0.23	4.85	1.09
X08	X08	0.89	0.41	11.3	0.36	3.68	1.32
X09	X09	4.64	0.20	15.9	0.95	3.16	3.00
X10	X10	10.76	0.06	24.5	0.63	2.52	1.58
X12	X12	20.06	0.05	36.8	1.03	1.98	2.04
X13	X13	3.19	0.05	30.4	0.16	2.22	0.37
X14	X14	11.06	0.05	31.3	0.57	2.19	1.24
X18	X18	0.23	0.68	5.0	0.16	4.85	0.76
X20	X20	2.57	0.06	24.9	0.14	2.50	0.35
X21	X21	3.42	0.05	26.9	0.18	2.39	0.42
X22	X22	1.13	0.78	7.7	0.87	4.26	3.72
X23	X23	87.48	0.07	62.4	5.89	1.41	8.30
X24	X24	0.70	0.05	12.8	0.04	3.48	0.13
X25	X25	7.24	0.28	13.8	2.02	3.38	6.84
X26	X26	0.88	0.13	20.4	0.11	2.79	0.31
X27	X27	5.32	0.05	26.1	0.27	2.43	0.66
X28	X28	6.22	0.17	13.0	1.05	3.46	3.64
XP1	XP1	19.84	0.37	12.8	7.25	3.49	25.28

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Project Name: Canyonside Filing 4 - Proposed Basins

Prepared By: JNS

Peak Runoff Rational Method (100-Year Storm)

			Rainfall Depth-Duration-Frequency (1-hr) =				2.60
Design Point	**Basin ID**	**Basin Area (Ac)**	**Runoff Coeff (100-Year)**	T_c **(min)**	**C X A**	**I (in/hr)**	**Q (cfs)**
A	A	11.59	0.49	11.7	5.70	6.59	37.61
B	B	6.21	0.49	18.3	3.05	5.36	16.37
B01	B01	0.59	0.81	6.7	0.48	8.12	3.86
B02	B02	0.92	0.85	5.0	0.78	8.82	6.89
B03	B03	0.93	0.79	5.8	0.73	8.46	6.19
B04	B04	0.79	0.49	13.2	0.39	6.25	2.44
B05 (I)	B05 (I)	4.10	0.51	9.9	2.08	7.06	14.71
B05 (F)	B05 (F)	4.10	0.85	5.3	3.50	8.68	30.39
B06	B06	0.44	0.84	6.3	0.37	8.27	3.05
B07	B07	0.93	0.81	10.1	0.75	7.01	5.29
B08	B08	0.17	0.84	5.3	0.14	8.69	1.23
B09	B09	0.38	0.81	5.9	0.31	8.44	2.59
B10	B10	0.68	0.85	6.1	0.58	8.35	4.81
B11	B11	0.96	0.67	9.8	0.64	7.09	4.54
C	C	1.37	0.50	9.1	0.69	7.28	4.99
C01	C01	0.98	0.78	8.7	0.76	7.42	5.65
C02	C02	0.68	0.85	5.0	0.57	8.82	5.06
C03	C03	0.80	0.82	9.5	0.66	7.18	4.71
C04	C04	1.91	0.80	9.3	1.52	7.24	11.03
C05	C05	2.05	0.69	12.2	1.42	6.47	9.20
OS1	OS1	5.88	0.49	27.1	2.89	4.33	12.52
OS2	OS2	6.03	0.61	16.3	3.70	5.67	20.99
X01	X01	0.33	0.89	5.0	0.30	8.82	2.63
X03	X03	0.30	0.89	5.0	0.26	8.82	2.33
X04	X04	0.26	0.89	5.0	0.24	8.82	2.08
X08	X08	0.89	0.67	11.3	0.59	6.69	3.96
X09	X09	4.64	0.57	15.9	2.64	5.75	15.16
X10	X10	10.76	0.50	24.5	5.34	4.58	24.46
X12	X12	20.06	0.49	36.8	9.87	3.61	35.60
X13	X13	3.19	0.49	30.4	1.57	4.05	6.36
X14	X14	11.06	0.49	31.3	5.45	3.98	21.65
X18	X18	0.23	0.81	5.0	0.19	8.82	1.64
X20	X20	2.57	0.49	24.9	1.27	4.54	5.77
X21	X21	3.42	0.49	26.9	1.69	4.35	7.33
X22	X22	1.13	0.85	7.7	0.96	7.74	7.45
X23	X23	87.48	0.50	62.4	43.76	2.56	112.03
X24	X24	0.70	0.49	12.8	0.35	6.34	2.19
X25	X25	7.24	0.61	13.8	4.39	6.14	26.96
X26	X26	0.88	0.53	20.4	0.46	5.07	2.35
X27	X27	5.32	0.49	26.1	2.62	4.42	11.57
X28	X28	6.22	0.55	13.0	3.43	6.30	21.59
XP1	XP1	19.84	0.65	12.8	12.88	6.34	81.67

Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 13 2024

INLET 21 (B05)

Drop Grate Inlet

Location	=	Sag
Curb Length (ft)	=	-0-
Throat Height (in)	=	-0-
Grate Area (sqft)	=	4.50
Grate Width (ft)	=	3.00
Grate Length (ft)	=	3.00

Gutter

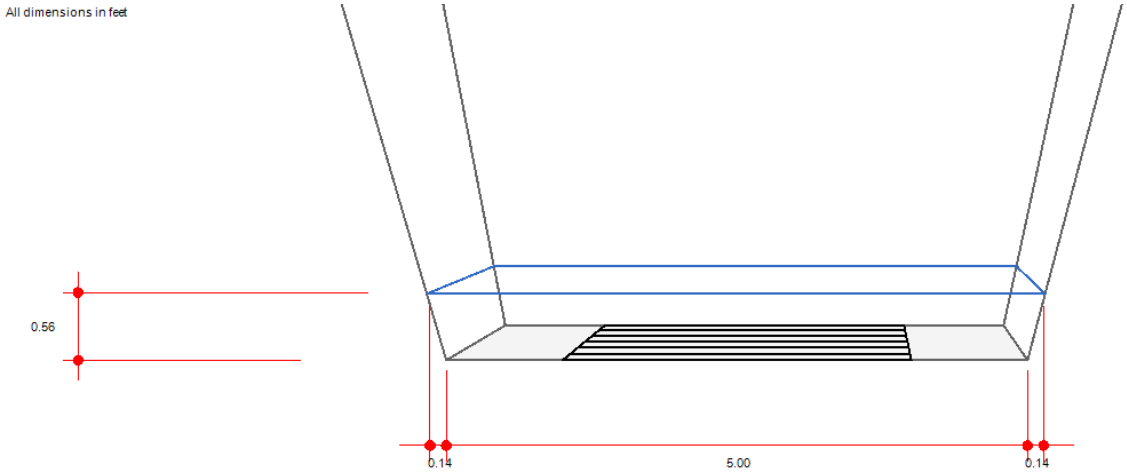
Slope, Sw (ft/ft)	=	4.000
Slope, Sx (ft/ft)	=	4.000
Local Depr (in)	=	-0-
Gutter Width (ft)	=	5.00
Gutter Slope (%)	=	-0-
Gutter n-value	=	-0-

Calculations

Compute by:		Known Q
Q (cfs)	=	14.91

Highlighted

Q Total (cfs)	=	14.91
Q Capt (cfs)	=	14.91
Q Bypass (cfs)	=	-0-
Depth at Inlet (in)	=	6.67
Efficiency (%)	=	100
Gutter Spread (ft)	=	5.28
Gutter Vel (ft/s)	=	-0-
Bypass Spread (ft)	=	-0-
Bypass Depth (in)	=	-0-



STORMCAD OUTPUT TABLES

Storm Line B & PA2 Bypass - 5-Year

Catchment Table - Time: 0.00 hours

Label	Outflow Element	Area (acres)	Runoff Coeff.	Time of C (min)	Catchment CA (acres)	Intensity (in/h)	Flow (cfs)
B01	INLET-02	0.590	0.680	6.700	0.401	3.491	1.41
B02	INLET-06	0.920	0.760	5.000	0.699	3.799	2.68
B03	INLET-05	0.930	0.650	5.800	0.605	3.647	2.22
B04	INLET-14	0.790	0.050	13.200	0.040	2.696	0.11
B05	INLET-10	4.100	0.780	5.300	3.198	3.740	12.06
B06	INLET-07	0.440	0.750	6.300	0.330	3.559	1.18
B07	INLET-09	0.930	0.690	10.100	0.642	3.018	1.95
B08	INLET-08	0.170	0.760	5.300	0.129	3.740	0.49
B09	INLET-11	0.380	0.690	5.900	0.262	3.629	0.96
B10	INLET-12	0.680	0.760	6.100	0.517	3.593	1.87
B11	INLET-13	0.960	0.400	9.800	0.384	3.054	1.18
OS1	INLET-21	5.880	0.050	27.100	0.294	1.864	0.55
X01	INLET-01	0.330	0.860	5.000	0.284	3.799	1.09
X03	INLET-03	0.300	0.860	5.000	0.258	3.799	0.99
X04	INLET-04	0.260	0.860	5.000	0.224	3.799	0.86
X08	INLET-15	0.890	0.410	11.300	0.365	2.884	1.06
X09	INLET-16	4.640	0.200	15.900	0.928	2.473	2.31
X12	FES-04	20.060	0.050	36.800	1.003	1.553	1.57
X13	FES-05	3.190	0.050	30.400	0.160	1.744	0.28
X14	FES-05	11.060	0.050	31.300	0.553	1.714	0.96

Catch Basin Table - Time: 0.00 hours

Label	Rim (ft)	Invert (ft)	Flow (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Inlet Location	Notes
FES-04	6,349.75	6,344.00	1.57	6,344.41	6,344.41	In Sag	30" FES
FES-05	6,343.69	6,341.90	1.23	6,342.71	6,342.71	In Sag	18" FES
INLET-01	6,415.84	6,410.41	1.09	6,410.80	6,410.80	In Sag	15' TYPE R INLET
INLET-02	6,405.67	6,397.51	3.32	6,398.20	6,398.20	In Sag	10' TYPE R INLET
INLET-03	6,405.31	6,400.91	0.99	6,401.28	6,401.28	In Sag	10' TYPE R INLET
INLET-04	6,395.31	6,391.06	0.86	6,391.41	6,391.41	In Sag	10' TYPE R INLET
INLET-05	6,384.27	6,379.91	2.22	6,380.47	6,380.47	In Sag	15' TYPE R INLET
INLET-06	6,384.34	6,375.52	8.31	6,376.64	6,376.64	In Sag	15' TYPE R INLET
INLET-07	6,358.81	6,354.51	1.18	6,354.92	6,354.92	In Sag	10' TYPE R INLET
INLET-08	6,355.78	6,350.10	1.61	6,350.58	6,350.58	In Sag	10' TYPE R INLET
INLET-09	6,350.06	6,345.60	1.95	6,346.12	6,346.12	In Sag	10' TYPE R INLET
INLET-10	6,348.01	6,344.48	12.06	6,345.65	6,345.65	In Sag	TYPE C INLET
INLET-11	6,350.29	6,343.81	13.72	6,345.06	6,345.06	In Sag	10' TYPE R INLET
INLET-12	6,349.43	6,344.38	1.87	6,344.89	6,344.89	In Sag	10' TYPE R INLET
INLET-13	6,349.82	6,342.70	16.29	6,344.06	6,344.06	In Sag	10' TYPE R INLET
INLET-14	6,353.01	6,345.38	6.82	6,346.39	6,346.39	In Sag	TYPE D INLET
INLET-15	6,362.98	6,357.70	1.06	6,358.06	6,358.06	In Sag	TYPE C INLET
INLET-16	6,361.07	6,355.21	3.22	6,355.87	6,355.87	In Sag	TYPE C INLET
INLET-21	6,374.86	6,367.17	0.55	6,367.45	6,367.45	In Sag	TYPE C INLET
OUTL-1	6,381.00	6,371.10	9.50	6,372.29	6,372.29	In Sag	OUTLET STRUCTURE
OUTL-2	6,339.83	6,337.42	5.00	6,338.21	6,338.21	In Sag	OUTLET STRUCTURE

STORMCAD OUTPUT TABLES

Storm Line B & PA2 Bypass - 5-Year

Conduit Table - Time: 0.00 hours

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (ft)	Slope (%)	Dia. (in)	Mann.	Flow (cfs)	Velocity (ft/s)	Depth (ft)	Capacity (cfs)	Froude Number	HGL (In) (ft)	HGL (Out) (ft)
P-1	INLET-01	INLET-02	6,410.41	6,397.82	314.1	4.01	18.0	0.013	1.09	6.26	0.39	21.03	2.760	6,410.80	6,398.05
P-2	INLET-03	INLET-02	6,400.91	6,398.61	96.7	2.38	18.0	0.013	0.99	5.07	0.37	16.20	2.144	6,401.28	6,398.86
P-3	INLET-02	SD MH-01	6,397.51	6,389.41	201.0	4.03	18.0	0.013	3.32	8.70	0.69	21.09	2.864	6,398.20	6,389.81
P-4	SD MH-01	SD MH-02	6,389.21	6,386.90	57.6	4.01	18.0	0.013	3.26	8.64	0.69	21.03	2.856	6,389.90	6,387.30
P-5	INLET-04	TIE INTO EXISTING PIPE 5	6,391.07	6,388.73	97.9	2.39	18.0	0.013	0.86	4.86	0.34	16.24	2.133	6,391.41	6,389.08
P-6	SD MH-02	SD MH-03	6,386.70	6,380.82	147.0	4.00	18.0	0.013	4.01	9.16	0.77	21.01	2.857	6,387.47	6,381.26
P-7	SD MH-03	INLET-06	6,380.62	6,375.71	122.5	4.01	18.0	0.013	3.96	9.14	0.76	21.03	2.859	6,381.38	6,376.64
P-8	INLET-05	TIE INTO EXISTING PIPE 8	6,379.91	6,377.57	106.2	2.20	18.0	0.013	2.22	6.25	0.56	15.59	2.115	6,380.47	6,377.95
P-9	TIE INTO EXISTING PIPE 8	INLET-06	6,377.56	6,377.39	8.0	2.13	18.0	0.013	2.19	6.15	0.56	15.31	2.077	6,378.12	6,377.82
P-10	INLET-06	SD MH-04	6,375.52	6,373.98	34.0	4.53	18.0	0.013	8.31	11.71	1.12	22.35	2.983	6,376.64	6,374.67
P-11	SD MH-04	FES-01	6,369.16	6,366.42	60.9	4.50	18.0	0.013	8.29	11.68	1.12	22.28	2.975	6,370.28	6,367.07
P-12	INLET-07	SD MH-05	6,354.51	6,352.20	47.1	4.90	18.0	0.013	1.18	6.89	0.41	23.26	3.050	6,354.92	6,352.43
P-13	SD MH-05	INLET-08	6,352.00	6,350.30	108.2	1.57	18.0	0.013	1.18	4.61	0.41	13.16	1.765	6,352.41	6,350.60
P-14	INLET-08	SD MH-06	6,350.10	6,346.32	101.0	3.74	18.0	0.013	1.61	6.86	0.48	20.32	2.711	6,350.58	6,346.61
P-15	SD MH-06	INLET-11	6,346.12	6,344.73	139.4	1.00	18.0	0.013	1.59	4.29	0.47	10.50	1.426	6,346.59	6,345.12
P-16	INLET-09	INLET-11	6,345.60	6,344.81	78.4	1.00	18.0	0.013	1.95	4.55	0.53	10.50	1.428	6,346.12	6,345.25
P-17	INLET-10	INLET-11	6,344.48	6,344.01	47.3	1.00	30.0	0.013	12.06	7.26	1.16	41.01	1.544	6,345.65	6,344.96
P-18	INLET-11	INLET-13	6,343.81	6,342.80	101.3	1.00	30.0	0.013	13.72	7.52	1.25	41.02	1.537	6,345.06	6,344.06
P-19	INLET-12	INLET-13	6,344.38	6,343.70	67.6	1.00	18.0	0.013	1.87	4.49	0.52	10.50	1.427	6,344.89	6,344.13
P-20	INLET-13	SD MH-07	6,342.70	6,340.90	179.3	1.00	30.0	0.013	16.29	7.88	1.36	41.01	1.520	6,344.06	6,342.43
P-21	SD MH-07	SD MH-08	6,340.80	6,339.76	104.3	1.00	30.0	0.013	16.06	7.85	1.35	41.01	1.522	6,342.16	6,341.44
P-22	INLET-14	SD MH-08	6,345.38	6,340.76	67.2	6.88	18.0	0.013	6.82	12.92	1.01	27.54	3.737	6,346.39	6,341.27
P-23	SD MH-08	FBAY-1	6,339.26	6,339.10	15.6	1.00	36.0	0.013	21.60	8.42	1.49	66.69	1.586	6,340.75	6,340.40

STORMCAD OUTPUT TABLES

Storm Line B & PA2 Bypass - 100-Year

Catchment Table - Time: 0.00 hours

Label	Outflow Element	Area (acres)	Runoff Coeff.	Time of C (min)	Catchment CA (acres)	Intensity (in/h)	Flow (cfs)
B01	INLET-02	0.590	0.810	6.700	0.478	7.575	3.65
B02	INLET-06	0.920	0.850	5.000	0.782	8.242	6.50
B03	INLET-05	0.930	0.790	5.800	0.735	7.912	5.86
B04	INLET-14	0.790	0.490	13.200	0.387	5.850	2.28
B05	INLET-10	4.100	0.850	5.300	3.485	8.115	28.51
B06	INLET-07	0.440	0.840	6.300	0.370	7.721	2.88
B07	INLET-09	0.930	0.810	10.100	0.753	6.548	4.97
B08	INLET-08	0.170	0.840	5.300	0.143	8.115	1.17
B09	INLET-11	0.380	0.810	5.900	0.308	7.873	2.44
B10	INLET-12	0.680	0.850	6.100	0.578	7.796	4.54
B11	INLET-13	0.960	0.670	9.800	0.643	6.626	4.30
OS1	INLET-21	5.880	0.490	27.100	2.881	4.045	11.75
X01	INLET-01	0.330	0.890	5.000	0.294	8.242	2.44
X03	INLET-03	0.300	0.890	5.000	0.267	8.242	2.22
X04	INLET-04	0.260	0.890	5.000	0.231	8.242	1.92
X08	INLET-15	0.890	0.670	11.300	0.596	6.257	3.76
X09	INLET-16	4.640	0.570	15.900	2.645	5.365	14.30
X12	FES-04	20.060	0.490	36.800	9.829	3.370	33.39
X13	FES-05	3.190	0.490	30.400	1.563	3.783	5.96
X14	FES-05	11.060	0.490	31.300	5.419	3.718	20.31

Catch Basin Table - Time: 0.00 hours

Label	Rim (ft)	Invert (ft)	Flow (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Inlet Location	Notes
FES-04	6,349.75	6,344.00	33.39	6,349.75	6,349.75	In Sag	30" FES
FES-05	6,343.69	6,341.90	26.17	6,343.69	6,343.69	In Sag	18" FES
INLET-01	6,415.84	6,410.41	2.44	6,411.00	6,411.00	In Sag	15' TYPE R INLET
INLET-02	6,405.67	6,397.51	7.93	6,398.60	6,398.60	In Sag	10' TYPE R INLET
INLET-03	6,405.31	6,400.91	2.22	6,401.47	6,401.47	In Sag	10' TYPE R INLET
INLET-04	6,395.31	6,391.06	1.92	6,391.59	6,391.59	In Sag	10' TYPE R INLET
INLET-05	6,384.27	6,379.91	5.86	6,380.84	6,380.84	In Sag	15' TYPE R INLET
INLET-06	6,384.34	6,375.52	20.53	6,376.99	6,376.99	In Sag	15' TYPE R INLET
INLET-07	6,358.81	6,354.51	2.88	6,355.15	6,355.15	In Sag	10' TYPE R INLET
INLET-08	6,355.78	6,350.10	3.91	6,350.86	6,350.86	In Sag	10' TYPE R INLET
INLET-09	6,350.06	6,345.60	4.97	6,346.83	6,346.83	In Sag	10' TYPE R INLET
INLET-10	6,348.01	6,344.48	28.51	6,346.92	6,346.92	In Sag	TYPE C INLET
INLET-11	6,350.29	6,343.81	33.10	6,346.70	6,346.70	In Sag	10' TYPE R INLET
INLET-12	6,349.43	6,344.38	4.54	6,346.17	6,346.17	In Sag	10' TYPE R INLET
INLET-13	6,349.82	6,342.70	40.70	6,346.04	6,346.04	In Sag	10' TYPE R INLET
INLET-14	6,353.01	6,345.38	18.72	6,346.84	6,346.84	In Sag	TYPE D INLET
INLET-15	6,362.98	6,357.70	3.76	6,358.39	6,358.39	In Sag	TYPE C INLET
INLET-16	6,361.07	6,355.21	17.53	6,356.65	6,356.65	In Sag	TYPE C INLET
INLET-21	6,374.86	6,367.17	11.75	6,368.47	6,368.47	In Sag	TYPE C INLET
OUTL-1	6,381.00	6,371.10	19.40	6,372.56	6,372.56	In Sag	OUTLET STRUCTURE
OUTL-2	6,339.83	6,337.42	22.90	6,339.83	6,339.83	In Sag	OUTLET STRUCTURE

APPENDIX C

EXTENDED DETENTION BASIN/ WATER QUALITY ENHANCEMENT BMP'S

Pond B Outlet Structures Design Spreadsheets
Pond B Emergency Overflow Weir Calculations
Pond B Forebay Design Spreadsheets

Pond X12 Outlet Structures Design Spreadsheets

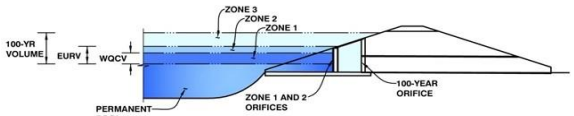
Pond X14 Outlet Structures Design Spreadsheets

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Canyonside Filing 4**

Basin ID: **Pond B**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	23.50	acres
Watershed Length =	2,372	ft
Watershed Length to Centroid =	232	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	45.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Note: Lc/L Ratio < 0.1

Lc / L Ratio = 0.1

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.380	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.002	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.947	acre-feet	1.06	inches
5-yr Runoff Volume (P1 = 1.43 in.) =	1.573	acre-feet	1.43	inches
10-yr Runoff Volume (P1 = 1.66 in.) =	1.997	acre-feet	1.66	inches
25-yr Runoff Volume (P1 = 1.69 in.) =	2.132	acre-feet		inches
50-yr Runoff Volume (P1 = 2.26 in.) =	3.238	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	3.985	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	5.063	acre-feet		inches
Approximate 2-yr Detention Volume =	0.783	acre-feet		
Approximate 5-yr Detention Volume =	1.275	acre-feet		
Approximate 10-yr Detention Volume =	1.447	acre-feet		
Approximate 25-yr Detention Volume =	1.404	acre-feet		
Approximate 50-yr Detention Volume =	1.733	acre-feet		
Approximate 100-yr Detention Volume =	2.054	acre-feet		

Define Zones and Basin Geometry

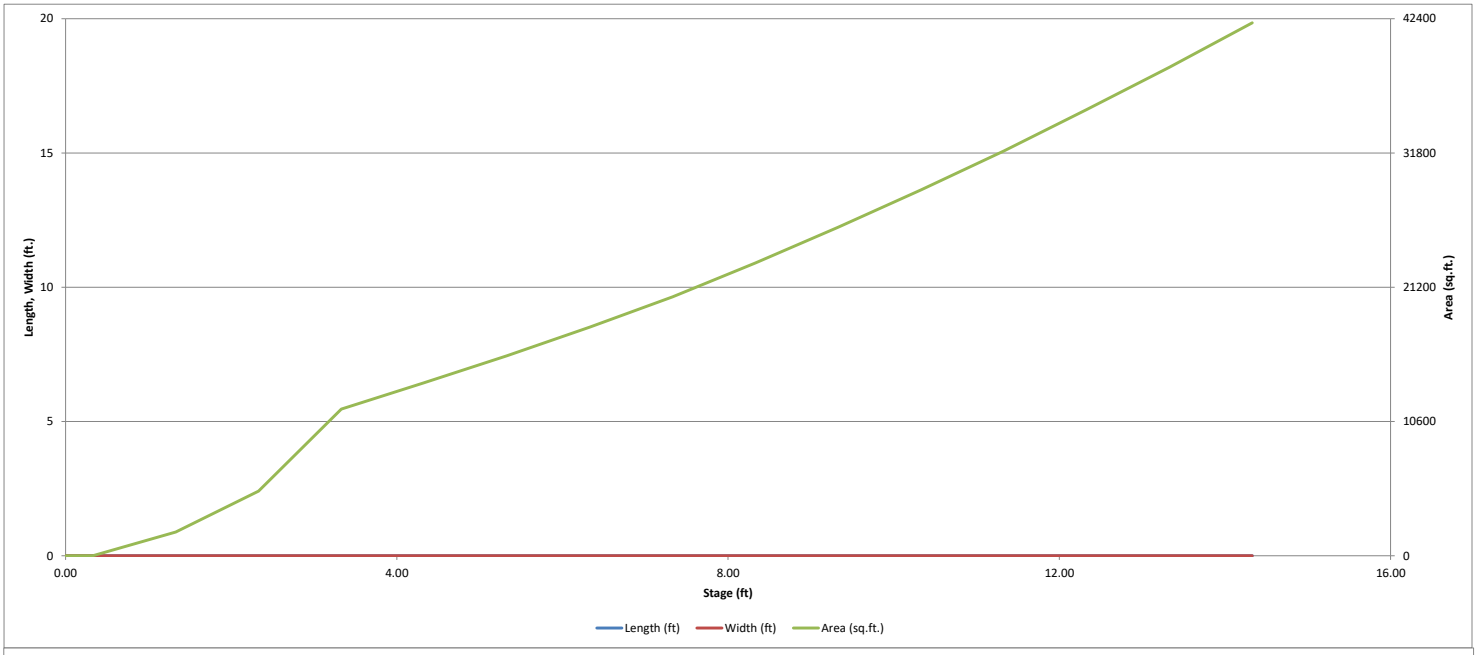
Zone 1 Volume (WQCV) =	0.380	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.622	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.053	acre-feet
Total Detention Basin Volume =	2.054	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

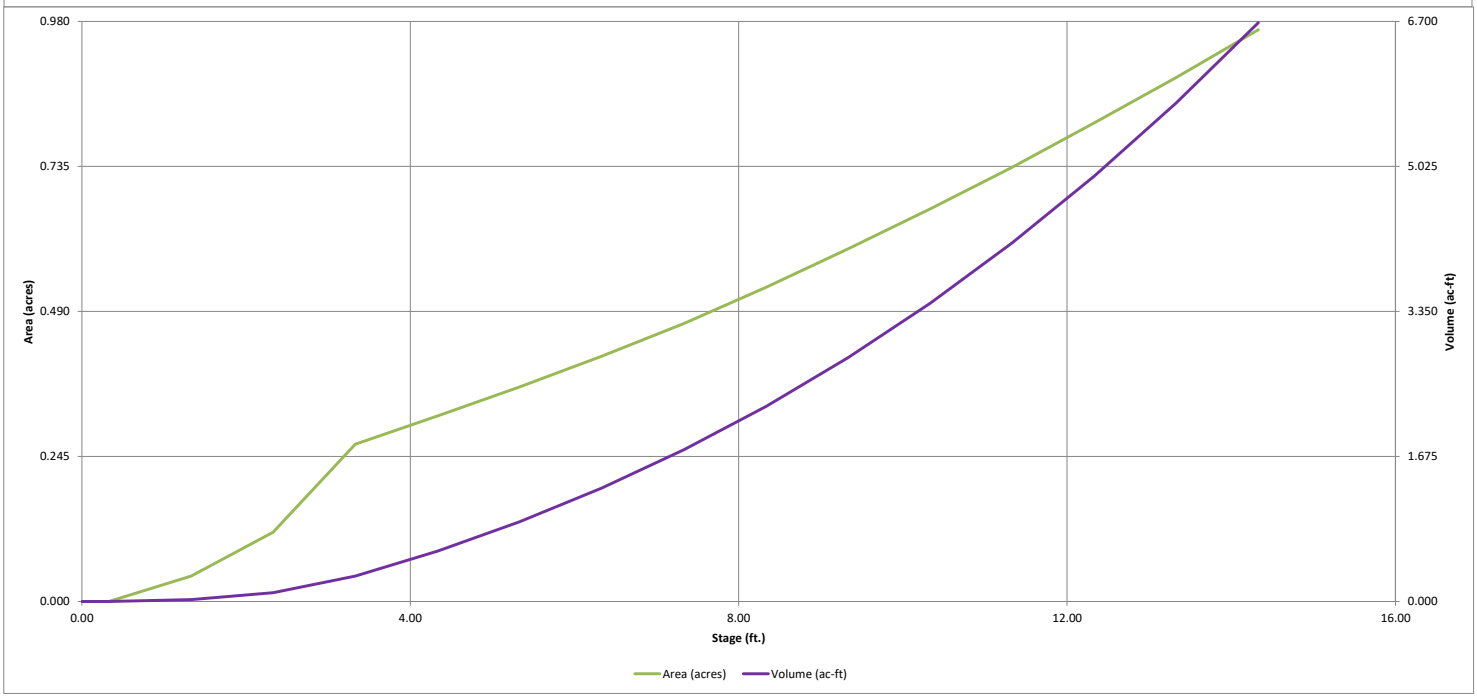
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
6338	--	0.33	--	--	--	1	0.000	0	0.000
6339	--	1.33	--	--	--	1,869	0.043	935	0.021
6340	--	2.33	--	--	--	5,099	0.117	4,419	0.101
6341	--	3.33	--	--	--	11,576	0.266	12,757	0.293
6342	--	4.33	--	--	--	13,655	0.313	25,373	0.582
6343	--	5.33	--	--	--	15,783	0.362	40,092	0.920
6344	--	6.33	--	--	--	18,052	0.414	57,010	1.309
6345	--	7.33	--	--	--	20,447	0.469	76,259	1.751
6346	--	8.33	--	--	--	23,120	0.531	98,042	2.251
6347	--	9.33	--	--	--	25,938	0.595	122,571	2.814
6348	--	10.33	--	--	--	28,885	0.663	149,982	3.443
6349	--	11.33	--	--	--	31,957	0.734	180,404	4.141
6350	--	12.33	--	--	--	35,221	0.809	213,993	4.913
6351	--	13.33	--	--	--	38,567	0.885	250,887	5.760
6352	--	14.33	--	--	--	42,074	0.966	291,208	6.685

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



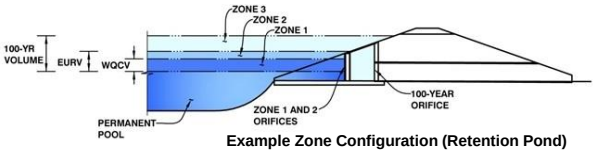


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Canyonside Filing 4**

Basin ID: **Pond B**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.65	0.380	Orifice Plate
Zone 2 (EURV)	5.56	0.622	Rectangular Orifice
Zone 3 (100-year)	7.96	1.053	Weir&Pipe (Restrict)
Total (all zones)		2.054	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.55	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.00	inches
Orifice Plate: Orifice Area per Row =	0.60	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.167E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60	2.40	3.20			
Orifice Area (sq. inches)	0.60	0.60	0.60	0.60	0.60			

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.55	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.200	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	4.00	N/A	inches
Vertical Orifice Width =	4.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.11	N/A	ft^2
Vertical Orifice Centroid =	0.17	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.2	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.20	N/A	feet
Overflow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.94	N/A	
Overflow Grate Open Area w/o Debris =	11.48	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.74	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.65	N/A	ft^2
Outlet Orifice Centroid =	0.60	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.61	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	14.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	50.00	H:V
Freeboard above Max Water Surface =	0.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.60	feet
Stage at Top of Freeboard =	15.10	feet
Basin Area at Top of Freeboard =	0.97	acres
Basin Volume at Top of Freeboard =	6.69	acre-ft

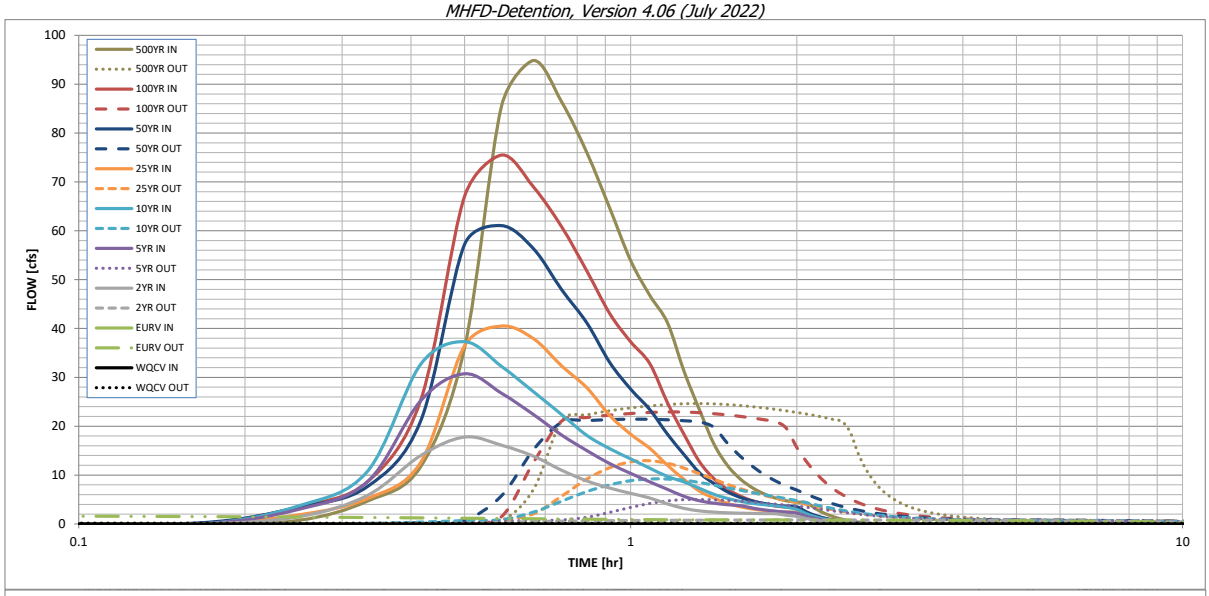
Routed Hydrograph Results

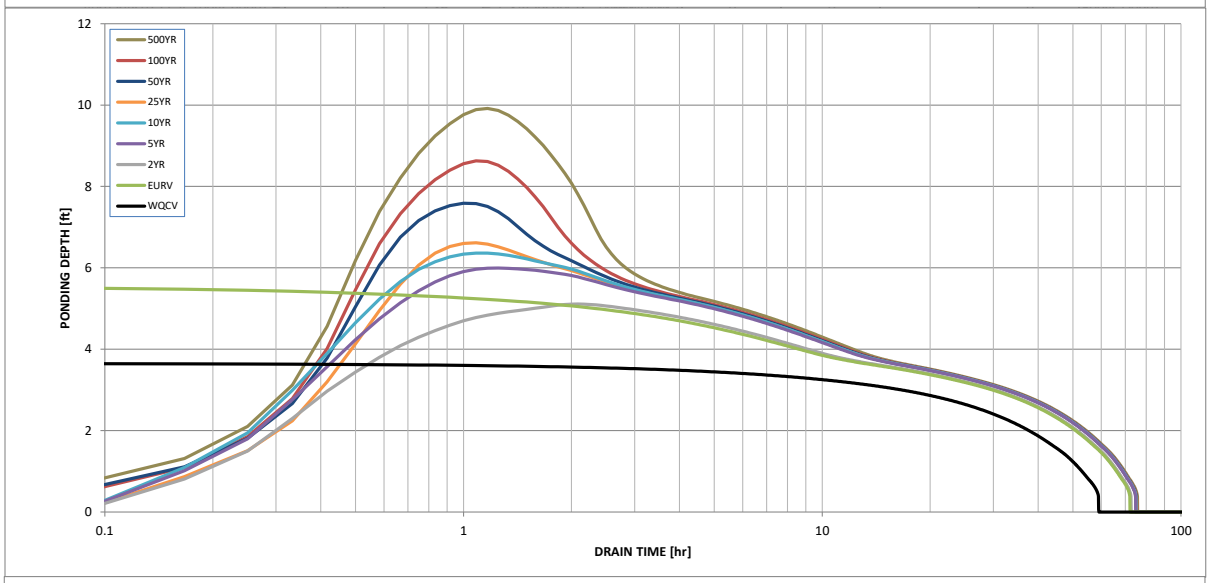
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

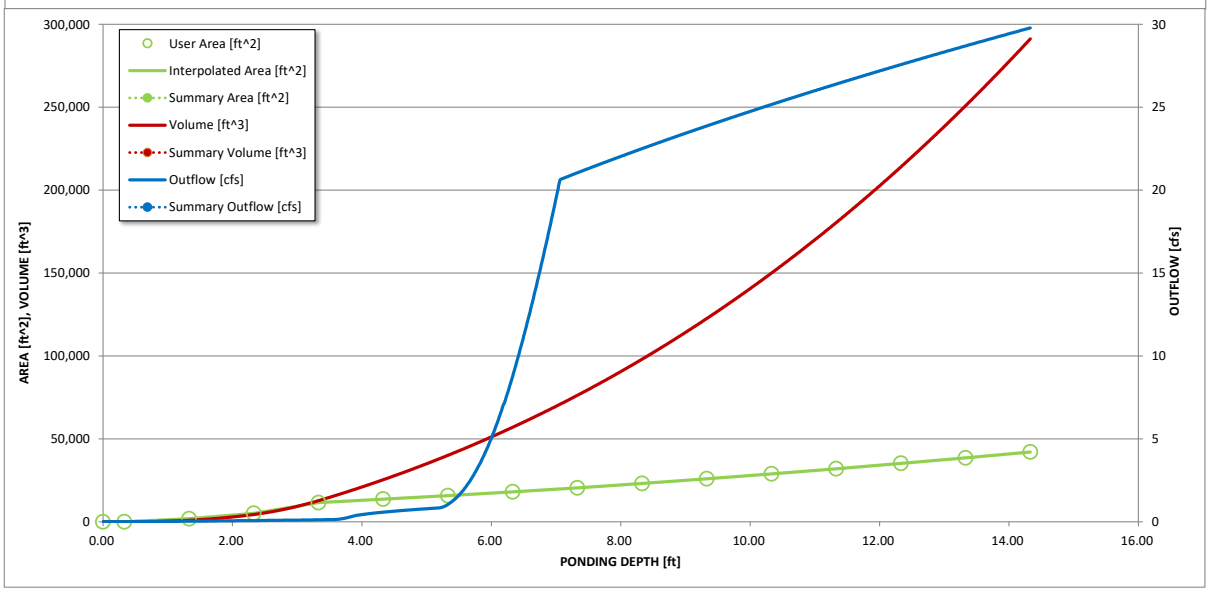
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.69	2.26	2.60	3.14
CUHP Runoff Volume (acre-ft) =	0.380	1.002	0.947	1.573	1.997	2.132	3.238	3.985	5.063
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.947	1.573	1.997	2.132	3.238	3.985	5.063
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.1	11.4	15.9	20.0	34.5	44.1	57.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.49	0.68	0.85	1.47	1.88	2.46
Peak Inflow Q (cfs) =	N/A	N/A	17.8	30.7	37.3	40.5	61.1	75.5	94.8
Peak Outflow Q (cfs) =	0.2	1.8	0.8	5.0	9.2	12.9	21.4	22.9	24.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.6	0.6	0.52	0.4
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	0.08	N/A	0.3	0.7	1.0	1.8	1.9	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	52	59	60	58	55	54	49	45	41
Time to Drain 99% of Inflow Volume (hours) =	**56**	66	67	67	65	65	62	60	58
Maximum Ponding Depth (ft) =	3.65	5.56	5.11	6.00	6.36	6.62	7.59	8.63	9.92
Area at Maximum Ponding Depth (acres) =	0.28	0.37	0.35	0.40	0.42	0.43	0.48	0.55	0.63
Maximum Volume Stored (acre-ft) =	0.380	1.005	0.842	1.171	1.321	1.427	1.870	2.413	3.171

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.11	0.73
	0:15:00	0.00	0.00	1.47	2.97	3.68	1.85	3.38	3.48	4.65
	0:20:00	0.00	0.00	5.82	8.61	10.73	5.19	7.63	8.61	11.76
	0:25:00	0.00	0.00	14.01	25.24	32.71	12.63	21.14	25.38	35.97
	0:30:00	0.00	0.00	17.78	30.73	37.30	36.43	57.18	67.01	85.44
	0:35:00	0.00	0.00	16.11	26.76	32.26	40.49	61.06	75.49	94.85
	0:40:00	0.00	0.00	13.87	22.39	27.06	37.92	56.33	68.97	86.37
	0:45:00	0.00	0.00	10.99	18.19	22.38	32.34	47.94	60.80	75.96
	0:50:00	0.00	0.00	8.80	15.00	18.10	27.85	41.12	51.74	64.61
	0:55:00	0.00	0.00	7.34	12.34	15.40	22.18	33.03	43.03	53.90
	1:00:00	0.00	0.00	6.26	10.35	13.32	18.37	27.60	37.29	46.76
	1:05:00	0.00	0.00	5.31	8.60	11.40	15.47	23.39	32.80	41.12
	1:10:00	0.00	0.00	4.09	7.07	9.71	11.98	18.34	24.75	31.18
	1:15:00	0.00	0.00	3.18	5.64	8.59	9.09	14.16	18.29	23.30
	1:20:00	0.00	0.00	2.67	4.74	7.28	6.69	10.45	12.70	16.29
	1:25:00	0.00	0.00	2.42	4.25	6.05	5.29	8.25	9.22	11.88
	1:30:00	0.00	0.00	2.28	3.93	5.20	4.19	6.53	7.05	9.11
	1:35:00	0.00	0.00	2.21	3.73	4.61	3.50	5.39	5.66	7.32
	1:40:00	0.00	0.00	2.15	3.23	4.20	3.04	4.65	4.71	6.09
	1:45:00	0.00	0.00	2.11	2.87	3.92	2.75	4.16	4.07	5.27
	1:50:00	0.00	0.00	2.08	2.61	3.71	2.55	3.83	3.65	4.73
	1:55:00	0.00	0.00	1.78	2.42	3.41	2.44	3.62	3.45	4.46
	2:00:00	0.00	0.00	1.56	2.21	2.98	2.37	3.51	3.37	4.35
	2:05:00	0.00	0.00	1.10	1.56	2.07	1.67	2.45	2.37	3.06
	2:10:00	0.00	0.00	0.76	1.07	1.43	1.15	1.69	1.65	2.13
	2:15:00	0.00	0.00	0.52	0.72	0.98	0.79	1.16	1.14	1.46
	2:20:00	0.00	0.00	0.34	0.47	0.65	0.53	0.77	0.75	0.97
	2:25:00	0.00	0.00	0.22	0.30	0.42	0.34	0.50	0.49	0.63
	2:30:00	0.00	0.00	0.13	0.19	0.26	0.22	0.32	0.31	0.40
	2:35:00	0.00	0.00	0.07	0.11	0.14	0.13	0.18	0.17	0.22
	2:40:00	0.00	0.00	0.03	0.05	0.06	0.06	0.08	0.08	0.10
	2:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 4 2025

Pond B Emergency Overflow Weir 2x100-year Inflow

Drop Grate Inlet

Location	=	Sag
Curb Length (ft)	=	-0-
Throat Height (in)	=	-0-
Grate Area (sqft)	=	36.00
Grate Width (ft)	=	3.00
Grate Length (ft)	=	12.00

Gutter

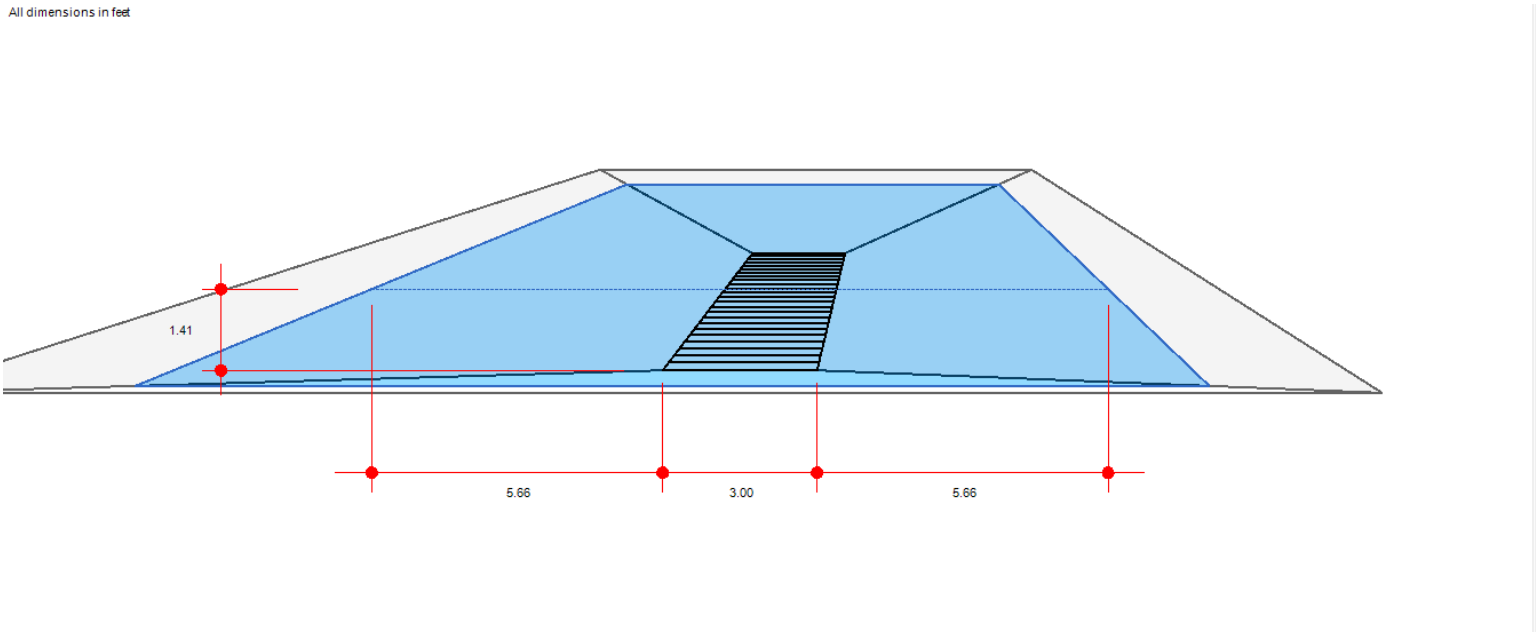
Slope, Sw (ft/ft)	=	0.250
Slope, Sx (ft/ft)	=	0.250
Local Depr (in)	=	-0-
Gutter Width (ft)	=	3.00
Gutter Slope (%)	=	-0-
Gutter n-value	=	-0-

Calculations

Compute by:		Known Q
Q (cfs)	=	151.40

Highlighted

Q Total (cfs)	=	151.40
Q Capt (cfs)	=	151.40
Q Bypass (cfs)	=	-0-
Depth at Inlet (in)	=	16.98
Efficiency (%)	=	100
Gutter Spread (ft)	=	14.32
Gutter Vel (ft/s)	=	-0-
Bypass Spread (ft)	=	-0-
Bypass Depth (in)	=	-0-



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Mar 17 2025

Emergency Overflow Weir - 5-year Inflow Pipe Capacity Calculation

Circular

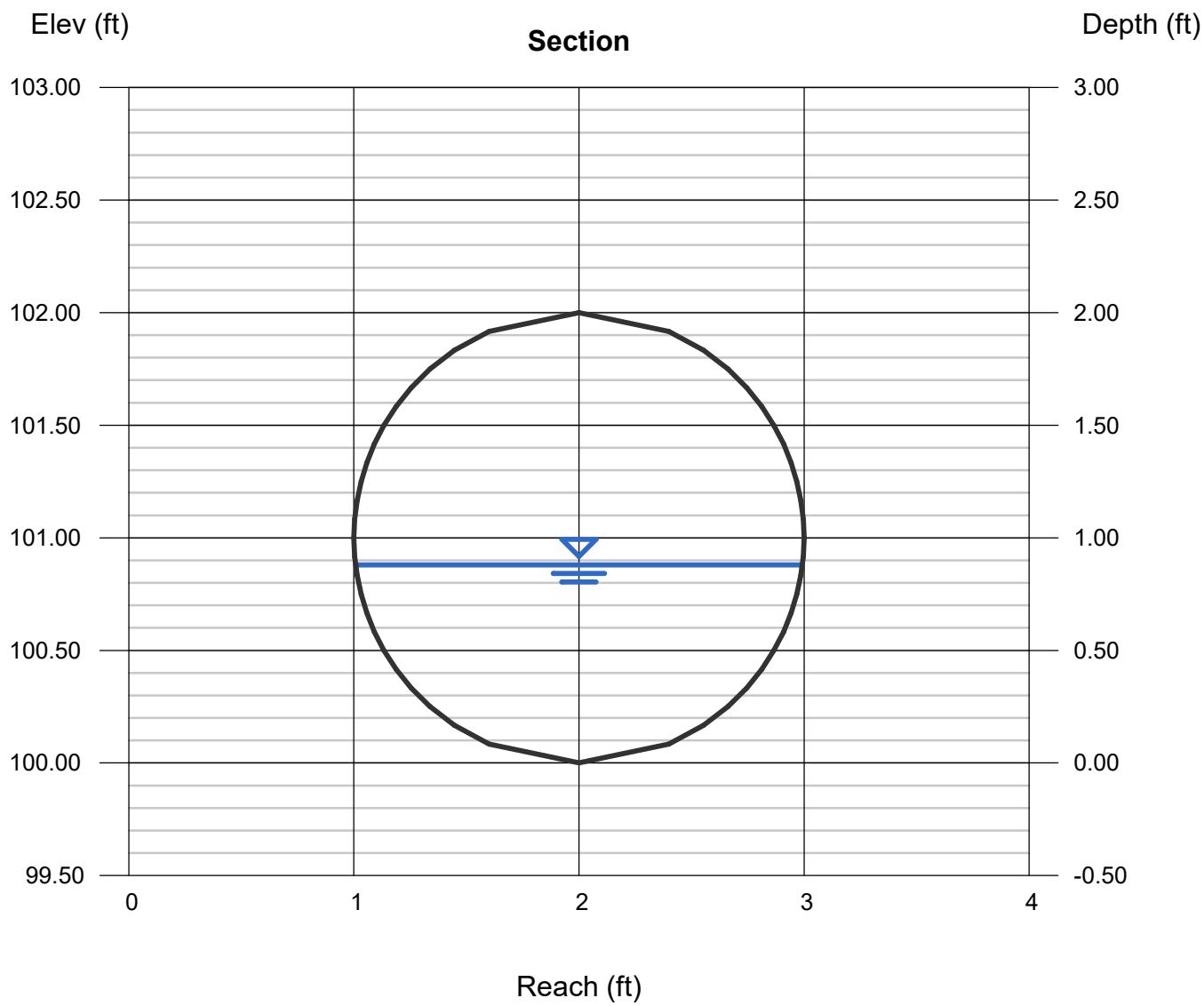
Diameter (ft)	=	2.00
Invert Elev (ft)	=	100.00
Slope (%)	=	11.58
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	30.70

Highlighted

Depth (ft)	=	0.88
Q (cfs)	=	30.70
Area (sqft)	=	1.34
Velocity (ft/s)	=	22.91
Wetted Perim (ft)	=	2.91
Crit Depth, Yc (ft)	=	1.88
Top Width (ft)	=	1.99
EGL (ft)	=	9.04



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Mar 17 2025

Emergency Overflow Weir - 100-year Inflow Pipe Capacity Calculation

Circular

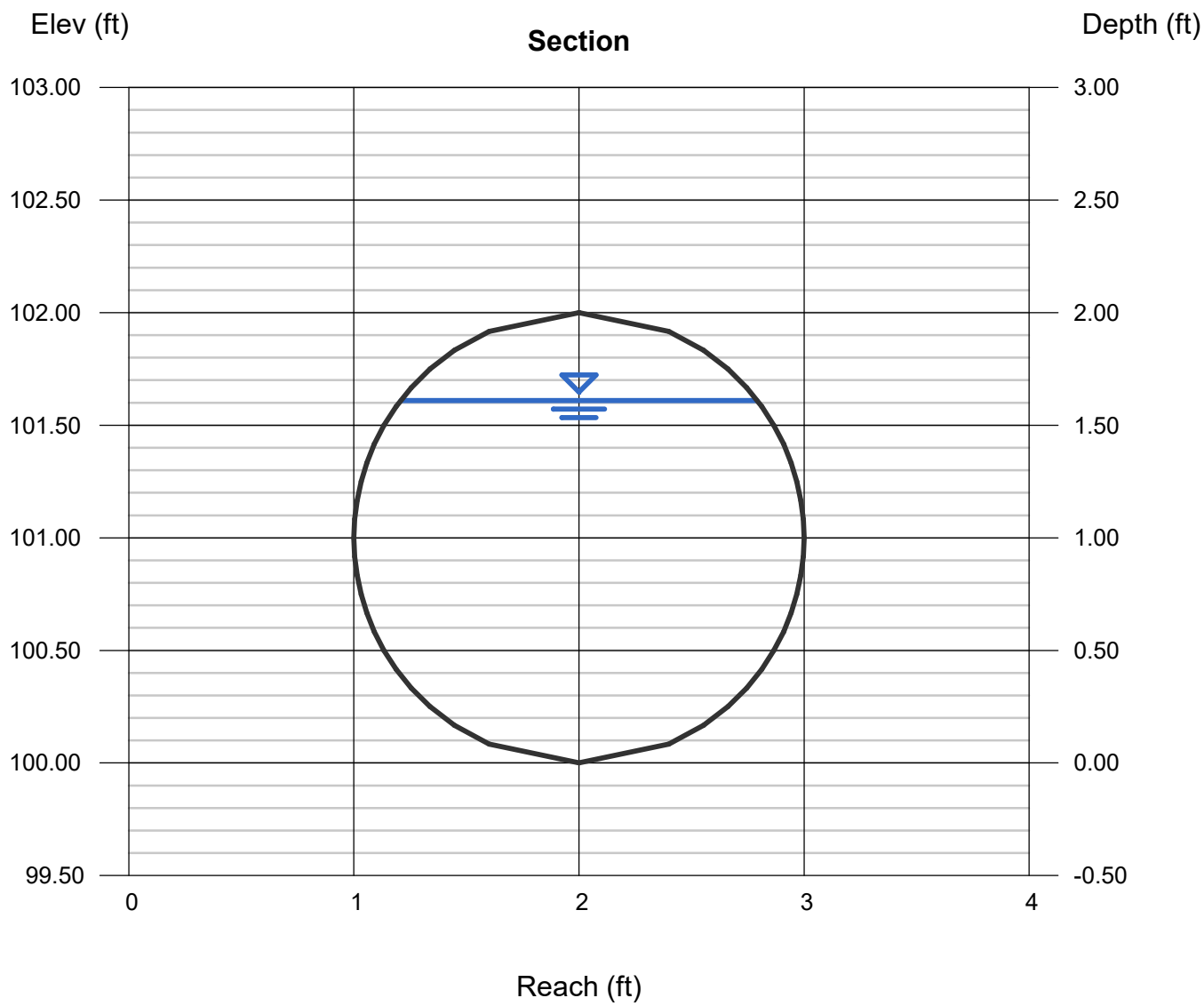
Diameter (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 11.58
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 75.50

Highlighted

Depth (ft)	= 1.61
Q (cfs)	= 75.50
Area (sqft)	= 2.71
Velocity (ft/s)	= 27.82
Wetted Perim (ft)	= 4.46
Crit Depth, Yc (ft)	= 2.00
Top Width (ft)	= 1.58
EGL (ft)	= 13.64



Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**BAB**
Company:	**Terracina Design**
Date:	**February 21, 2024**
Project:	**Canyonside Filing 4**
Location:	**Pond B - NW Forebay**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 24.7 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.247

C) Contributing Watershed Area — Area = 5.520 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = in

E) Design Concept
(Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN}= 0.062 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$ — $V_{DESIGN\ OTHER}$= ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$= ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 1% of the WQCV) — V_{FMIN} = 0.001 ac-ft

B) Actual Forebay Volume — V_F = ac-ft

C) Forebay Depth
(D_F = 12 inch maximum) — D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 19.12 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$) — Q_F = 0.38 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = in

G) Rectangular Notch Width — Calculated W_N = 3.8 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: BAB
Company: Terracina Design
Date: February 21, 2024
Project: Canyonside Filing 4
Location: Pond B - NW Forebay

6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◯ Concrete ◯ Soft Bottom
F) Slope of Trickle Channel	S = [ ] ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = [ ] ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = [ ] sq ft
C) Outlet Type	Choose One: ◯ Orifice Plate ◯ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = [ ] inches
E) Total Outlet Area	A_{ot} = [ ] square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = [ ] in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = [ ] cu ft
C) Initial Surcharge Provided Above Micropool	V_s= [ ] cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = [ ] square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	[ ]
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio = [ ]
D) Total Water Quality Screen Area (based on screen type)	A_{total} = [ ] sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= [ ] feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= [ ] inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = [ ] inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: BAB
Company: Terracina Design
Date: February 21, 2024
Project: Canyonside Filing 4
Location: Pond B - NW Forebay

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Ze = ____ ft / ft
11. Vegetation	Choose One ○ Irrigated ○ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**BAB**
Company:	**Terracina Design**
Date:	**February 21, 2024**
Project:	**Canyonside Filing 4**
Location:	**Pond B - SE Forebay**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 78.1 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.781

C) Contributing Watershed Area — Area = 11.775 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = in

E) Design Concept
(Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$) — V_{DESIGN}= 0.311 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$= ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$= ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.009 ac-ft

B) Actual Forebay Volume — V_F = ac-ft

C) Forebay Depth
(D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 78.21 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$) — Q_F = 1.56 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = in

G) Rectangular Notch Width — Calculated W_N = 6.7 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**BAB**
Company:	**Terracina Design**
Date:	**February 21, 2024**
Project:	**Canyonside Filing 4**
Location:	**Pond B - SE Forebay**

6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ◯ Concrete ◯ Soft Bottom
F) Slope of Trickle Channel	S = [ ] ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = [ ] ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = [ ] sq ft
C) Outlet Type	Choose One: ◯ Orifice Plate ◯ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = [ ] inches
E) Total Outlet Area	A_{ot} = [ ] square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = [ ] in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 41 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= [ ] cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = [ ] square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio = [ ]
D) Total Water Quality Screen Area (based on screen type)	A_{total} = [ ] sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= [ ] feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= [ ] inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = [ ] inches

Design Procedure Form: Extended Detention Basin (EDB)

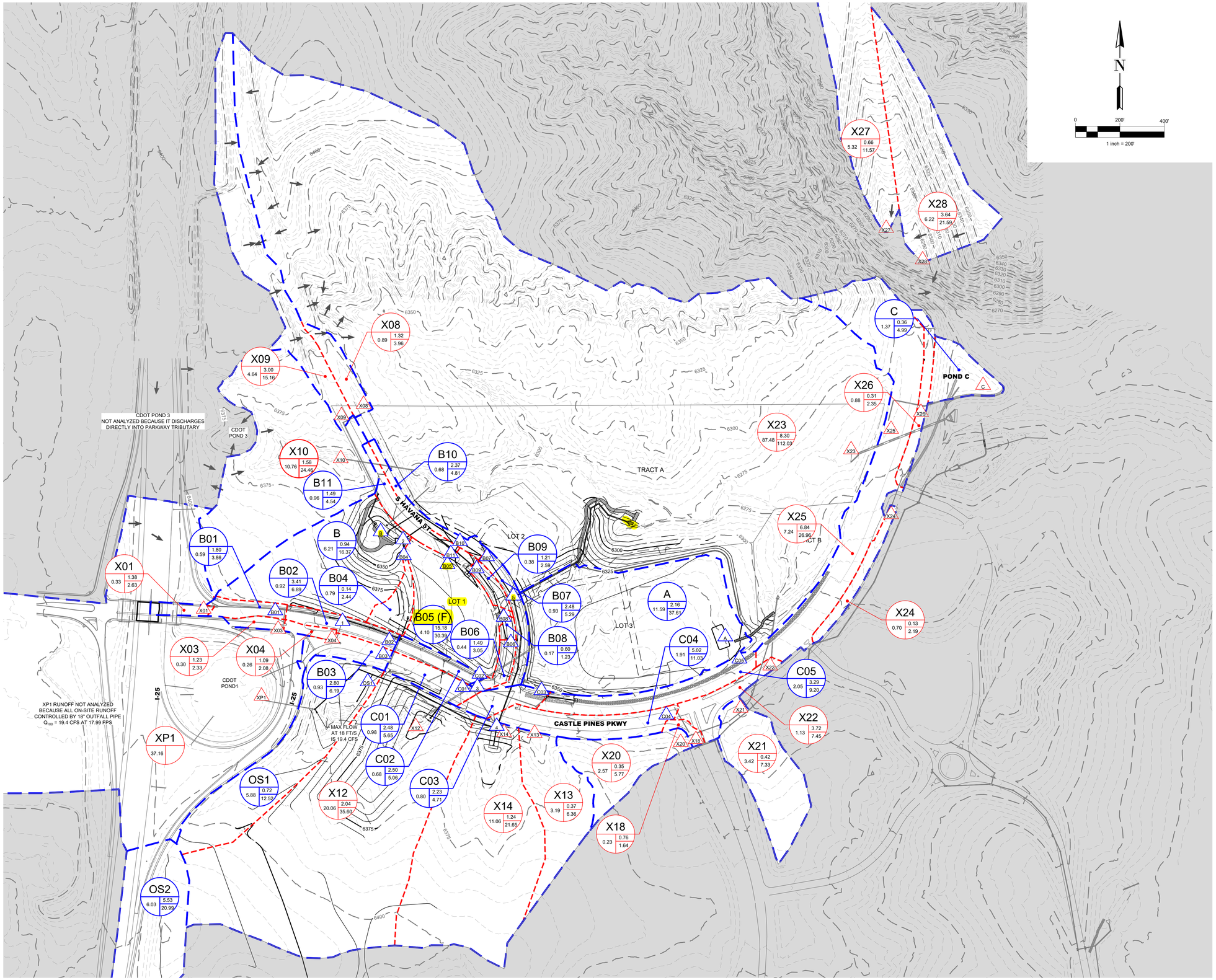
Designer: BAB
Company: Terracina Design
Date: February 21, 2024
Project: Canyonside Filing 4
Location: Pond B - SE Forebay

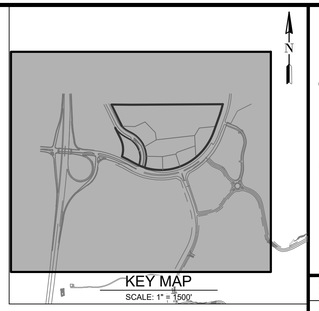
10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Ze = ft / ft
11. Vegetation	Choose One ○ Irrigated ○ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	

Notes:

APPENDIX E
DRAINAGE MAPS

Existing Drainage Maps
Proposed Drainage Maps





LEGEND

- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR DRAINAGE BASIN
- PROPOSED MINOR DRAINAGE BASIN
- STORM (FES, MH, & INLET) — EXISTING / PROPOSED
- EX-1 (AREA X.XX (AC)) / PR-1 (AREA X.XX (AC)) — BASIN DESIGNATION
- 0.XX — MINOR RUNOFF (CFS)
- 0.XX — MAJOR RUNOFF (CFS)
- DIRECTIONAL FLOW ARROW
- EX-1 / PR-1 — DESIGN POINT
- EMERGENCY OVERFLOW ROUTE

Runoff Summary Table

Design Point	Basin ID	Basin Area	5-Year Runoff (CFS)	100-Year Runoff (CFS)
A	A	11.59	2.16	37.61
B01	B01	0.59	1.80	3.86
B02	B02	0.92	3.41	6.89
B03	B03	0.93	2.80	6.19
B04	B04	0.79	0.14	2.44
B05 (I)	B05 (I)	4.10	1.34	14.71
B05 (F)	B05 (F)	4.10	15.18	30.39
B06	B06	0.44	1.49	3.05
B07	B07	0.93	2.48	5.29
B08	B08	0.17	0.60	1.23
B09	B09	0.38	1.21	2.59
B10	B10	0.68	2.37	4.81
B11	B11	0.96	1.49	4.54
B	B	6.21	0.94	16.37
C01	C01	0.98	2.48	5.65
C02	C02	0.68	2.50	5.06
C03	C03	0.80	2.23	4.71
C04	C04	1.91	5.02	11.03
C05	C05	2.05	3.29	9.20
C	C	1.37	0.36	4.99
OS1	OS1	5.88	0.72	12.52
OS2	OS2	6.03	5.53	20.99
X01	X01	0.33	1.38	2.63
X03	X03	0.30	1.23	2.33
X04	X04	0.26	1.09	2.08
X08	X08	0.89	1.32	3.96
X09	X09	4.64	3.00	15.16
X10	X10	10.76	1.58	24.46
X12	X12	20.06	2.04	35.60
X13	X13	3.19	0.37	6.36
X14	X14	11.06	1.24	21.65
X18	X18	0.23	0.76	1.64
X20	X20	2.57	0.35	5.77
X21	X21	3.42	0.42	7.33
X22	X22	1.13	3.72	7.45
X23	X23	87.48	8.30	112.03
X24	X24	0.70	0.13	2.19
X25	X25	7.24	6.84	26.96
X26	X26	0.88	0.31	2.35
X27	X27	5.32	0.66	11.57
X28	X28	6.22	3.64	21.59
XP1	XP1	37.16		

NOTES:

1) SOME BASINS WERE ASSESSED UNDER INTERIM AND FINAL CONDITIONS. THE CONDITIONS ARE NOTED IN THE BASIN ID WITH (I) INDICATING INTERIM CONDITIONS AND (F) INDICATING FINAL CONDITIONS.

terracina design
10200 E. Girard Ave, A-314
Denver, CO 80231
ph: 303.632.8867

#	REVISION DESCRIPTION	DATE	BY
1	1ST SUBMITTAL	12/07/2023	BAB
2	2ND SUBMITTAL	03/15/2024	BAB

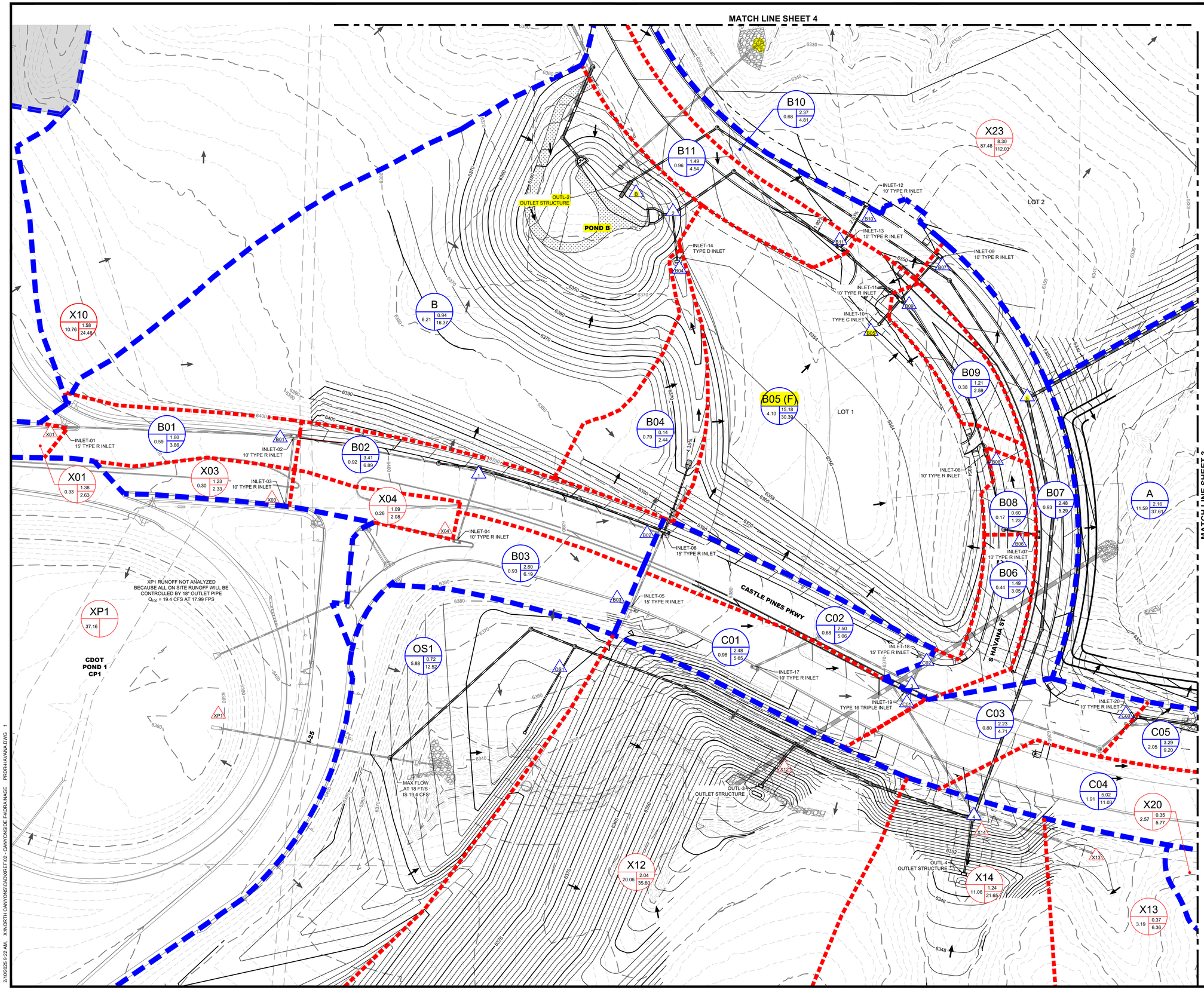
NOT FOR CONSTRUCTION

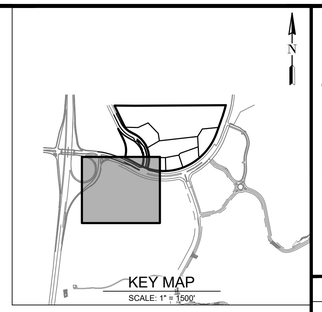
CANYONSIDE
CITY OF CASTLE PINES, COLORADO
PROPOSED DRAINAGE BASIN MAP
OVERALL PROPOSED DRAINAGE MAP

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

SHEET 1 OF 5

2/10/2025 9:22 AM X:\NORTH CANYONS\CAD\XREF\02_CANYONSIDE FI\DRAINAGE PRDR-HAVANA OVERALL.DWG 1





N

0 60' 120'

1 inch = 60'

LEGEND

4880	PROPOSED MAJOR CONTOUR
4879	PROPOSED MINOR CONTOUR
4880	EXISTING MAJOR CONTOUR
4879	EXISTING MINOR CONTOUR
	PROPOSED MAJOR DRAINAGE BASIN
	PROPOSED MINOR DRAINAGE BASIN
EXISTING / PROPOSED	STORM (FES, MH, & INLET)
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AREA X.XX (AC) / 0.XX 0.XX	MINOR RUNOFF (CFS) / MAJOR RUNOFF (CFS)
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CANYONSIDE
CITY OF CASTLE PINES, COLORADO
PROPOSED DRAINAGE BASIN MAP
PROPOSED DRAINAGE MAPS (1 OF 4)

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

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