EPC STORMWATER REVIEW COMMENTS IN ORANGE BOXES WITH BLACK TEXT

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Final Drainage Report
The Rock Commerce Center

Prepared for:

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Signature Page

The Rock Commerce Center

Design Engineer's Statement

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

SIGNATURE (Affix Seal) : ____ 10/20/23
Colorado P.E. No. 33123 Date

Developer's Statement

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

____ ______________
[Jeremy Records, Principal] Date
[Central Development LLC]
[1660 S Albion St, Suite 200
Denver, CO 80222]

El Paso County

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

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

Conditions:

Table of Contents

General Location and Description

Introduction

The purpose of this Final Drainage Report is to identify on-site and off-site drainage patterns, storm sewer, inlet locations, areas tributary to the site, and to safely route the developed flows to the proposed full spectrum pond. Analyses for the proposed drainage patterns and requirements for the proposed The Rock Commerce Center development, hereafter referred to as the Site, are presented in the appendices of this Report.

Site Location

The Site is located on unplatted land in the Northwest Quarter of Section 11, Township 11 South, Range 67 West of the 6th Principal Meridian, El Paso County, Colorado. The site is bordered on the west side by Monument Hill Road and I-25, Palmer Ridge High School to the north and west, and 18950 Base Camp Road to the south, see Appendix A. The site will have two connections onto Monument Hill Road and one connection to the southeast to Base Camp Road.

Description of Property

The Site encompasses approximately 11.61 acres and is currently undeveloped. The project area was determined by an ALTA/NSPS Land Title Survey conducted by Aztec Consultants Inc. dated 02/23/2023. This survey can be seen in Appendix A of this report. Native grasses and weeds currently cover the site with a few small trees. The site generally falls north to south but has a ridge running diagonally from the northwest corner toward Monument Hill Road splitting the site north and south. The northern section of site slopes at about 12% from west to east. The middle of the site slopes at about 4% from the northeast to the southwest. The southern section of site slopes at about 4% from the west to east.

The property is proposed to include a 164,166 SF commercial warehouse/showroom with associated parking, sidewalks, drive aisles, and landscaping. The building will be located in the middle of the site running north to south parallel to Monument Hill Road. The total disturbed area is 12.30 acres. The disturbed area is greater than the project area due to offsite improvements and grading required for Monument Hill Road. There will also be some offsite improvements required to create an access to Base Camp Road.

The Site is located within the Crystal Creek Drainage Basin which outfalls to Monument Lake per the *El Paso County Drainage Basin Map (DBMP), prepared by the Board of Commissioners, El Paso County, dated 2005*.

There are no existing irrigation facilities on the Site.

There is an existing 18” RCP storm sewer located near the northwest corner of the Site located in a roadside swale next to Monument Hill Road This storm sewer crosses Monument Hill Road and ties into a 42” storm sewer which flows under I-25 to outfall west of I-25. An existing and outfalls into the I-25 right of way where it then enters another storm sewer that outfalls to the west of I-25.

The property lies within the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panel 08041C0276G dated December 18, 2018. Based on a review of the FIRM panel, the Site is located within Flood Zone X which is designated as an area determined to be outside the 0.2% (500-year) annual chance floodplain (see Appendix A).

The NRCS soil survey indicates that the soil on site is primarily Tomah-Crowfoot loamy sands and Tomah-Crowfoot complex, whose hydrologic soil group is Type B. A soil map has been included in the appendix for reference.

Drainage Basins and Subbasins

Existing Major Basin Description

The Site is located within the Crystal Creek Drainage Basin. The Crystal Creek Basin outfalls to Monument Lake. The Site is included in the *Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, dated September 1993*. *The Final Drainage Report for Palmer Ridge High School*, *prepared by Tetra Tech, dated July 3, 2007* (PRHS Report) also includes a small portion of the site. Both of these previous drainage reports focus primarily on the flows entering and flowing through Crystal Creek. The flows from the site flow west crossing under I-25 before flowing southwest in an undefined channel towards Crystal Creek and eventually Monument Lake.

Existing Subbasin Description

The Site currently is made up of three existing basins that are all part of the Crystal Creek Drainage Basin. Basin A is the north basin that is 2.35 acres and drains east to west to an existing 18” storm sewer at Design Point A that eventually outfalls west of I-25. Basin A has a total surface runoff of 1.5 cfs in the 10-year event and 4.6 cfs in the 100-year event at Design Point A. These flows are the total basin flows from Basin A, not the routed flows at Design Point A. Basin B is the largest existing basin with 7.40 acres flowing northeast to southwest into an existing 24” storm sewer at Design Point B. This existing storm sewer outfalls on the west side of Monument Hill Road where the flow enters another storm sewer to eventually outfall west of I-25. Basin B has a total surface runoff of 3.7 cfs in the 10 -year event and 11.4 cfs in the 100-year event at Design Point B. These flows are the total basin flows from Basin B, not the routed flows at Design Point B. Both Basin A and B flow in an undefined channel on the west side of I-25 to the southwest until eventually making it to Monument Lake. Basin C is the south basin on the site with 1.86 acres flowing east to southwest. Basin C has a total surface runoff of 1.1 cfs in the 10-year event and 3.4 cfs in the 100-year event at Design Point C. These flows are the total basin flows from Basin C, not the routed flows at Design Point C. The runoff from this basin currently enters a roadside ditch on the east side of Monument Hill Road where it flows south away from the site to eventually enter Crystal Creek. An Existing Conditions Map is included in Appendix E.

There are four existing off-site basins that currently flow onto the site or into the Monument Hill Road swale adjacent to the Site. Basin OSA1 is a west portion of the Palmer Ridge High School that includes the school's west entrance and a detention pond. Basin OSA1 is 0.75 acres and flows northeast to southwest where it enters the existing 24" storm sewer at Design Point A. The flow from Basin OSA1 at Design Point A is 2.0 cfs in the 10-year event and 3.4 cfs in the 100-year event. These flows are the total basin flows from Basin OSA1, not the routed flows at Design Point A. Basin EP1 represents Detention Pond B from the PRHS Report. According to the PRHS Report the 100-year release rate from the existing pond is 35.33 cfs at Design Point A. Basin OSB1 is a southwest portion of the Palmer Ridge High School that includes field, lawn, and parts of the school's track. Basin OSB1 is 1.14 acres and flows east to west on to the Site. The runoff then flows through Basin B until it reaches the existing 24" storm sewer at Design Point B. The flow generated from Basin OSB1 at Design Point B is 0.8 cfs in the 10-year event and 2.5 cfs in the 100-year event. These flows are the total basin flows from Basin OSB1, not the routed flows at Design Point B. Basin OSB2 is the east half section of Monument Hill Road and its road side ditch. Basin OSB2 is 0.76 acres and flows east to west into the road side ditch then south towards Design Point B. The runoff then flows through the existing 24" storm sewer at Design Point B. The flow generated from Basin OSB2 at Design Point B is 1.5 cfs in the 10-year event and 2.6 cfs in the 100-year event. These flows are the total basin flows from Basin OSB2, not the routed flows at Design Point B. The largest existing offsite basin is Basin OSC1 at 1.91 acres. Basin OSC1 is the southwest corner of the Palmer Ridge High School and includes field, lawn, and parts of the school's track. Basin OSC1 flows northeast to southwest flowing through Basin C until it reaches the roadside ditch next to Monument Hill Road at Design Point C. The flow generated from Basin OSC1 is 1.0 cfs in the 10-year event and 3.0 cfs in the 100-year event. These flows are the total basin flows from Basin OSC1, not the routed flows at Design Point C.

After routing flows from off-site and on-site basins through the Standard SF form for the 10-year and 100-year storm events the existing drainage values were found:

Design Point A has a combined 3.07 cfs for the 10-year event from Basins A1 and Basin OSA1. Design Point A has a combined 7.27 cfs for the 100-year event from Basins A1 and Basin OSA1. The Existing Pond B from the Lewis Palmer Ridge High School Drainage Report has an emergency overflow that is tributary to Design Point A. Assuming the outlet structure is completely clogged Design Point A would receive an extra 35.33 cfs.

Design Point B has a combined 5.53 cfs for the 10-year event from Basins B1 and Basin OSB1. Design Point B has a combined 15.26 cfs for the 100-year event from Basins B1 and Basin OSB1.

Design Point C has a combined 1.97 cfs for the 10-year event from Basins C1 and Basin OSC1. Design Point C has a combined 6.02 cfs for the 100-year event from Basins C1 and Basin OSC1.

Drainage Design Criteria

This Report has been prepared in accordance with the *El Paso County Drainage Criteria Manual Volume 1 & 2 October 2018*. Supplemental information is taken from the *Mile High Flood District Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3*.

Water Quality is required to be provided on the site and the developed 100-year release rate is 90% of the predeveloped flow from the Site. Existing storm sewers are located in the northwest and southwest corners of the site within drainage easements. The pond sizing and outlet design was done through the Mile High Flood District Detention v4-06 spreadsheet. A tributary area table is provided in Appendix B. The table shows that the area on-site the is tributary to the pond is 10.98 acres at 77% imperviousness. The Full Spectrum Pond will also accept water from 5 off-site basins for a total of 3.2 acres. The Full Spectrum Pond was sized for the full site of 11.38 acres. The Full Spectrum Pond is over detaining runoff to offset the runoff not detained on-site. The pond is not sized to detain the additional runoff from the off-site basins but the emergency overflow is sized to be able to pass the developed 100-year runoff plus the additional off-site runoff. The outlet of the proposed full spectrum pond is planned to discharge into the existing roadside ditch and enter the existing 24" storm sewer near the southwest of the Site. The full spectrum pond will be designed so the release of the 100-year runoff will be restricted to a release rate equal to or less than 90% of the predeveloped runoff. It was estimated that the predeveloped 10-year runoff to be 4.0 cfs and the 100-year runoff to be 11.7 cfs. For the purpose of this Report, the 100-year storm event will be released from the pond at a rate of 10.4 cfs. The release rate of 10.4 cfs was chosen since it is 88.9% of the predeveloped runoff.

The hydrologic design was computed using the Rational Method as defined by El Paso County Drainage Criteria Manual. The 10-year storm was used as the minor storm event, while the 100-year storm was used as the major event. The one-hour point rainfall depth used for the 10-year storm was 1.75 inches and 2.52 inches for the 100-year event. The Rational Method was used to analyze fully developed conditions. Hydraulic grade lines were calculated using Haestead's StormCadd and are attached in the appendices. On-site detention includes a full spectrum detention pond with water quality control volume, excess urban runoff volume, and the 100-year flood volume. The 100-year release is required to be less than 10.4 cfs. Inlets were sized using the UD-Inlet_V4.06 spreadsheet. The full spectrum pond was sized using the MHFD-Detention _v4.06 spreadsheet.

Runoff/Proposed Basin Description

Major Basins

The Site in its development condition includes 3 primary Basins described as Basins A, B, and C. The Proposed Drainage Map in included in Appendix E. Basin B is the largest basin with 10.58 acres on-site plus an additional 3.88 acres of an off-site basin tributary to it. Basin B consists of 30 on-site basins and 8 off-site basins. The on-site basins are numbered B1 through B30 and the off-site basins are numbered OSB1 through OSB8. Basin A has 0.12

acres on-site plus an additional 0.71 acres of an off-site tributary to it. Basin C has 0.11 acres on-site and no off-site basins.

Sub-Basins

Basin A1 (0.09 Acres):

Basin A1 represents the northwest edge of the Site and includes the portion of the roadside ditch along Monument Hill Road that is located on the site. Basin A1 is tributary to the existing 18" storm sewer located in the northwest of the Site and discharges under Monument Hill Road and to the west side of I-25. This Basin has an overall imperviousness of 0%. This Basin it not tributary to the proposed full spectrum pond. Water quality is not required for this basin because under exclusion I.7.1.B.7 the land is undeveloped and will remain undeveloped.

C_{10} = 0.15 C_{100} = 0.35

Q_{10} = 0.1 CFS Q_{100} = 0.2 CFS

Basin OSA1 (0.71 Acres)

Basin OSA1 consists of a portion of the Palmer Ridge High School site and the east half section of Monument Hill Road. This basin all flows to the road side ditch and is tributary to the northwest existing storm sewer. This Basin has an overall imperviousness of 63%.

C_{10} = 0.64 C_{100} = 0.74

Q_{10} = 2.4 CFS Q_{100} = 4.0 CFS

The combined Basin A 100-year overland routed runoff of 3.51 CFS discharges to the existing 18" storm sewer at Design Point A and will not be routed through the proposed full spectrum pond.

Basin B1 (0.53 Acres)

Basin B1 consists of parking lot, sidewalk, and landscape islands located to the west of proposed Building. It will also receive the water from a portion of the roof in basin B16. The grades of this Basin generally slope at 3% and 4%. Runoff will sheet flow to a 2-foot concrete drainage pan where the concentrated flow will be collected in a Triple Type 13 Inlet at Design Point 1 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 64%. Emergency overflow from this Basin will route to the next downstream Sub-basin, B2.

C_{10} = 0.64 C_{100} = 0.74

Q_{10} = 2.0 CFS Q_{100} = 3.4 CFS

Basin B2 (0.48 Acres)

Basin B2 consists of parking lot, sidewalk, and landscape islands located to the west of proposed Building B. It will also receive the water from a portion of the roof in basins B17 and B18. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 2-foot concrete drainage pan where the concentrated flow will be collected in a Triple Type 13 Inlet at Design Point 2 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 73%.

C_{10} = 0.71 C_{100} = 0.80

Q_{10} = 2.0 CFS Q_{100} = 3.2 CFS

Basin B3 (0.30 Acres)

Basin B3 consists of parking lot, sidewalk, and landscape islands located to the west of the proposed building. This basin also includes the north entrance into the site. It will also receive the water from a portion of the roof in basin B19 and the off-site basin OSB7. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow away from the proposed building to the curb and gutter on the west side. The concentrated flow will be then be conveyed through a curb chase at Design Point 3 and conveyed to the next downstream basin, B4. This Basin has an overall imperviousness of 95%.

C_{10} = 0.88 C_{100} = 0.93

Q_{10} = 1.6 CFS Q_{100} = 2.4 CFS

Basin B4 (0.19 Acres)

Basin B4 consists of parking lot, sidewalk, and landscape islands located to the west of the proposed building. It will also receive the water from a portion of the roof in basin B20. The grades of this Basin generally slope at 3%. Runoff will sheet flow away from the proposed building to the curb and gutter on the west side. The concentrated flow will be then be conveyed to a 10' Type R Inlet at Design Point 4 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 100%.

C_{10} = 0.92 C_{100} = 0.96

Q_{10} = 1.0 CFS Q_{100} = 1.5 CFS

Basin B5 (0.40 Acres)

Basin B5 consists of parking lot, sidewalk, and landscape islands located to the west and south of the proposed building. It will also receive the water from a portion of the roof in basin B21. The grades of this Basin generally slope at 3% and 7%. Runoff will sheet flow away from the proposed building to the curb and gutter on the west side. The concentrated flow will be then be conveyed to a Single Type 13 Combo Inlet at Design Point 5 and conveyed to the proposed Full spectrum pond via storm sewer. This Basin has an overall imperviousness of 82%. Emergency overflow from this Basin will overtop of curb and enter the proposed full spectrum pond.

C_{10} = 0.78 C_{100} = 0.85

Q_{10} = 1.8 CFS Q_{100} = 2.9 CFS

Basin B6 (0.31 Acres)

Basin B6 consists of parking lot, sidewalk, landscape islands, and landscape buffer located to the north of proposed Building. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 2-foot concrete drainage pan where the concentrated flow will be collected in a Single Type 13 Inlet at Design Point 6 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 68%.

C_{10} = 0.68 C_{100} = 0.77

Q_{10} = 1.2 CFS Q_{100} = 2.0 CFS

Basin B7 (0.40 Acres)

Basin B7 consists of parking lot, sidewalk, landscape islands, and landscape buffer located to the north of proposed Building. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 2-foot concrete drainage pan where the concentrated flow will be collected in a Single Type 13 Inlet at Design Point 7 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 58%. Emergency overflow from this Basin will route to the next downstream Basin, B6.

C_{10} = 0.60 C_{100} = 0.70

Q_{10} = 1.4 CFS Q_{100} = 2.4 CFS

Basin B8 (0.98 Acres)

Basin B8 consists of loading dock and landscape islands located to the east of proposed Building. It will also receive the water from a portion of the roof in basin B22. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 10-foot concrete drainage pan where the concentrated flow will be collected in a Double Type 13 Inlet at Design Point 8 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 68%.

C_{10} = 0.68 C_{100} = 0.77

Q_{10} = 3.9 CFS Q_{100} = 6.4 CFS

Basin B9 (0.59 Acres)

Basin B9 consists of loading dock and landscape islands located to the east of proposed Building. It will also receive the water from a portion of the roof in basin B23. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 10-foot concrete drainage pan where the concentrated flow will be collected in a on grade Single Type 13 Inlet at Design Point 9 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 71%. Emergency overflow from this Basin will route to the next downstream Basin, B10.

C_{10} = 0.70 C_{100} = 0.78

Q_{10} = 2.4 CFS Q_{100} = 3.9 CFS

Basin B10 (0.67 Acres)

Basin B10 consists of loading dock located to the east of proposed Building. It will also receive the water from the offsite basin OSB1 and a portion of the roof in basin B24. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a 10-foot concrete drainage pan where the concentrated flow will be collected in a Triple Type 13 Inlet at Design Point 10 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 83%.

C_{10} = 0.79 C_{100} = 0.85

Q_{10}= 3.1 CFS Q_{100} = 4.9 CFS

Basin B11 (0.37 Acres)

Basin B11 consists of loading dock and landscape islands located to the east of proposed Building. It will also receive the water from the off-site basin OSB2 and a portion of the roof in basin B25. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a curb and gutter on the west side of the drive aisle where the concentrated flow will be collected in a 5' Type R Inlet at Design Point 11 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 74%.

C_{10} = 0.72 C_{100} = 0.80

Q_{10} = 1.6 CFS Q_{100} = 2.5 CFS

Basin B12 (0.75 Acres)

Basin B12 consists of loading dock located to the east of proposed Building. It will also receive the water from the off-site basin OSB3 and a portion of the roof in basin B26. The grades of this Basin generally slope between 3% to 5%. Runoff will sheet flow to a curb and gutter on the east side of the drive aisle where the concentrated flow will be collected in an on-grade Triple Type 13 Combo Inlet at Design Point 12 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 89%. Emergency overflow from this Basin will route to the next downstream Basin, B13.

C_{10} = 0.83 C_{100} = 0.89

Q_{10} = 3.6 CFS Q_{100} = 5.6 CFS

Basin B13 (0.43 Acres)

Basin B13 consists of loading dock and landscaping located to the east and south of proposed Building. It will also receive the water from the off-site basin OSB4 and a portion of the roof in basin B27. The grades of this Basin generally slope between 3% to 7%. Runoff will sheet flow to a curb and gutter on the west side of the drive aisle where the concentrated flow will be collected in a 10' Type R Inlet at Design Point 13 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 81%. Emergency overflow from this Basin will route to the next downstream Basin, B14.

$C_{10} = 0.77$ $C_{100} = 0.84$

$Q_{10} = 2.0$ CFS $Q_{100} = 3.1$ CFS

Basin B14 (0.08 Acres)

Basin B14 consists of drive aisle and landscape islands located to the south of proposed Building. The grades of this Basin generally slope between 3% to 7%. Runoff will sheet flow to a curb and gutter where the concentrated flow will be collected in a Single Type 13 Combo Inlet at Design Point 14 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 87%.

$C_{10} = 0.82$ $C_{100} = 0.88$

$Q_{10} = 0.4$ CFS $Q_{100} = 0.6$ CFS

Basin B15 (0.11 Acres)

Basin B15 consists of a loading dock area and landscape islands located to the east of proposed Building. It will also receive the water from the off-site basin OSB5. The grades of this Basin generally slope between 4% to 8%. Runoff will sheet flow to a curb and gutter on the north side of the entrance drive where the concentrated flow will be collected in a on grade Triple Type 13 Combo Inlet at Design Point 15 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 97%.

$C_{10} = 0.90$ $C_{100} = 0.94$

$Q_{10} = 0.6$ CFS $Q_{100} = 0.9$ CFS

Basin B16 (0.30 Acres)

Basin B16 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B1. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B17 (0.30 Acres)

Basin B17 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B2. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B18 (0.30 Acres)

Basin B18 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B2. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B19 (0.30 Acres)

Basin B19 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B3. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B20 (0.30 Acres)

Basin B20 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B4. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B21 (0.30 Acres)

Basin B21 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to grade through a drainage chase located on the west side of proposed Building into Basin B5. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B22 (0.42 Acres)

Basin B22 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B8. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.8CFS Q_{100} = 2.9 CFS

Basin B23 (0.36 Acres)

Basin B23 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B9. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.6 CFS Q_{100} = 2.5 CFS

Basin B24 (0.30 Acres)

Basin B24 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B10. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.0 CFS

Basin B25 (0.30 Acres)

Basin B25 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B11. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.84

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B26 (0.30 Acres)

Basin B26 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B12. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B27 (0.30 Acres)

Basin B27 consists of a portion of the proposed roof. The slope of the rooftop is 2.5% and runoff will sheet flow to a roof drain. Runoff will then discharge to the east side of proposed Building into Basin B13. This Basin has an overall imperviousness of 90%.

C_{10} = 0.75 C_{100} = 0.81

Q_{10} = 1.3 CFS Q_{100} = 2.1 CFS

Basin B28 (0.06 Acres)

Basin B28 consists of a portion of the roadside ditch next to Monument Hill Road that is on site. The grades of this Basin generally slope between 4% to 15%. Runoff will sheet flow to roadside ditch where the concentrated flow will be conveyed under the north entrance to the south half of the roadside ditch via an 18" culvert at design point RC1. This Basin has an overall imperviousness of 0%. This Basin it not tributary to the proposed full spectrum pond. Water quality is not required for this basin because under exclusion I.7.1.B.7 the land is undeveloped and will remain undeveloped.

$C_{10} = 0.15$ $C_{100} = 0.35$

$Q_{10} = 0.0$ CFS $Q_{100} = 0.1$ CFS

Basin B29 (0.38 Acres)

Basin B29 consists of a portion of the roadside ditch next to Monument Hill Road and landscaping. The grades of this Basin generally slope between 4% to 33%. Runoff will sheet flow to the Monument Hill Road roadside ditch where the concentrated flow will be collected by the existing southwest 24" storm sewer at design point B. It will then be conveyed to the west side of I-25 via the existing storm sewer. This Basin has an overall imperviousness of 0%. This Basin it not tributary to the proposed full spectrum pond. Water quality is not required for this basin because under exclusion I.7.1.B.7 the land is undeveloped and will remain undeveloped.

$C_{10} = 0.15$ $C_{100} = 0.35$

$Q_{10} = 0.2$ CFS $Q_{100} = 0.8$ CFS

Basin B30 (0.61 Acres)

Basin B30 consists of the proposed full spectrum pond that include lawn and the gravel access road. The sides of the full spectrum pond will be 33% except for the access road that is a max of 10%. The runoff will sheet flow down to the trickle channel where the concentrated flow will then flow west to the outlet structure. This basin has an overall imperviousness of 3%.

$C_{10} = 0.08$ $C_{100} = 0.44$

$Q_{10} = 0.3$ CFS $Q_{100} = 1.9$ CFS

Basin B31 (0.02 Acres)

Basin B31 consists of road at the central entrance of the site along Monument Hill Road. The basin will drain northeast to southwest into the curb at the south side of the entrance. The concentrated gutter flow will then discharge into the road side ditch and flow to Design Point B. This basin has an overall imperviousness of 100%. This Basin it not tributary to the proposed full spectrum pond. Water quality is not required for this basin because under exclusion I.7.1.C.1 that allows for 20%, not to exceed 1 acre, of the development to not be captured for water quality.

$C_{10} = 0.87$ $C_{100} = 0.90$

$Q_{10} = 0.1$ CFS $Q_{100} = 0.1$ CFS

Basin OSB1 (0.08 Acres)

Basin OSB1 consists of lawn and field on the west edge of the Palmer Ridge School Site. The grades of this Basin generally slope between 6% to 8%. Runoff will sheet flow to the southwest onto the site and enter the curb and gutter in basin B10. Where the concentrated flow will be collected in a Triple Type 13 Inlet at Design Point 10 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 0%.

$C_{10} = 0.15$ $C_{100} = 0.35$

$Q_{10} = 0.1$ CFS $Q_{100} = 0.2$ CFS

Basin OSB2 (0.34 Acres)

Basin OSB2 consists of lawn, field, and a portion of the school's track on the west edge of the Palmer Ridge School Site. The grades of this Basin generally slope between 1% to 12%. Runoff will sheet flow to the west onto the site and enter the curb and gutter in basin B11. Where the concentrated flow will be collected in a 5' Type R Inlet at Design Point 11 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 0%.

$C_{10} = 0.15$ $C_{100} = 0.35$

$Q_{10} = 0.2$ CFS $Q_{100} = 0.8$ CFS

Basin OSB3 (0.78 Acres)

Basin OSB3 consists of lawn, field, and a portion of the school's track on the west edge of the Palmer Ridge School Site. The grades of this Basin generally slope between 1% to 25%. Runoff will sheet flow to the west onto the site and enter the curb and gutter in basin B12. Where the concentrated flow will be collected in a Triple Type 13 Combo Inlet at Design Point 12 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 0%.

C_{10} = 0.15 C_{100} = 0.35

Q_{10} = 0.6 CFS Q_{100} = 1.9 CFS

Basin OSB4 (1.88 Acres)

Basin OSB4 consists of lawn, field, and a portion of the school's track on the west edge of the Palmer Ridge School Site. The grades of this Basin generally slope between 1% to 25%. Runoff will sheet flow to the west onto the site and enter the curb and gutter in basin B13. Where the concentrated flow will be collected in a 10' Type R Inlet at Design Point 13 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 0%.

C_{10} = 0.15 C_{100} = 0.35

Q_{10} = 1.1 CFS Q_{100} = 3.7 CFS

Basin OSB5 (0.06 Acres)

Basin OSB5 consists of landscaping, parking lot, and drive aisle between the site and Case Camp Road to the southeast. The grades of this Basin generally slope between 3% to 7%. Runoff will sheet flow to the northwest onto the site and enter the curb and gutter in basin B15. Where the concentrated flow will be collected in a 5' Type R Inlet at Design Point 15 and conveyed to the proposed full spectrum pond via storm sewer. This Basin has an overall imperviousness of 71%.

C_{10} = 0.70 C_{100} = 0.78

Q_{10} = 0.2 CFS Q_{100} = 0.4 CFS

Basin OSB6 (0.21 Acres)

Basin OSB6 consists of a half section of Monument Hill Road and a portion of the roadside ditch to the west of the site. The grades of this Basin generally slope between 2% to 20%. Runoff will sheet flow to the southeast and enter the roadside ditch. Where the concentrated flow will be conveyed under the north entrance of the site to the south half of the roadside ditch, via an 18” culvert at Design Point RC1. This Basin has an overall imperviousness of 49%. This basin it not tributary to the proposed full spectrum pond.

C_{10} = 0.53 C_{100} = 0.65

Q_{10} = 0.6 CFS Q_{100} = 1.0 CFS

Basin OSB7 (0.05 Acres)

Basin OSB7 consists of a half section of Monument Hill Road and the north connection to the site. The grades of this Basin generally slope between 2% to 4%. Runoff will sheet flow to the southeast enter the site through the north entrance. The sheet flow will be collected in the curb and gutter in Basin B3. This Basin has an overall imperviousness of 100%.

C_{10} = 0.92 C_{100} = 0.96

Q_{10} = 0.3 CFS Q_{100} = 0.4 CFS

Basin OSB8 (0.47 Acres)

Basin OSB8 consists of a half section of Monument Hill Road and a portion of the roadside ditch to the west of the site. The grades of this Basin generally slope between 2% to 33%. Runoff will sheet flow to the southeast and enter the roadside ditch. Where the concentrated flow will be collected by the existing southwest 24” storm sewer at design point B. It will then be conveyed to the west side of I-25 via the existing storm sewer. This Basin has an overall imperviousness of 65%. This Basin it not tributary to the proposed full spectrum pond.

C_{10} = 0.65 C_{100} = 0.75

Q_{10} = 1.6 CFS Q_{100} = 2.7 CFS

The combined Basin B 100-year runoff of 54.14 cfs that discharges to the proposed full spectrum pond at Design Point O-1 and 1.31 cfs at Design Point O-2. Basins B28 and B29 combine with Basins OSB6 and OSB8 in the roadside ditch adjacent to Monument Hill Road to discharge into the existing 24” storm sewer at Design Point B. The previously mentioned basins have a combined 100-year runoff of 4.29 cfs that enters the roadside ditch without being routed through the full spectrum pond. This flow of 4.29 cfs then combines with the

100-year release from the full spectrum pond of 10.4 cfs and enters the 24” existing storm sewer at Design Point B. Since, the full spectrum pond delays the release on the 100-year event, the peak flow at Design Point B is 10.4 cfs.

Basin C1 (0.22 Acres):

Basin C1 represents the southwest edge of the site and includes the south entrance road. Basin C1 will sheet flow south to enter the Monument Hill Road roadside ditch that runs south from the site. This Basin has an overall imperviousness of 80%. Water quality is not required for this basin because under exclusion I.7.1.C.1 that allows for 20%, not to exceed 1 acres, of the development to not be captured for water quality.

C_{10} = 0.76 C_{100} = 0.84

Q_{10} = 1.0 CFS Q_{100} = 1.6 CFS

Basin C has a total 100-year runoff of 1.6 cfs that discharges to the existing roadside ditch next to Monument Hill Road without being routed through the proposed full spectrum pond.

Under exclusion I.7.1.B.7 the project is allowed to have 20%, not to exceed 1 acre of development to not be captured and treated for water quality. There are 5 on-site basin that are not captured and treated that sum to 0.77 acres. These basins are Basins A1, B28, B29, B31, and C1.

The proposed drainage design will decrease 100-year flows going to the existing storm sewer at Design Point A from 7.27 cfs to 3.51 cfs. With the restriction of the outflows from the proposed full spectrum pond, the 100-year flows at Design Point B will decrease from 15.26 cfs to 10.4 cfs. It will decrease the 100-year flows entering the roadside ditch next to Monument Hill Road at Design Point C from 6.02 cfs to 1.6 cfs. These values and calculations can be found in Appendix B in the Existing and Developed SF Form Tables. The proposed Site will not have an adverse impact on existing downstream conveyance systems.

Stormwater Detention and Water Quality Design

Runoff from the Site will surface flow and be piped to a full spectrum pond located near the southwest corner of the Site. The full spectrum pond has been sized using the MHFD-Detention_v4.06 spreadsheet to meet the El Paso County Drainage Criteria Manual Standards. The full spectrum pond has been sized to provide Water Quality Control Volume (WQCV), Excess Urban Runoff Volume (EURV) and 100-year flood protection for the developed Site. The full spectrum pond has been sized for 11.4 acres with a watershed imperviousness of 77%. The area that is tributary to the pond is 10.98 acres however, 11.4 acres was used to size the pond to over detain stormwater on the site. This was done offset the stormwater that is not being detained on-site. The full spectrum pond is approximately 80 feet by 230 feet in size. Runoff enters the full spectrum pond via a forebay at the east end of the pond, Forebay O-1, and an 18” FES at about the midpoint of the south side of the pond, Design Point O-2. Forebay O-1 notch was calculated at 5.7 inches wide to release at 1.08 cfs. The calculation for Forebay O-1 were made using the UD-BMP v3.07 from Mile High Flood District. The required WQCV is 0.294 ac-ft. The micropool water surface elevation and outlet pipe are at a water surface elevation of 7134.23. The WQCV provided is 0.294 ac-ft at an elevation of 7137.55. The WQCV is drained through an orifice plate that has four 1-1/4" diameter with 23" between the bottom two holes and 15" spacing for the top two holes. The 99% drain time for the WQCV is 40 hours. The EURV storage provided by the full spectrum pond is 0.675 ac-ft at an elevation of 7140.11. The EURV will be drained from the full spectrum pond through the same orifice plate as the WQCV. In the 100-year storm event, runoff overtops the overflow weir and is released through an 18" storm sewer with a restrictor plate. The restrictor plate will be 8.5 inches above the invert of the 18" pipe. An additional 0.518 ac-ft volume is provided in the full spectrum pond for the release of the 100-year runoff. The 100-year runoff will pond to an elevation of 7141.64 and will discharge at a maximum of 10.4 cfs into the roadside ditch next to Monument Hill Road The 99% drain time of the 100-year volume is 76 hours. A concrete emergency spillway is provided on the west side of the full spectrum pond. The spillway crest length is 20 feet with an invert elevation of 7142.00. The spillway end slopes are 5H:1V. The emergency spillway discharges into the roadside ditch next to Monument Hill Road The spillway was over sized to allow the flows from offsite to be bypassed over the spillway in the 100-year event. The full spectrum pond calculations are included in Appendix C.

A 15' wide maintenance access road is provided to the outlet structure of the proposed full spectrum pond.

The County of El Paso requires the UDFCD Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the WQCV, stabilizing drainageways, and implementing long-term source controls. The four steps and how they are implemented into the proposed design is below:

1) Step one is Employ Runoff Reduction Practices.
   - The existing roadside ditch on the west side of the site are being conserved and landscaping islands are being used. With the grades on site, there are no more opportunities to implement Runoff Reduction Practices.

2) Step two is Stabilize Drainage Ways.
   - No stream is located within the vicinity of this project so step three does not apply. Stormwater runoff from the Site is being provided water quality treatment and discharged into a storm sewer system rather than flowing directly into the Monument Hill Road roadside ditch. The Monument Hill Road roadside ditch is located on the west property line. This project will benefit the Monument Hill Road roadside ditch by reducing the amount of sediment tributary to the ditch from the Site and by improving the embankment and running slope of the ditch.

3) Step three is Provide a Water Quality Capture Volume.
   - Water Quality Capture Volume is provided in the full spectrum pond and is released over a period of 40 hours. Which lowers the peak flow at the existing storm sewer in the Monument Hill Road roadside ditch.

4) Step four is Identify Best Management Practices to be used to control industrial and commercial pollutants.
   - All parking, driving aisle, and loading docks drain to the proposed storm sewer system and are discharged into the full spectrum pond. This will remove pollutants from the commercial runoff.

Drainage Fees

The Site will require $23,078 per Impervious Acre for the 2023 Drainage Fee and an additional $1,262 per Impervious Acre for the 2023 Bridge Fee. With 9.04 acres of impervious area, the Site will require a Drainage Fee of $208,625.12. With 9.04 acres of impervious area, the Site will require a Bridge Fee of $11,408.48. The impervious area was determined by add all on-site areas on the SF form that include roof, drive/walk, and gravel road. This calculation can be seen in the table called Impervious Area Table in Appendix B.

$23,078 per Impervious Acre = $23,078*9.04 = $208,625.12
$1,262 per Impervious Acre = $1,262*9.04 = $11,408.48

Erosion Control Plan

A Grading and Erosion Control Plan will be submitted to the County for review and approval prior to construction.

Construction Cost Estimate

Storm sewer and water quality are required for the Site. All drainage and detention facilities are private and non-reimbursable. The storm infrastructure includes RCP storm sewer, inlets and manholes. The full spectrum pond includes an outlet structure and spillway. Below is a cost estimate for the private storm facilities and the full spectrum pond.

Strom Sewer		QUANTITY	UNIT	UNIT PRICE	TOTAL COST
	18" RCP (0-8' depth)	1,150	LF	$50.00	$57,500
	24" RCP (0-8' depth)	1,150	LF	$65.00	$74,750
	36" RCP (0-8' depth)	654	LF	$100.00	$65,400
	5' Dia. Manhole	20	EA	$4,500.00	$90,000
	5' Type 'R' Inlet	2	EA	$4,750.00	$9,500
	6' Dia. Manhole	2	EA	$6,000.00	$12,000
	10' Type 'R' Inlet	1	EA	$6,500.00	$6,500
	18" Flared End Section	4	EA	$1,350.00	$5,400
	Type '13' Inlet	22	EA	$3,500.00	$77,000
	Type 'VL' Rip Rap	1,270	CY	$110.00	$139,700
	Type 'VH' Rip Rap - Spillway	2,400	CY	$100.00	$240,000
	Concrete Drainage Pan	1,255	LF	$5.00	$6,275
	Cutoff Wall - Spillway	10	CY	$1,250.00	$12,500
	Pond Gravel Access Road	4,385	SY	$10.00	$43,850
	Forebay (36"-42" Inlet)	1	EA	$15,000.00	$15,000
	Pond Outlet Structure	1	EA	$15,000.00	$15,000
	Trickle Channel	200	LF	$90.00	$18,000
				Subtotal	**$888,375**
				15% Contingency	**$133,256**
				TOTAL COST	**$1,021,631**

Other Government Agency Requirements

The proposed drainage improvements on The Rock Commerce Center will not require any other agency approval. It is not with the FEMA floodplain so will not require further review or floodplain map revisions. The full spectrum pond's spillway will not need review by the State Engineer's office since it is less than 10' in height at the centerline of the spillway

Conclusion

The proposed drainage improvements on The Rock Commerce Center will have no adverse effects to the surrounding properties, downstream storm conveyance system, or regional drainage facilities. The Site was designed in compliance with the El Paso County Stormwater Criteria. The Site development proposed is in conformance with the approved land use and zoning. This Report and its findings are in conformance with all pertinent studies related to this site. The existing roadside ditches along Monument Hill Road are in stable condition currently. The existing ditch will require new erosion control measures during and post construction. This project will require the regrading of the road side ditches so their current state will be improved. The culvert within the road side ditch running under the proposed access drive will require type VL riprap at its outlet. There will be erosion control blanket placed in the road side ditch north of the culvert but no riprap is required for protection. In the 100-year event the velocity is 1.15 fps within the road side ditch. This velocity is less than the velocities stated in table 10-4. The subcritical flow value is also less than the riprap requirements listed in table 10-6. The two culverts under I-25 currently have permanent inlet protection and new permanent inlet protection is being installed with the public improvement plans submitted with this project. The existing culverts will also be receiving less flow than in the current conditions and the flow capacity calculations are included in Appendix B of this Report.

References

REFERENCES

1. Drainage Criteria Manual Volumes 1 & 2, El Paso County. October 2018.

2. Mile High and Flood District, Denver, Colorado, Urban Storm Drainage Criteria Manual, Volume 1-3, latest online addition.

3. The El Paso County Drainage Basin Map (DBMP), El Paso County Board of Commissioners, 2005

4. Final Drainage Report for Palmer Ridge High School, Monument, Colorado, Tetra Tech, July 3, 2007

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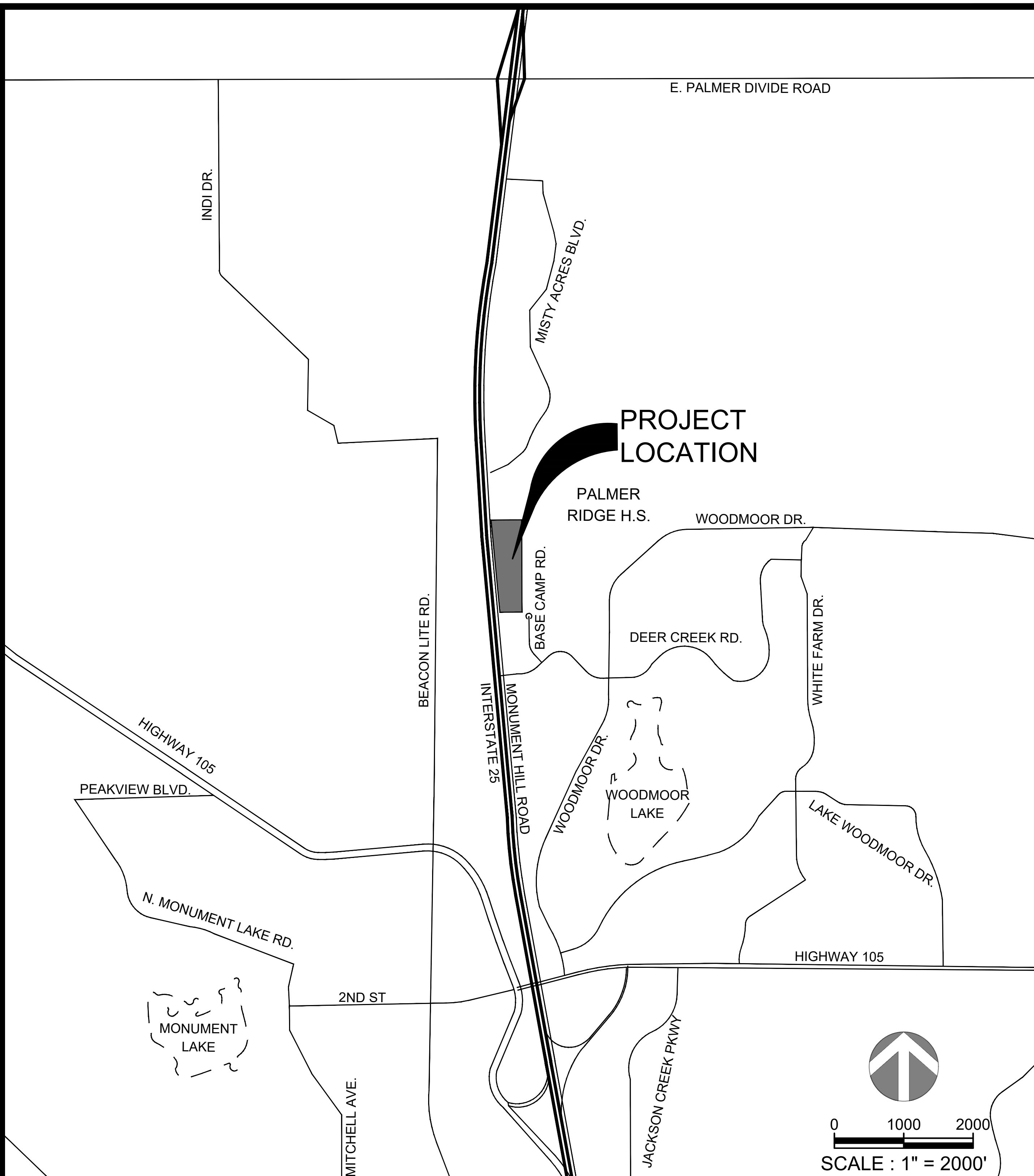
Appendix A - Vicinity Map, FIRM Map, Soils Map



THE ROCK LOT 1 FILING NO. 1

VICINITY MAP

EXHIBIT

15 YEARS Redland
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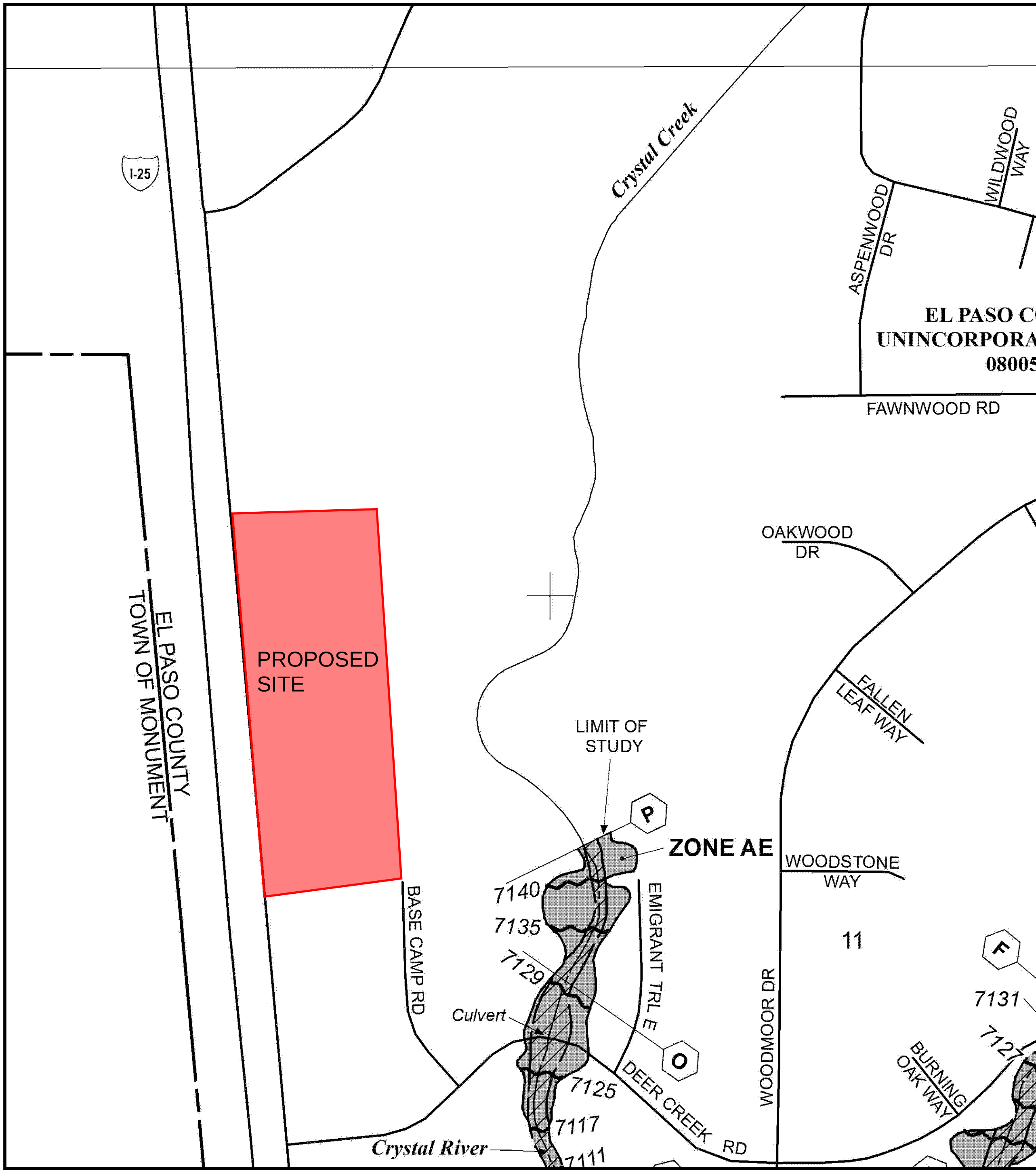
- Land Planning
- Civil Engineering
- Landscape Architecture
- Construction Management

PROJECT NO: 23009.001

DATE: 07/28/2023

DRAWING NO: 1 OF 1

C:\Users\csalz\appdata\local\temp\AcPublish_22880\23009 Vicinity Map.dwg tab: Layout1 Jul 27, 2023 – 4:26pm csalz



MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0276G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 276 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0276	G
MONUMENT, TOWN OF	080064	0276	G
PALMER LAKE, TOWN OF	080065	0276	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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

MAP NUMBER
08041C0276G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

Hydrologic Soil Group—El Paso County Area, Colorado

Map Scale: 1:2,660 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	13.6	93.8%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	0.9	6.2%
Totals for Area of Interest			**14.5**	**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

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Appendix B - Hydrologic Calculation

TOTAL IMPERVIOUS AREA TABLE			
BASIN	DRIVE/WALK (AC)	ROOF (AC)	GRAVEL (AC)
B16	0.00	0.30	0.00
B1	0.34	0.00	0.00
B17	0.00	0.30	0.00
B18	0.00	0.30	0.00
B2	0.35	0.00	0.00
B19	0.00	0.30	0.00
B3	0.29	0.00	0.00
B20	0.00	0.30	0.00
B4	0.19	0.00	0.00
B21	0.00	0.30	0.00
B5	0.33	0.00	0.00
B27	0.00	0.30	0.00
B7	0.23	0.00	0.00
B6	0.21	0.00	0.00
B8	0.67	0.00	0.00
B22	0.00	0.42	0.00
B9	0.42	0.00	0.00
B23	0.00	0.36	0.00
B24	0.00	0.30	0.00
B10	0.56	0.00	0.00
B25	0.00	0.30	0.00
B26	0.00	0.30	0.00
B11	0.27	0.00	0.00
B12	0.66	0.00	0.00
B13	0.35	0.00	0.00
B14	0.07	0.00	0.00
B15	0.11	0.00	0.00
C1	0.18	0.00	0.00
A1	0.00	0.00	0.00
B28	0.00	0.00	0.00
B29	0.00	0.00	0.00
B30	0.00	0.00	0.05
B31	0.02	0.00	0.00
TOTAL	5.23	3.76	0.05
TOTAL IMPERVIOUS AREA:		9.04	

Redland

STANDARD FORM SF-1 - UNDEVELOPED RUNOFF COEFFICIENTS

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/19/2023
JURISDICTION: El Paso

LAND USE:	Drive/Walk	Roof	Lawn	Undeveloped Land	Gravel Road
IMPERVIOUSNESS	100%	90%	0%	2%	40%
C10 VALUES	0.92	0.75	0.15	0.17	0.63
C100 VALUES	0.96	0.81	0.35	0.36	0.7

NRCS SOIL TYPE: TYPE B

OVERALL SITE STUDY AREA

DESIGN BASIN	DESIGN POINT	Drive/Walk (AC)	Roof (AC)	Lawn (AC)	Undeveloped Land (AC)	Gravel Road (AC)	TOTAL AREA (AC)	$C_d(10)$	$C_d(100)$	Imp (%)
A1	A	0.00	0.00	0.00	2.35	0.00	2.35	0.17	0.36	2%
OSA1	A	0.40	0.00	0.00	0.35	0.00	0.75	0.57	0.68	54%
BASIN A		0.40			2.71		3.10			14%
		12.7%			87.3%		100.0%			
B1	B	0.00	0.00	0.00	7.40	0.00	7.40	0.17	0.36	2%
OSB1	B	0.00	0.00	0.00	1.14	0.00	1.14	0.17	0.36	2%
OSB2	B	0.38	0.00	0.00	0.38	0.00	0.76	0.55	0.66	51%
BASIN B		0.38			8.92		9.29			6%
		4.1%			95.9%		100.0%			
C1	C	0.00	0.00	0.00	1.86	0.00	1.86	0.17	0.36	2%
OSC1	C	0.00	0.00	0.00	1.91	0.00	1.91	0.17	0.36	2%
BASIN C					3.77		3.77			2%
					100.0%		100.0%			

STANDARD FORM SF-2 - UNDEVELOPED
TIME OF CONCENTRATION

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/16/2023
JURISDICTION: El Paso

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)						tc CHECK (URBANIZED BASINS)			FINAL Tc	RUNOFF COEFFICIENT	
DESIGN BASIN (1)	AREA (AC) (2)	C_{10} (3)	LENGTH* (FT) (4)	SLOPE (%) (5)	T_i (MINUTES) (6)	LENGTH (FT) (7)	SLOPE (%) (8)	C_v (9)	Land Surface (10)	VEL (FPS) (11)	T_t (MINUTES) (12)	COMP. t_c (13)	TOTAL LENGTH (14)	REGIONAL tc (15)	Min. t_c	C_{10}	C_{100}
A1	2.35	0.17	110	5.0%	10	445	5.0%	5.0	Tillage/Field	1.1	6.6	17.1	555	25.9	17.1	0.17	0.36
OSA1	0.75	0.57	128	3.5%	7.3	192	4.3%	5.0	Tillage/Field	1.0	3.1	10.4	320	17.0	10.4	0.57	0.68
B1	7.40	0.17	197	4.0%	15.1	962	4.4%	5.0	Tillage/Field	1.0	15.3	30.4	1159	26.3	26.3	0.17	0.36
OSB1	1.14	0.17	85	2.0%	12.5	104	16.0%	5.0	Tillage/Field	2.0	0.9	13.3	189	25.7	13.3	0.17	0.36
OSB2	0.76	0.55	100	2.0%	8.1	750	4.1%	5.0	Tillage/Field	1.0	12.3	20.4	850	17.8	17.8	0.55	0.66
C1	1.86	0.17	155	5.0%	12.4	385	3.3%	5.0	Tillage/Field	0.9	7.1	19.5	540	25.9	19.5	0.17	0.36
OSC1	1.91	0.17	165	1.0%	21.9	210	7.0%	5.0	Tillage/Field	1.3	2.6	24.5	375	25.8	24.5	0.17	0.36

Redland

STANDARD FORM SF-3 - UNDEVELOPED
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: The Rock Commerce Center

DATE: 10/16/2023

PROJECT NUMBER: 23009

P_1 (1-Hour Rainfall) = 1.75

JURISDICTION: El Paso

CALCULATED BY: CJS

CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME		
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{10}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
	A	A1	2.4	0.17	17.1	0.4	3.73	1.5	17.09	0.82	3.73	3.07								
	A	OSA1	0.7	0.57	10.4	0.4	4.66	2.0	17.09	0.82	3.73	3.07								
	B	B1	7.4	0.17	26.3	1.3	2.97	3.7	26.27	1.86	2.97	5.53								
	B	OSB1	1.1	0.17	13.3	0.2	4.19	0.8	26.27	1.86	2.97	5.53								
	B	OSB2	0.8	0.55	17.8	0.4	3.66	1.5	26.27	1.86	2.97	5.53								
	C	C1	1.9	0.17	19.5	0.3	3.49	1.1	24.55	0.64	3.08	1.97								
	C	OSC1	1.9	0.17	24.5	0.3	3.08	1.0	24.55	0.64	3.08	1.97								

Redland

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

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

P_1 (1-Hour Rainfall) = 2.52

DATE: 10/16/2023
JURISDICTION: El Paso

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	A	A1	2.4	0.36	17.1	0.8	5.37	4.6	17.09	1.35	5.37	7.27									
	A	OSA1	0.7	0.68	10.4	0.5	6.71	3.4	17.09	1.35	5.37	7.27									
	B	B1	7.4	0.36	26.3	2.7	4.27	11.4	26.27	3.57	4.27	15.26									
	B	OSB1	1.1	0.36	13.3	0.4	6.04	2.5	26.27	3.57	4.27	15.26									
	B	OSB2	0.8	0.66	17.8	0.5	5.27	2.6	26.27	3.57	4.27	15.26									
	C	C1	1.9	0.36	19.5	0.7	5.03	3.4	24.55	1.36	4.44	6.02									
	C	OSC1	1.9	0.36	24.5	0.7	4.44	3.0	24.55	1.36	4.44	6.02									

BASIN SUMMARY - UNDEVELOPED

Redland

PROJECT NAME:	The Rock Commerce Center	DATE:	10/16/2023
PROJECT NUMBER:	23009.000	JURISDICTION:	El Paso
CALCULATED BY:	CJS		
CHECKED BY:	MC		

Basin Summary Table

Basin	Area (AC)	Runoff Coefficients		I (%)	Peak Flows (cfs)	
		C_{10}	C_{100}		Q_{10}	Q_{100}
A1	2.35	0.17	0.36	2%	1.5	4.6
OSA1	0.75	0.57	0.68	54%	2.0	3.4
B1	7.40	0.17	0.36	2%	3.7	11.4
OSB1	1.14	0.17	0.36	2%	0.8	2.5
OSB2	0.76	0.41	0.66	51%	1.5	2.6
C1	1.86	0.17	0.36	2%	1.1	3.4
OSC1	1.91	0.17	0.36	2%	1.0	3.0

STANDARD FORM SF-1 - DEVELOPED RUNOFF COEFFICIENTS

Redland

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/19/2023
JURISDICTION: El Paso

LAND USE:	Drive/Walk	Roof	Lawn	Undeveloped Land	Gravel Road
IMPERVIOUSNESS	100%	90%	0%	2%	40%
C10 VALUES	0.92	0.75	0.15	0.17	0.63
C100 VALUES	0.96	0.81	0.35	0.36	0.7

NRCS SOIL TYPE: TYPE B

OVERALL SITE STUDY AREA

DESIGN BASIN	DESIGN POINT	Drive/Walk (AC)	Roof (AC)	Lawn (AC)	Undeveloped Land (AC)	Gravel Road (AC)	TOTAL AREA (AC)	$C_d(10)$	$C_d(100)$	Imp (%)
B16	1	0.00	0.30	0.00			0.30	0.75	0.81	90%
B1	1	0.34	0.00	0.19			0.53	0.64	0.74	64%
B17	2	0.00	0.30	0.00			0.30	0.75	0.81	90%
B18	2	0.00	0.30	0.00			0.30	0.75	0.81	90%
B2	2	0.35	0.00	0.13			0.48	0.71	0.80	73%
B19	3	0.00	0.30	0.00			0.30	0.75	0.81	90%
B3	3	0.29	0.00	0.02			0.30	0.88	0.93	95%
B20	4	0.00	0.30	0.00			0.30	0.75	0.81	90%
B4	4	0.19	0.00	0.00			0.19	0.92	0.96	100%
B21	5	0.00	0.30	0.00			0.30	0.75	0.81	90%
B5	5	0.33	0.00	0.07			0.40	0.78	0.85	82%
B27	13	0.00	0.30	0.00			0.30	0.75	0.81	90%
B7	7	0.23	0.00	0.17			0.40	0.60	0.70	58%
B6	6	0.21	0.00	0.10			0.31	0.68	0.77	68%
B8	8	0.67	0.00	0.31			0.98	0.68	0.77	68%
B22	8	0.00	0.42	0.00			0.42	0.75	0.81	90%
B9	9	0.42	0.00	0.17			0.59	0.70	0.78	71%
B23	9	0.00	0.36	0.00			0.36	0.75	0.81	90%
B24	10	0.00	0.30	0.00			0.30	0.75	0.81	90%
B10	10	0.56	0.00	0.12			0.67	0.79	0.85	83%
B25	11	0.00	0.30	0.00			0.30	0.75	0.81	90%
B26	12	0.00	0.30	0.00			0.30	0.75	0.81	90%
B11	11	0.27	0.00	0.09			0.37	0.72	0.80	74%
B12	12	0.66	0.00	0.08			0.75	0.83	0.89	89%
B13	13	0.35	0.00	0.08			0.43	0.77	0.84	81%
B14	14	0.07	0.00	0.01			0.08	0.82	0.88	87%
B15	15	0.11	0.00	0.00			0.11	0.90	0.94	97%
C1	C	0.18	0.00	0.05			0.22	0.76	0.84	80%
A1	A	0.00	0.00	0.09			0.09	0.15	0.35	0%

Redland

STANDARD FORM SF-1 - DEVELOPED
RUNOFF COEFFICIENTS

PROJECT NAME: The Rock Commerce Center

PROJECT NUMBER: 23009

CALCULATED BY: CJS

CHECKED BY: MC

DATE: 10/19/2023

JURISDICTION: El Paso

B28	RC1	0.00	0.00	0.06			0.06	0.15	0.35	0%
B29	B	0.00	0.00	0.36			0.36	0.15	0.35	0%
OSB1	10	0.00	0.00	0.08			0.08	0.15	0.35	0%
OSB2	11	0.00	0.00	0.34			0.34	0.15	0.35	0%
OSB3	12	0.00	0.00	0.78			0.78	0.15	0.35	0%
OSB4	13	0.00	0.00	1.88			1.88	0.15	0.35	0%
OSA1	A	0.45	0.00	0.26			0.71	0.64	0.74	63%
OSB6	RC1	0.10	0.00	0.11			0.21	0.53	0.65	49%
OSB7	4	0.05	0.00	0.00			0.05	0.92	0.96	100%
OSB8	B	0.31	0.00	0.16			0.47	0.65	0.75	65%
OSB5	15	0.04	0.00	0.02			0.06	0.70	0.78	71%
B30	16	0.00	0.00	0.56		0.05	0.61	0.08	0.44	3%
B31	B	0.02					0.02	0.87	0.90	100%

Redland

STANDARD FORM SF-2 - DEVELOPED
TIME OF CONCENTRATION

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/16/2023
JURISDICTION: El Paso

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)						tc CHECK (URBANIZED BASINS)			FINAL Tc	RUNOFF COEFFICIENT	
DESIGN BASIN (1)	AREA (AC) (2)	C_{10} (3)	LENGTH* (FT) (4)	SLOPE (%) (5)	T_i (MINUTES) (6)	LENGTH (FT) (7)	SLOPE (%) (8)	C_v (9)	Land Surface (10)	VEL (FPS) (11)	T_t (MINUTES) (12)	COMP. t_c (13)	TOTAL LENGTH (14)	REGIONAL tc (15)	Min. t_c	C_{10}	C_{100}
B16	0.30	0.75	50	2.5%	3	210	2.5%	20.0	Paved Areas	3.2	1.1	4.5	260	10.9	5.0	0.75	0.81
B1	0.53	0.64	77	30.0%	2.4	228	0.8%	20.0	Paved Areas	1.7	2.2	4.6	305	15.4	5.0	0.64	0.74
B17	0.30	0.75	100	2.5%	4.7	200	2.0%	20.0	Paved Areas	2.8	1.2	5.9	300	10.9	5.9	0.75	0.81
B18	0.30	0.75	50	2.5%	3.3	210	2.5%	20.0	Paved Areas	3.2	1.1	4.5	260	10.9	5.0	0.75	0.81
B2	0.48	0.71	70	5.0%	3.5	189	75.0%	20.0	Paved Areas	17.3	0.2	3.6	259	13.6	5.0	0.71	0.80
B19	0.30	0.75	50	2.5%	3.3	375	1.5%	20.0	Paved Areas	2.4	2.6	5.9	425	11.1	5.9	0.75	0.81
B3	0.30	0.88	40	2.5%	1.9	230	1.0%	20.0	Paved Areas	2.0	1.9	3.8	270	10.2	5.0	0.88	0.93
B20	0.30	0.75	50	2.5%	3.3	210	2.5%	20.0	Paved Areas	3.2	1.1	4.5	260	10.9	5.0	0.75	0.81
B4	0.19	0.92	65	3.0%	1.8	115	1.0%	20.0	Paved Areas	2.0	1.0	2.8	180	9.1	5.0	0.92	0.96
B21	0.30	0.75	50	2.5%	3.3	265	2.5%	20.0	Paved Areas	3.2	1.4	4.7	315	10.9	5.0	0.75	0.81
B5	0.40	0.78	60	3.0%	3.1	275	3.5%	20.0	Paved Areas	3.7	1.2	4.4	335	12.2	5.0	0.78	0.85
B27	0.30	0.75	50	2.5%	3.3	300	2.5%	20.0	Paved Areas	3.2	1.6	4.9	350	10.9	5.0	0.75	0.81
B7	0.40	0.60	90	30.0%	2.8	45	1.0%	20.0	Paved Areas	2.0	0.4	3.2	135	16.2	5.0	0.60	0.70
B6	0.31	0.68	90	25.0%	2.5	66	1.0%	20.0	Paved Areas	2.0	0.6	3.1	156	14.5	5.0	0.68	0.77
B8	0.98	0.68	65	33.0%	2.0	324	2.5%	20.0	Paved Areas	3.2	1.7	3.7	389	14.6	5.0	0.68	0.77
B22	0.42	0.75	75	2.0%	4.4	120	2.0%	20.0	Paved Areas	2.8	0.7	5.1	195	10.8	5.1	0.75	0.81
B9	0.59	0.70	100	18.0%	2.8	175	1.2%	20.0	Paved Areas	2.2	1.3	4.2	275	14.1	5.0	0.70	0.78
B23	0.36	0.75	50	2.5%	3.3	250	2.0%	20.0	Paved Areas	2.8	1.5	4.8	300	10.9	5.0	0.75	0.81
B24	0.30	0.75	50	2.5%	3.3	200	0.5%	20.0	Paved Areas	1.4	2.4	5.7	250	11.0	5.7	0.75	0.81
B10	0.67	0.79	100	18.0%	2.2	250	0.5%	20.0	Paved Areas	1.4	2.9	5.1	350	12.4	5.1	0.79	0.85

Redland

STANDARD FORM SF-2 - DEVELOPED
TIME OF CONCENTRATION

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/16/2023
JURISDICTION: El Paso

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)						tc CHECK (URBANIZED BASINS)			FINAL Tc	RUNOFF COEFFICIENT	
DESIGN BASIN (1)	AREA (AC) (2)	C_{10} (3)	LENGTH* (FT) (4)	SLOPE (%) (5)	T_i (MINUTES) (6)	LENGTH (FT) (7)	SLOPE (%) (8)	C_v (9)	Land Surface (10)	VEL (FPS) (11)	T_t (MINUTES) (12)	COMP. t_c (13)	TOTAL LENGTH (14)	REGIONAL tc (15)	Min. t_c	C_{10}	C_{100}
B25	0.30	0.75	50	2.5%	3.3	120	2.5%	20.0	Paved Areas	3.2	0.6	4.0	170	10.8	5.0	0.75	0.81
B26	0.30	0.75	50	2.5%	3.3	280	2.5%	20.0	Paved Areas	3.2	1.5	4.8	330	10.9	5.0	0.75	0.81
B11	0.37	0.72	100	6.5%	3.7	10	1.0%	20.0	Paved Areas	2.0	0.1	3.8	110	13.4	5.0	0.72	0.80
B12	0.75	0.83	100	3.0%	3.4	290	1.7%	20.0	Paved Areas	2.6	1.9	5.2	390	11.2	5.2	0.83	0.89
B13	0.43	0.77	100	3.0%	4.2	175	4.0%	20.0	Paved Areas	4.0	0.7	4.9	275	12.4	5.0	0.77	0.84
B14	0.08	0.82	85	7.0%	2.5	47	4.2%	20.0	Paved Areas	4.1	0.2	2.6	132	11.2	5.0	0.82	0.88
B15	0.11	0.90	70	3.0%	2.2	70	4.0%	20.0	Paved Areas	4.0	0.3	2.5	140	9.6	5.0	0.90	0.94
C1	0.22	0.76	50	2.5%	3.2	125	2.0%	20.0	Paved Areas	2.8	0.7	4.0	175	12.6	5.0	0.76	0.84
A1	0.09	0.15	60	3.3%	9.0	215	3.0%	7.0	Short Pasture/Lawn	1.2	3.0	12.0	275	26.2	12.0	0.15	0.35
B28	0.06	0.15	40	5.0%	6.4	200	7.5%	7.0	Short Pasture/Lawn	1.9	1.7	8.2	240	26.1	8.2	0.15	0.35
B29	0.36	0.15	40	5.0%	6.4	470	4.0%	7.0	Short Pasture/Lawn	1.4	5.6	12.0	510	26.3	12.0	0.15	0.35
OSB1	0.08	0.15	75	7.4%	7.7	180	4.0%	20.0	Paved Areas	4.0	0.8	8.5	255	26.1	8.5	0.15	0.35
OSB2	0.34	0.15	100	3.9%	11.1	165	3.5%	20.0	Paved Areas	3.7	0.7	11.8	265	26.1	11.8	0.15	0.35
OSB3	0.78	0.15	100	7.2%	9.0	230	10.9%	20.0	Paved Areas	6.6	0.6	9.6	330	26.1	9.6	0.15	0.35
OSB4	1.88	0.15	100	2.3%	13.2	350	14.3%	7.0	Short Pasture/Lawn	2.6	2.2	15.4	450	26.1	15.4	0.15	0.35
OSA1	0.71	0.64	100	2.5%	6.2	250	3.5%	20.0	Paved Areas	3.7	1.1	7.3	350	15.4	7.3	0.64	0.74
OSB6	0.21	0.53	75	2.5%	6.7	200	7.5%	20.0	Paved Areas	5.5	0.6	7.3	275	17.7	7.3	0.53	0.65
OSB7	0.05	0.92	84	4.0%	1.9	0	1.0%	20.0	Paved Areas	2.0	0.0	1.9	84	9.0	5.0	0.92	0.96
OSB8	0.47	0.65	90	2.5%	5.7	470	4.0%	20.0	Paved Areas	4.0	2.0	7.7	560	15.2	7.7	0.65	0.75
OSB5	0.06	0.70	60	7.0%	3.0	120	1.0%	20.0	Paved Areas	2.0	1.0	4.0	180	14.0	5.0	0.70	0.78

Redland

STANDARD FORM SF-2 - DEVELOPED
TIME OF CONCENTRATION

PROJECT NAME: The Rock Commerce Center
PROJECT NUMBER: 23009
CALCULATED BY: CJS
CHECKED BY: MC

DATE: 10/16/2023
JURISDICTION: El Paso

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)						tc CHECK (URBANIZED BASINS)			FINAL Tc	RUNOFF COEFFICIENT	
DESIGN BASIN (1)	AREA (AC) (2)	C_{10} (3)	LENGTH* (FT) (4)	SLOPE (%) (5)	T_i (MINUTES) (6)	LENGTH (FT) (7)	SLOPE (%) (8)	C_v (9)	Land Surface (10)	VEL (FPS) (11)	T_t (MINUTES) (12)	COMP. t_c (13)	TOTAL LENGTH (14)	REGIONAL tc (15)	Min. t_c	C_{10}	C_{100}
B30	0.61	0.08	50	33.0%	4.1	200	1.0%	7.0	Short Pasture/Lawn	0.7	4.8	8.9	250	25.7	8.9	0.08	0.44
B31	0.02	0.87	100	7.0%	2.2	475	4.6%	7.0	Short Pasture/Lawn	1.5	5.3	7.5	575	9.3	7.5	0.87	0.90

Redland

STANDARD FORM SF-3 - DEVELOPED
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: The Rock Commerce Center

DATE: 10/16/2023

PROJECT NUMBER: 23009

P_1 (1-Hour Rainfall) = 1.75

JURISDICTION: El Paso

CALCULATED BY: CJS

CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{10}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	B16	0.3	0.75	5.0	0.2	5.94	1.3	5.00	0.56	5.94	3.35									
	1	B1	0.5	0.64	5.0	0.3	5.94	2.0	5.00	0.56	5.94	3.35									
	2	B17	0.3	0.75	5.9	0.2	5.67	1.3	5.91	0.79	5.67	4.46									
	2	B18	0.3	0.75	5.0	0.2	5.94	1.3	5.91	0.79	5.67	4.46									
	2	B2	0.5	0.71	5.0	0.3	5.94	2.0	5.91	0.79	5.67	4.46									
	3	B19	0.3	0.75	5.9	0.2	5.67	1.3	5.89	0.49	5.67	2.78									
	3	B3	0.3	0.88	5.0	0.3	5.94	1.6	5.89	0.49	5.67	2.78									
	4	B20	0.3	0.75	5.0	0.2	5.94	1.3	5.00	0.44	5.94	2.63									
	4	B4	0.2	0.92	5.0	0.2	5.94	1.0	5.00	0.44	5.94	2.63									
	5	B21	0.3	0.75	5.0	0.2	5.94	1.3	5.00	0.54	5.94	3.19									
	5	B5	0.4	0.78	5.0	0.3	5.94	1.8	5.00	0.54	5.94	3.19									
	13	B27	0.3	0.75	5.0	0.2	5.94	1.3	15.40	0.84	3.92	3.30									
	7	B7	0.4	0.60	5.0	0.2	5.94	1.4	5.00	0.24	5.94	1.40									
	6	B6	0.3	0.68	5.0	0.2	5.94	1.2	5.00	0.21	5.94	1.24									
	8	B8	1.0	0.68	5.0	0.7	5.94	3.9	5.12	0.98	5.90	5.76									
	8	B22	0.4	0.75	5.1	0.3	5.90	1.8	5.12	0.98	5.90	5.76									
	9	B9	0.6	0.70	5.0	0.4	5.94	2.4	5.00	0.68	5.94	4.03									
	9	B23	0.4	0.75	5.0	0.3	5.94	1.6	5.00	0.68	5.94	4.03									
	10	B24	0.3	0.75	5.7	0.2	5.73	1.3	8.49	0.76	5.04	3.85									
	10	B10	0.7	0.79	5.1	0.5	5.89	3.1	8.49	0.76	5.04	3.85									

Redland

STANDARD FORM SF-3 - DEVELOPED
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: The Rock Commerce Center

DATE: 10/16/2023

PROJECT NUMBER: 23009

P_1 (1-Hour Rainfall) = 1.75

JURISDICTION: El Paso

CALCULATED BY: CJS

CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{10}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	11	B25	0.3	0.75	5.0	0.2	5.94	1.3	11.80	0.54	4.42	2.39									
	12	B26	0.3	0.75	5.0	0.2	5.94	1.3	9.60	0.96	4.81	4.63									
	11	B11	0.4	0.72	5.0	0.3	5.94	1.6	11.80	0.54	4.42	2.39									
	12	B12	0.7	0.83	5.2	0.6	5.86	3.6	9.60	0.96	4.81	4.63									
	13	B13	0.4	0.77	5.0	0.3	5.94	2.0	15.40	0.84	3.92	3.30									
	14	B14	0.1	0.82	5.0	0.1	5.94	0.4	5.00	0.06	5.94	0.38									
	15	B15	0.1	0.90	5.0	0.1	5.94	0.6	5.00	0.14	5.94	0.85									
	C	C1	0.2	0.76	5.0	0.2	5.94	1.0	5.00	0.17	5.94	1.01									
	A	A1	0.1	0.15	12.0	0.0	4.39	0.1	11.99	0.47	4.39	2.05									
	RC1	B28	0.1	0.15	8.2	0.0	5.10	0.0	8.18	0.12	5.10	0.61									
	B	B29	0.4	0.15	12.0	0.1	4.39	0.2	12.04	0.38	4.39	1.66									
	10	OSB1	0.1	0.15	8.5	0.0	5.04	0.1	8.49	0.76	5.04	3.85									
	11	OSB2	0.3	0.15	11.8	0.1	4.42	0.2	11.80	0.54	4.42	2.39									
	12	OSB3	0.8	0.15	9.6	0.1	4.81	0.6	9.60	0.96	4.81	4.63									
	13	OSB4	1.9	0.15	15.4	0.3	3.92	1.1	15.40	0.84	3.92	3.30									
	A	OSA1	0.7	0.64	7.3	0.5	5.29	2.4	11.99	0.47	4.39	2.05									
	RC1	OSB6	0.2	0.53	7.3	0.1	5.31	0.6	8.18	0.12	5.10	0.61									
	4	OSB7	0.1	0.92	5.0	0.0	5.94	0.3	5.00	0.44	5.94	2.63									
	B	OSB8	0.5	0.65	7.7	0.3	5.21	1.6	12.04	0.38	4.39	1.66									
	15	OSB5	0.1	0.70	5.0	0.0	5.94	0.2	5.00	0.14	5.94	0.85									

STANDARD FORM SF-3 - DEVELOPED

STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: The Rock Commerce Center

DATE: 10/16/2023

PROJECT NUMBER: 23009

P_1 (1-Hour Rainfall) = 1.75

JURISDICTION: El Paso

CALCULATED BY: CJS

CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF: DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{10}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF: t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	STREET: SLOPE (%)	STREET FLOW(cfs)	PIPE: DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	TRAVEL TIME: LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	16	B30	0.6	0.08	8.9	0.1	4.96	0.3	8.87	0.05	4.96	0.26									
	B	B31	0.0	0.87	7.5	0.0	5.26	0.1	12.04	0.38	4.39	1.66									

Redland

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

PROJECT NAME: The Rock Commerce Center
DATE: 10/16/2023
PROJECT NUMBER: 23009
P_1 (1-Hour Rainfall) = 2.52
JURISDICTION: El Paso
CALCULATED BY: CJS
CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	1	B16	0.3	0.81	5.0	0.2	8.55	2.1	5.00	0.63	8.55	5.42									
	1	B1	0.5	0.74	5.0	0.4	8.55	3.4	5.00	0.63	8.55	5.42									
	2	B17	0.3	0.81	5.9	0.2	8.16	2.0	5.91	0.86	8.16	7.04									
	2	B18	0.3	0.81	5.0	0.2	8.55	2.1	5.91	0.86	8.16	7.04									
	2	B2	0.5	0.80	5.0	0.4	8.55	3.2	5.91	0.86	8.16	7.04									
	3	B19	0.3	0.81	5.9	0.2	8.17	2.0	5.89	0.52	8.17	4.28									
	3	B3	0.3	0.93	5.0	0.3	8.55	2.4	5.89	0.52	8.17	4.28									
	4	B20	0.3	0.81	5.0	0.2	8.55	2.1	5.00	0.47	8.55	4.03									
	4	B4	0.2	0.96	5.0	0.2	8.55	1.5	5.00	0.47	8.55	4.03									
	5	B21	0.3	0.81	5.0	0.2	8.55	2.1	5.00	0.58	8.55	4.98									
	5	B5	0.4	0.85	5.0	0.3	8.55	2.9	5.00	0.58	8.55	4.98									
	13	B27	0.3	0.81	5.0	0.2	8.55	2.1	15.40	1.27	5.65	7.16									
	7	B7	0.4	0.70	5.0	0.3	8.55	2.4	5.00	0.28	8.55	2.39									
	6	B6	0.3	0.77	5.0	0.2	8.55	2.0	5.00	0.24	8.55	2.02									
	8	B8	1.0	0.77	5.0	0.8	8.55	6.4	5.12	1.09	8.50	9.26									
	8	B22	0.4	0.81	5.1	0.3	8.50	2.9	5.12	1.09	8.50	9.26									
	9	B9	0.6	0.78	5.0	0.5	8.55	3.9	5.00	0.75	8.55	6.42									
	9	B23	0.4	0.81	5.0	0.3	8.55	2.5	5.00	0.75	8.55	6.42									
	10	B24	0.3	0.81	5.7	0.2	8.25	2.0	8.49	0.84	7.25	6.13									
	10	B10	0.7	0.85	5.1	0.6	8.49	4.9	8.49	0.84	7.25	6.13									

STANDARD FORM SF-3 - DEVELOPED

STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: The Rock Commerce Center

DATE: 10/16/2023

PROJECT NUMBER: 23009

P_1 (1-Hour Rainfall) = 2.52

JURISDICTION: El Paso

CALCULATED BY: CJS

CHECKED BY: MC

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	11	B25	0.3	0.81	5.0	0.2	8.55	2.1	11.80	0.66	6.37	4.18									
	12	B26	0.3	0.81	5.0	0.2	8.55	2.1	9.60	1.18	6.93	8.16									
	11	B11	0.4	0.80	5.0	0.3	8.55	2.5	11.80	0.66	6.37	4.18									
	12	B12	0.7	0.89	5.2	0.7	8.44	5.6	9.60	1.18	6.93	8.16									
	13	B13	0.4	0.84	5.0	0.4	8.55	3.1	15.40	1.27	5.65	7.16									
	14	B14	0.1	0.88	5.0	0.1	8.55	0.6	5.00	0.07	8.55	0.58									
	15	B15	0.1	0.94	5.0	0.1	8.55	0.9	5.00	0.15	8.55	1.31									
	C	C1	0.2	0.84	5.0	0.2	8.55	1.6	5.00	0.19	8.55	1.60									
	A	A1	0.1	0.35	12.0	0.0	6.33	0.2	11.99	0.55	6.33	3.51									
	RC1	B28	0.1	0.35	8.2	0.0	7.35	0.1	8.18	0.16	7.35	1.15									
	B	B29	0.4	0.35	12.0	0.1	6.32	0.8	12.04	0.50	6.32	3.14									
	10	OSB1	0.1	0.35	8.5	0.0	7.25	0.2	8.49	0.84	7.25	6.13									
	11	OSB2	0.3	0.35	11.8	0.1	6.37	0.8	11.80	0.66	6.37	4.18									
	12	OSB3	0.8	0.35	9.6	0.3	6.93	1.9	9.60	1.18	6.93	8.16									
	13	OSB4	1.9	0.35	15.4	0.7	5.65	3.7	15.40	1.27	5.65	7.16									
	A	OSA1	0.7	0.74	7.3	0.5	7.62	4.0	11.99	0.55	6.33	3.51									
	RC1	OSB6	0.2	0.65	7.3	0.1	7.64	1.0	8.18	0.16	7.35	1.15									
	4	OSB7	0.1	0.96	5.0	0.1	8.55	0.4	5.00	0.47	8.55	4.03									
	B	OSB8	0.5	0.75	7.7	0.4	7.51	2.7	12.04	0.50	6.32	3.14									
	15	OSB5	0.1	0.78	5.0	0.0	8.55	0.4	5.00	0.15	8.55	1.31									

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

PROJECT NAME: The Rock Commerce Center
DATE: 10/16/2023
PROJECT NUMBER: 23009
P_1 (1-Hour Rainfall) = 2.52
JURISDICTION: El Paso
CALCULATED BY: CJS
CHECKED BY: MC

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STORM LINE	DESIGN POINT	DESIGN BASIN	AREA (AC)	RUNOFF COEFF C_{100}	t_c (minutes)	C*A(ac)	I (in/hr)	Q (cfs)	t_c(minutes)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	t_t (minutes)	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	16	B30	0.6	0.44	8.9	0.3	7.14	1.9	8.87	0.27	7.14	1.92									
	B	B31	0.0	0.90	7.5	0.0	7.57	0.1	12.04	0.50	6.32	3.14									

BASIN SUMMARY - DEVELOPED

Redland

PROJECT NAME: The Rock Commerce Center DATE: 10/16/2023
PROJECT NUMBER: 23009.000 JURISDICTION: El Paso
CALCULATED BY: CJS
CHECKED BY: 0

Basin Summary Table

Basin	Area (AC)	Runoff Coefficients		I (%)	Peak Flows (cfs)	
		C10	C_{100}		Q10	Q_{100}
B16	0.30	0.75	0.81	90%	1.3	2.1
B1	0.53	0.64	0.74	64%	2.0	3.4
B17	0.30	0.75	0.81	90%	1.3	2.0
B18	0.30	0.75	0.81	90%	1.3	2.1
B2	0.48	0.71	0.80	73%	2.0	3.2
B19	0.30	0.75	0.81	90%	1.3	2.0
B3	0.30	0.88	0.93	95%	1.6	2.4
B20	0.30	0.75	0.81	90%	1.3	2.1
B4	0.19	0.92	0.96	100%	1.0	1.5
B21	0.30	0.75	0.81	90%	1.3	2.1
B5	0.40	0.78	0.85	82%	1.8	2.9
B27	0.30	0.75	0.81	90%	1.3	2.1
B7	0.40	0.60	0.70	58%	1.4	2.4
B6	0.31	0.68	0.77	68%	1.2	2.0
B8	0.98	0.68	0.77	68%	3.9	6.4
B22	0.42	0.75	0.81	90%	1.8	2.9
B9	0.59	0.70	0.78	71%	2.4	3.9
B23	0.36	0.75	0.81	90%	1.6	2.5
B24	0.30	0.75	0.81	90%	1.3	2.0
B10	0.67	0.79	0.85	83%	3.1	4.9
B25	0.30	0.75	0.81	90%	1.3	2.1
B26	0.30	0.75	0.81	90%	1.3	2.1
B11	0.37	0.72	0.80	74%	1.6	2.5
B12	0.75	0.83	0.89	89%	3.6	5.6
B13	0.43	0.77	0.84	81%	2.0	3.1
B14	0.08	0.82	0.88	87%	0.4	0.6
B15	0.11	0.90	0.94	97%	0.6	0.9
C1	0.22	0.76	0.84	80%	1.0	1.6
A1	0.09	0.15	0.35	0%	0.1	0.2
B28	0.06	0.15	0.35	0%	0.0	0.1
B29	0.36	0.15	0.35	0%	0.2	0.8
OSB1	0.08	0.15	0.35	0%	0.1	0.2
OSB2	0.34	0.15	0.35	0%	0.2	0.8
OSB3	0.78	0.15	0.35	0%	0.6	1.9
OSB4	1.88	0.15	0.35	0%	1.1	3.7
OSA1	0.71	0.64	0.74	63%	2.4	4.0
OSB6	0.21	0.53	0.65	49%	0.6	1.0
OSB7	0.05	0.92	0.96	100%	0.3	0.4
OSB8	0.47	0.65	0.75	65%	1.6	2.7
OSB5	0.06	0.70	0.78	71%	0.2	0.4
B30	0.61	0.08	0.44	3%	0.3	1.9
B31	0.02	0.87	0.90	100%	0.1	0.1

Redland
WHERE GREAT PLACES BEGIN
720.283.6783 Office
1500 West Canal Court
Littleton, Colorado 80120
REDLAND.COM

Appendix C - Hydraulic Calculations

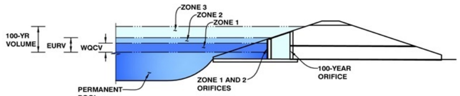
BASINS TRIBUTARY TO POND		
BASIN	AREA	% IMPERVIOUS
B1	0.53	64%
B2	0.48	73%
B3	0.3	95%
B4	0.19	100%
B5	0.4	82%
B6	0.31	68%
B7	0.4	58%
B8	0.98	68%
B9	0.59	71%
B10	0.67	83%
B11	0.37	74%
B12	0.75	89%
B13	0.43	81%
B14	0.08	87%
B15	0.11	97%
B16	0.3	90%
B17	0.3	90%
B18	0.3	90%
B19	0.3	90%
B20	0.3	90%
B21	0.3	90%
B22	0.42	90%
B23	0.36	90%
B24	0.3	90%
B25	0.3	90%
B26	0.3	90%
B27	0.3	90%
B30	0.61	3%
TOTAL:	10.98	77%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **23009 - The Rock Lot 1 Filing No. 1**

Basin ID: **Basin B**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	11.38	acres		
Watershed Length =	1,550	ft		
Watershed Length to Centroid =	775	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	77.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.294	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.969	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.867	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.153	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.392	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.660	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.907	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.192	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.39 in.) =	3.067	acre-feet	3.39	inches
Approximate 2-yr Detention Volume =	0.765	acre-feet		
Approximate 5-yr Detention Volume =	1.011	acre-feet		
Approximate 10-yr Detention Volume =	1.261	acre-feet		
Approximate 25-yr Detention Volume =	1.352	acre-feet		
Approximate 50-yr Detention Volume =	1.405	acre-feet		
Approximate 100-yr Detention Volume =	1.488	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.294	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.675	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.518	acre-feet
Total Detention Basin Volume =	1.488	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		
7135	--	1.00	--	--	--	747	0.017	374	0.009
7136	--	2.00	--	--	--	4,659	0.107	3,077	0.071
7137	--	3.00	--	--	--	9,002	0.207	9,907	0.227
7138	--	4.00	--	--	--	10,517	0.241	19,667	0.451
7139	--	5.00	--	--	--	12,089	0.278	30,970	0.711
7140	--	6.00	--	--	--	13,719	0.315	43,875	1.007
7141	--	7.00	--	--	--	15,407	0.354	58,438	1.342
7142	--	8.00	--	--	--	17,156	0.394	74,720	1.715
	--	9.00	--	--	--	18,969	0.435	92,782	2.130
	--	10.00	--	--	--	20,803	0.478	112,668	2.586
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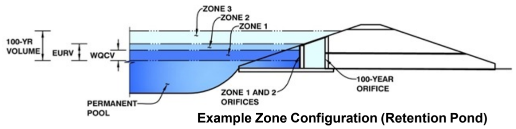
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: 23009 - The Rock Lot 1 Filing No. 1

Basin ID: Basin B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.32	0.294	Orifice Plate
Zone 2 (EURV)	5.88	0.675	Orifice Plate
Zone 3 (100-year)	7.41	0.518	Weir&Pipe (Restrict)
Total (all zones)		1.488	

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 =	5.88	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	1.30	sq. inches (diameter = 1-1/4 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	9.028E-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	1.91	3.16	4.41				
Orifice Area (sq. inches)	1.30	1.30	1.30	1.30				

change to 1.35

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	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 =	5.88	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	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 % =	0%	N/A	%

assume 50%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.88	N/A	feet
Overflow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	10.48	N/A	
Overflow Grate Open Area w/o Debris =	8.61	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.61	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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.82	N/A	ft^2
Outlet Orifice Centroid =	0.41	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.52	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	5.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.62	feet
Stage at Top of Freeboard =	9.62	feet
Basin Area at Top of Freeboard =	0.46	acres
Basin Volume at Top of Freeboard =	2.41	acre-ft

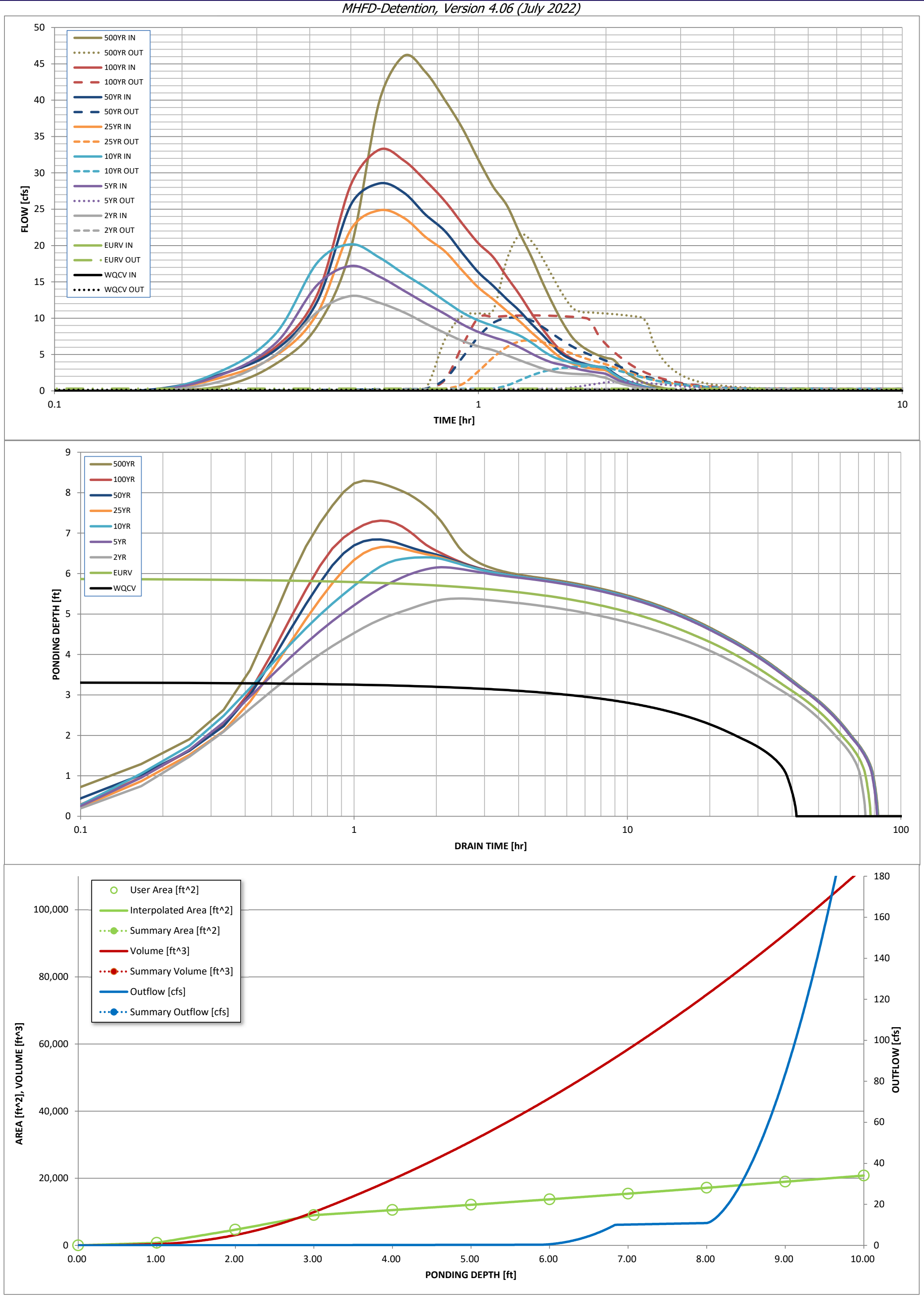
Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.39
CUHP Runoff Volume (acre-ft) =	0.294	0.969	0.867	1.153	1.392	1.660	1.907	2.192	3.067
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.867	1.153	1.392	1.660	1.907	2.192	3.067
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.9	2.6	4.0	7.3	9.2	11.7	18.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.23	0.35	0.64	0.80	1.03	1.61
Peak Inflow Q (cfs) =	N/A	N/A	13.1	17.2	20.2	24.9	28.6	33.2	46.1
Peak Outflow Q (cfs) =	0.1	0.3	0.3	1.3	3.4	7.0	10.0	10.4	21.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.8	1.0	1.1	0.9	1.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.8	1.1	1.2	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	67	72	71	69	68	66	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	71	78	78	77	76	76	74
Maximum Ponding Depth (ft) =	3.32	5.88	5.39	6.16	6.40	6.67	6.84	7.31	8.30
Area at Maximum Ponding Depth (acres) =	0.22	0.31	0.29	0.32	0.33	0.34	0.35	0.37	0.41
Maximum Volume Stored (acre-ft) =	0.295	0.970	0.819	1.055	1.136	1.224	1.285	1.453	1.831

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			

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	SD IN1	SD IN2	SD IN3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT/Denver 13 Valley Grate	CDOT/Denver 13 Valley Grate	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.4	4.5	5.4
Major Q_{Known} (cfs)	5.4	7.0	8.3

Bypass (Carry-Over) Flow from Upstream

Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.4**	**4.5**	**5.4**
Major Total Design Peak Flow, Q (cfs)	**5.4**	**7.0**	**8.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	SD IN4	SD IN5	SD IN6
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT/Denver 13 Combination	CDOT/Denver 13 Valley Grate	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.2	1.2	1.4
Major Q_{Known} (cfs)	5.0	2.0	2.4

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.2**	**1.2**	**1.4**
Major Total Design Peak Flow, Q (cfs)	**5.0**	**2.0**	**2.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	SD IN7	SD IN8	SD IN9
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	In Sump
Inlet Type	CDOT/Denver 13 Valley Grate	CDOT/Denver 13 Valley Grate	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.8	4.0	3.9
Major Q_{Known} (cfs)	9.3	6.4	6.1

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	2.1
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	3.7

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.8**	**4.0**	**6.0**
Major Total Design Peak Flow, Q (cfs)	**9.3**	**6.4**	**9.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	2.1	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	3.7	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	SD IN10	SD IN11	SD IN12
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT/Denver 13 Combination	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.4	4.6	3.3
Major Q_{Known} (cfs)	4.2	8.2	7.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.2
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	1.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.4**	**4.6**	**3.5**
Major Total Design Peak Flow, Q (cfs)	**4.2**	**8.2**	**8.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.2	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	1.0	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	SD IN13	SD IN14
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	On Grade	On Grade
Inlet Type	CDOT/Denver 13 Combination	CDOT/Denver 13 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.4	0.9
Major Q_{Known} (cfs)	0.6	1.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.1

Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

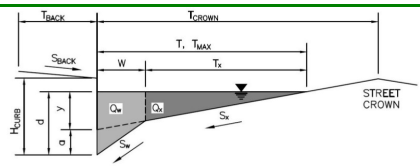
Minor Total Design Peak Flow, Q (cfs)	**0.4**	**0.9**
Major Total Design Peak Flow, Q (cfs)	**0.6**	**1.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.1	0.0

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

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

Project:

Inlet ID: SD IN1



Gutter Geometry:

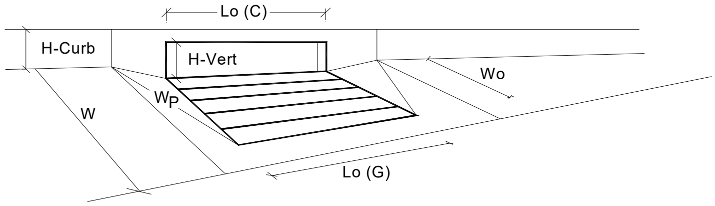
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	14.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.035	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	14.0	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 5.02 (August 2022)

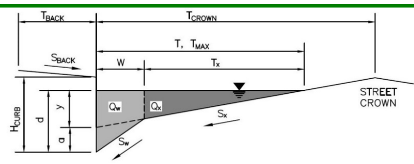


		MINOR	MAJOR	
Design Information (Input) CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.8	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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.59	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.64	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
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 =	**4.4**	**5.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.4	5.4	cfs

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

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

Project:
Inlet ID: **SD IN2**



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} =	0.000	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} =	14.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	6.48	6.48	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline (y + a)	d =	7.75	7.75	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	16.0	16.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.304	0.304	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

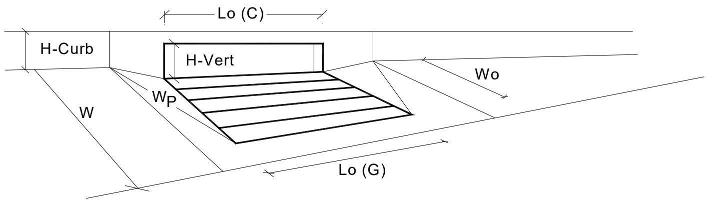
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.1	29.8	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	11.1	27.8	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.411	0.184	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	SUMP	SUMP	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d $\geq$ 6"	R =	SUMP	SUMP	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



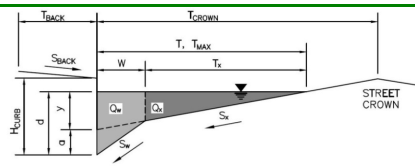
Design Information (Input)	CDOT/Denver 13 Valley Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	8.2	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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.56	0.70	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.61	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
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 =	**5.3**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.5	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:

Inlet ID: **SD IN3**



Gutter Geometry:

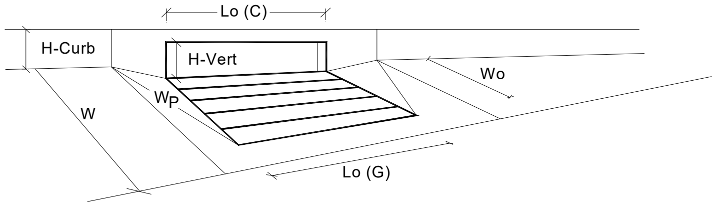
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.010	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.3	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 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.3	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 (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

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	0.35	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} =	0.93	0.95	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

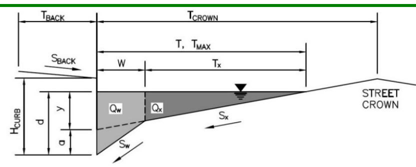
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.4	8.3	cfs

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

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

Project:

Inlet ID: SD IN4



Gutter Geometry:

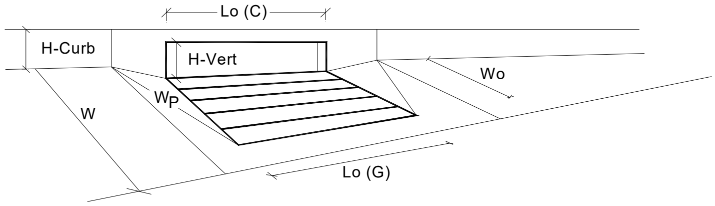
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	13.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

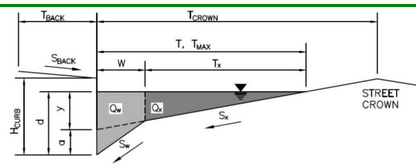


		MINOR	MAJOR	
Design Information (Input) — CDOT/Denver 13 Combination				
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (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} =	0.43	0.43	
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) =	3.30	3.30	
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 (see USDCM Figure ST-5)	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 =**	**5.1**	**5.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.2	5.0	cfs

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

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

Project:
Inlet ID: SD IN5



Gutter Geometry:

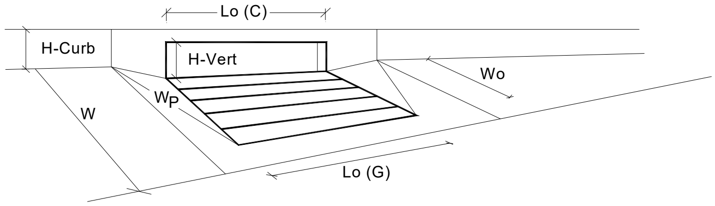
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	12.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	7.9	7.9	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 5.02 (August 2022)

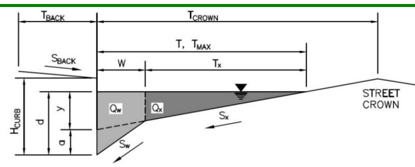


Design Information (Input)	CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	7.9	7.9	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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	0.68	0.68	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	1.00	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	N/A	N/A	
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 =**	**4.0**	**4.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	1.2	2.0	cfs

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

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

Project:
Inlet ID: SD IN6

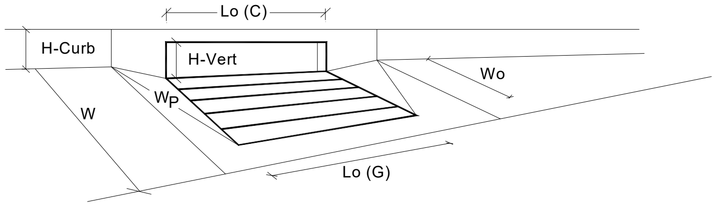


Gutter Geometry:

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} =	0.000		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} =	12.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	2.00		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} =	0.020		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	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	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

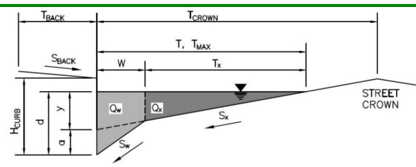


		MINOR	MAJOR	
Design Information (Input) CDOT/Denver 13 Valley Grate				
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
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} =	N/A	N/A	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	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.6**	**2.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.4	2.4	cfs

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

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

Project:
Inlet ID: SD IN7



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} =	0.000	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} =	11.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	5.00	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.5	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.8	8.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression ($T * S_x * 12$)	y =	6.00	8.64	inches
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	d_C =	5.0	5.0	inches
Gutter Depression ($d_C - (W * S_x * 12)$)	a =	2.58	2.58	inches
Water Depth at Gutter Flowline (y + a)	d =	8.58	11.22	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	7.5	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.815	0.646	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section ($Q_T - Q_X - Q_{BACK}$)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	#DIV/0!	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

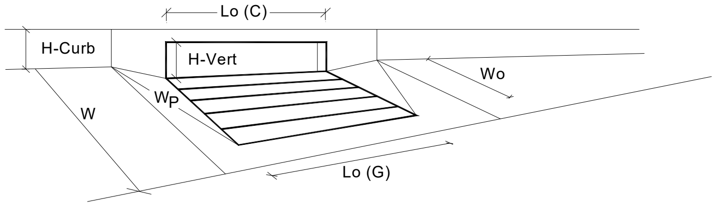
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	12.9	12.9	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	7.9	7.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.803	0.803	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section ($Q_d - Q_X$)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	SUMP	SUMP	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d $\geq$ 6"	R =	SUMP	SUMP	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

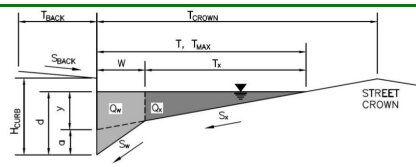


Design Information (Input)	CDOT/Denver 13 Valley Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.6	8.8	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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.78	0.80	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	1.00	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
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 =**	**9.4**	**9.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.8	9.3	cfs

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

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

Project:
Inlet ID: SD IN8



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} =	0.000	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} =	11.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	5.00	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 =	0.005	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

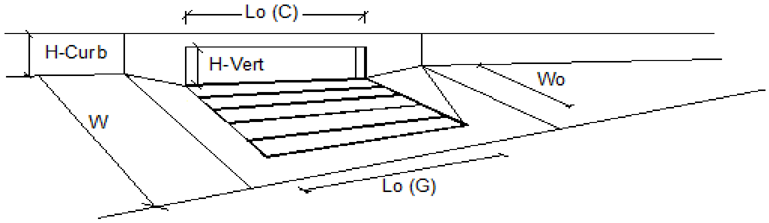
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.5	12.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.7**	**8.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.03 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.42 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



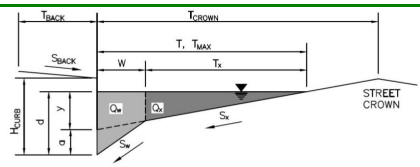
Design Information (Input)	CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	N/A	N/A	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.0**	**2.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.1**	**3.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**49**	**43**	**%**

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

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

Project:
Inlet ID: **SD IN9**



Gutter Geometry:

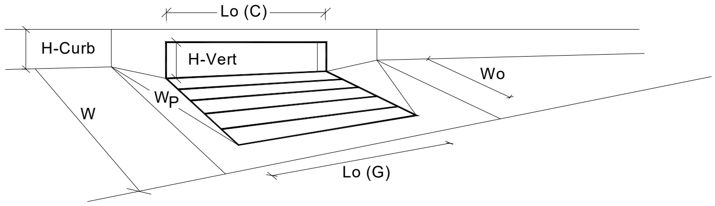
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	11.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	5.00		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} =	0.020		
		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} =	10.0	10.0	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 5.02 (August 2022)

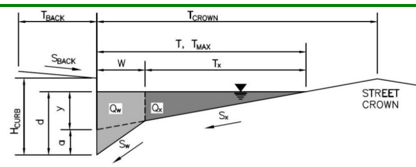


Design Information (Input)	CDOT/Denver 13 Valley Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.6	8.6	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} =	0.43	0.43	
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) =	3.30	3.30	
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) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.78	0.78	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.81	0.81	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
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 =	**11.4**	**11.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	6.0	9.8	cfs

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

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

Project:
Inlet ID: SD IN10



Gutter Geometry:

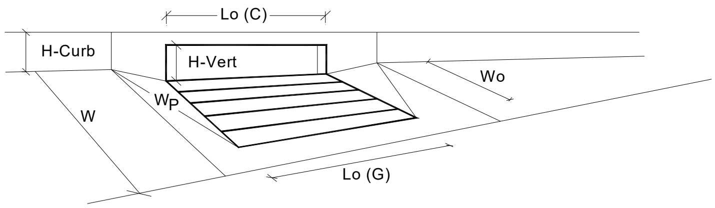
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.070	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	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	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

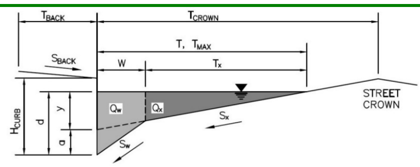


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	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 (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
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} =	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 =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.4	4.2	cfs

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

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

Project:
Inlet ID: SD IN11



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.1	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100	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} =	54.0	ft
Gutter Width	W =	2.00	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 =	0.014	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

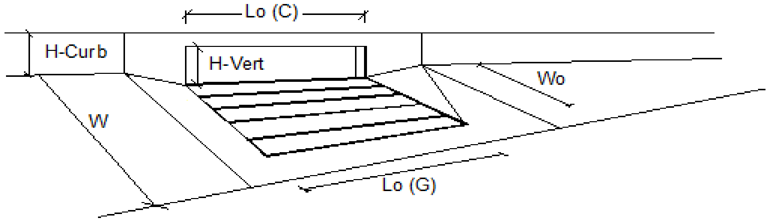
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.5**	**8.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.63 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.16 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



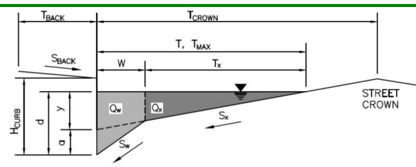
Design Information (Input)	CDOT/Denver 13 Combination	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =**	**4.4**	**7.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**1.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**96**	**88**	**%**

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

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

Project:
Inlet ID: SD IN12



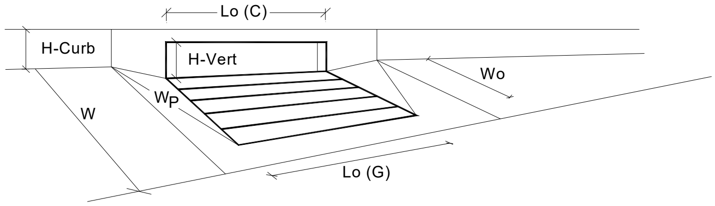
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.040		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.0	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 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.3	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 (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

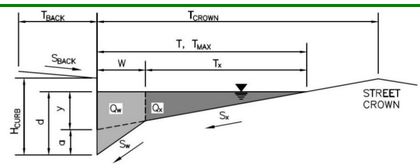
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.36	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	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 =**	**8.3**	**9.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.5	8.2	cfs

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

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

Project:
Inlet ID: SD IN13



Gutter Geometry:

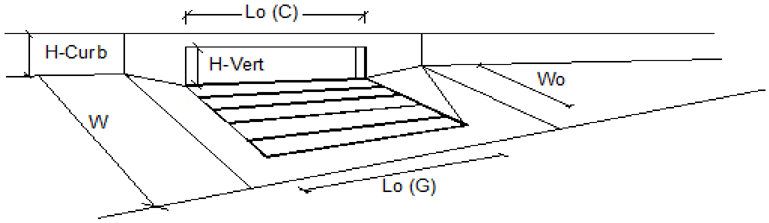
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.1		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	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 Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.0**	**13.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.38 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.58 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



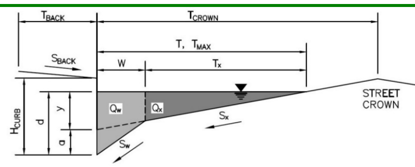
Design Information (Input)	CDOT/Denver 13 Combination		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
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 =**	**0.4**	**0.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**94**	**90**	**%**

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

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

Project:
Inlet ID: SD IN14



Gutter Geometry:

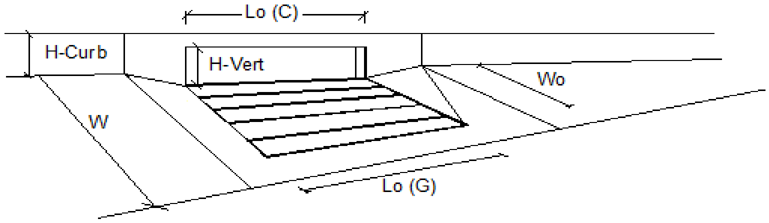
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.1		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	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 Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.0**	**13.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.85 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.41 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT/Denver 13 Combination		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	0.50	0.50	
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 =**	**0.9**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**104**	**97**	**%**

Channel Report

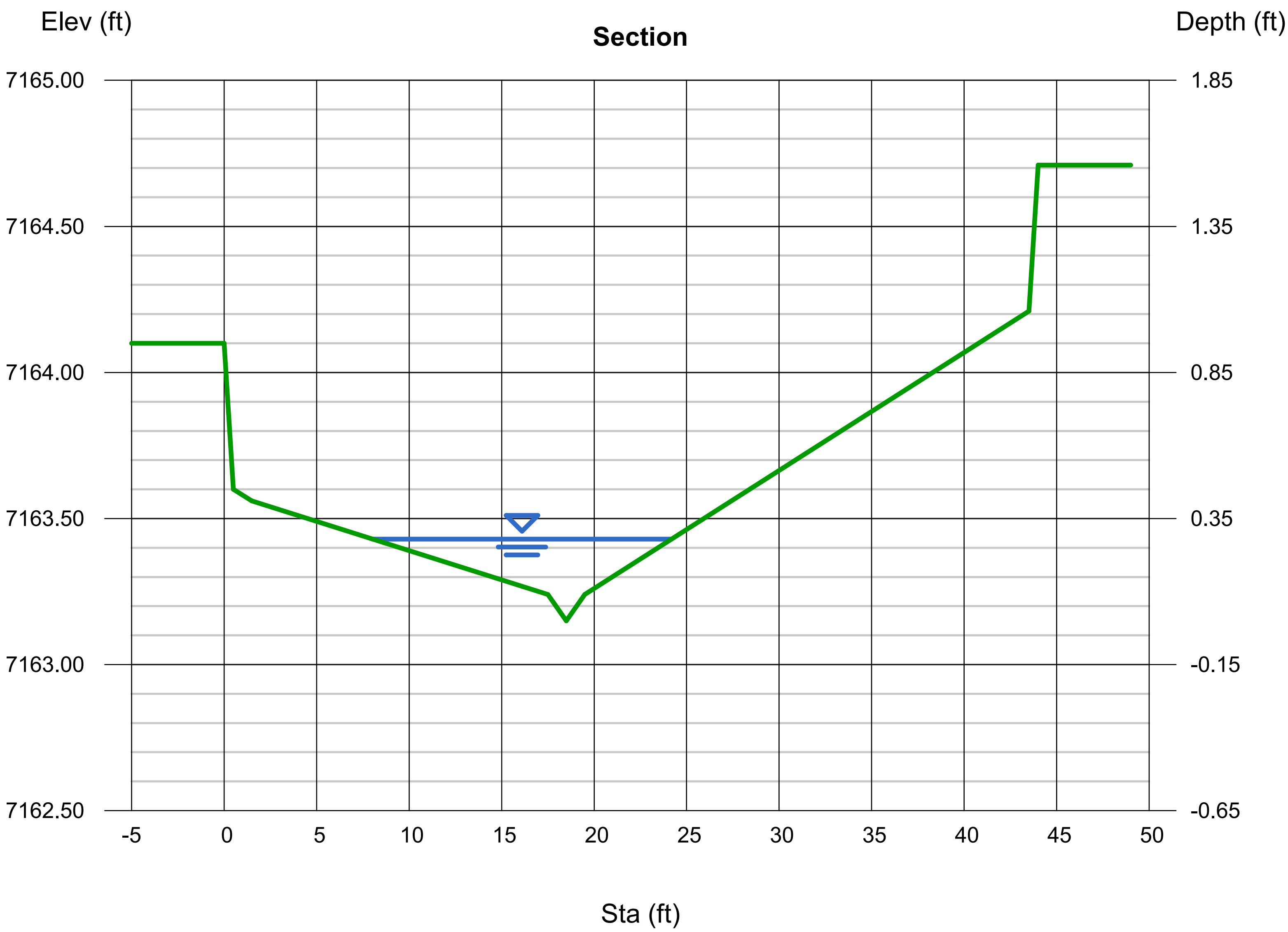
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Sunday, Oct 15 2023

Drainage Pan @ Design Point 1 - 10yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7163.15	Depth (ft)	= 0.28
Slope (%)	= 0.60	Q (cfs)	= 3.400
N-Value	= 0.013	Area (sqft)	= 1.81
		Velocity (ft/s)	= 1.88
Calculations		Wetted Perim (ft)	= 16.18
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.28
Known Q (cfs)	= 3.40	Top Width (ft)	= 16.17
		EGL (ft)	= 0.33

(Sta, El, n)-(Sta, El, n)...

(0.00, 7164.10)-(0.50, 7163.60, 0.013)-(1.50, 7163.56, 0.013)-(17.50, 7163.24, 0.013)-(18.50, 7163.15, 0.013)-(19.50, 7163.24, 0.013)-(43.50, 7164.21, 0.013) -(44.00, 7164.71, 0.013)



Channel Report

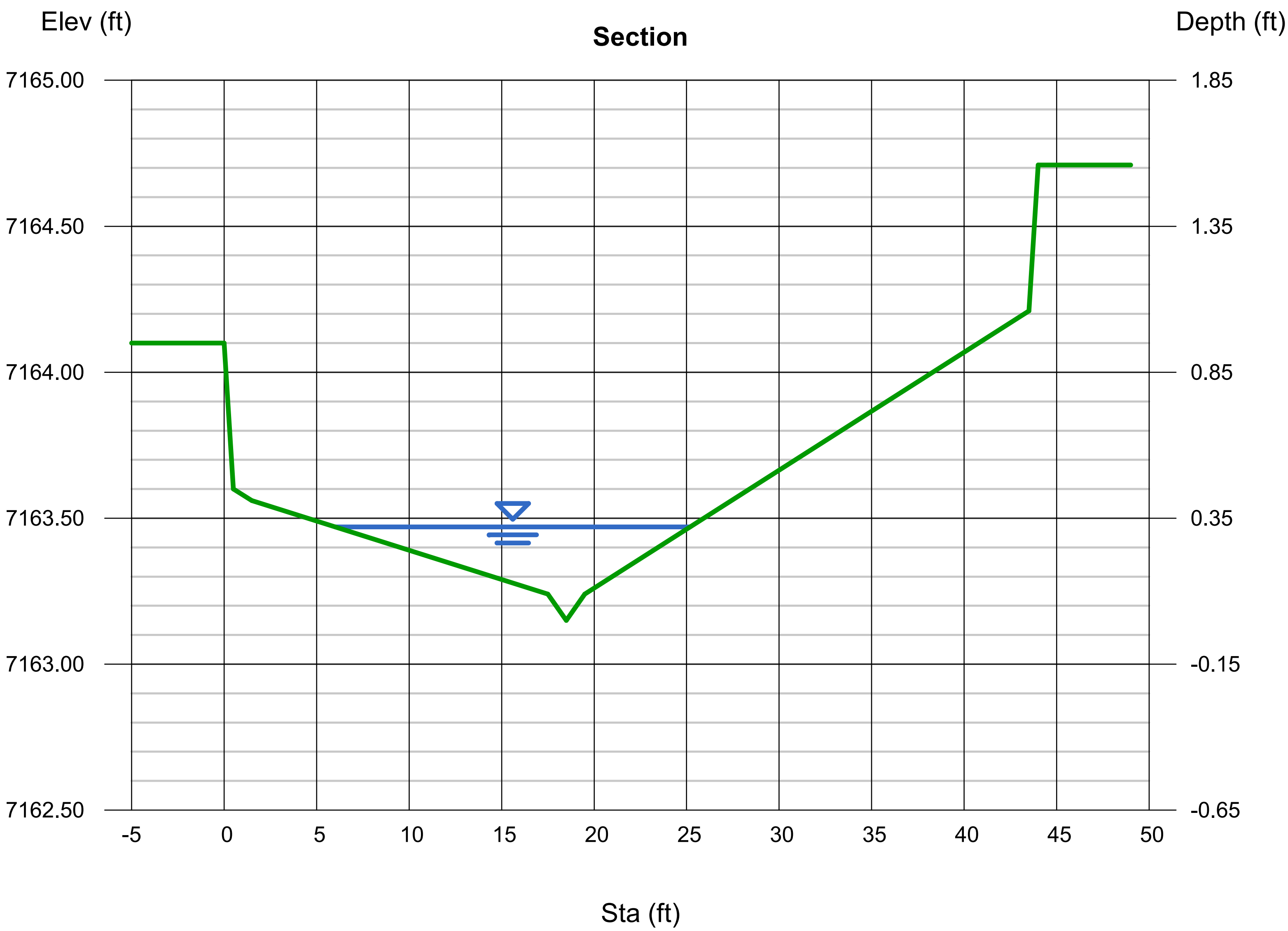
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 15 2023

Drainage Pan @ Design Point 1 - 100yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7163.15	Depth (ft)	= 0.32
Slope (%)	= 0.60	Q (cfs)	= 5.400
N-Value	= 0.013	Area (sqft)	= 2.52
		Velocity (ft/s)	= 2.14
Calculations		Wetted Perim (ft)	= 19.18
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.33
Known Q (cfs)	= 5.40	Top Width (ft)	= 19.16
		EGL (ft)	= 0.39

(Sta, El, n)-(Sta, El, n)...

(0.00, 7164.10)-(0.50, 7163.60, 0.013)-(1.50, 7163.56, 0.013)-(17.50, 7163.24, 0.013)-(18.50, 7163.15, 0.013)-(19.50, 7163.24, 0.013)-(43.50, 7164.21, 0.013)-(44.00, 7164.71, 0.013)



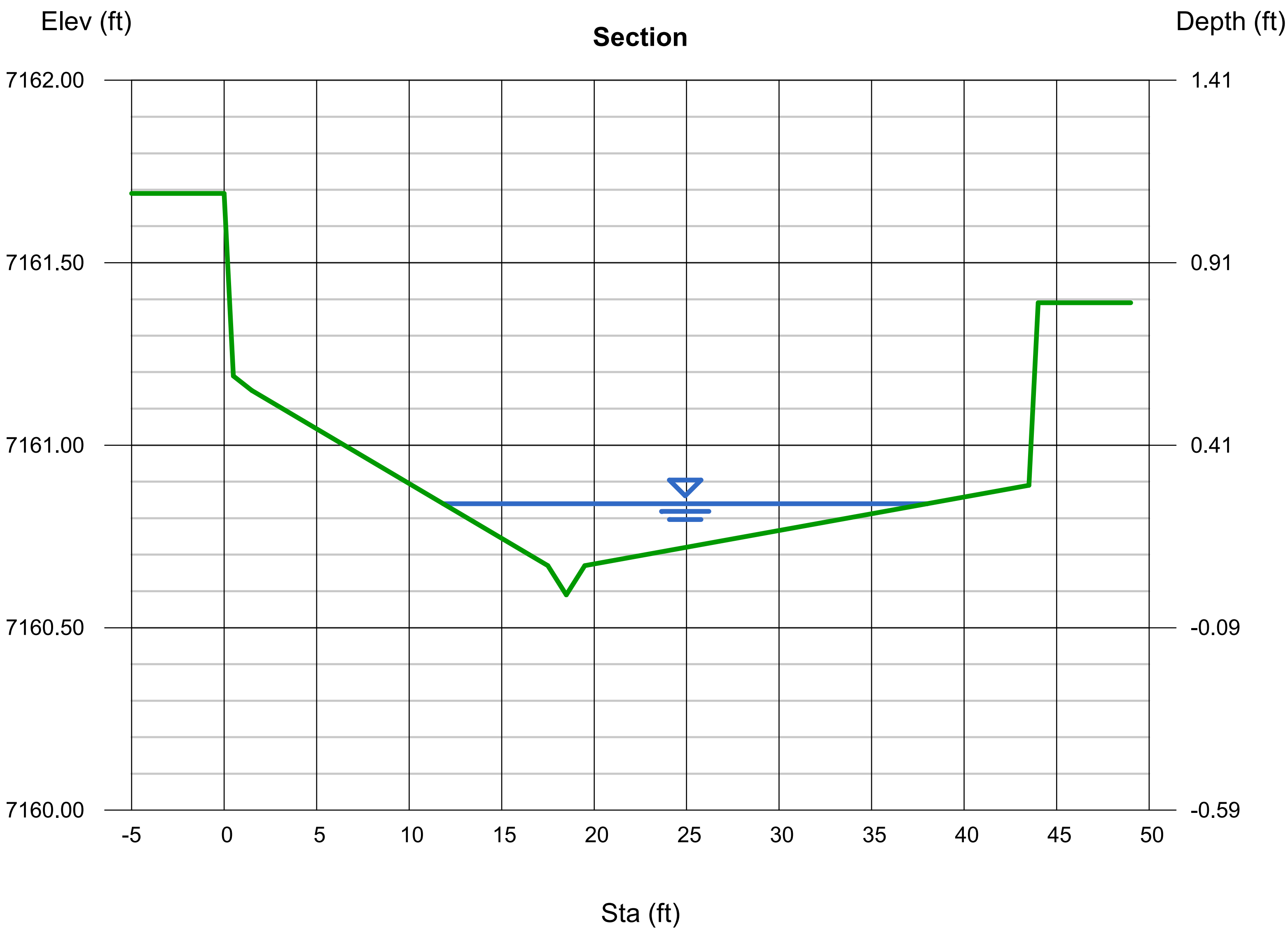
Channel Report

Drainage Pan @ Design Point 2 - 10yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7160.59	Depth (ft)	= 0.25
Slope (%)	= 0.60	Q (cfs)	= 4.500
N-Value	= 0.013	Area (sqft)	= 2.47
		Velocity (ft/s)	= 1.82
Calculations		Wetted Perim (ft)	= 26.19
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.26
Known Q (cfs)	= 4.50	Top Width (ft)	= 26.18
		EGL (ft)	= 0.30

(Sta, El, n)-(Sta, El, n)...

(0.00, 7161.69)-(0.50, 7161.19, 0.013)-(1.50, 7161.15, 0.013)-(17.50, 7160.67, 0.013)-(18.50, 7160.59, 0.013)-(19.50, 7160.67, 0.013)-(43.50, 7160.89, 0.013)-(44.00, 7161.39, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 15 2023

Drainage Pan @ Design Point 2 - 100yr

User-defined

Invert Elev (ft)	= 7160.59
Slope (%)	= 0.60
N-Value	= 0.013

Calculations

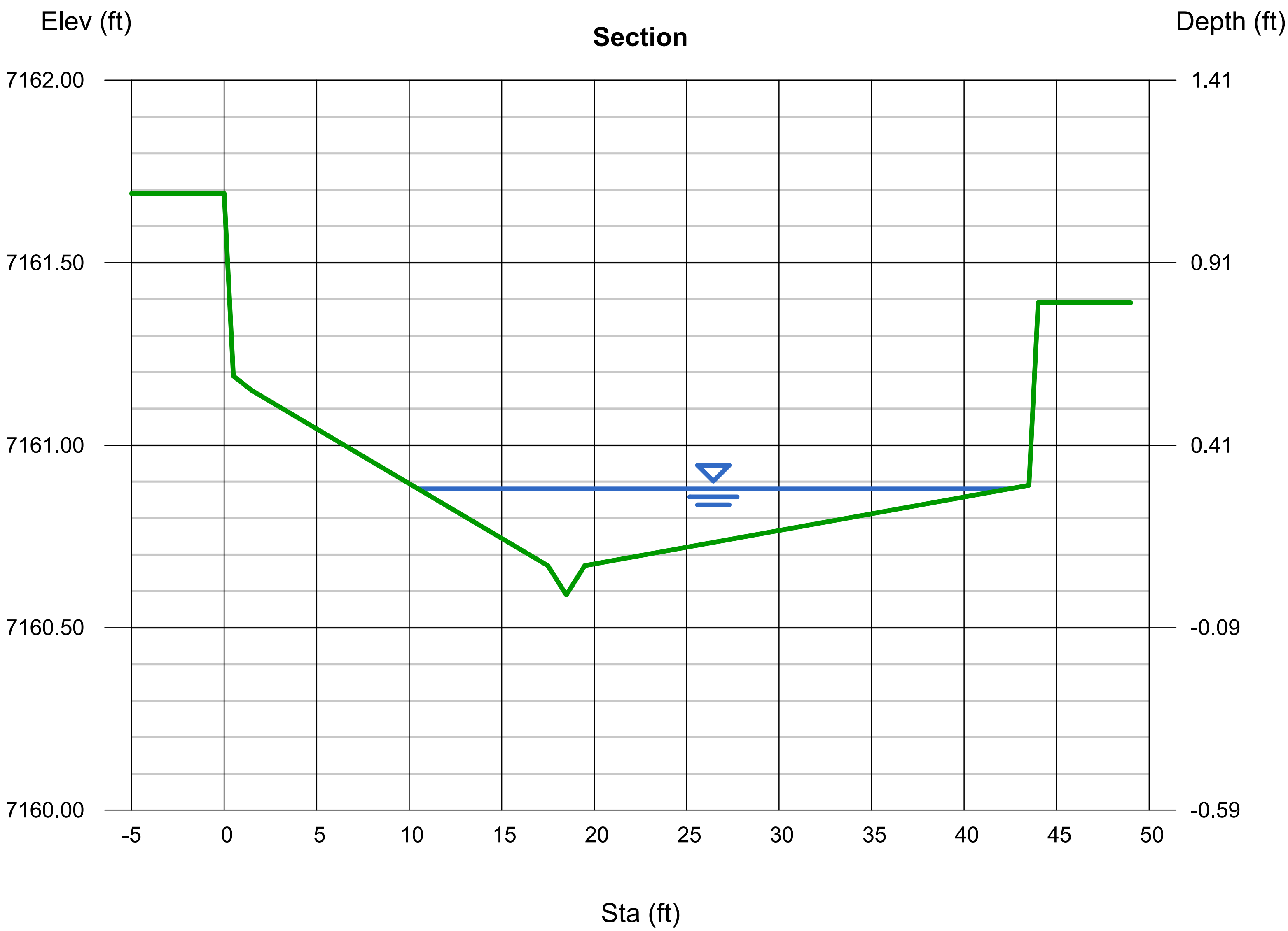
Compute by:	Known Q
Known Q (cfs)	= 7.00

Highlighted

Depth (ft)	= 0.29
Q (cfs)	= 7.000
Area (sqft)	= 3.64
Velocity (ft/s)	= 1.92
Wetted Perim (ft)	= 31.89
Crit Depth, Yc (ft)	= 0.30
Top Width (ft)	= 31.88
EGL (ft)	= 0.35

(Sta, El, n)-(Sta, El, n)...

(0.00, 7161.69)-(0.50, 7161.19, 0.013)-(1.50, 7161.15, 0.013)-(17.50, 7160.67, 0.013)-(18.50, 7160.59, 0.013)-(19.50, 7160.67, 0.013)-(43.50, 7160.89, 0.013) -(44.00, 7161.39, 0.013)

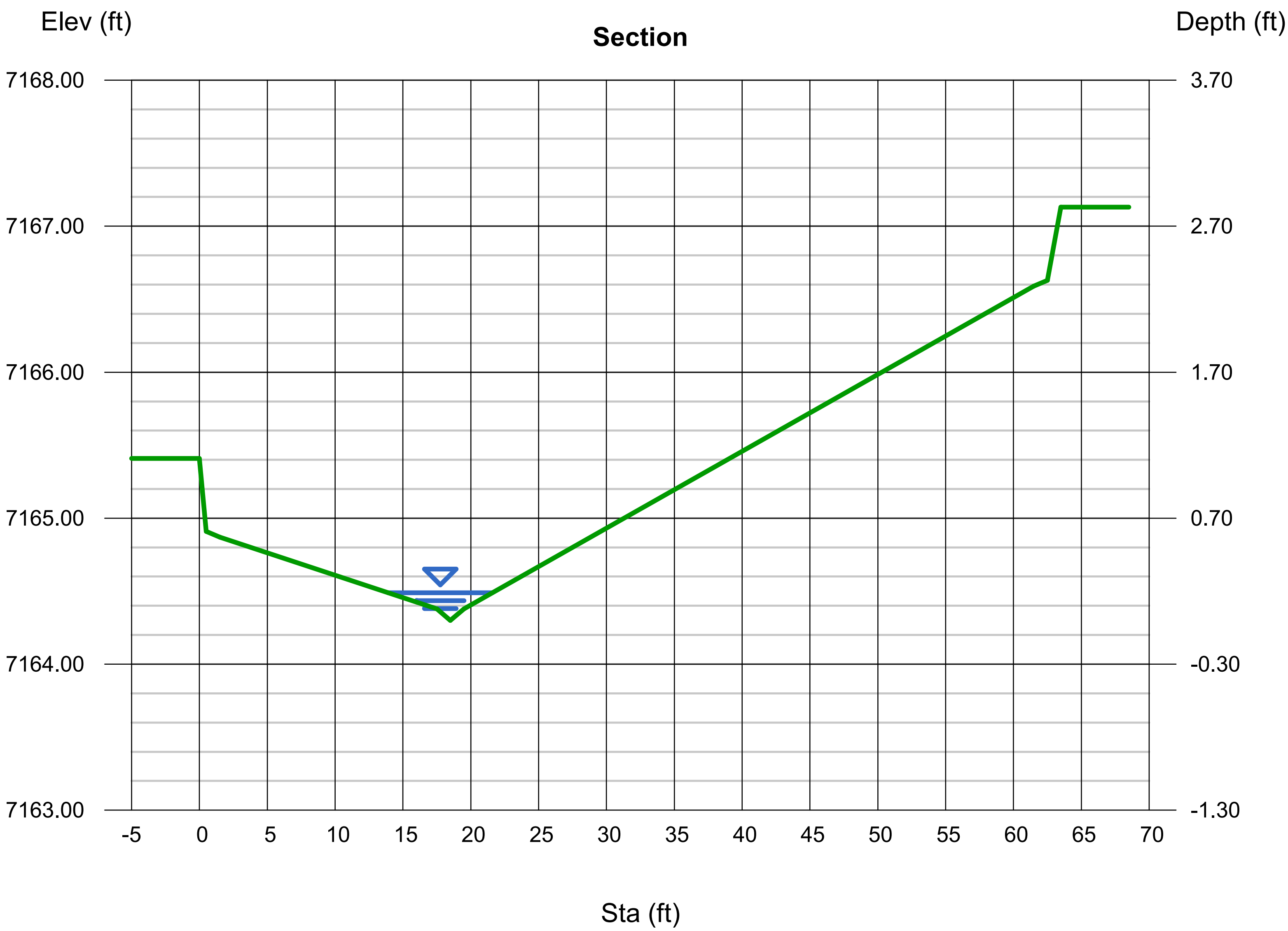


Channel Report

Drainage Pan @ Design Point 6 - 10yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7164.30	Depth (ft)	= 0.19
Slope (%)	= 1.00	Q (cfs)	= 1.200
N-Value	= 0.013	Area (sqft)	= 0.61
		Velocity (ft/s)	= 1.96
Calculations		Wetted Perim (ft)	= 7.68
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.21
Known Q (cfs)	= 1.20	Top Width (ft)	= 7.67
		EGL (ft)	= 0.25

(Sta, El, n)-(Sta, El, n)...
(0.00, 7165.41)-(0.50, 7164.91, 0.013)-(1.50, 7164.87, 0.013)-(17.50, 7164.38, 0.013)-(18.50, 7164.30, 0.013)-(19.50, 7164.38, 0.013)-(61.50, 7166.59, 0.013)
-(62.50, 7166.63, 0.013)-(63.50, 7167.13, 0.013)



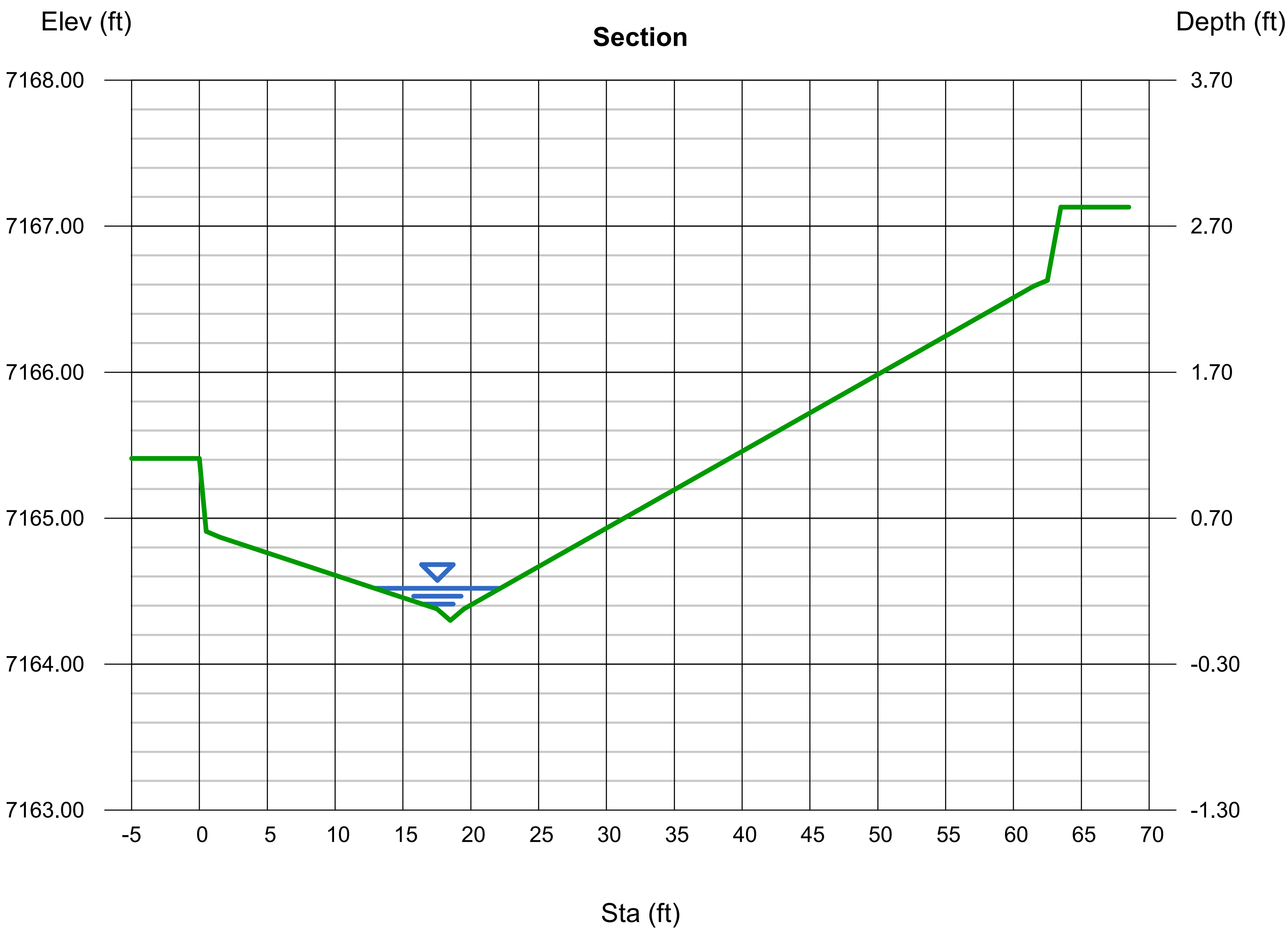
Channel Report

Drainage Pan @ Design Point 6 - 100yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7164.30	Depth (ft)	= 0.22
Slope (%)	= 1.00	Q (cfs)	= 2.000
N-Value	= 0.013	Area (sqft)	= 0.87
		Velocity (ft/s)	= 2.31
Calculations		Wetted Perim (ft)	= 9.25
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.25
Known Q (cfs)	= 2.00	Top Width (ft)	= 9.24
		EGL (ft)	= 0.30

(Sta, El, n)-(Sta, El, n)...

(0.00, 7165.41)-(0.50, 7164.91, 0.013)-(1.50, 7164.87, 0.013)-(17.50, 7164.38, 0.013)-(18.50, 7164.30, 0.013)-(19.50, 7164.38, 0.013)-(61.50, 7166.59, 0.013)
-(62.50, 7166.63, 0.013)-(63.50, 7167.13, 0.013)



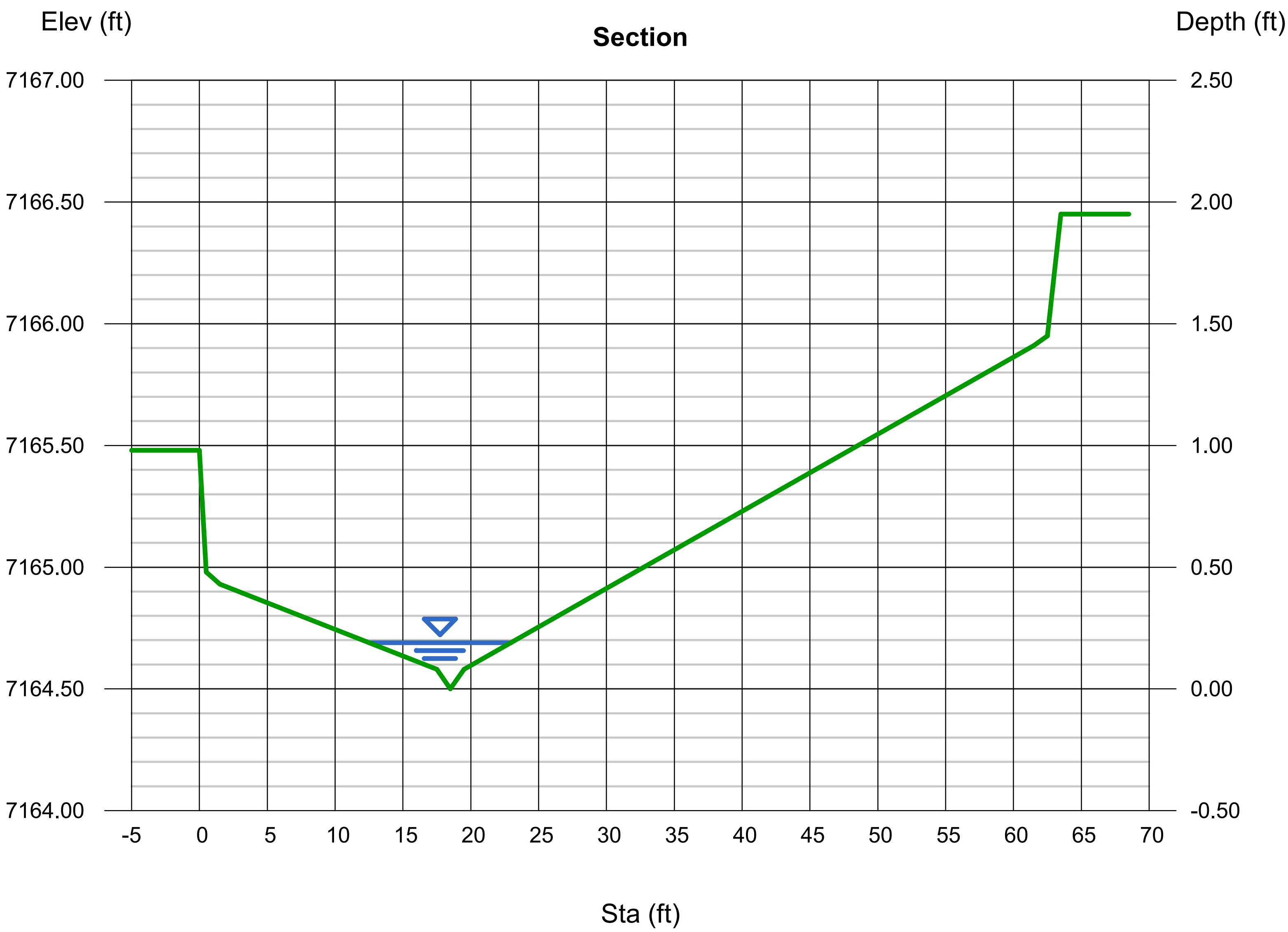
Channel Report

Drainage Pan @ Design Point 7 - 10yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7164.50	Depth (ft)	= 0.19
Slope (%)	= 1.00	Q (cfs)	= 1.400
N-Value	= 0.013	Area (sqft)	= 0.77
		Velocity (ft/s)	= 1.83
Calculations		Wetted Perim (ft)	= 10.50
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.21
Known Q (cfs)	= 1.40	Top Width (ft)	= 10.49
		EGL (ft)	= 0.24

(Sta, El, n)-(Sta, El, n)...

(0.00, 7165.48)-(0.50, 7164.98, 0.013)-(1.50, 7164.93, 0.013)-(17.50, 7164.58, 0.013)-(18.50, 7164.50, 0.013)-(19.50, 7164.58, 0.013)-(61.50, 7165.91, 0.013)
-(62.50, 7165.95, 0.013)-(63.50, 7166.45, 0.013)



Channel Report

Drainage Pan @ Design Point 7 - 100yr

User-defined

Invert Elev (ft)	= 7164.50
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

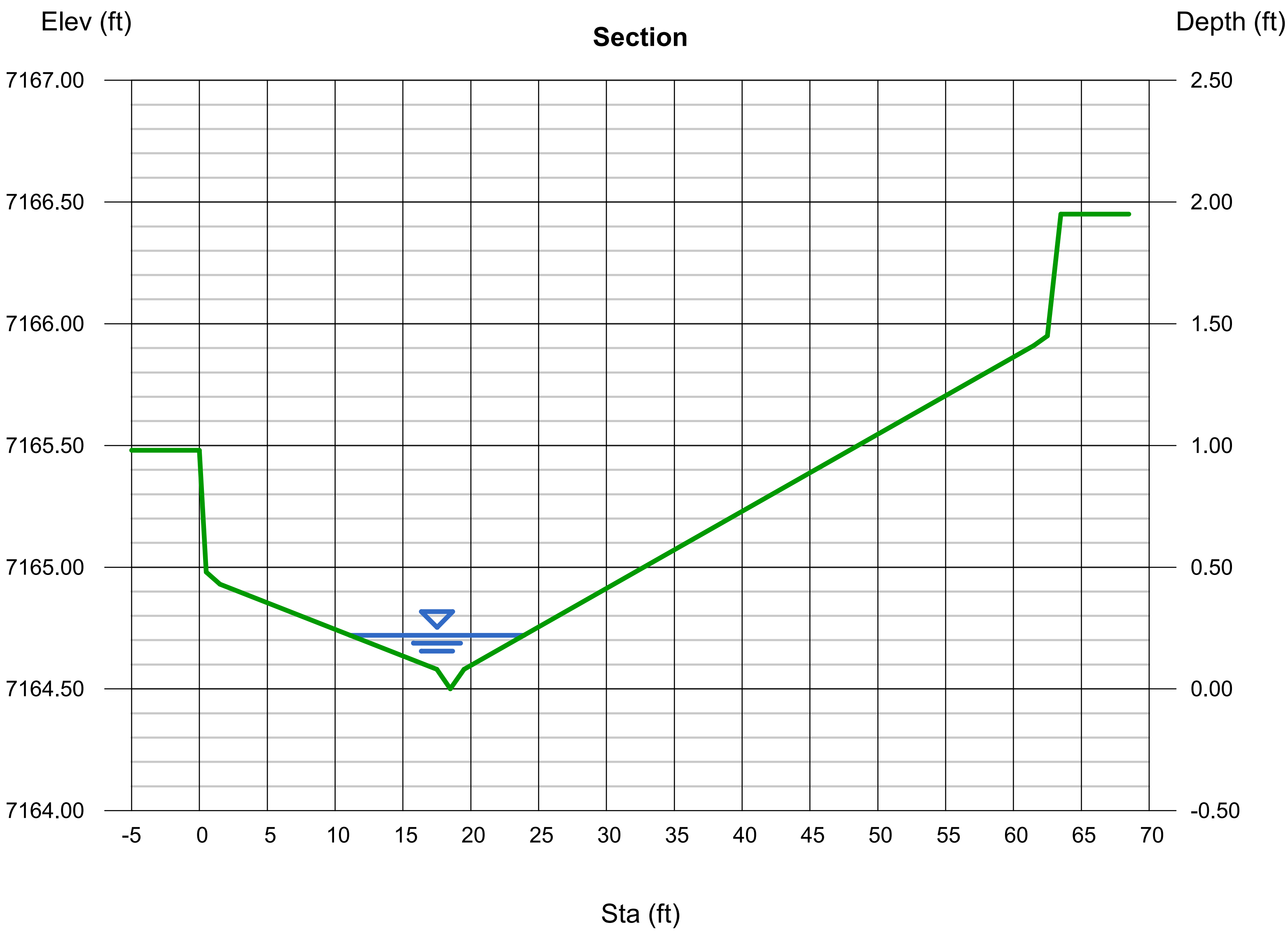
Compute by:	Known Q
Known Q (cfs)	= 2.40

Highlighted

Depth (ft)	= 0.22
Q (cfs)	= 2.400
Area (sqft)	= 1.12
Velocity (ft/s)	= 2.14
Wetted Perim (ft)	= 12.84
Crit Depth, Yc (ft)	= 0.24
Top Width (ft)	= 12.83
EGL (ft)	= 0.29

(Sta, El, n)-(Sta, El, n)...

(0.00, 7165.48)-(0.50, 7164.98, 0.013)-(1.50, 7164.93, 0.013)-(17.50, 7164.58, 0.013)-(18.50, 7164.50, 0.013)-(19.50, 7164.58, 0.013)-(61.50, 7165.91, 0.013)-(62.50, 7165.95, 0.013)-(63.50, 7166.45, 0.013)



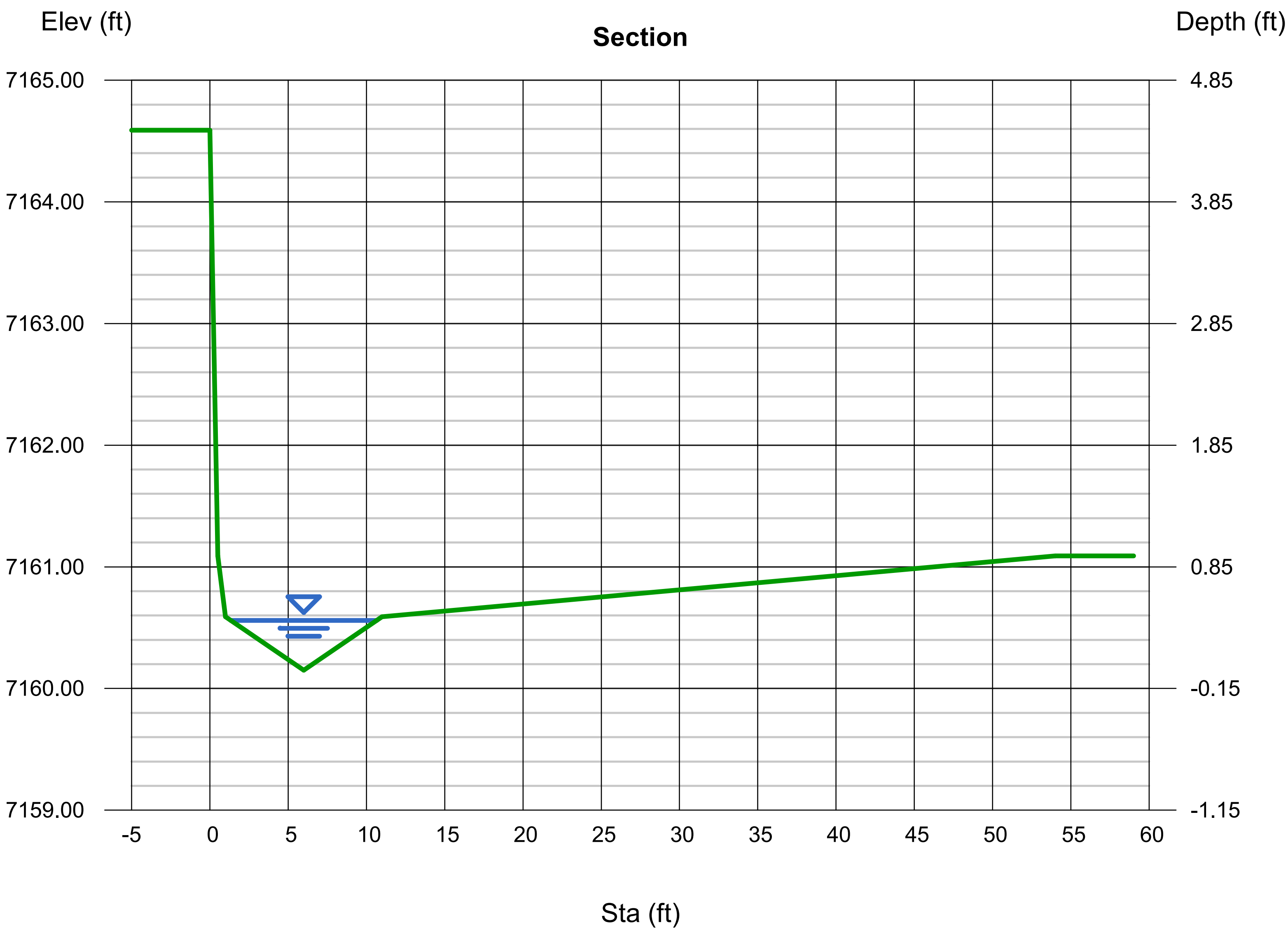
Channel Report

Drainage Pan @ Design Point 8 - 10yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7160.15	Depth (ft)	= 0.41
Slope (%)	= 0.60	Q (cfs)	= 5.800
N-Value	= 0.013	Area (sqft)	= 1.91
		Velocity (ft/s)	= 3.03
Calculations		Wetted Perim (ft)	= 9.36
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.44
Known Q (cfs)	= 5.80	Top Width (ft)	= 9.32
		EGL (ft)	= 0.55

(Sta, El, n)-(Sta, El, n)...

(0.00, 7164.59)-(0.50, 7161.09, 0.013)-(1.00, 7160.59, 0.013)-(6.00, 7160.15, 0.013)-(11.00, 7160.59, 0.013)-(54.00, 7161.09, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 15 2023

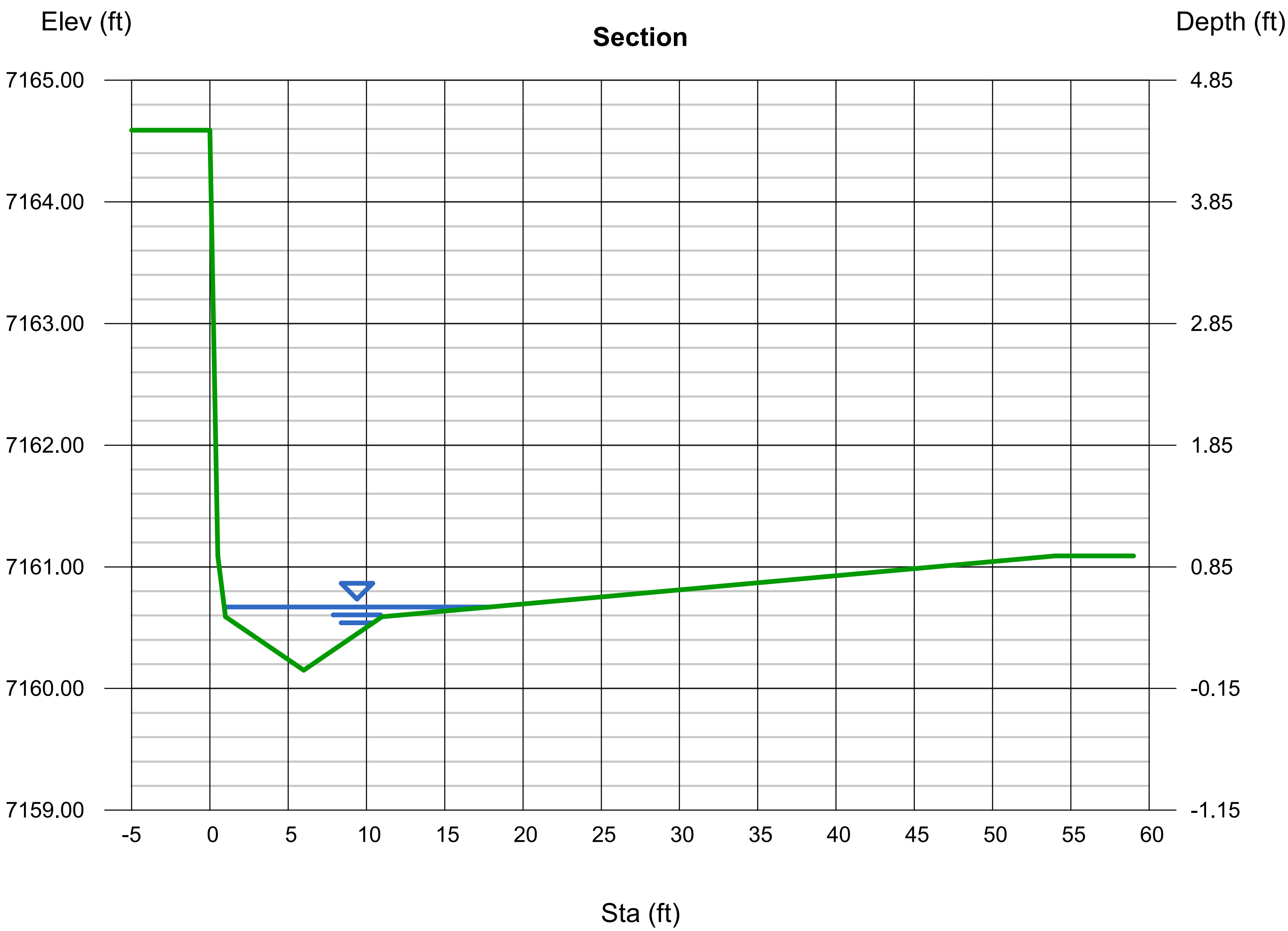
Drainage Pan @ Design Point 8 - 100yr

User-defined
Invert Elev (ft) = 7160.15
Slope (%) = 0.60
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 9.30

Highlighted
Depth (ft) = 0.52
Q (cfs) = 9.300
Area (sqft) = 3.28
Velocity (ft/s) = 2.84
Wetted Perim (ft) = 17.04
Crit Depth, Yc (ft) = 0.55
Top Width (ft) = 16.97
EGL (ft) = 0.65

(Sta, El, n)-(Sta, El, n)...
(0.00, 7164.59)-(0.50, 7161.09, 0.013)-(1.00, 7160.59, 0.013)-(6.00, 7160.15, 0.013)-(11.00, 7160.59, 0.013)-(54.00, 7161.09, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 15 2023

Drainage Pan @ Design Point 10 - 10yr

User-defined

Invert Elev (ft)	=	7156.46
Slope (%)	=	0.60
N-Value	=	0.013

Calculations

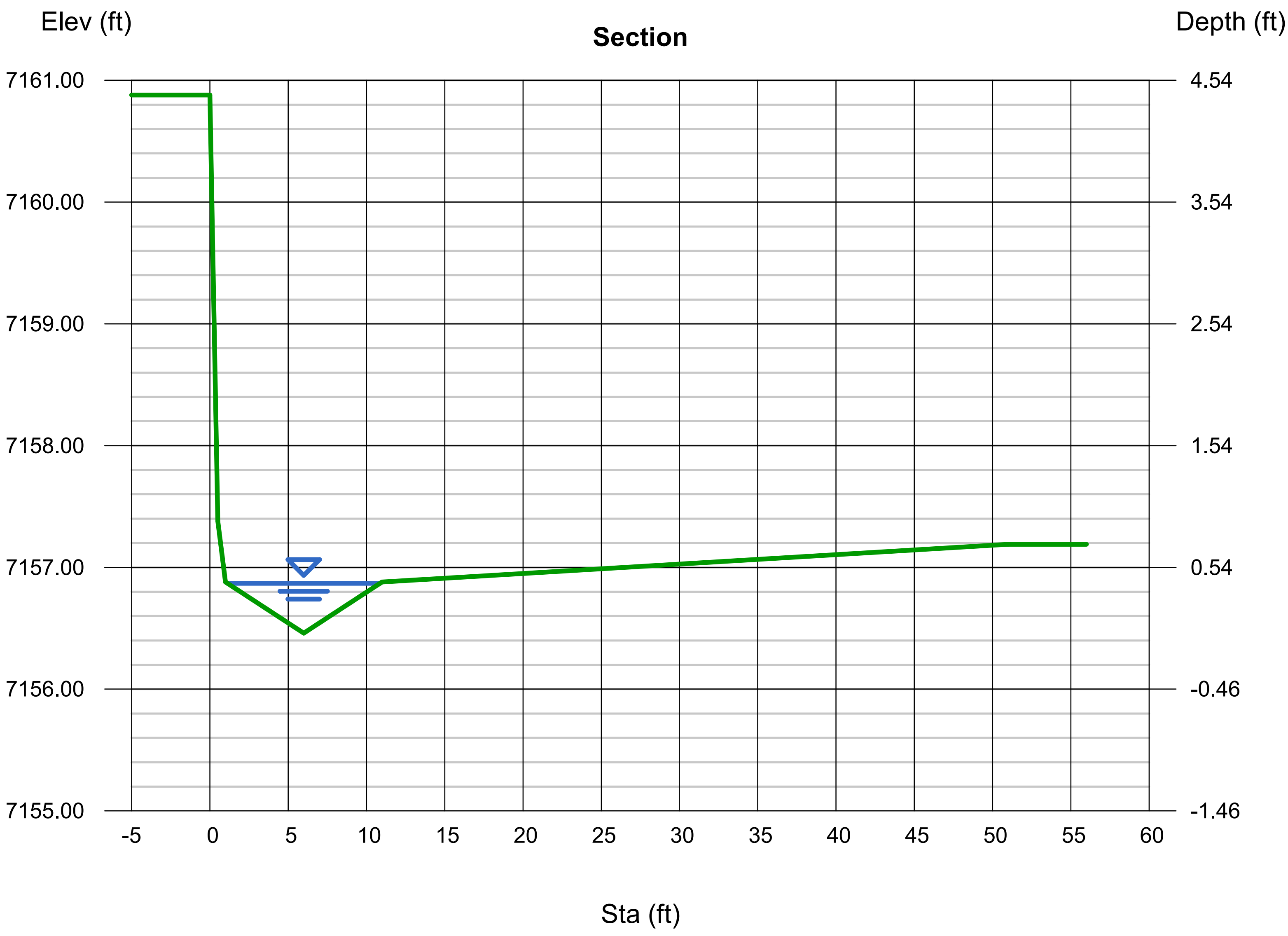
Compute by:		Known Q
Known Q (cfs)	=	6.00

Highlighted

Depth (ft)	=	0.41
Q (cfs)	=	6.000
Area (sqft)	=	2.00
Velocity (ft/s)	=	3.00
Wetted Perim (ft)	=	9.80
Crit Depth, Yc (ft)	=	0.46
Top Width (ft)	=	9.77
EGL (ft)	=	0.55

(Sta, El, n)-(Sta, El, n)...

(0.00, 7160.88)-(0.50, 7157.38, 0.013)-(1.00, 7156.88, 0.013)-(6.00, 7156.46, 0.013)-(11.00, 7156.88, 0.013)-(51.00, 7157.19, 0.013)

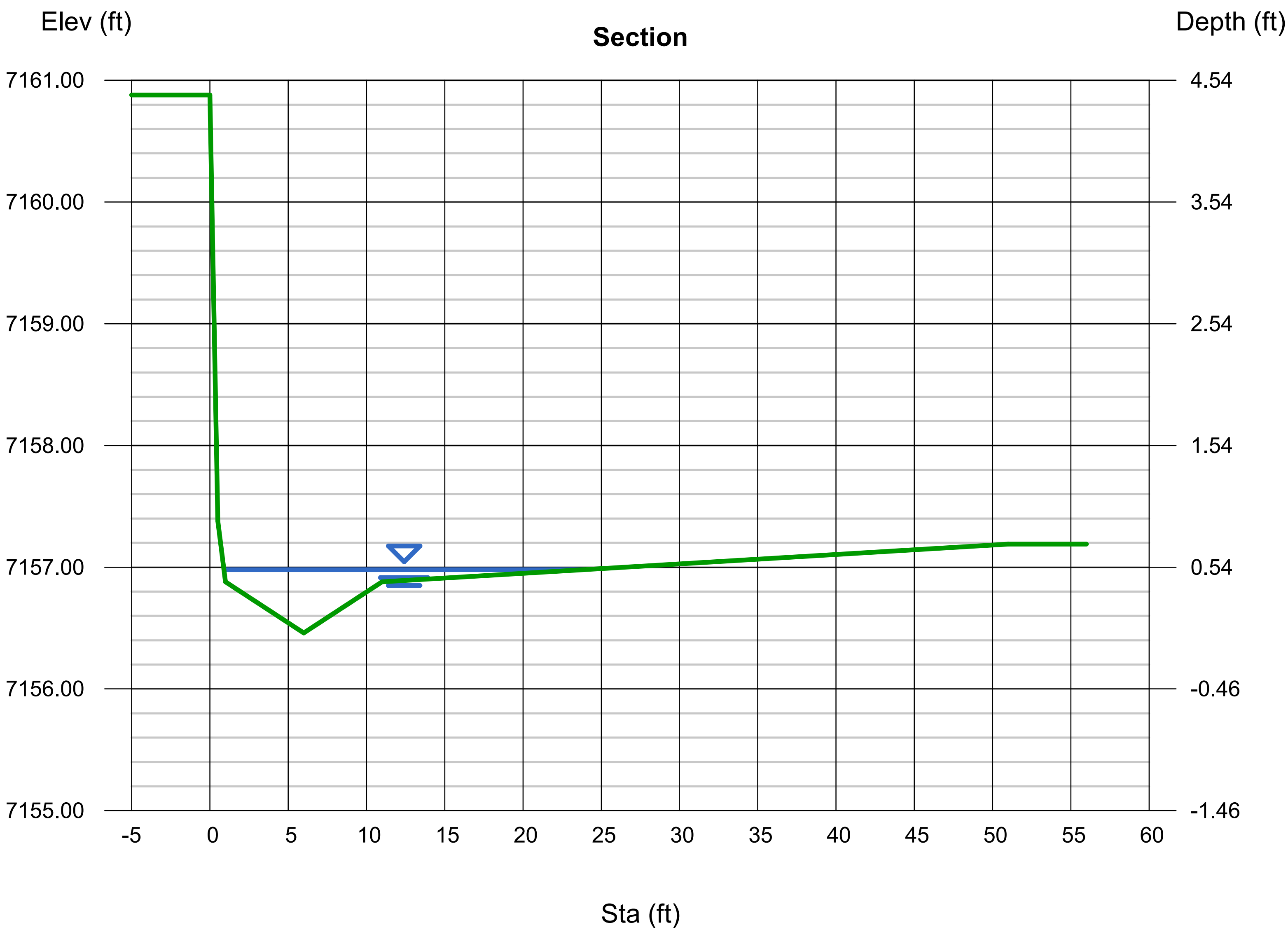


Channel Report

Drainage Pan @ Design Point 10 - 100yr

User-defined		**Highlighted**	
Invert Elev (ft)	= 7156.46	Depth (ft)	= 0.52
Slope (%)	= 0.60	Q (cfs)	= 9.800
N-Value	= 0.013	Area (sqft)	= 3.75
		Velocity (ft/s)	= 2.61
Calculations		Wetted Perim (ft)	= 23.09
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.55
Known Q (cfs)	= 9.80	Top Width (ft)	= 23.01
		EGL (ft)	= 0.63

(Sta, El, n)-(Sta, El, n)...
(0.00, 7160.88)-(0.50, 7157.38, 0.013)-(1.00, 7156.88, 0.013)-(6.00, 7156.46, 0.013)-(11.00, 7156.88, 0.013)-(51.00, 7157.19, 0.013)



Culvert Report

Drainage Chase @ Design Point 3

Invert Elev Dn (ft)	=	7157.72
Pipe Length (ft)	=	9.00
Slope (%)	=	3.33
Invert Elev Up (ft)	=	7158.02
Rise (in)	=	6.0
Shape	=	Box
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

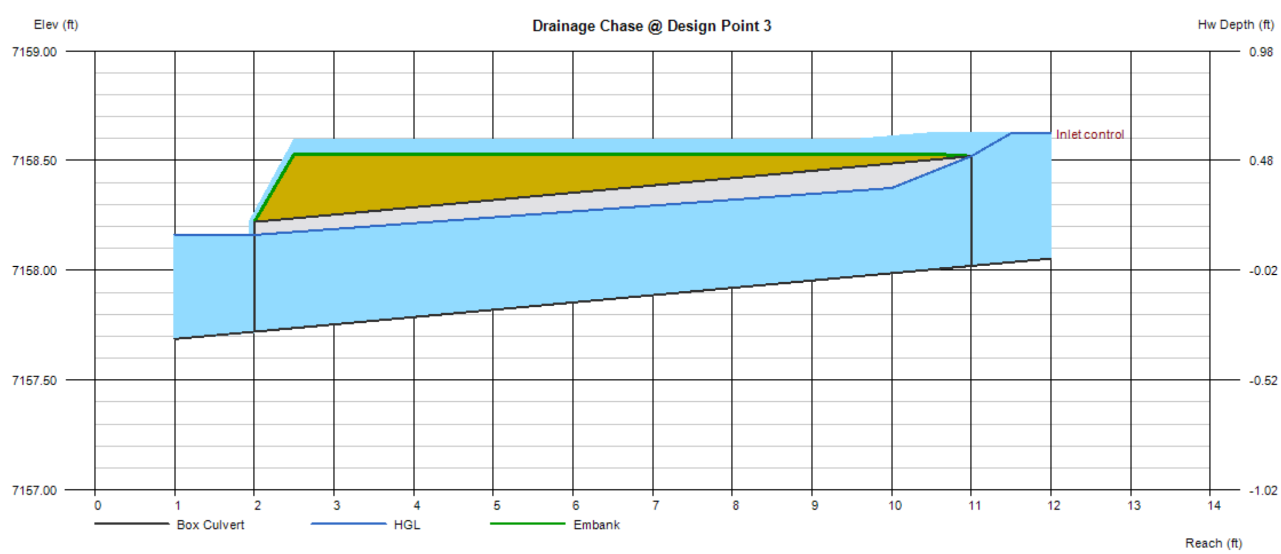
Top Elevation (ft)	=	7158.53
Top Width (ft)	=	8.00
Crest Width (ft)	=	3.00

Calculations

Qmin (cfs)	=	2.78
Qmax (cfs)	=	4.28
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

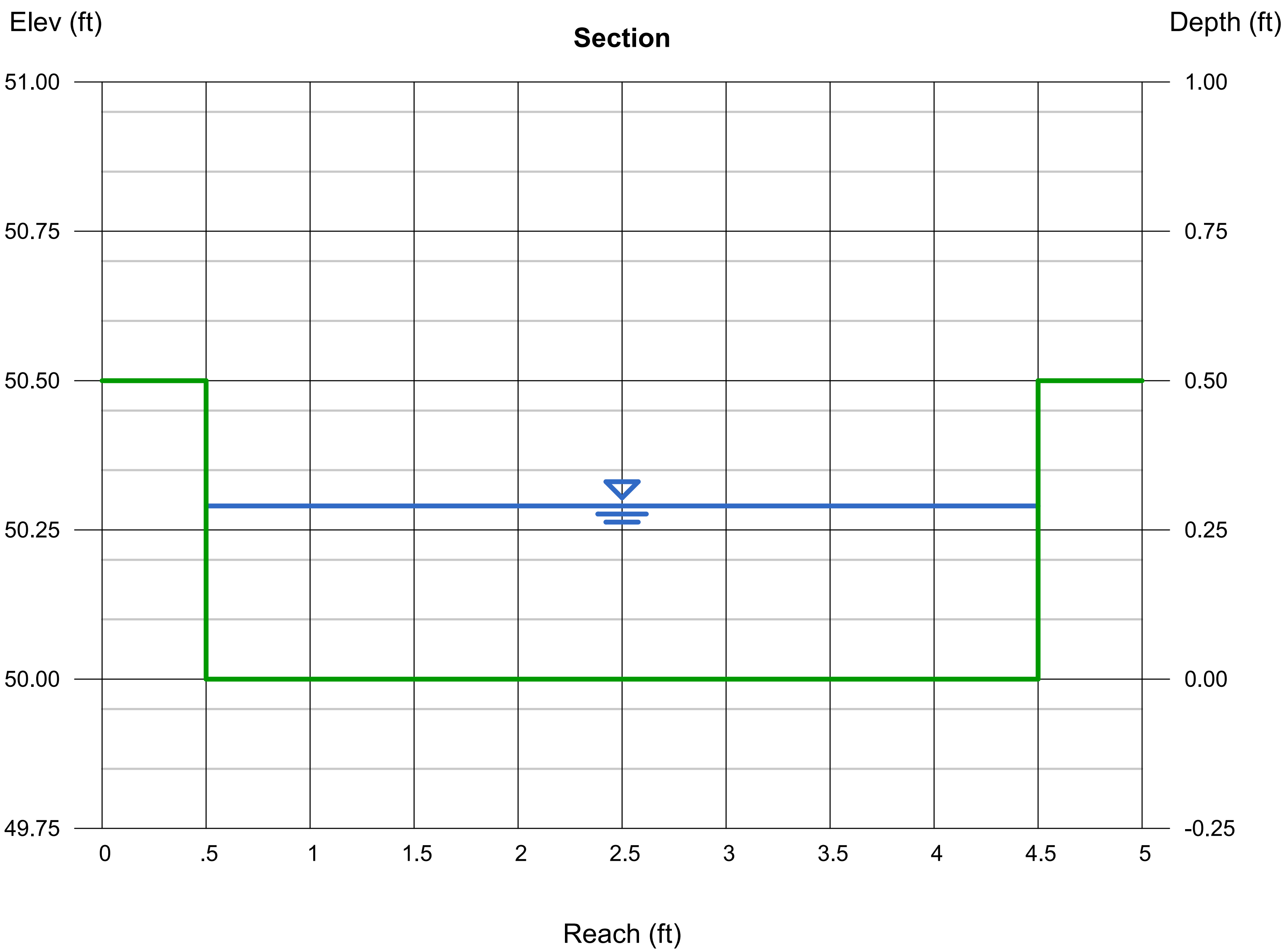
Qtotal (cfs)	=	4.24
Qpipe (cfs)	=	4.01
Qovertop (cfs)	=	0.23
Veloc Dn (ft/s)	=	3.03
Veloc Up (ft/s)	=	3.50
HGL Dn (ft)	=	7158.16
HGL Up (ft)	=	7158.40
Hw Elev (ft)	=	7158.63
Hw/D (ft)	=	1.21
Flow Regime	=	Inlet Control



Channel Report

Detention Pond Trickle Channel

Rectangular			**Highlighted**		
Bottom Width (ft)	=	4.00	Depth (ft)	=	0.29
Total Depth (ft)	=	0.50	Q (cfs)	=	5.200
			Area (sqft)	=	1.16
Invert Elev (ft)	=	50.00	Velocity (ft/s)	=	4.48
Slope (%)	=	1.00	Wetted Perim (ft)	=	4.58
N-Value	=	0.013	Crit Depth, Yc (ft)	=	0.38
			Top Width (ft)	=	4.00
Calculations			EGL (ft)	=	0.60
Compute by:		Known Q			
Known Q (cfs)	=	5.20			



Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: Cameron Salz
Company: Redland Consultants
Date: November 15, 2023
Project: The Rock Commerce Center
Location: Monument Hill Road - Road Side Ditch

1. Design Discharge for 2-Year Return Period	Q_2 = 0.20 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 100.0 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR}= 2.5 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.070 ft / ft
B) Design Slope	S_D = 0.070 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 25.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 0.00 ft
5. Vegetation	Choose One
A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	◉ Grass From Seed ○ Grass From Sod
6. Design Velocity (0.333 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.66 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.11 ft
A) Flow Area	A_2 = 0.3 sq ft
B) Top Width of Swale	W_T = 5.5 ft
C) Froude Number (0.50 maximum)	F = 0.50
D) Hydraulic Radius	R_H = 0.05
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.04
F) Manning's n (based on SCS vegetal retardance curve E for seeded grass)	n = 0.080
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One ○ YES ◉ NO
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One ◉ Temporary ○ Permanent

Notes:

Culvert Report

DRAINAGE CHASE FOR ROOF DRAIN (TYP.)

Invert Elev Dn (ft)	=	7157.72
Pipe Length (ft)	=	9.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7157.90
Rise (in)	=	6.0
Shape	=	Box
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	90D Headwall, Chamfered or Beveled Inlet Edges
Culvert Entrance	=	90D headwall w/3/4-in chamfers
Coeff. K,M,c,Y,k	=	0.515, 0.667, 0.0375, 0.79, 0.2

Embankment

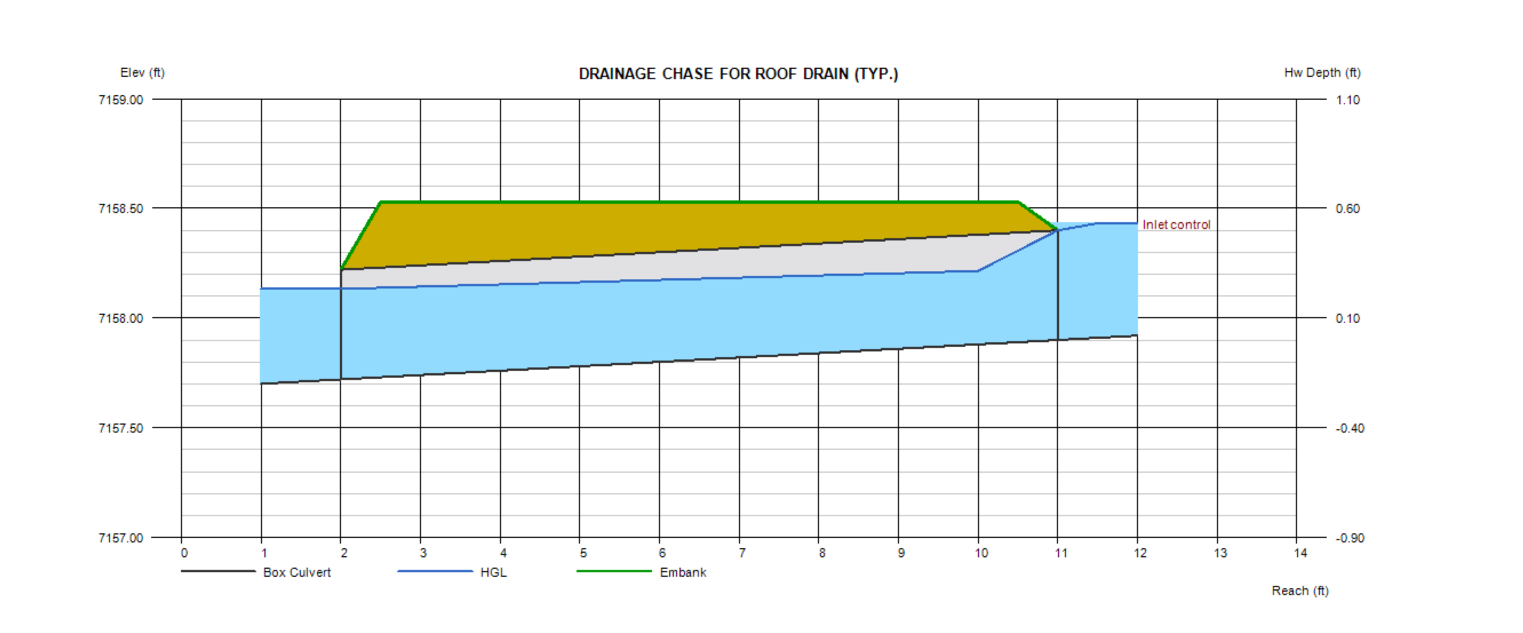
Top Elevation (ft)	=	7158.53
Top Width (ft)	=	8.00
Crest Width (ft)	=	2.00

Calculations

Qmin (cfs)	=	1.30
Qmax (cfs)	=	2.10
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2.10
Qpipe (cfs)	=	2.10
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	2.54
Veloc Up (ft/s)	=	3.23
HGL Dn (ft)	=	7158.13
HGL Up (ft)	=	7158.23
Hw Elev (ft)	=	7158.43
Hw/D (ft)	=	1.06
Flow Regime	=	Inlet Control



Culvert Report

Existing Culvert @ Design Point A

Invert Elev Dn (ft)	= 7165.30
Pipe Length (ft)	= 30.00
Slope (%)	= 4.67
Invert Elev Up (ft)	= 7166.70
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

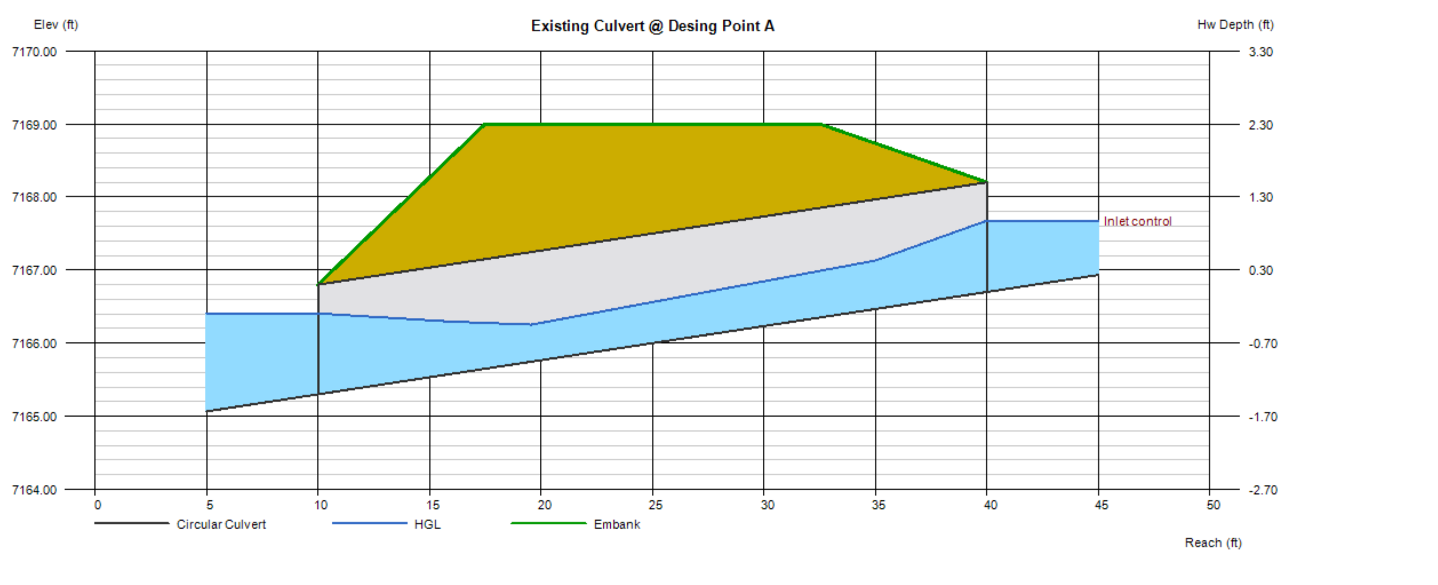
Top Elevation (ft)	= 7169.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 15.00

Calculations

Qmin (cfs)	= 2.05
Qmax (cfs)	= 3.51
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 3.51
Qpipe (cfs)	= 3.51
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.51
Veloc Up (ft/s)	= 4.23
HGL Dn (ft)	= 7166.41
HGL Up (ft)	= 7167.42
Hw Elev (ft)	= 7167.68
Hw/D (ft)	= 0.65
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Oct 16 2023

Existing Culvert @ Design Point B

Invert Elev Dn (ft)	= 7131.50
Pipe Length (ft)	= 65.00
Slope (%)	= 1.08
Invert Elev Up (ft)	= 7132.20
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

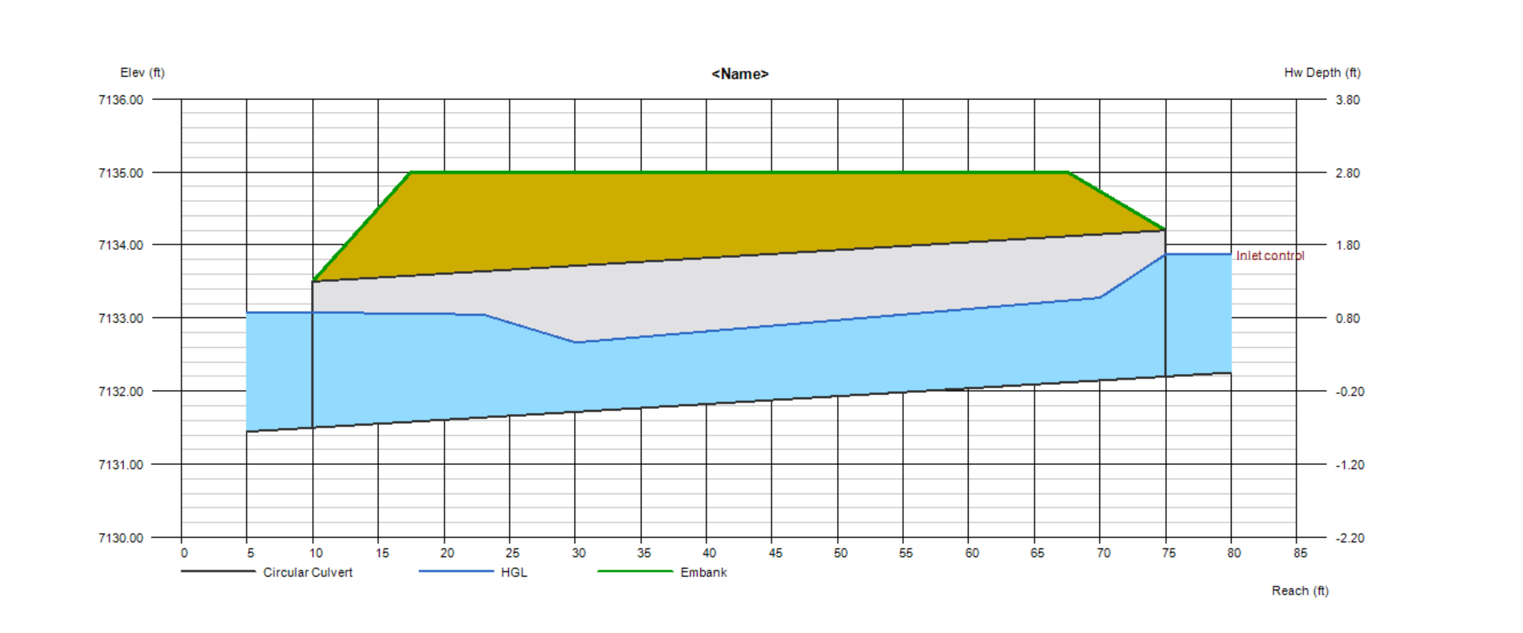
Top Elevation (ft)	= 7135.00
Top Width (ft)	= 50.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 3.40
Qmax (cfs)	= 10.40
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 10.40
Qpipe (cfs)	= 10.40
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.91
Veloc Up (ft/s)	= 5.54
HGL Dn (ft)	= 7133.08
HGL Up (ft)	= 7133.35
Hw Elev (ft)	= 7133.87
Hw/D (ft)	= 0.83
Flow Regime	= Inlet Control

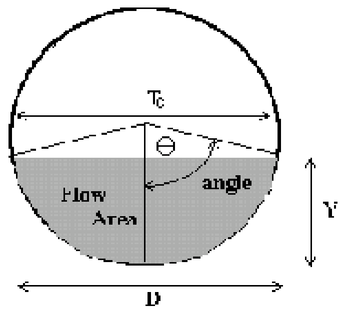


CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: P-23009 The Rock Commerce Center

Pipe ID: Pipe at Design Point O-2



Design Information (Input)			
Pipe Invert Slope	So =	0.0059	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	1.31	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	8.09	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.10	radians
Flow area	An =	0.39	sq ft
Top width	Tn =	1.34	ft
Wetted perimeter	Pn =	1.65	ft
Flow depth	Yn =	0.41	ft
Flow velocity	Vn =	3.37	fps
Discharge	Qn =	1.31	cfs
Percent of Full Flow	Flow =	16.2%	of full flow
Normal Depth Froude Number	Fr_n =	1.10	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.13	radians
Critical flow area	Ac =	0.42	sq ft
Critical top width	Tc =	1.36	ft
Critical flow depth	Yc =	0.43	ft
Critical flow velocity	Vc =	3.15	fps
Critical Depth Froude Number	Fr_c =	1.00	

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Cameron Salz**
Company:	**Redland**
Date:	**October 16, 2023**
Project:	**The Rock Commerce Center**
Location:	**El Paso County**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 77.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.770

C) Contributing Watershed Area — Area = 11.380 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}= 0.294 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 = 0 %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 100 %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 0 %

J) Excess Urban Runoff Volume (EURV) Design Volume — $EURV_{DESIGN}$ = 0.973 ac-f t
- For HSG A: $EURV_A = 1.68 * i^{1.28}$
- For HSG B: $EURV_B = 1.36 * i^{1.08}$
- For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$

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 = 3.00 ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

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 = 0.020 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} = 54.14 cfs
- ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.08 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 = 5.7 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Cameron Salz
Company: Redland
Date: October 16, 2023
Project: The Rock Commerce Center
Location: El Paso County

6. Trickle Channel	
A) Type of Trickle Channel	Choose One: (●) Concrete ( ) Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 10 sq ft
C) Outlet Type	Choose One: (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.36 inches
E) Total Outlet Area	A_{ot} = 0.85 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 38 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 3.3 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 29 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.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
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} = 41 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 6.06 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 100.72 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Cameron Salz**
Company:	**Redland**
Date:	**October 16, 2023**
Project:	**The Rock Commerce Center**
Location:	**El Paso County**

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 = 4.00 ft / ft

11. Vegetation

Choose One
- ○ Irrigated
- ◉ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

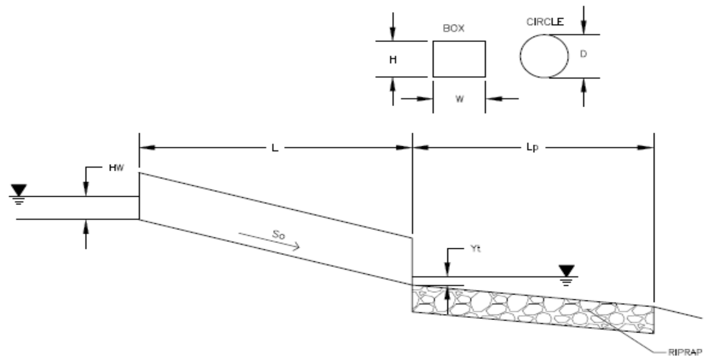
Notes:

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: P-23009 The Rock Commerce Center

ID: Pond Invert O-2



Soil Type:

Choose One:
- ○ Sandy
- ◉ Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	1.31	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)	Grooved Edge Projecting		
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7137.26	ft
Outlet Elevation **OR** Slope	Elev OUT =	7137	ft
Culvert Length	L =	32	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	7137.61	ft
Max Allowable Channel Velocity	V =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.36	ft
Culvert Critical Depth	Y_c =	0.43	ft
Froude Number	Fr =	1.39	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.49	
Sum of All Loss Coefficients	k_s =	1.69	ft
Headwater:			
Inlet Control Headwater	HW_I =	0.58	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**N/A**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**N/A**	

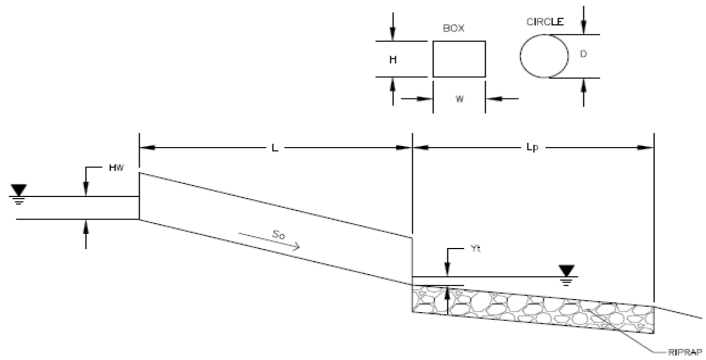
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	0.48	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.61	ft
Tailwater/Diameter	Yt/D =	0.41	
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow Area at Max Channel Velocity	A_t =	0.19	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**5**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	0.93	ft
Minimum Theoretical Riprap Size	d_{50} min=	1	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: P-23009 The Rock Commerce Center
ID: Culvert at Design Point O-3



Soil Type:
Choose One:
○ Sandy
◉ Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	1.15	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Beveled Edge (1:1)	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7156.62	ft
Outlet Elevation **OR** Slope	Elev OUT =	7153.87	ft
Culvert Length	L =	65.4	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.23	ft
Culvert Critical Depth	Y_c =	0.40	ft
Froude Number	Fr =	3.06	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.01	
Sum of All Loss Coefficients	k_s =	2.21	ft
Headwater:			
Inlet Control Headwater	HW_I =	0.53	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**N/A**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**N/A**	

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

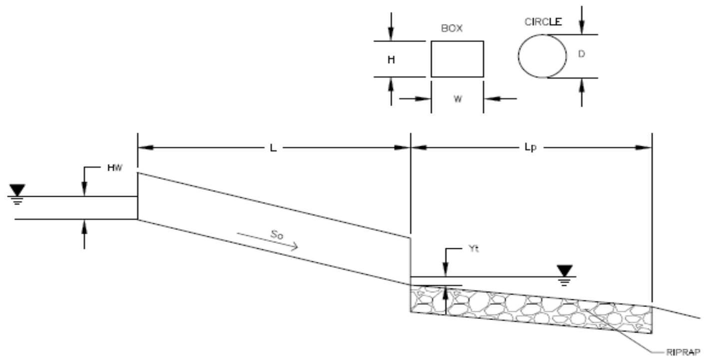
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	0.42	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow Area at Max Channel Velocity	A_t =	0.16	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**5**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	0.86	ft
Minimum Theoretical Riprap Size	d_{50} min=	1	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: P-23009 The Rock Commerce Center

ID: Pond Outlet @ Design Point O-4



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Design Information:

Design Discharge	Q =	10.4	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)	Grooved Edge Projecting		
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7134.29	ft
Outlet Elevation **OR** Slope	Elev OUT =	7134	ft
Culvert Length	L =	41.25	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

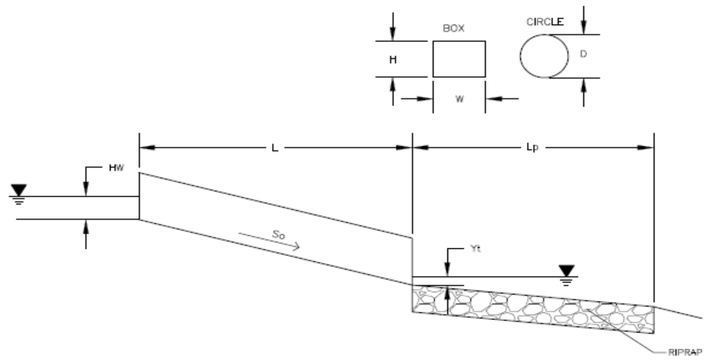
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	1.50	ft
Culvert Critical Depth	Y_c =	1.24	ft
Froude Number	Fr =	-	**Pressure flow!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.75	
Sum of All Loss Coefficients	k_s =	1.95	ft
Headwater:			
Inlet Control Headwater	HW_I =	2.12	ft
Outlet Control Headwater	HW_O =	2.13	ft
Design Headwater Elevation	**HW =**	**7136.42**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.42**	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.77	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.70	
Flow Area at Max Channel Velocity	A_t =	2.08	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	$\mathbf{L_p}$ **=**	**8**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**4**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	-	ft
Minimum Theoretical Riprap Size	d_{50} min=	5	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: P-23009 The Rock Commerce Center
ID: Design Point C Run Down

i dont see riprap at DP-C on the Plans. Please confirm location



Soil Type:
Choose One:
○ Sandy
◉ Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	1.6	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7134.54	ft
Outlet Elevation **OR** Slope	Elev OUT =	7133.19	ft
Culvert Length	L =	15	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.40	ft
Culvert Critical Depth	Y_c =	0.48	ft
Froude Number	Fr =	1.40	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.23	
Sum of All Loss Coefficients	k_s =	1.43	ft
Headwater:			
Inlet Control Headwater	HW_I =	0.65	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**N/A**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**N/A**	

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

Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	0.58	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow Area at Max Channel Velocity	A_t =	0.23	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**5**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	0.95	ft
Minimum Theoretical Riprap Size	d_{50} min=	1	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

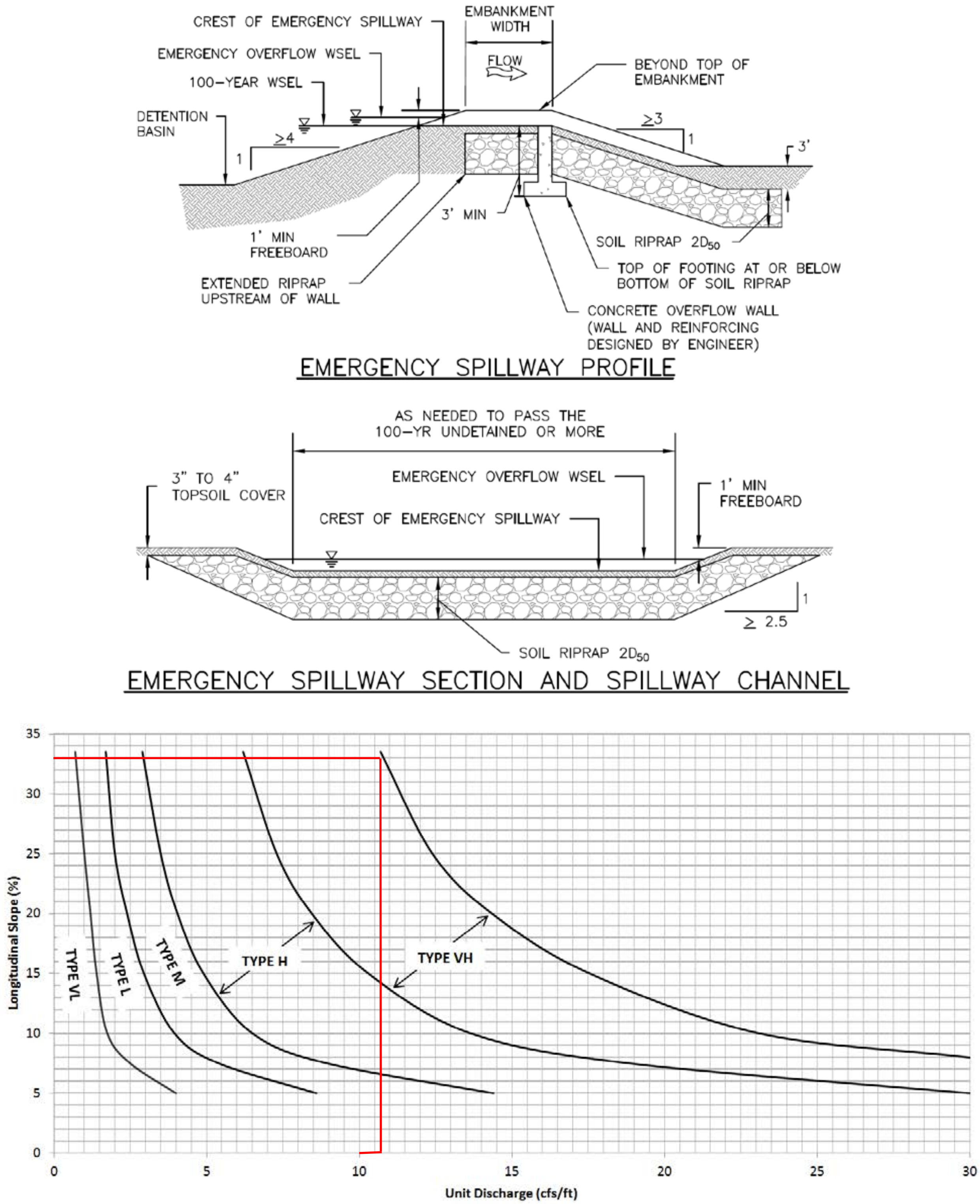
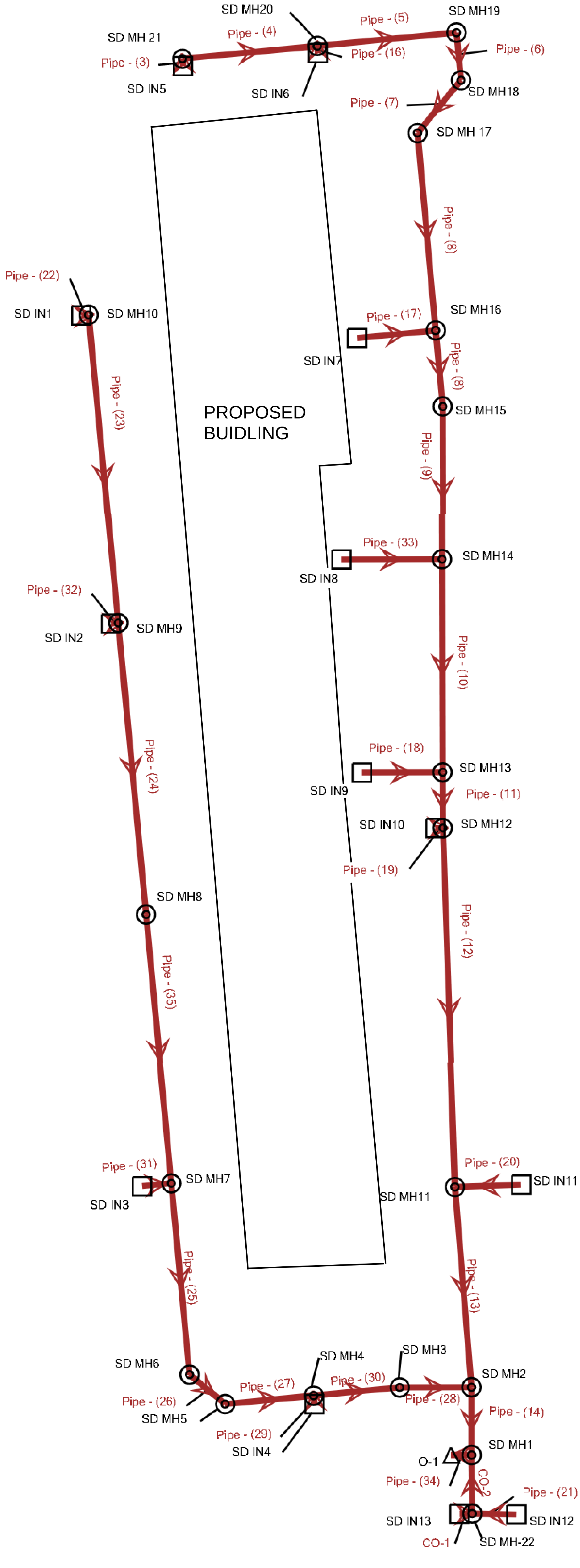


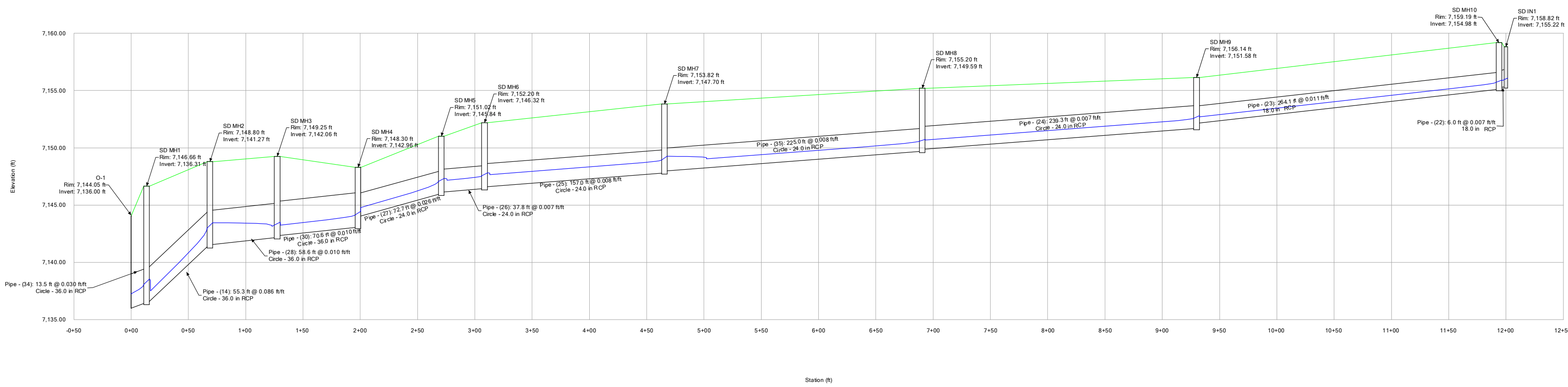
Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

STORMCAD NETWORK PREVEIW FOR THE ROCK COMMERCE CENTER

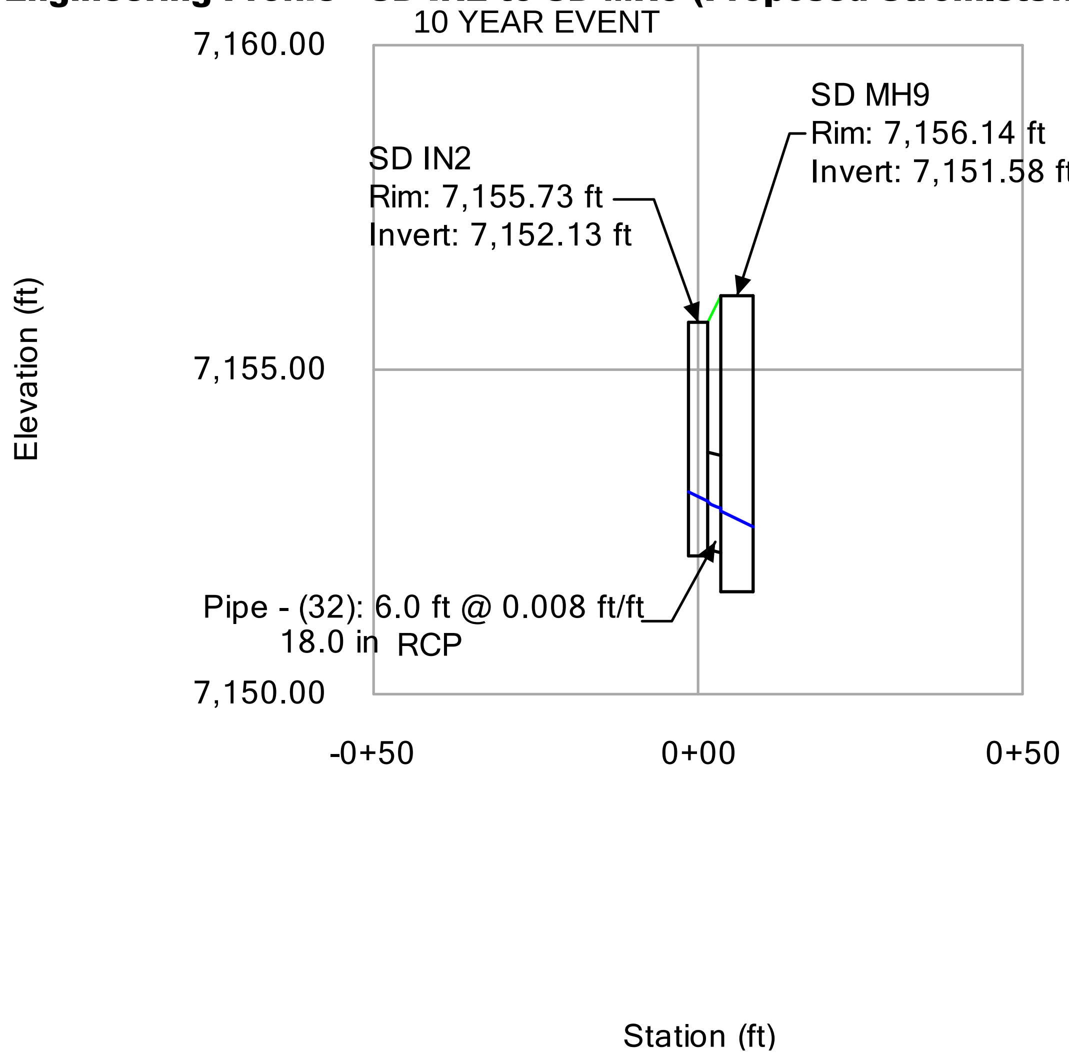


Profile Report
Engineering Profile - O-1 to SD IN1 (Proposed Strom.stsw)

10 YEAR EVENT



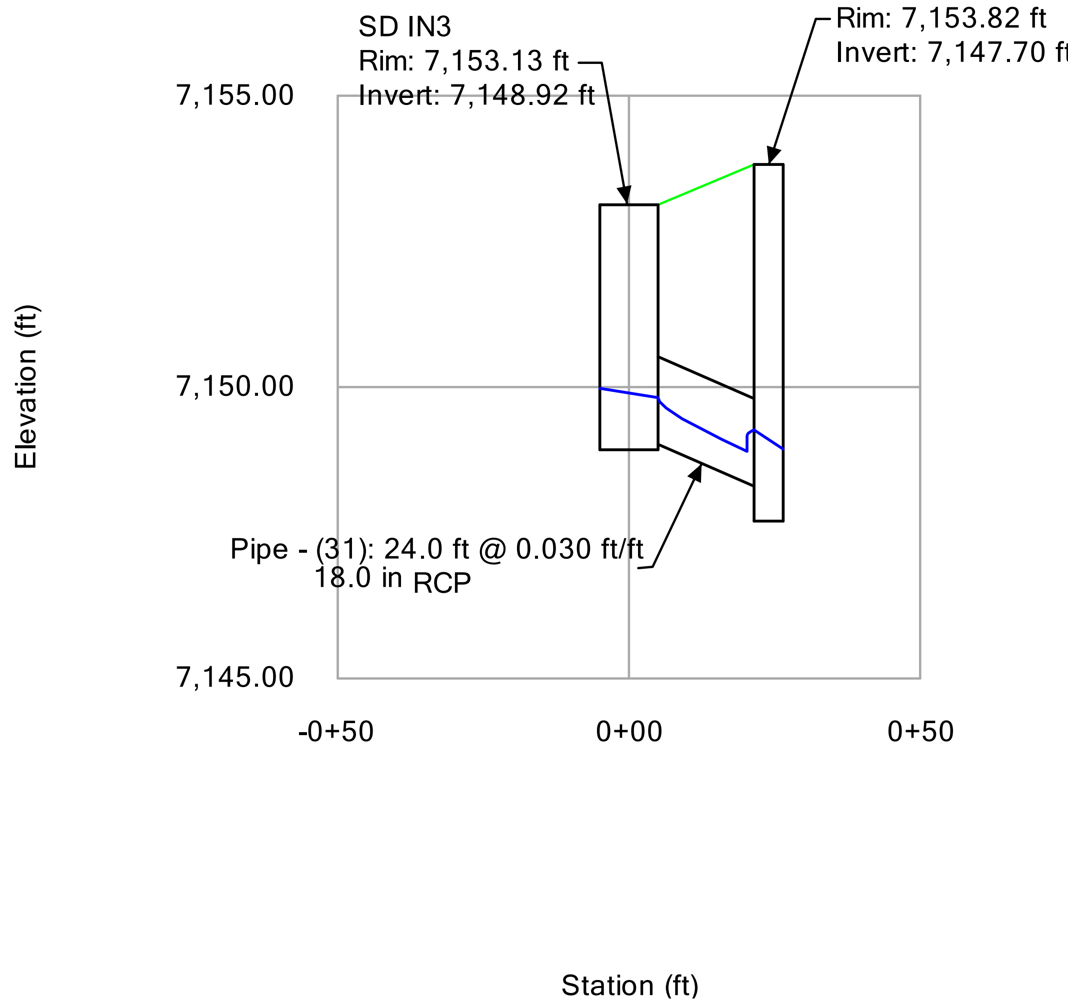
Profile Report
Engineering Profile - SD IN2 to SD MH9 (Proposed Strom.stsw)



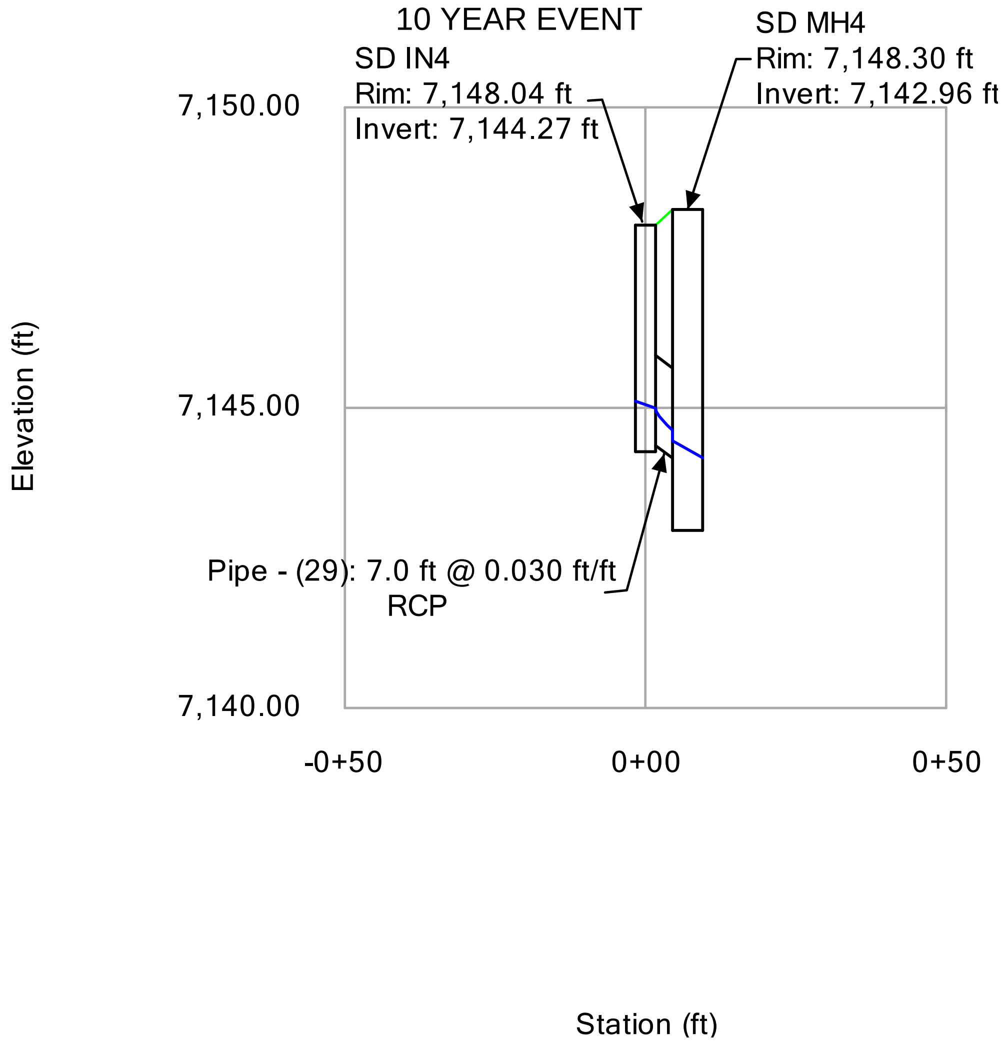
Profile Report

Engineering Profile - SDIN3 to SD MH7 (Proposed Strom.stsw)

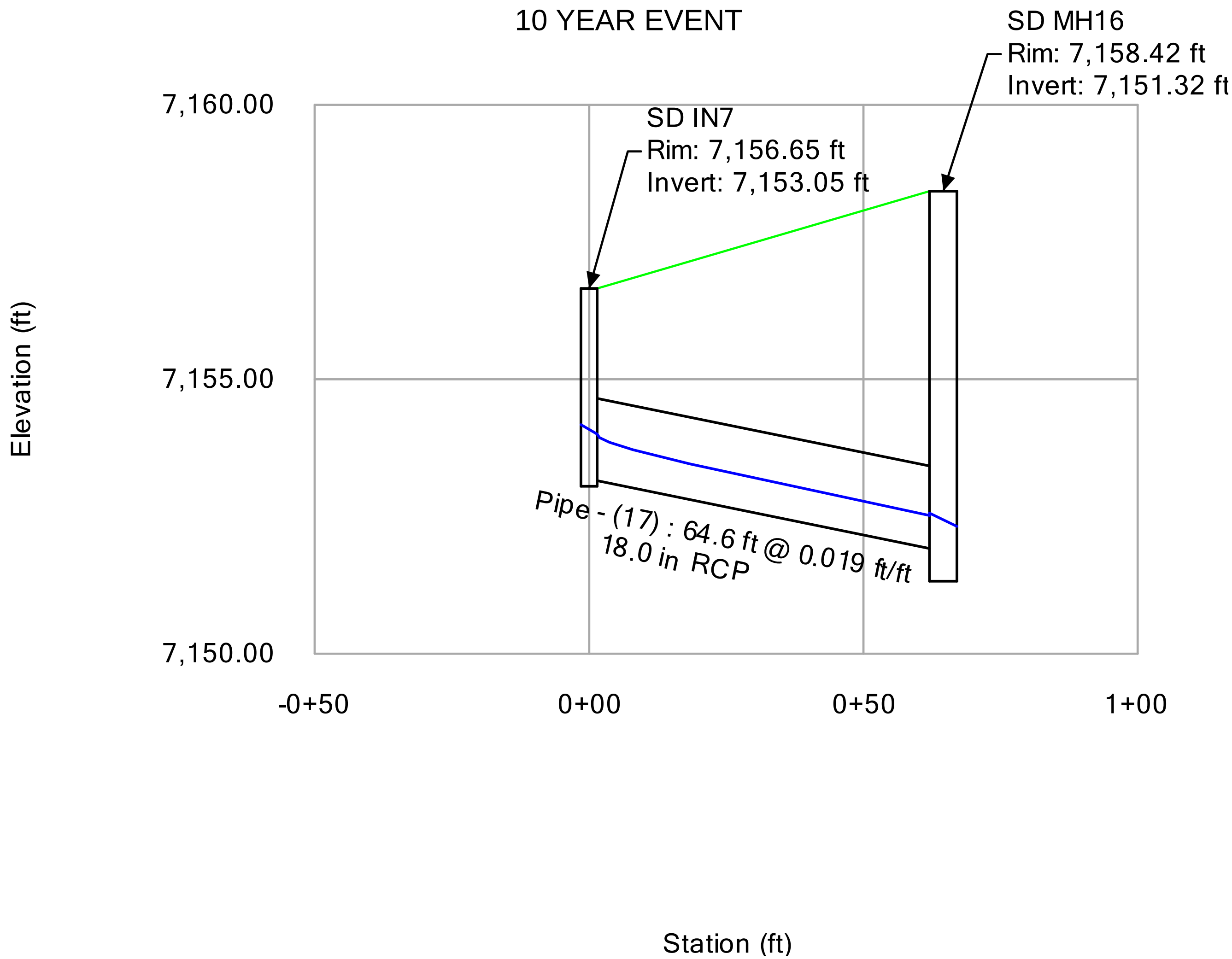
10 YEAR EVENT



Profile Report
Engineering Profile - SD IN4 to SD MH4 (Proposed Strom.stsw)



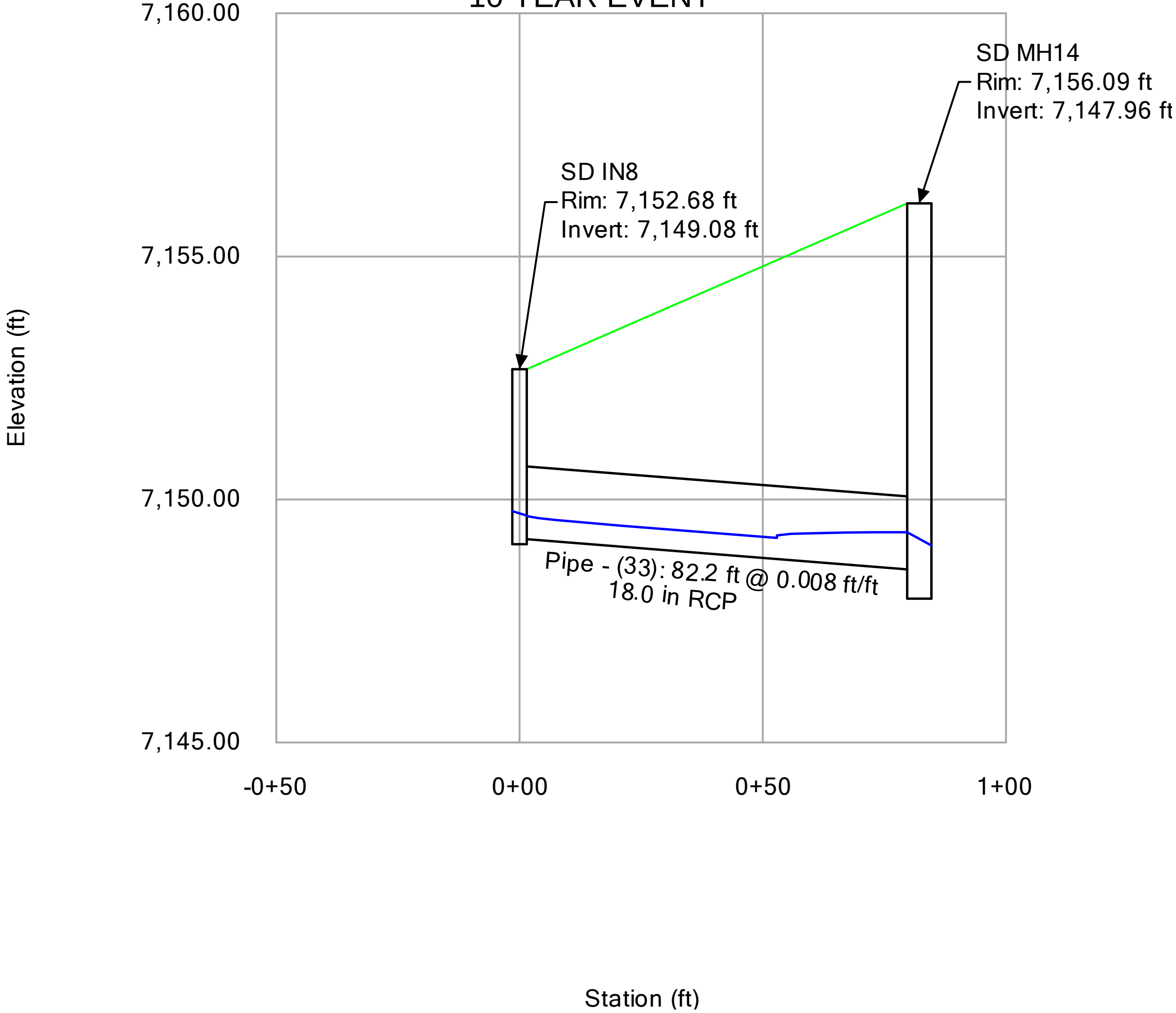
Profile Report
Engineering Profile - SD IN7 to SD MH16 (Proposed Strom.stsw)



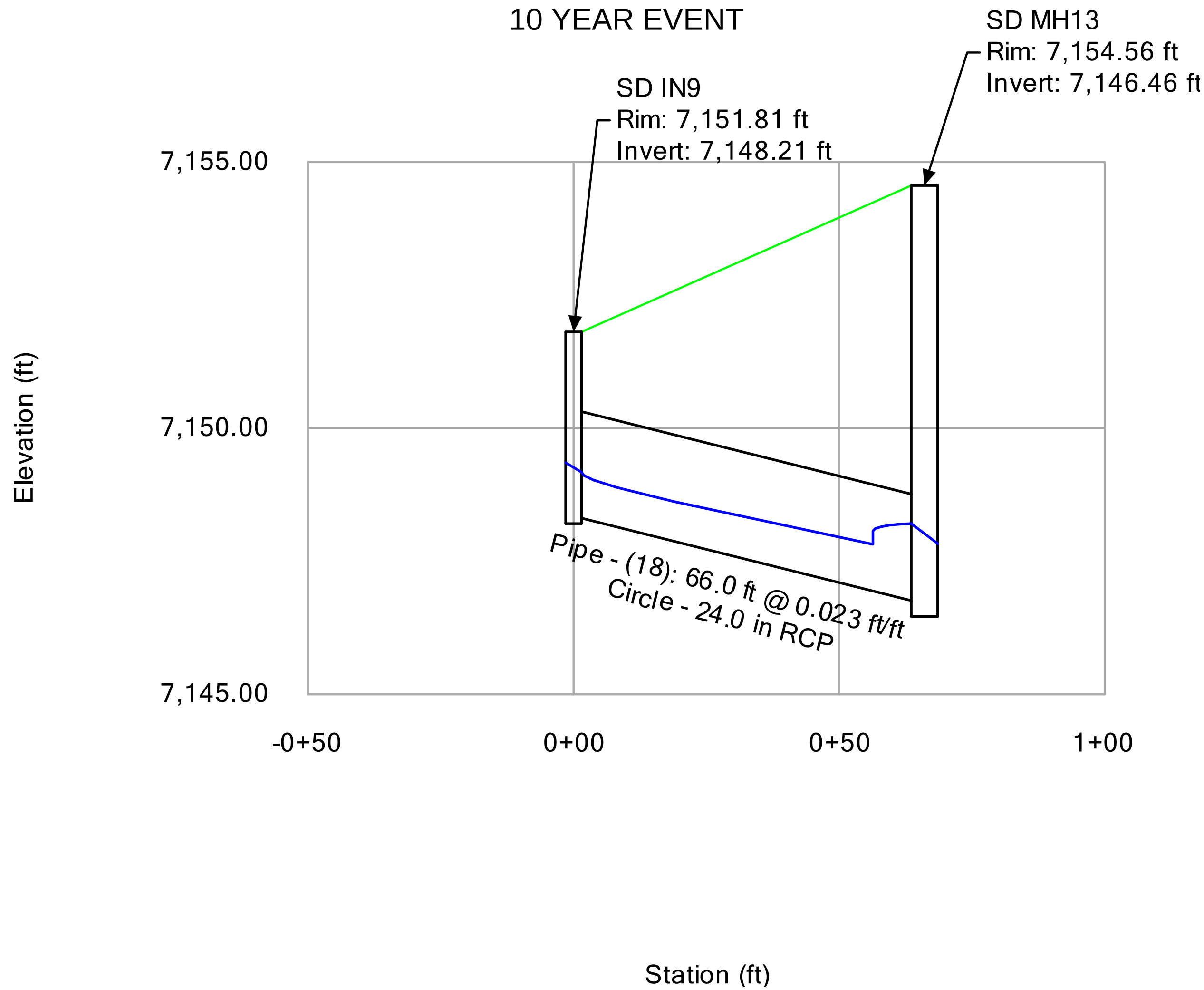
Profile Report

Engineering Profile - SD IN8 to SD MH14 (Proposed Strom.stsw)

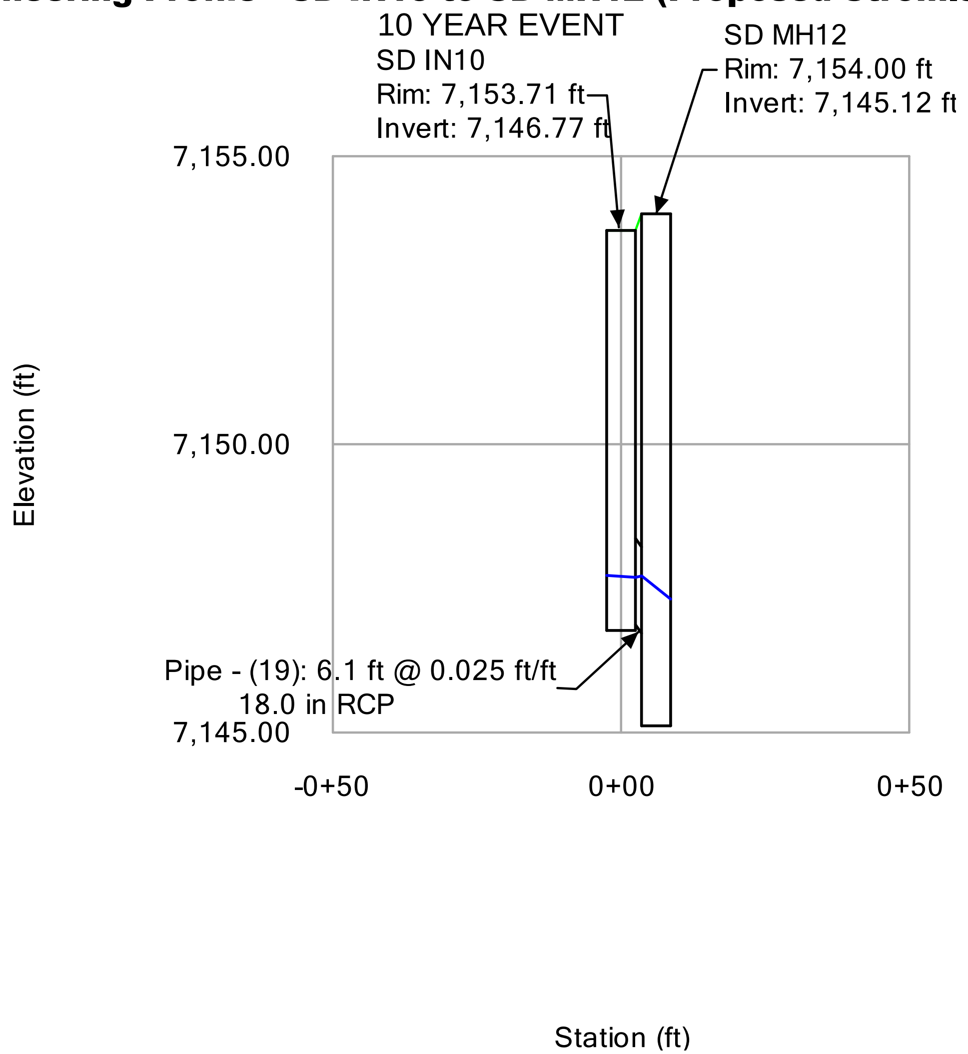
10 YEAR EVENT



Profile Report
Engineering Profile - SD IN9 to SD MH13 (Proposed Strom.stsw)



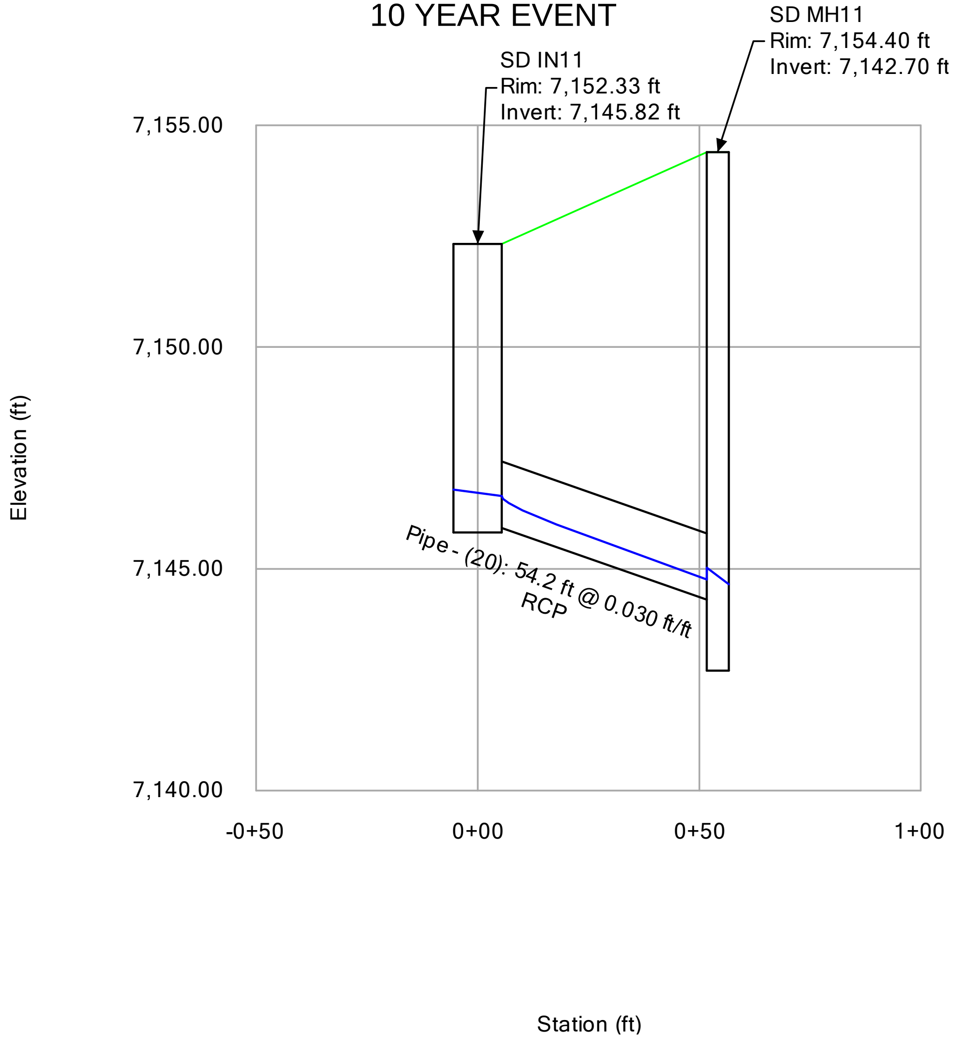
Profile Report
Engineering Profile - SD IN10 to SD MH12 (Proposed Strom.stsw)



Profile Report

Engineering Profile - SD IN11 to SD MH11 (Proposed Strom.stsw)

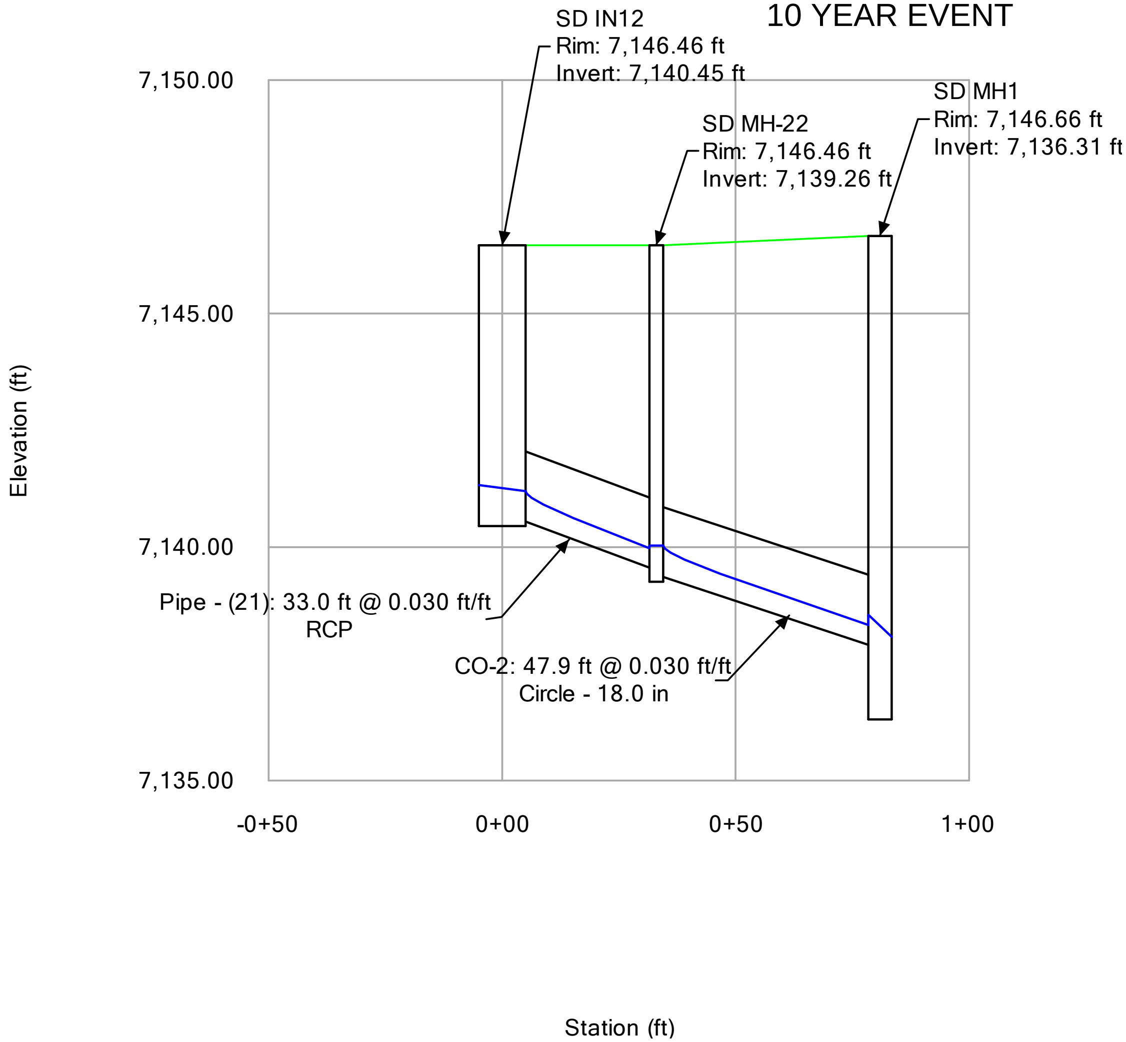
10 YEAR EVENT



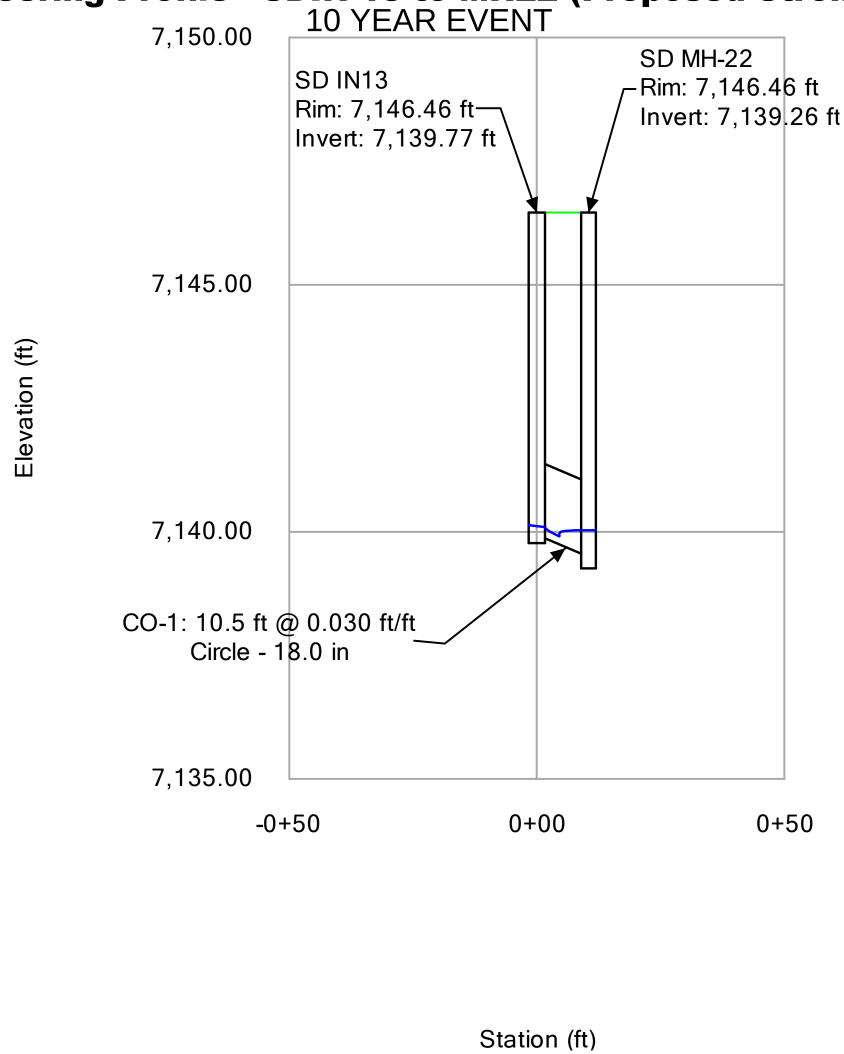
Profile Report

Engineering Profile - SD IN12 to SD MH1 (Proposed Strom.stsw)

10 YEAR EVENT



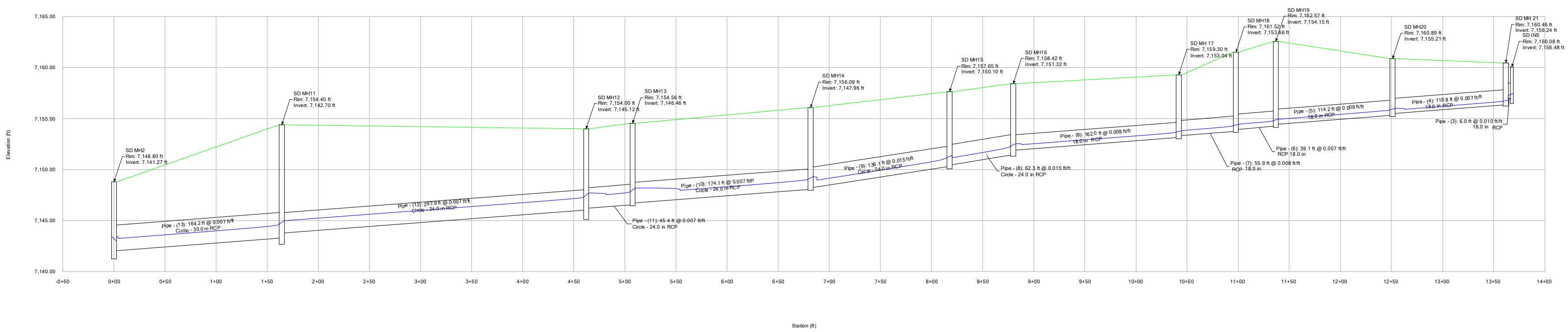
Profile Report
Engineering Profile - SDIN 13 to MH22 (Proposed Strom.stsw)



Profile Report

Engineering Profile - SD MH2 to SD IN5 (Proposed Strom.stsw)

10 YEAR EVENT



FlexTable: Catch Basin Table - 10 YEAR EVENT

Label	Notes	Elevation (Ground) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)
SD IN11	CDOT Type 13 Combo	7,152.33	Standard	0.500	0.14
SD IN13	CDOT Type 13 Combo	7,146.46	Standard	0.500	0.01
SD IN12	CDOT Type R	7,146.46	Standard	0.500	0.12
SD IN4	CDOT Type 13 Combo	7,148.04	Standard	0.500	0.12
SD IN3	CDOT Type R	7,153.13	Standard	0.500	0.16
SD IN10	CDOT Type R	7,153.71	Standard	0.500	0.03
SD IN9	CDOT Type 13	7,151.81	Standard	0.500	0.15
SD IN8	CDOT Type 13	7,152.68	Standard	0.500	0.09
SD IN7	CDOT Type 13	7,156.65	Standard	0.500	0.17
SD IN6	CDOT Type 13	7,160.43	Standard	0.500	0.07
SD IN5	CDOT Type 13	7,160.08	Standard	0.500	0.07
SD IN1	CDOT Type 13	7,158.82	Standard	0.500	0.12
SD IN2	CDOT Type 13	7,155.73	Standard	0.500	0.15

FlexTable: Manhole Table - 10 YEAR EVENT

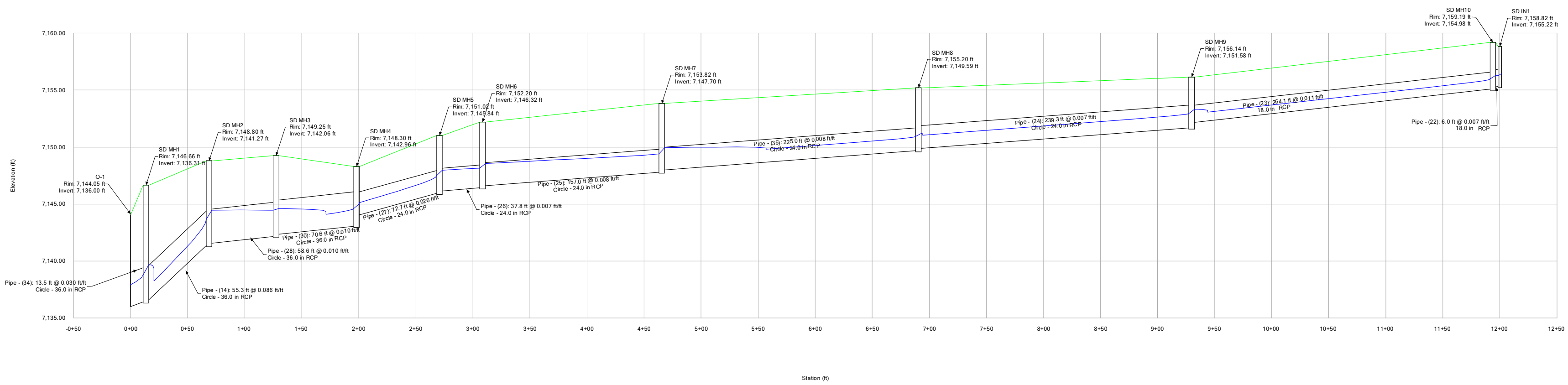
Label	Notes	Elevation (Rim) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)
SD MH19	5' DIA MH	7,162.57	Standard	0.800	0.16
SD MH18	5' DIA MH	7,161.52	Standard	0.600	0.12
SD MH20	5' DIA MH	7,160.89	Standard	0.700	0.14
SD MH 21	5' DIA MH	7,160.46	Standard	0.800	0.11
SD MH 17	5' DIA MH	7,159.30	Standard	0.600	0.12
SD MH10	5' DIA MH	7,159.19	Standard	0.800	0.19
SD MH16	5' DIA MH	7,158.42	Standard	0.700	0.24
SD MH15	5' DIA MH	7,157.65	Standard	0.600	0.21
SD MH9	5' DIA MH	7,156.14	Standard	0.700	0.24
SD MH14	5' DIA MH	7,156.09	Standard	0.700	0.27
SD MH8	5' DIA MH	7,155.20	Standard	0.500	0.17
SD MH13	5' DIA MH	7,154.56	Standard	0.700	0.38
SD MH11	5' DIA MH	7,154.40	Standard	0.700	0.38
SD MH12	5' DIA MH	7,154.00	Standard	0.700	0.40
SD MH7	5' DIA MH	7,153.82	Standard	0.700	0.33
SD MH6	5' DIA MH	7,152.20	Standard	0.600	0.28
SD MH5	5' DIA MH	7,151.02	Standard	0.600	0.27
SD MH3	5' DIA MH	7,149.25	Standard	0.600	0.24
SD MH2	6' DIA MH	7,148.80	Standard	0.700	0.46
SD MH4	5' DIA MH	7,148.30	Standard	0.700	0.29
SD MH1	6' DIA MH	7,146.66	Standard	0.700	0.47
SD MH-22	5' DIA MH	7,146.46	Standard	0.700	0.18

FlexTable: Conduit Table - 10 YEAR EVENT

Label	Diameter (in)	Slope (Calculated) (ft/ft)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Manning's n	Flow (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Froude Number (Normal)
Pipe - (5)	18.0	0.008	4.23	7,155.31	7,154.45	0.013	2.18	7,155.87	7,154.95	7,156.07	7,155.23	1.236
Pipe - (6)	18.0	0.007	4.19	7,154.25	7,153.96	0.013	2.13	7,154.80	7,154.46	7,155.01	7,154.73	1.229
Pipe - (7)	18.0	0.008	4.20	7,153.76	7,153.34	0.013	2.12	7,154.31	7,153.83	7,154.51	7,154.11	1.237
Pipe - (4)	18.0	0.007	3.43	7,156.34	7,155.51	0.013	1.05	7,156.72	7,156.01	7,156.86	7,156.08	1.228
Pipe - (16)	18.0	0.010	3.95	7,155.80	7,155.74	0.013	1.20	7,156.21	7,156.10	7,156.36	7,156.31	1.418
Pipe - (3)	18.0	0.010	3.80	7,157.00	7,156.94	0.013	1.05	7,157.38	7,157.27	7,157.52	7,157.47	1.414
Pipe - (8)	18.0	0.008	4.19	7,153.14	7,151.92	0.013	2.09	7,153.69	7,152.56	7,153.89	7,152.69	1.239
Pipe - (22)	18.0	0.007	4.34	7,155.32	7,155.28	0.013	2.80	7,155.95	7,155.88	7,156.19	7,156.16	1.154
Pipe - (23)	18.0	0.011	5.20	7,155.08	7,152.18	0.013	2.79	7,155.71	7,152.82	7,155.95	7,153.05	1.493
Pipe - (8)	24.0	0.015	7.15	7,151.42	7,150.50	0.013	6.46	7,152.32	7,151.40	7,152.67	7,151.74	1.819
Pipe - (17)	18.0	0.019	7.39	7,153.15	7,151.92	0.013	4.86	7,154.00	7,152.52	7,154.34	7,153.37	1.948
Pipe - (9)	24.0	0.015	7.18	7,150.30	7,148.26	0.013	6.42	7,151.20	7,149.33	7,151.54	7,149.55	1.833
Pipe - (24)	24.0	0.007	5.58	7,151.68	7,149.89	0.013	6.43	7,152.58	7,150.68	7,152.92	7,151.16	1.282
Pipe - (32)	18.0	0.008	5.10	7,152.23	7,152.18	0.013	3.77	7,152.97	7,152.86	7,153.26	7,153.22	1.275
Pipe - (10)	24.0	0.007	5.87	7,148.06	7,146.76	0.013	7.81	7,149.05	7,148.21	7,149.44	7,148.37	1.265
Pipe - (33)	18.0	0.008	3.94	7,149.18	7,148.56	0.013	1.68	7,149.67	7,149.33	7,149.84	7,149.38	1.240
Pipe - (35)	24.0	0.008	5.54	7,149.69	7,148.00	0.013	6.21	7,150.57	7,149.26	7,150.91	7,149.40	1.286
Pipe - (11)	24.0	0.007	6.60	7,146.56	7,146.22	0.013	12.45	7,147.83	7,147.71	7,148.37	7,148.09	1.190
Pipe - (18)	24.0	0.023	7.86	7,148.31	7,146.76	0.013	5.04	7,149.10	7,148.21	7,149.40	7,148.28	2.290
Pipe - (12)	24.0	0.007	6.65	7,146.02	7,143.80	0.013	13.00	7,147.32	7,144.99	7,147.88	7,145.68	1.175
Pipe - (13)	30.0	0.007	7.03	7,143.30	7,142.07	0.013	15.90	7,144.65	7,143.47	7,145.19	7,143.96	1.303
Pipe - (20)	18.0	0.030	8.01	7,145.92	7,144.30	0.013	3.61	7,146.65	7,144.75	7,146.93	7,145.75	2.469
Pipe - (19)	18.0	0.025	6.33	7,146.87	7,146.72	0.013	2.01	7,147.70	7,147.71	7,147.76	7,147.75	2.234
Pipe - (25)	24.0	0.008	6.29	7,147.80	7,146.62	0.013	10.07	7,148.94	7,147.82	7,149.40	7,148.23	1.238
Pipe - (31)	18.0	0.030	8.44	7,149.02	7,148.30	0.013	4.33	7,149.82	7,149.26	7,150.14	7,149.47	2.467
Pipe - (26)	24.0	0.007	6.23	7,146.42	7,146.14	0.013	9.88	7,147.54	7,147.34	7,148.00	7,147.73	1.232
Pipe - (27)	24.0	0.026	9.84	7,145.94	7,144.06	0.013	9.84	7,147.06	7,144.78	7,147.52	7,146.22	2.400
Pipe - (30)	36.0	0.010	7.15	7,143.06	7,142.36	0.013	12.13	7,144.17	7,143.51	7,144.57	7,143.88	1.596
Pipe - (28)	36.0	0.010	7.17	7,142.16	7,141.57	0.013	12.04	7,143.26	7,143.47	7,143.67	7,143.57	1.608
Pipe - (14)	36.0	0.086	19.16	7,141.37	7,136.61	0.013	25.69	7,143.01	7,138.56	7,143.67	7,138.99	4.684
Pipe - (29)	18.0	0.030	7.38	7,144.37	7,144.16	0.013	2.70	7,144.99	7,144.62	7,145.23	7,145.15	2.470
Pipe - (21)	18.0	0.030	7.57	7,140.55	7,139.56	0.013	2.95	7,141.20	7,140.21	7,141.45	7,140.46	2.472
Pipe - (34)	36.0	0.030	13.35	7,136.41	7,136.00	0.013	26.72	7,138.08	7,137.27	7,138.76	7,138.64	2.790
CO-1	18.0	0.030	3.83	7,139.87	7,139.56	0.013	0.30	7,140.20	7,140.21	7,140.22	7,140.22	2.236
CO-2	18.0	0.030	7.74	7,139.36	7,137.91	0.013	3.14	7,140.03	7,138.33	7,140.29	7,139.25	2.486

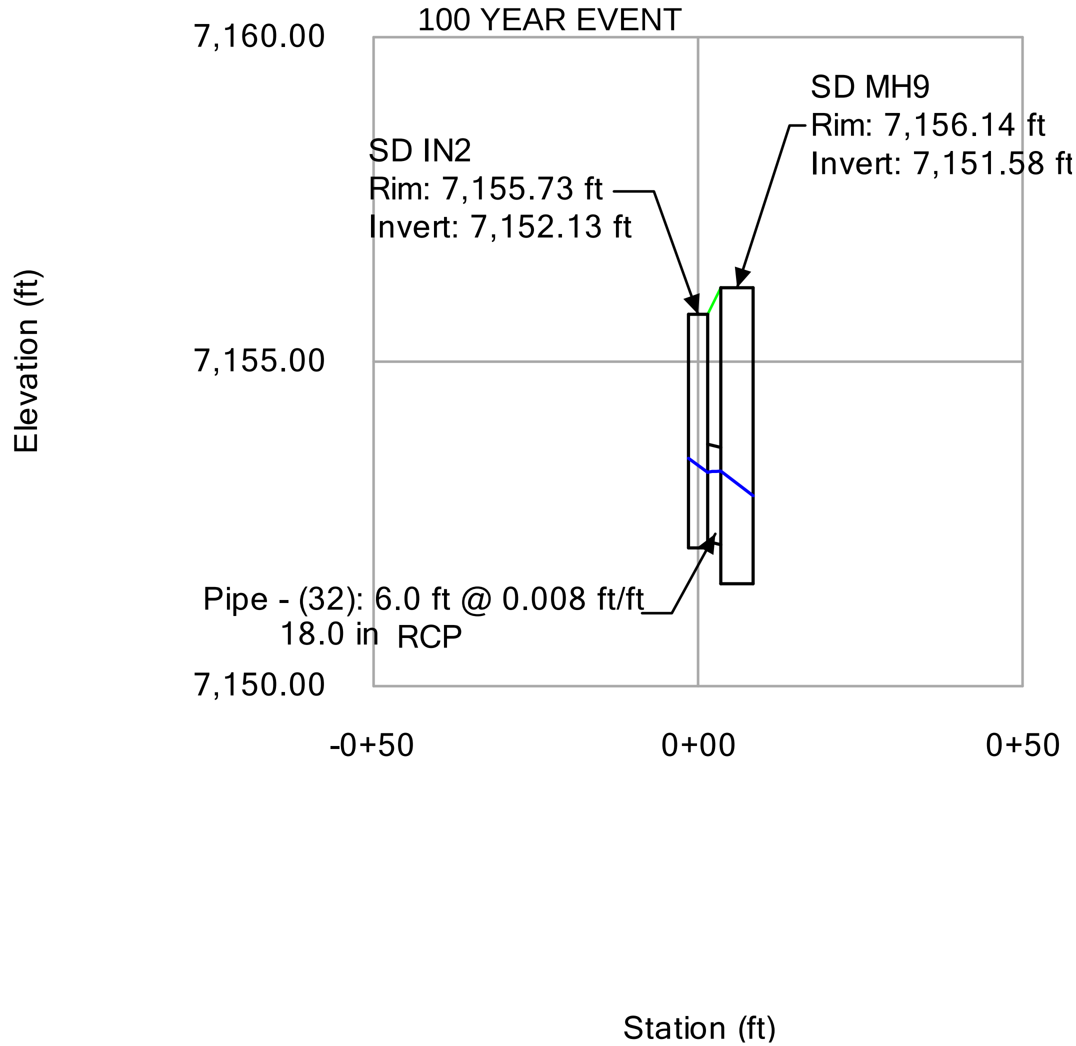
Profile Report
Engineering Profile - O-1 to SD IN1 (Proposed Strom.stsw)

100 YEAR EVENT



Profile Report

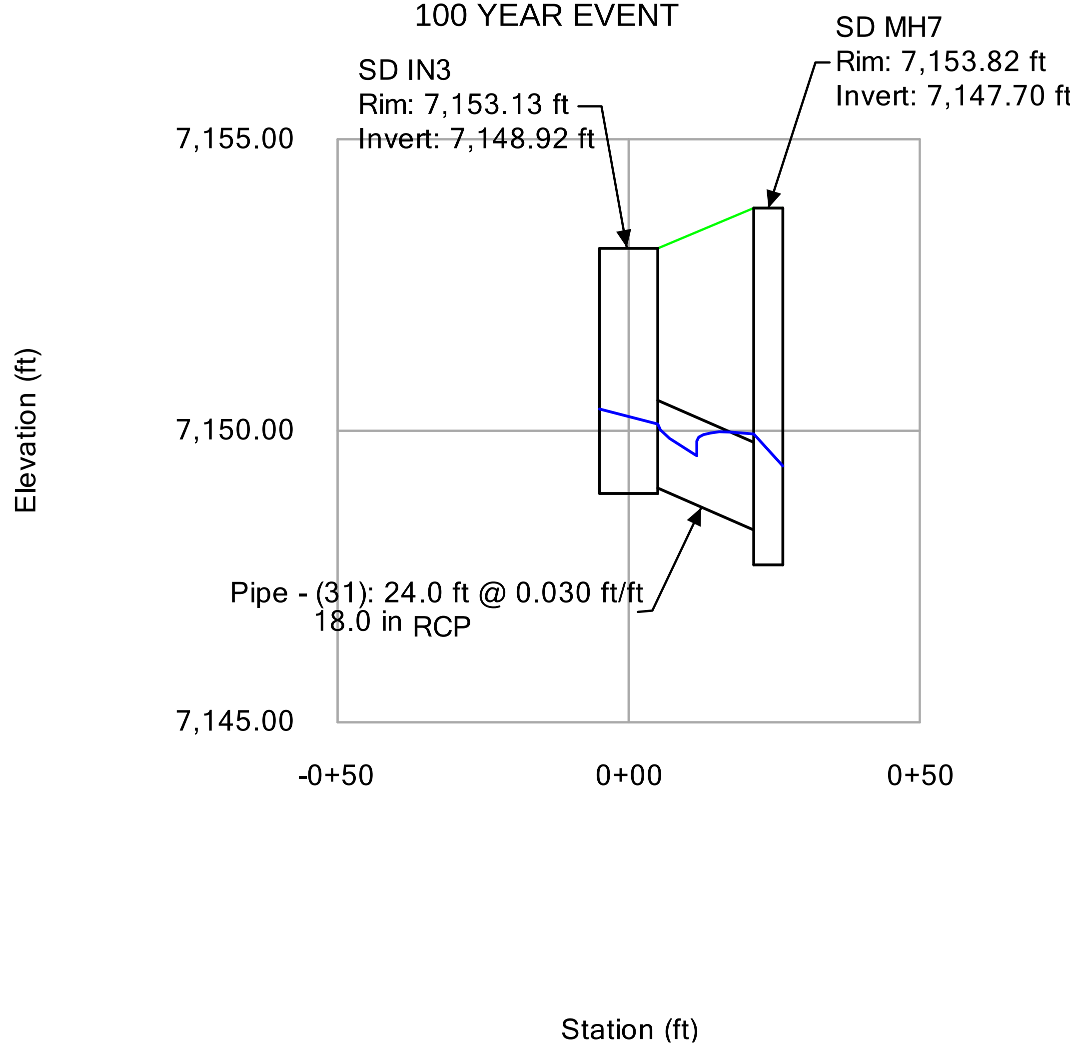
Engineering Profile - SD IN2 to SD MH9 (Proposed Strom.stsw)



Profile Report

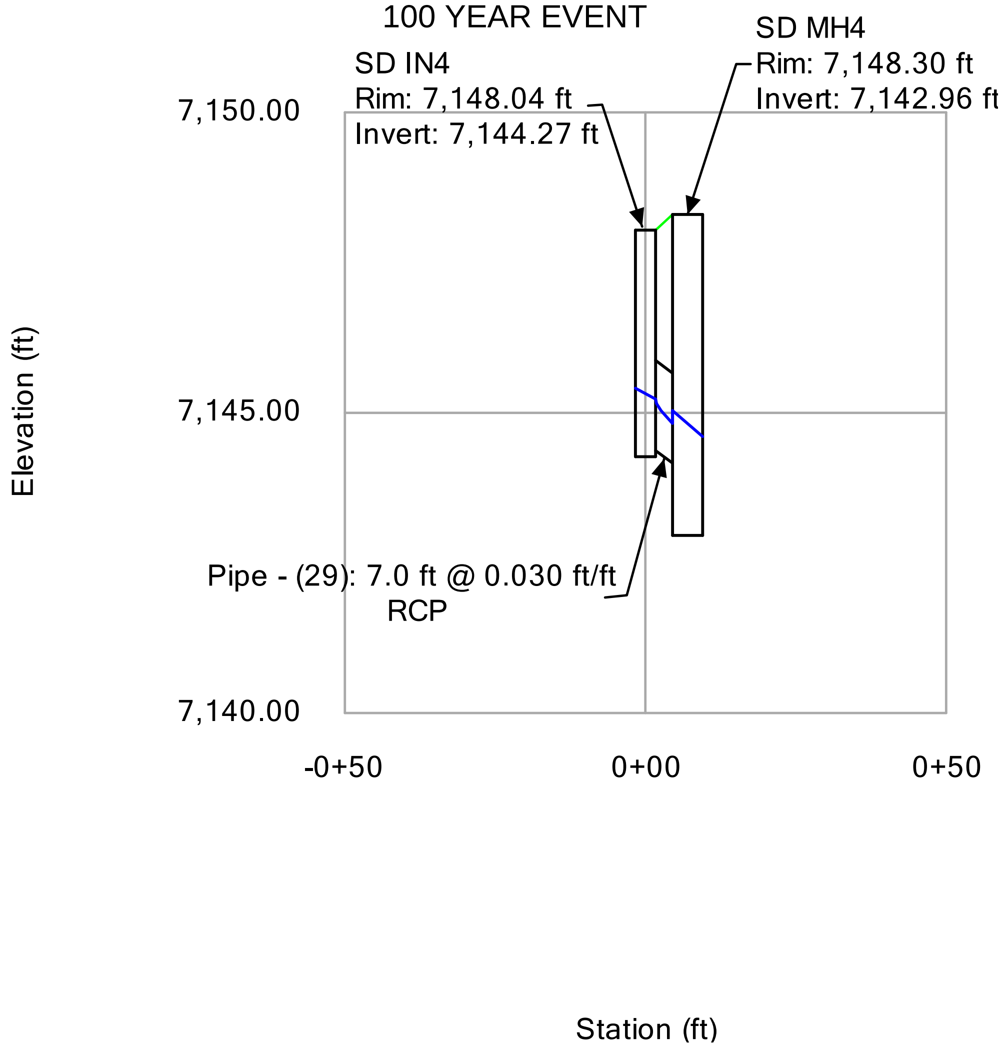
Engineering Profile - SDIN3 to SD MH7 (Proposed Strom.stsw)

100 YEAR EVENT



Profile Report

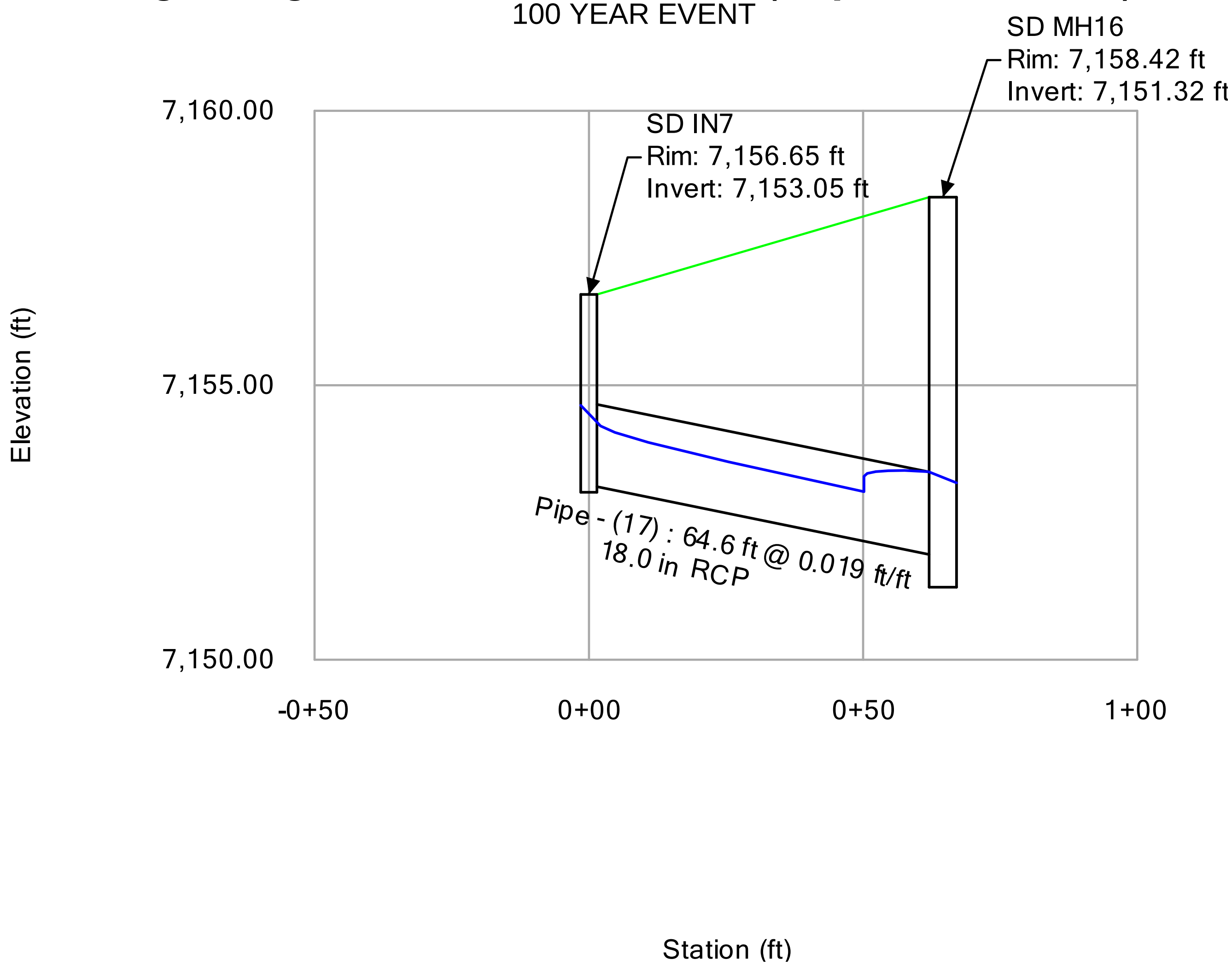
Engineering Profile - SD IN4 to SD MH4 (Proposed Strom.stsw)



Profile Report

Engineering Profile - SD IN7 to SD MH16 (Proposed Strom.stsw)

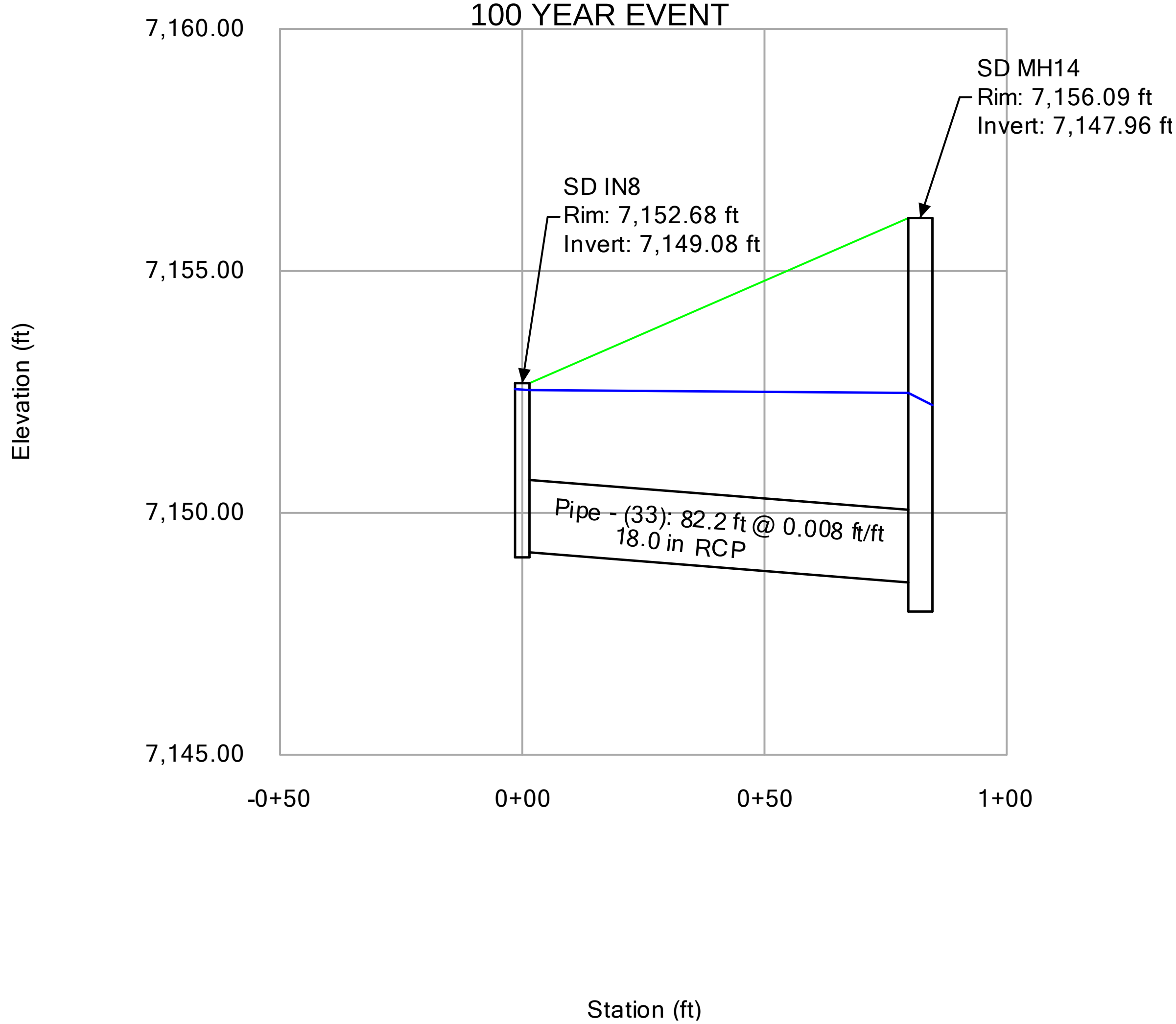
100 YEAR EVENT



Profile Report

Engineering Profile - SD IN8 to SD MH14 (Proposed Strom.stsw)

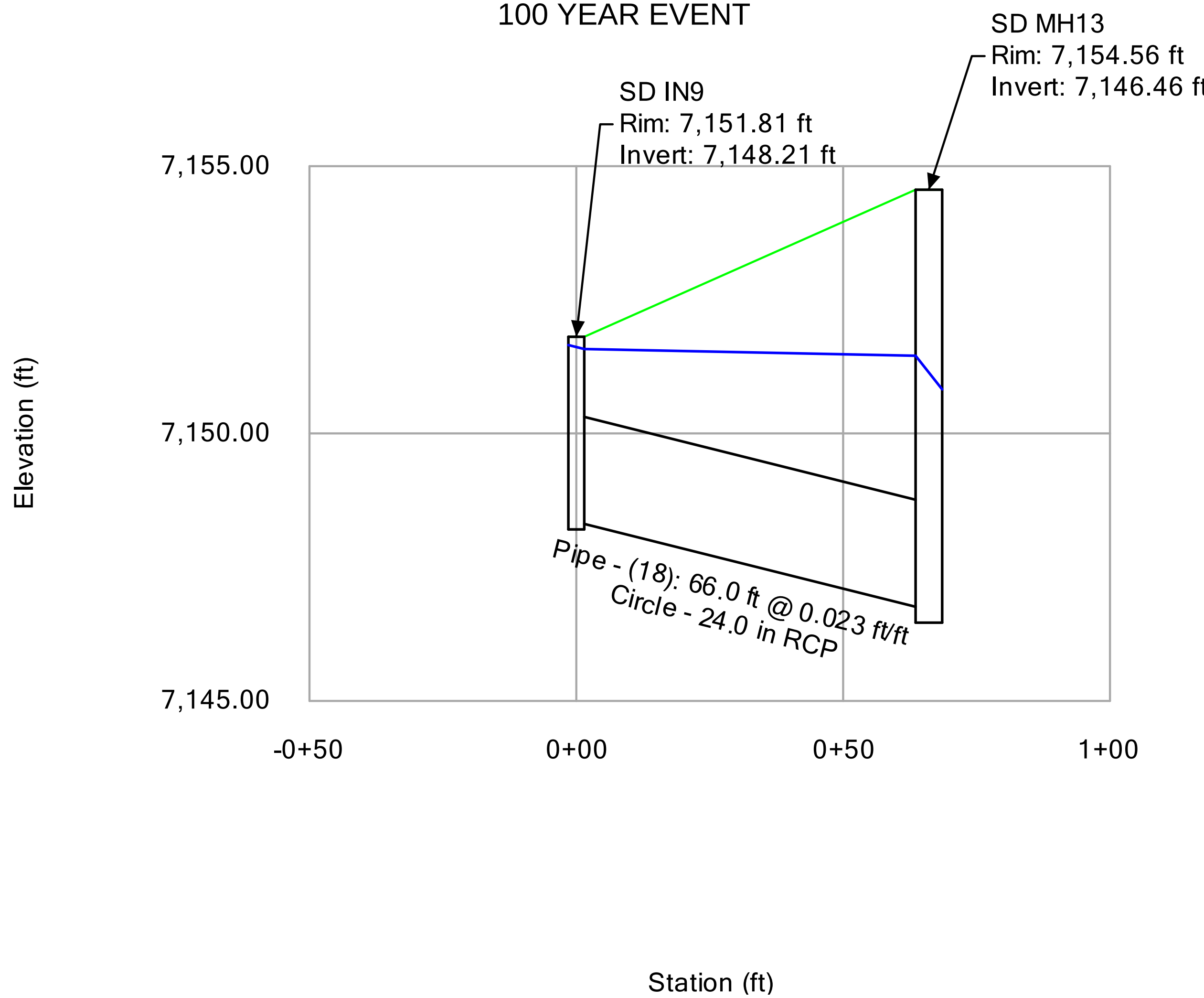
100 YEAR EVENT



Profile Report

Engineering Profile - SD IN9 to SD MH13 (Proposed Strom.stsw)

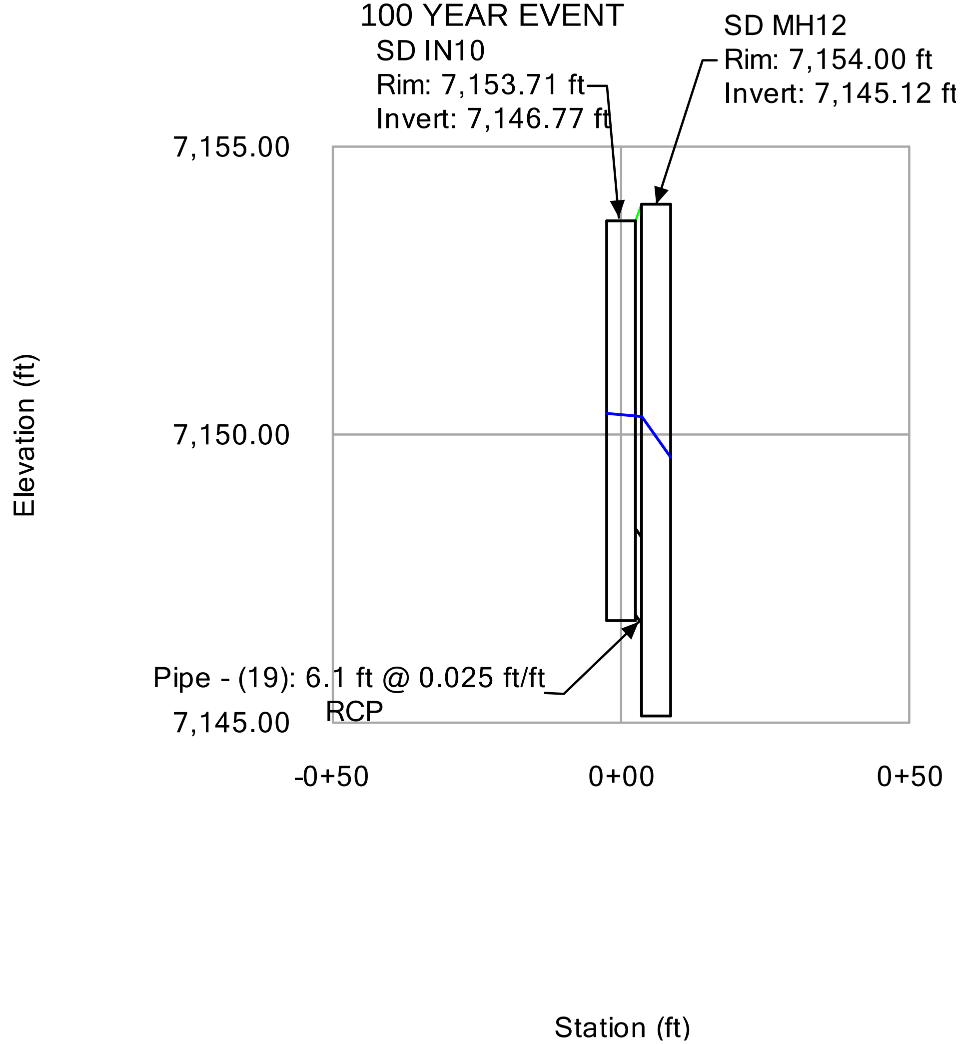
100 YEAR EVENT



Profile Report

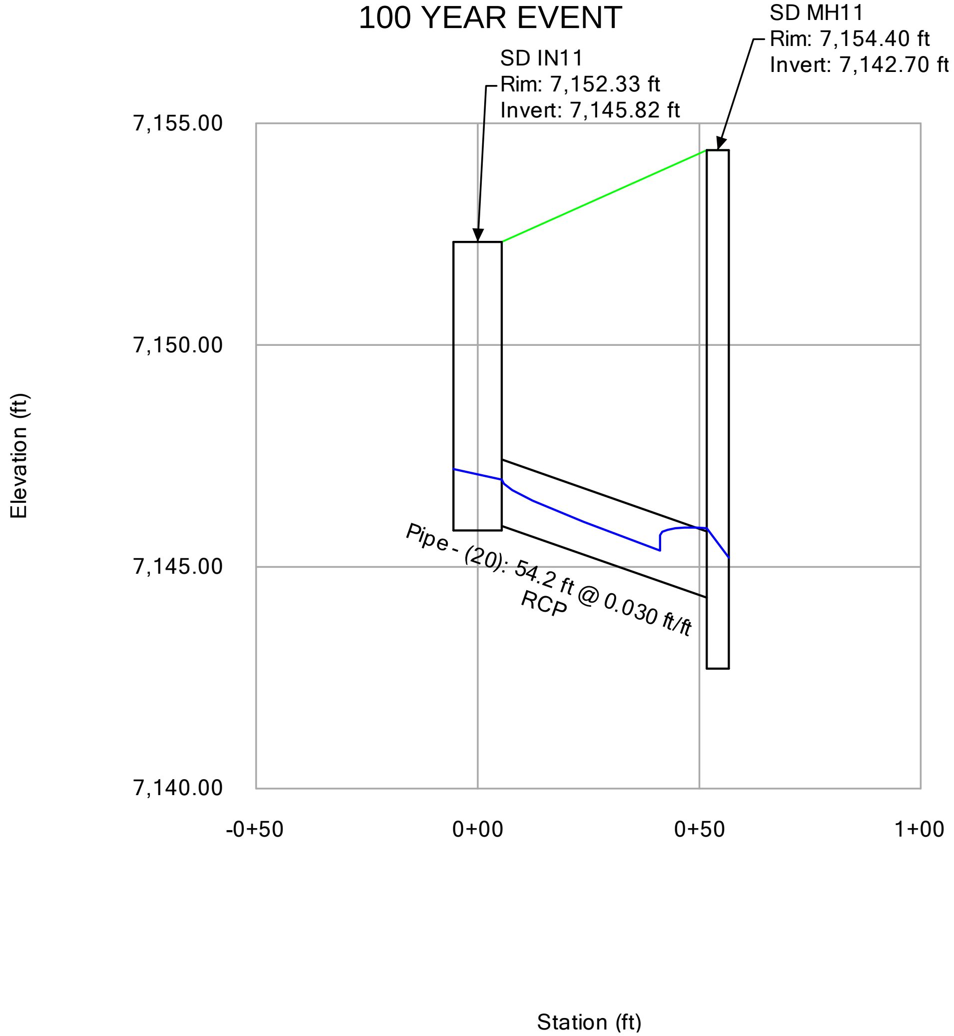
Engineering Profile - SD IN10 to SD MH12 (Proposed Strom.stsw)

100 YEAR EVENT



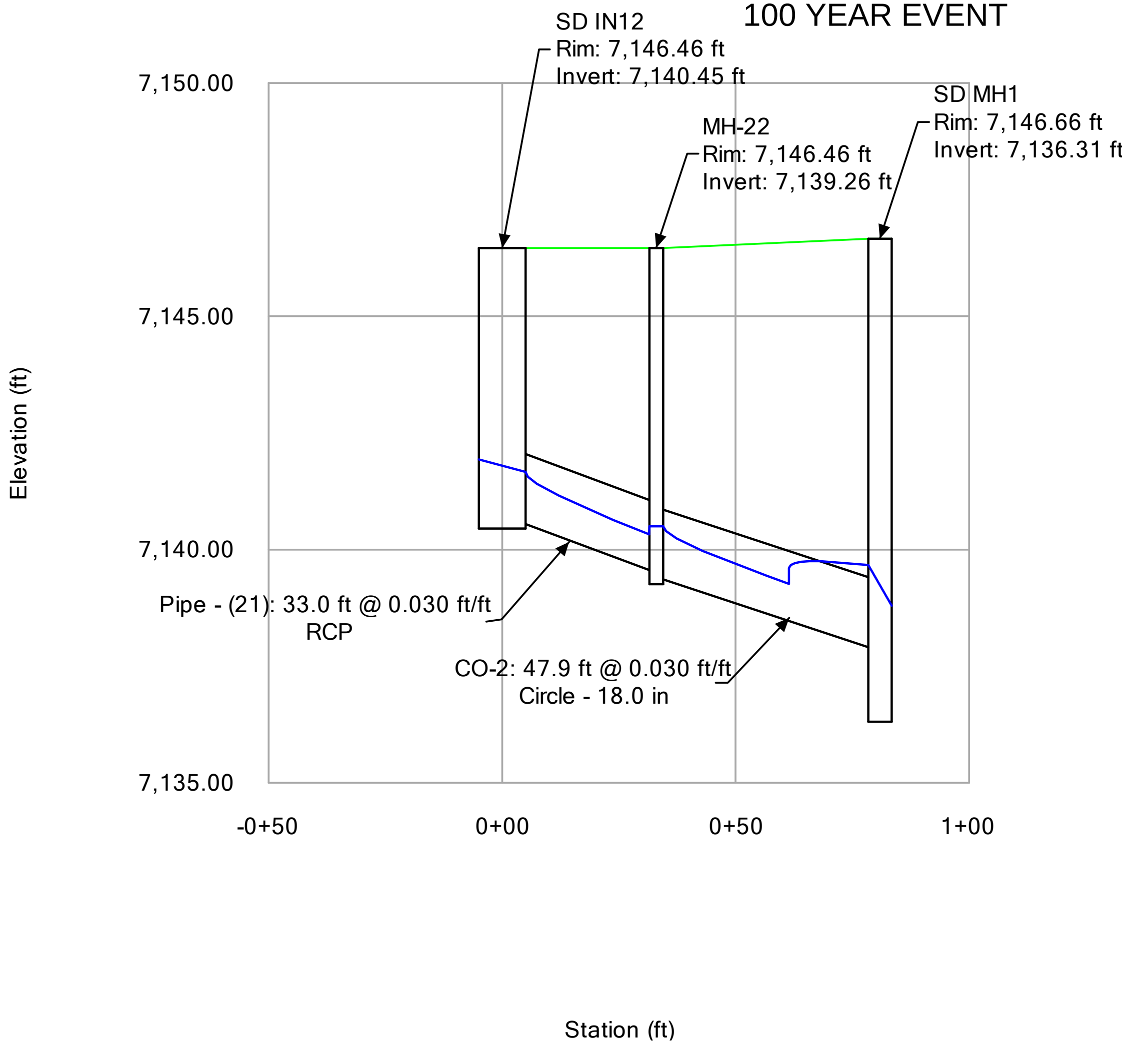
Profile Report
Engineering Profile - SD IN11 to SD MH11 (Proposed Strom.stsw)

100 YEAR EVENT



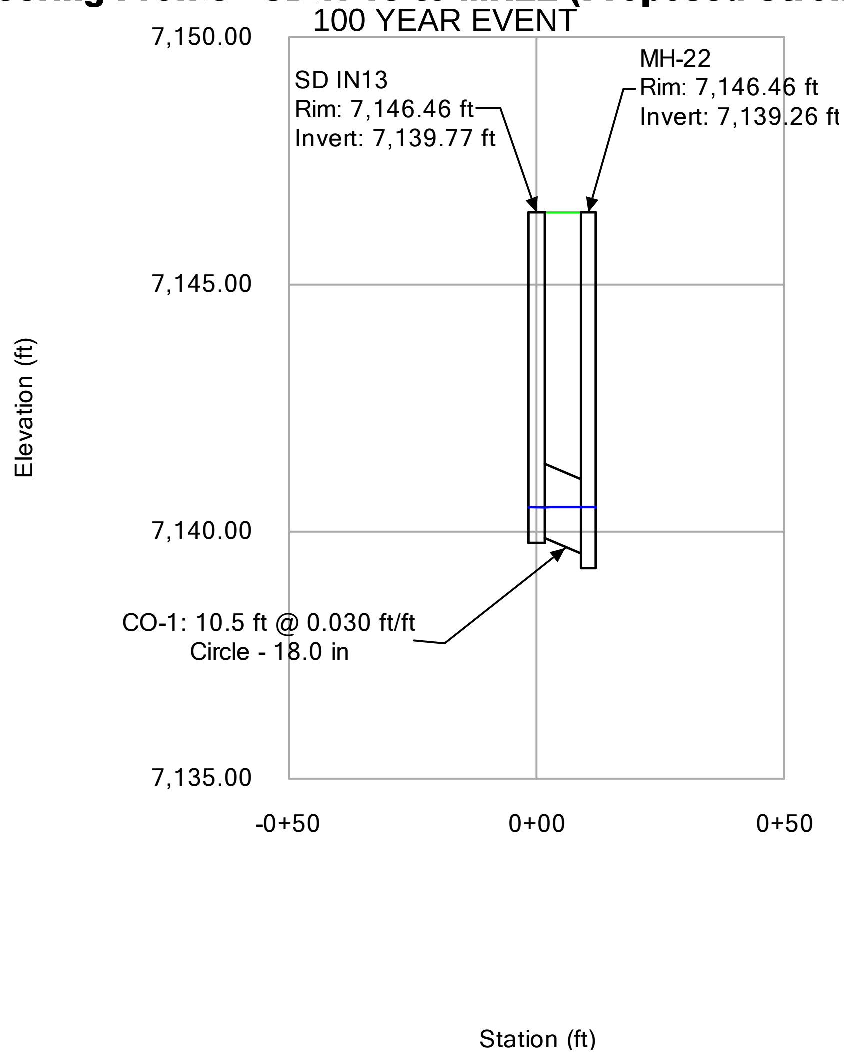
Profile Report
Engineering Profile - SD IN12 to SD MH1 (Proposed Strom.stsw)

100 YEAR EVENT

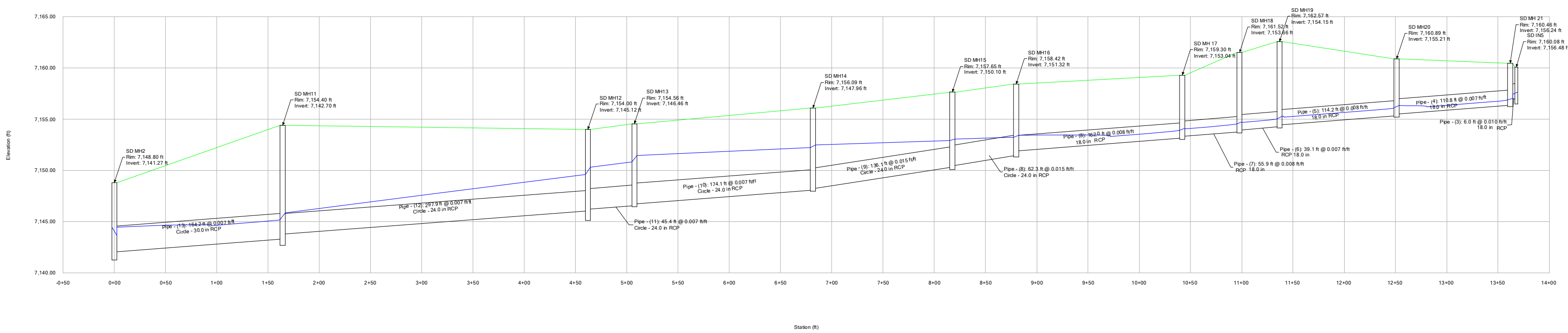


Profile Report

Engineering Profile - SDIN 13 to MH22 (Proposed Strom.stsw)



Profile Report
Engineering Profile - SD MH2 to SD IN5 (Proposed Strom.stsw)
100 YEAR EVENT



FlexTable: Catch Basin Table - 100 YEAR EVENT

Label	Notes	Elevation (Ground) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)
SD IN11	CDOT Type 13 Combo	7,152.33	Standard	0.500	0.24
SD IN13	CDOT Type 13 Combo	7,146.46	Standard	0.500	0.01
SD IN12	CDOT Type R	7,146.46	Standard	0.500	0.27
SD IN4	CDOT Type 13 Combo	7,148.04	Standard	0.500	0.18
SD IN3	CDOT Type R	7,153.13	Standard	0.500	0.26
SD IN10	CDOT Type R	7,153.71	Standard	0.500	0.04
SD IN9	CDOT Type 13	7,151.81	Standard	0.500	0.08
SD IN8	CDOT Type 13	7,152.68	Standard	0.500	0.02
SD IN7	CDOT Type 13	7,156.65	Standard	0.500	0.30
SD IN6	CDOT Type 13	7,160.43	Standard	0.500	0.11
SD IN5	CDOT Type 13	7,160.08	Standard	0.500	0.10
SD IN1	CDOT Type 13	7,158.82	Standard	0.500	0.16
SD IN2	CDOT Type 13	7,155.73	Standard	0.500	0.22

FlexTable: Manhole Table - 100 YEAR EVENT

Label	Notes	Elevation (Rim) (ft)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)
SD MH19	5' DIA MH	7,162.57	Standard	0.800	0.25
SD MH18	5' DIA MH	7,161.52	Standard	0.600	0.19
SD MH20	5' DIA MH	7,160.89	Standard	0.700	0.22
SD MH 21	5' DIA MH	7,160.46	Standard	0.800	0.16
SD MH 17	5' DIA MH	7,159.30	Standard	0.600	0.19
SD MH10	5' DIA MH	7,159.19	Standard	0.800	0.30
SD MH16	5' DIA MH	7,158.42	Standard	0.700	0.20
SD MH15	5' DIA MH	7,157.65	Standard	0.600	0.15
SD MH9	5' DIA MH	7,156.14	Standard	0.700	0.38
SD MH14	5' DIA MH	7,156.09	Standard	0.700	0.25
SD MH8	5' DIA MH	7,155.20	Standard	0.500	0.26
SD MH13	5' DIA MH	7,154.56	Standard	0.700	0.63
SD MH11	5' DIA MH	7,154.40	Standard	0.700	0.66
SD MH12	5' DIA MH	7,154.00	Standard	0.700	0.71
SD MH7	5' DIA MH	7,153.82	Standard	0.700	0.55
SD MH6	5' DIA MH	7,152.20	Standard	0.600	0.40
SD MH5	5' DIA MH	7,151.02	Standard	0.600	0.47
SD MH3	5' DIA MH	7,149.25	Standard	0.600	0.14
SD MH2	6' DIA MH	7,148.80	Standard	0.700	0.80
SD MH4	5' DIA MH	7,148.30	Standard	0.700	0.43
SD MH1	6' DIA MH	7,146.66	Standard	0.700	0.88
SD MH-22	5' DIA MH	7,146.46	Standard	0.700	0.39

FlexTable: Conduit Table - 100 YEAR EVENT

Label	Diameter (in)	Slope (Calculated) (ft/ft)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Manning's n	Flow (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Froude Number (Normal)
Pipe - (5)	18.0	0.008	5.11	7,155.31	7,154.45	0.013	4.37	7,156.11	7,155.30	7,156.43	7,155.58	1.191
Pipe - (6)	18.0	0.007	5.06	7,154.25	7,153.96	0.013	4.29	7,155.04	7,154.69	7,155.36	7,155.08	1.184
Pipe - (7)	18.0	0.008	5.07	7,153.76	7,153.34	0.013	4.27	7,154.55	7,154.06	7,154.87	7,154.46	1.193
Pipe - (4)	18.0	0.007	4.16	7,156.34	7,155.51	0.013	2.07	7,156.88	7,156.34	7,157.08	7,156.40	1.234
Pipe - (16)	18.0	0.010	4.83	7,155.80	7,155.74	0.013	2.41	7,156.39	7,156.34	7,156.61	7,156.55	1.428
Pipe - (3)	18.0	0.010	4.62	7,157.00	7,156.94	0.013	2.07	7,157.54	7,157.42	7,157.74	7,157.70	1.428
Pipe - (8)	18.0	0.008	5.06	7,153.14	7,151.92	0.013	4.23	7,153.93	7,153.42	7,154.24	7,153.51	1.196
Pipe - (22)	18.0	0.007	5.14	7,155.32	7,155.28	0.013	5.43	7,156.27	7,156.28	7,156.60	7,156.57	1.072
Pipe - (23)	18.0	0.011	6.21	7,155.08	7,152.18	0.013	5.42	7,155.98	7,153.31	7,156.35	7,153.54	1.434
Pipe - (8)	24.0	0.015	8.59	7,151.42	7,150.50	0.013	12.76	7,153.23	7,153.06	7,153.51	7,153.32	1.757
Pipe - (17)	18.0	0.019	8.71	7,153.15	7,151.92	0.013	9.33	7,154.33	7,153.42	7,154.94	7,153.86	1.805
Pipe - (9)	24.0	0.015	8.62	7,150.30	7,148.26	0.013	12.69	7,152.91	7,152.48	7,153.16	7,152.73	1.772
Pipe - (24)	24.0	0.007	6.57	7,151.68	7,149.89	0.013	12.23	7,152.94	7,151.19	7,153.47	7,151.69	1.194
Pipe - (32)	18.0	0.008	5.93	7,152.23	7,152.18	0.013	7.06	7,153.29	7,153.31	7,153.73	7,153.69	1.152
Pipe - (10)	24.0	0.007	6.87	7,148.06	7,146.76	0.013	15.08	7,152.23	7,151.46	7,152.59	7,151.81	1.125
Pipe - (33)	18.0	0.008	4.55	7,149.18	7,148.56	0.013	2.82	7,152.54	7,152.48	7,152.58	7,152.52	1.229
Pipe - (35)	24.0	0.008	6.54	7,149.69	7,148.00	0.013	11.87	7,150.93	7,149.94	7,151.45	7,150.17	1.205
Pipe - (11)	24.0	0.007	7.61	7,146.56	7,146.22	0.013	23.92	7,150.82	7,150.32	7,151.73	7,151.22	0.949
Pipe - (18)	24.0	0.023	9.51	7,148.31	7,146.76	0.013	9.88	7,151.58	7,151.46	7,151.73	7,151.61	2.283
Pipe - (12)	24.0	0.007	8.07	7,146.02	7,143.80	0.013	25.35	7,149.61	7,145.87	7,150.62	7,146.88	1.006
Pipe - (13)	30.0	0.007	8.16	7,143.30	7,142.07	0.013	31.32	7,145.21	7,144.47	7,146.15	7,145.12	1.095
Pipe - (20)	18.0	0.030	9.70	7,145.92	7,144.30	0.013	7.25	7,146.96	7,145.87	7,147.44	7,146.13	2.413
Pipe - (19)	18.0	0.025	7.82	7,146.87	7,146.72	0.013	4.24	7,150.33	7,150.32	7,150.42	7,150.41	2.238
Pipe - (25)	24.0	0.008	7.11	7,147.80	7,146.62	0.013	19.09	7,149.39	7,148.54	7,150.18	7,149.13	0.971
Pipe - (31)	18.0	0.030	9.96	7,149.02	7,148.30	0.013	7.99	7,150.12	7,149.94	7,150.63	7,150.26	2.399
Pipe - (26)	24.0	0.007	7.06	7,146.42	7,146.14	0.013	18.78	7,148.15	7,147.97	7,148.81	7,148.57	0.976
Pipe - (27)	24.0	0.026	11.66	7,145.94	7,144.06	0.013	18.70	7,147.50	7,145.12	7,148.29	7,147.02	2.296
Pipe - (30)	36.0	0.010	8.54	7,143.06	7,142.36	0.013	23.00	7,144.60	7,144.60	7,145.22	7,144.86	1.575
Pipe - (28)	36.0	0.010	8.57	7,142.16	7,141.57	0.013	22.86	7,144.46	7,144.47	7,144.70	7,144.63	1.587
Pipe - (14)	36.0	0.086	23.13	7,141.37	7,136.61	0.013	49.84	7,143.67	7,139.68	7,144.81	7,140.45	4.689
Pipe - (29)	18.0	0.030	8.78	7,144.37	7,144.16	0.013	5.00	7,145.23	7,145.03	7,145.58	7,145.37	2.462
Pipe - (21)	18.0	0.030	10.05	7,140.55	7,139.56	0.013	8.27	7,141.66	7,140.32	7,142.20	7,141.62	2.391
Pipe - (34)	36.0	0.030	16.15	7,136.41	7,136.00	0.013	54.16	7,138.80	7,137.92	7,140.05	7,139.92	2.692
CO-1	18.0	0.030	4.73	7,139.87	7,139.56	0.013	0.60	7,140.49	7,140.50	7,140.50	7,140.50	2.329
CO-2	18.0	0.030	10.20	7,139.36	7,137.91	0.013	8.65	7,140.50	7,139.68	7,141.06	7,140.05	2.393

Appendix D - Reference Documents

2.1. - Rainfall Depths

Rainfall depths must be determined based on the duration and return period of the design storm and the size of the drainage basin being evaluated. Depths can be derived by the methods described in the NOAA Atlas. The depths reported in the NOAA Atlas represent probable total depths for each duration and return period at a point on the ground. An extensive evaluation of available rain gage data was completed with the Carlton Study. While some increase in recorded depths was noted from the airport gage data, the other long-term gage locations showed that depths consistent with the NOAA Atlas can be expected. Since the NOAA Atlas is in the process of being updated, it was determined that the published atlas should continue to be used as the source of rainfall depths until this publication is revised or replaced.

The methods described in this Manual require only that the 1-hour, 6-hour and 24-hours depths be used as input. The storm return periods required for the application of methods in this Manual are the 2-, 5-, 10-, 25-, 50- and 100-year events. The 6-hour and 24-hour depths for these return periods can be read directly from Figures 6-6 through 6-17 at the end of this chapter. The1-hour depth for return periods can be calculated for all design return periods following this procedure:

Step 1: Calculate 2-year, 1-hour rainfall based on 2-year, 6-hour and 24-hour values.

$$Y_2 = 0.218 + 0.709 \cdot (X_1 \cdot X_1 / X_2) \qquad \text{(Eq. 6-1)}$$

Where:

Y_2 = 2-year, 1-hour rainfall (in)

X_1 = 2-year, 6-hour rainfall (in) from Figure 6-6

X_2 = 2-year, 24-hour rainfall (in) from Figure 6-12

Step 2: Calculate 100-year, 1-hour rainfall based on 2-year 6-hour and 24-hour values

$$Y_{100} = 1.897 + 0.439 \cdot (X_3 \cdot X_3 / X_4) - 0.008Z \qquad \text{(Eq. 6-2)}$$

Where:

Y_{100} = 100-year, 1-hour rainfall (in)

X_3 = 100-year, 6-hour rainfall (in) from Figure 6-11

X_4 = 100-year, 24-hour rainfall (in) from Figure 6-17

Z = Elevation in hundreds of feet above sea level

3.0. - RATIONAL METHOD

The Rational Method is used to determine runoff peak discharges for drainage basins up to and including 130 acres in size and when hydrologic routing is relatively simple. However, the drainage area should be divided into sub-basins that represent homogeneous land uses, soil types or land cover. The Rational Method is most typically applied for inlet and storm drain sizing.

The Rational Method is based on the direct relationship between rainfall and runoff, and is expressed by the following equation:

$$Q = C \cdot I \cdot A \qquad \text{(Eq. 6-5)}$$

In which:

Q = the maximum rate of runoff (cubic feet per second [cfs])

C = the runoff coefficient that is the ratio between the runoff volume from an area and the average rainfall depth over a given duration for that area

I = the average intensity of rainfall for a duration equal to the time of concentration (in/hr)

A = drainage basin area (acres)

The assumptions and limitations of the Rational Method are described in the UDFCD Manual, Volume 1, Runoff chapter. Standard Form 1 (SF-1) and Standard Form 2 (SF-2) are provided at the end of this chapter as Figure 6-23 and Figure 6-24, respectively to provide a standard format for Rational Method calculations. The SF-1 Form is used for calculating the time of concentration, and the SF-2 form is used to estimate accumulated peak discharges from multiple basins as storm runoff flows downstream in a channel or pipe. Results from the Rational Method calculations shall be included with the drainage report submittal. As an alternative to SF-1 and SF-2, the UD-Rational spreadsheet can be used to document basin parameters and calculations or other spreadsheets or programs can be used as long as the information and format is the similar to that shown in these standard forms.

3.1. - Rational Method Runoff Coefficient (C)

The runoff coefficient represents the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception, all of which affect the time distribution and peak rate of runoff. Runoff coefficients are based on the imperviousness of a particular land use and the hydrologic soil type of the area and are to be selected in accordance with Table 6-6.

The procedure for determining the runoff coefficient includes these steps:

1. Categorize the site area into one or more similar land uses, each with a representative imperviousness, according to the information in Table 6-6.
2. Based on the dominant hydrologic soil type in the area, use Table 6-6 to estimate the runoff coefficient for the particular land use category for the design storms of interest.
3. Calculate an area-weighted average runoff coefficient for the site based on the runoff coefficients from individual land use areas of the site.

When analyzing an area for design purposes, urbanization of the full watershed, including both on-site and off-site areas, shall be assumed.

Gravel parking areas, storage areas, and access drives proposed on Site Improvement Plans shall be analyzed based on an imperviousness of 80%. This is due to the potential for gravel areas being paved over time by property owners and the resulting adverse impacts on the stormwater management facilities and adjacent properties.

There are some circumstances where the selection of impervious percentage values may require additional investigation due to unique land characteristics (e.g., recent burn areas). When these circumstances arise, it is the designer's responsibility to verify that the correct land use assumptions are made.

When multiple sub-basins are delineated, the composite C value calculation is:

$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + \ldots C_i A_i)/A_t$ (Eq. 6-6)

Where:

C_c = composite runoff coefficient for total area

C_i = runoff coefficient for subarea corresponding to surface type or land use

A_i = area of surface type corresponding to Ci (units must be the same as those used for total area)

A_t = total area of all subareas for which composite runoff coefficient applies

i = number of surface types in the drainage area

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	**Percent Impervious**	**Runoff Coefficients**											
		2-year		**5-year**		**10-year**		**25-year**		**50-year**		**100-year**	
		HSG A&B	**HSG C&D**	**HSG A&B**	**HSG C&D**	**HSG A&B**	**HSG C&D**	**HSG A&B**	**HSG C&D**	**HSG A&B**	**HSG C&D**	**HSG A&B**	**HSG C&D**
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
⅛ Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
¼ Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
⅓ Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57

½ Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96

Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2. - Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$t_c = t_i + t_t$ (Eq. 6-7)

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min) ;0h5; 3.2.1.\Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)

C_5 = runoff coefficient for 5-year frequency (see Table 6-6)

L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)

S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize. ;0h5; 3.2.2.\Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	**C_v**
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried) *	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20
* For buried riprap, select C_v value based on type of vegetative cover.	

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7. ;0h5; 3.2.3.\First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = L / 180 + 10 \qquad \text{(Eq. 6-10)}$$

2.1. - DESIGN STORM WATER RUNOFF DETERMINATION

The City/County drainage policy permits the Rational Method and the Soil Conservation Service (SCS) Hydrograph Method as models to be used by designers in estimating storm water runoff for project purposes. The Rational Method is required for drainage basins of 100 acres or less. The SCS Hydrograph Method is required for drainage basins greater than 100 acres. For large complex Drainage Basin Planning Studies, computer models may be utilized following approval by City/County. Necessary data requirements, assumptions and detailed procedures for using models are discussed Section II. All drainage systems must be planned, designed and constructed to handle runoff from both the initial and major design storms. The initial design storm shall be the 10 year event. The major design storm shall be the 100-year event.

Normally in a roadway section, the initial drainage system should convey a substantial portion of the minor storm flows with the more intense or major storm flows conveyed by the available street capacity. Out of roadway sections, storm drain systems combined with overflow swales or drainageway or channel sections must be of adequate capacity to convey both design storms and protect adjacent properties.

NOAA Atlas 14, Volume 8, Version 2
Location name: Monument, Colorado, USA*
Latitude: 39.1092°, Longitude: -104.864°
Elevation: 7156 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.244 (0.200-0.297)	0.312 (0.256-0.379)	0.426 (0.348-0.518)	0.523 (0.424-0.638)	0.659 (0.517-0.830)	0.768 (0.587-0.974)	0.878 (0.648-1.14)	0.993 (0.702-1.31)	1.15 (0.780-1.55)	1.27 (0.839-1.73)
10-min	0.358 (0.293-0.434)	0.457 (0.375-0.555)	0.624 (0.509-0.759)	0.765 (0.621-0.934)	0.966 (0.757-1.22)	1.12 (0.859-1.43)	1.29 (0.949-1.66)	1.45 (1.03-1.92)	1.68 (1.14-2.27)	1.86 (1.23-2.53)
15-min	0.436 (0.358-0.530)	0.558 (0.457-0.677)	0.761 (0.621-0.926)	0.933 (0.757-1.14)	1.18 (0.923-1.48)	1.37 (1.05-1.74)	1.57 (1.16-2.03)	1.77 (1.25-2.34)	2.05 (1.39-2.76)	2.27 (1.50-3.09)
30-min	0.575 (0.471-0.698)	0.736 (0.603-0.894)	1.00 (0.820-1.22)	1.23 (1.00-1.51)	1.56 (1.22-1.96)	1.81 (1.38-2.30)	2.07 (1.53-2.68)	2.34 (1.65-3.09)	2.70 (1.84-3.64)	2.99 (1.97-4.06)
60-min	0.727 (0.596-0.882)	0.897 (0.735-1.09)	1.20 (0.975-1.45)	1.46 (1.18-1.78)	1.85 (1.46-2.35)	2.17 (1.67-2.78)	2.52 (1.86-3.27)	2.88 (2.04-3.82)	3.39 (2.31-4.59)	3.80 (2.51-5.17)
2-hr	0.878 (0.725-1.06)	1.06 (0.872-1.27)	1.38 (1.14-1.67)	1.69 (1.38-2.04)	2.15 (1.71-2.72)	2.54 (1.97-3.23)	2.96 (2.21-3.84)	3.42 (2.45-4.52)	4.08 (2.80-5.50)	4.61 (3.07-6.24)
3-hr	0.987 (0.818-1.18)	1.16 (0.958-1.39)	1.48 (1.22-1.78)	1.80 (1.48-2.17)	2.30 (1.85-2.92)	2.74 (2.14-3.49)	3.22 (2.42-4.18)	3.76 (2.71-4.97)	4.54 (3.14-6.12)	5.19 (3.46-6.99)
6-hr	1.20 (1.00-1.42)	1.39 (1.16-1.65)	1.76 (1.46-2.09)	2.13 (1.75-2.54)	2.72 (2.21-3.43)	3.24 (2.55-4.10)	3.83 (2.90-4.93)	4.48 (3.25-5.89)	5.44 (3.78-7.29)	6.24 (4.19-8.35)
12-hr	1.46 (1.22-1.71)	1.72 (1.44-2.02)	2.20 (1.84-2.60)	2.66 (2.21-3.15)	3.37 (2.74-4.19)	3.98 (3.14-4.98)	4.65 (3.54-5.92)	5.39 (3.92-7.00)	6.44 (4.50-8.55)	7.31 (4.94-9.72)
24-hr	1.76 (1.48-2.05)	2.09 (1.76-2.44)	2.68 (2.25-3.13)	3.22 (2.69-3.77)	4.02 (3.28-4.93)	4.70 (3.73-5.80)	5.43 (4.15-6.83)	6.22 (4.55-8.00)	7.33 (5.15-9.64)	8.23 (5.61-10.9)
2-day	2.09 (1.77-2.41)	2.44 (2.07-2.82)	3.08 (2.60-3.56)	3.65 (3.07-4.24)	4.51 (3.69-5.47)	5.23 (4.17-6.39)	6.00 (4.61-7.48)	6.82 (5.02-8.70)	8.00 (5.65-10.4)	8.94 (6.13-11.7)
3-day	2.26 (1.92-2.59)	2.65 (2.26-3.05)	3.34 (2.83-3.85)	3.95 (3.33-4.57)	4.86 (3.99-5.85)	5.61 (4.49-6.82)	6.41 (4.94-7.95)	7.26 (5.36-9.21)	8.46 (6.00-11.0)	9.42 (6.48-12.3)
4-day	2.39 (2.05-2.74)	2.81 (2.40-3.22)	3.54 (3.01-4.06)	4.18 (3.54-4.82)	5.13 (4.22-6.14)	5.91 (4.74-7.15)	6.73 (5.20-8.31)	7.61 (5.63-9.61)	8.83 (6.28-11.4)	9.81 (6.77-12.8)
7-day	2.79 (2.40-3.17)	3.23 (2.77-3.67)	4.00 (3.42-4.56)	4.68 (3.98-5.36)	5.70 (4.71-6.77)	6.53 (5.26-7.84)	7.42 (5.76-9.10)	8.36 (6.22-10.5)	9.68 (6.92-12.5)	10.7 (7.45-13.9)
10-day	3.15 (2.72-3.56)	3.62 (3.11-4.09)	4.43 (3.80-5.02)	5.15 (4.40-5.87)	6.23 (5.17-7.37)	7.11 (5.75-8.50)	8.05 (6.28-9.83)	9.05 (6.76-11.3)	10.5 (7.50-13.4)	11.6 (8.06-15.0)
20-day	4.17 (3.62-4.67)	4.77 (4.14-5.35)	5.80 (5.01-6.52)	6.69 (5.74-7.55)	7.97 (6.63-9.30)	8.99 (7.30-10.6)	10.1 (7.88-12.1)	11.2 (8.39-13.8)	12.7 (9.17-16.1)	13.9 (9.76-17.9)
30-day	5.00 (4.35-5.57)	5.73 (4.99-6.39)	6.95 (6.03-7.77)	7.98 (6.88-8.96)	9.42 (7.85-10.9)	10.5 (8.58-12.3)	11.7 (9.18-14.0)	12.9 (9.68-15.8)	14.4 (10.4-18.2)	15.7 (11.0-20.0)
45-day	6.03 (5.28-6.68)	6.92 (6.05-7.68)	8.36 (7.28-9.30)	9.55 (8.27-10.7)	11.2 (9.31-12.8)	12.4 (10.1-14.4)	13.6 (10.7-16.2)	14.8 (11.2-18.0)	16.4 (11.9-20.5)	17.6 (12.4-22.4)
60-day	6.90 (6.06-7.62)	7.92 (6.94-8.75)	9.54 (8.33-10.6)	10.8 (9.41-12.1)	12.6 (10.5-14.3)	13.9 (11.3-16.0)	15.1 (11.9-17.8)	16.3 (12.3-19.8)	17.9 (13.0-22.2)	19.0 (13.5-24.1)

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

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

Please refer to NOAA Atlas 14 document for more information.

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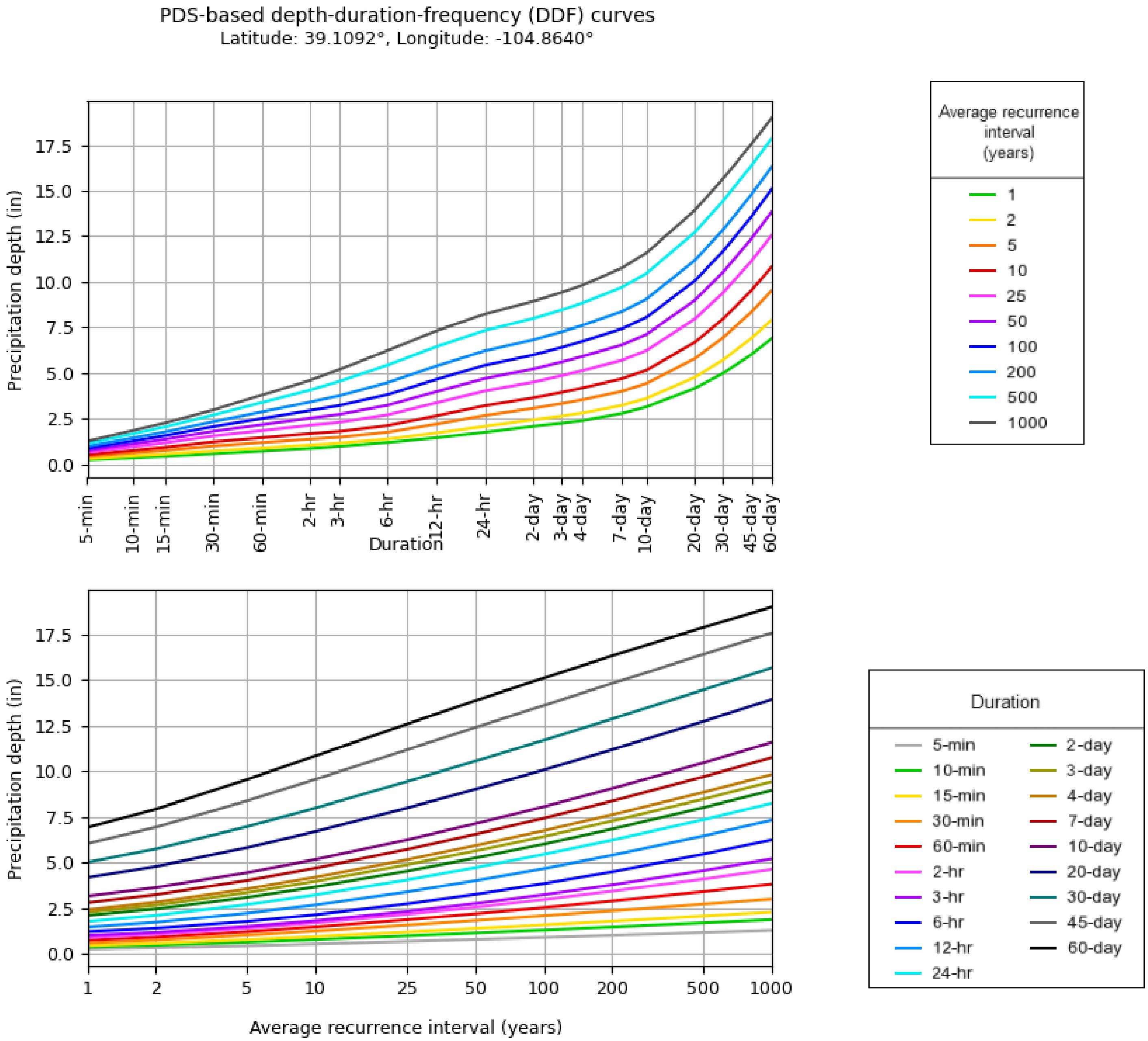
PF graphical



NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Thu Jun 8 22:07:23 2023

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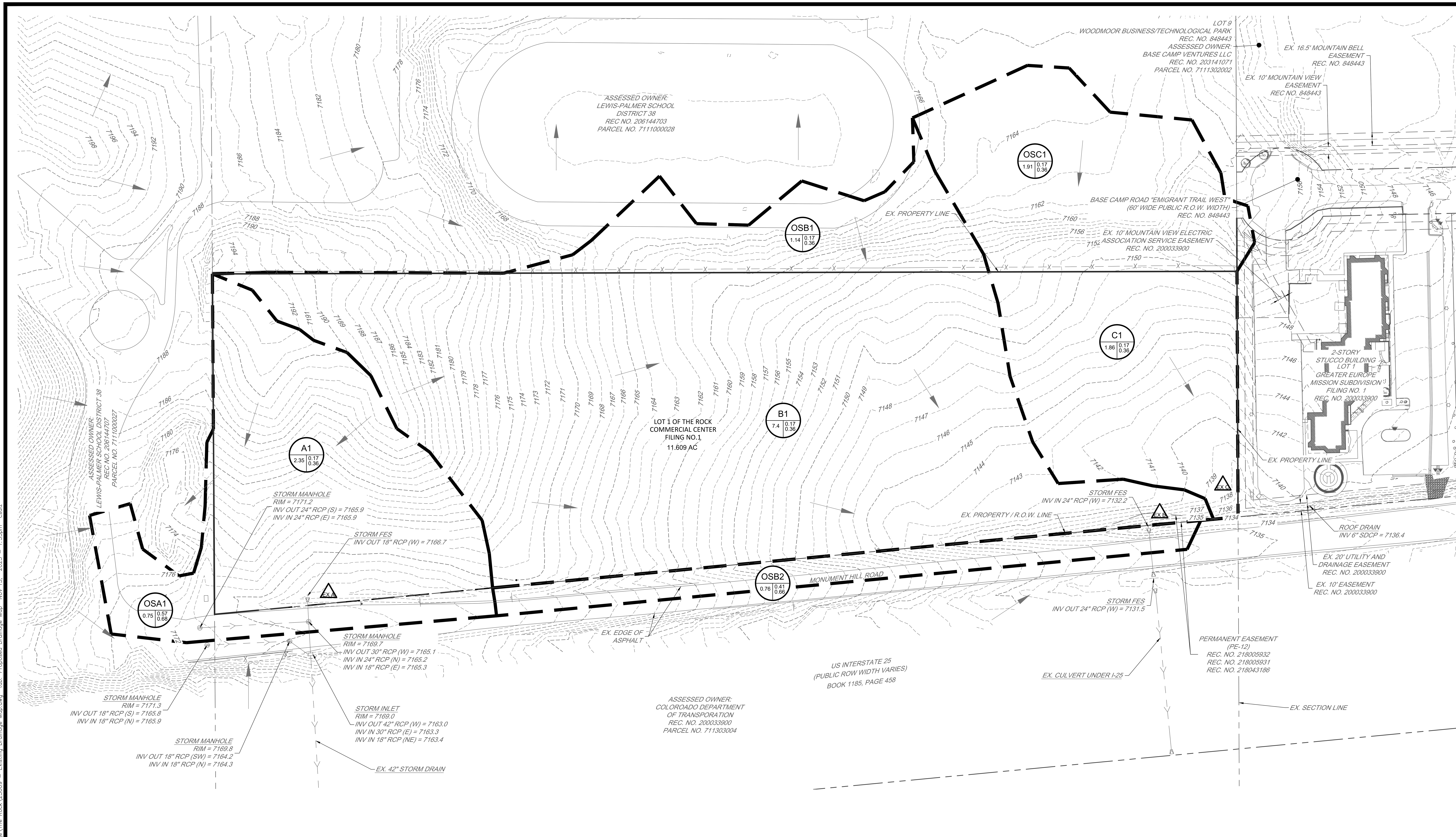
Maps & aerials

Small scale terrain

$VS^{0.17}/(S_s-1)^{0.66}$ * ($ft^{1/2}$/sec)	Rock Type***
1.4 to 3.2	VL
3.3 to 3.9	L
4.0 to 4.5	M
4.6 to 5.5	H
5.6 to 6.4	VH
*where:	
V = mean channel flow velocity, in fps;	
S = longitudinal channel slope, in feet per foot (ft/ft); and	
S_s = specific gravity of stone (minimum S_s = 2.50)	
** Table valid only for Froude number of 0.8 or less and side slopes no steeper than 2h:1v.	
*** Type VL and L riprap may be buried after placement to reduce vandalism.	

Channel Slope	**Lining**	**Permissible Mean Channel Velocity* (ft/sec)**
0 - 5%	Sodded grass	7
	Bermudagrass	6
	Reed canarygrass	5
	Tall fescue	5
	Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue	2.5
	Redtop	2.5
	Sericea lespedeza	2.5
	Annual lespedeza	2.5
	Small grains (temporary)	2.5
5 - 10%	Sodded grass	6
	Bermudagrass	5
	Reed canarygrass	4
	Tall fescue	4
	Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Sodded grass	5
	Bermudagrass	4
	Reed canarygrass	3
	Tall fescue	3
	Kentucky bluegrass	3
*For highly erodible soils, decrease permissible velocities by 25%.		
*Grass lined channels are dependent upon assurances of continuous growth and maintenance of grass.		

Appendix E - Drainage Maps



DRAINAGE LEGEND

- 5281 — EXISTING MINOR CONTOUR
- 5280 — EXISTING MAJOR CONTOUR
- EXISTING STORM SEWER LINE
- FEMA — FEMA 100-YEAR FLOOD PLAIN
- FEMA ZONE X
- SUB-BASIN BOUNDARY
- MAJOR BASIN BOUNDARY
- PROPERTY LINE
- A1 — EXISTING BASIN ID
- 0.00 — EXISTING 10 YEAR RUNOFF COEFFICIENT
- 0.00 — EXISTING 100 YEAR RUNOFF COEFFICIENT
- 0.00 — BASIN AREA (ACRES)
- EXISTING GRADE FLOW ARROW
- 00 — EXISTING DESIGN POINT

BASIN PEAK FLOW SUMMARY

BASIN	Q10	Q100
A1	1.5	4.6
OSA1	2.0	3.4
B1	3.7	11.4
OSB1	0.8	2.5
OSB2	1.5	2.6
C1	1.1	3.4
OSC1	1.0	3.0

DESIGN POINT FLOW SUMMARY

DESIGN POINT	Q10	Q100
A	3.07	7.27
B	5.53	15.26
C	1.97	6.02

PCD FILE NO. PPR2329

SCALE: 1" = 60'

15 YEARS Redland
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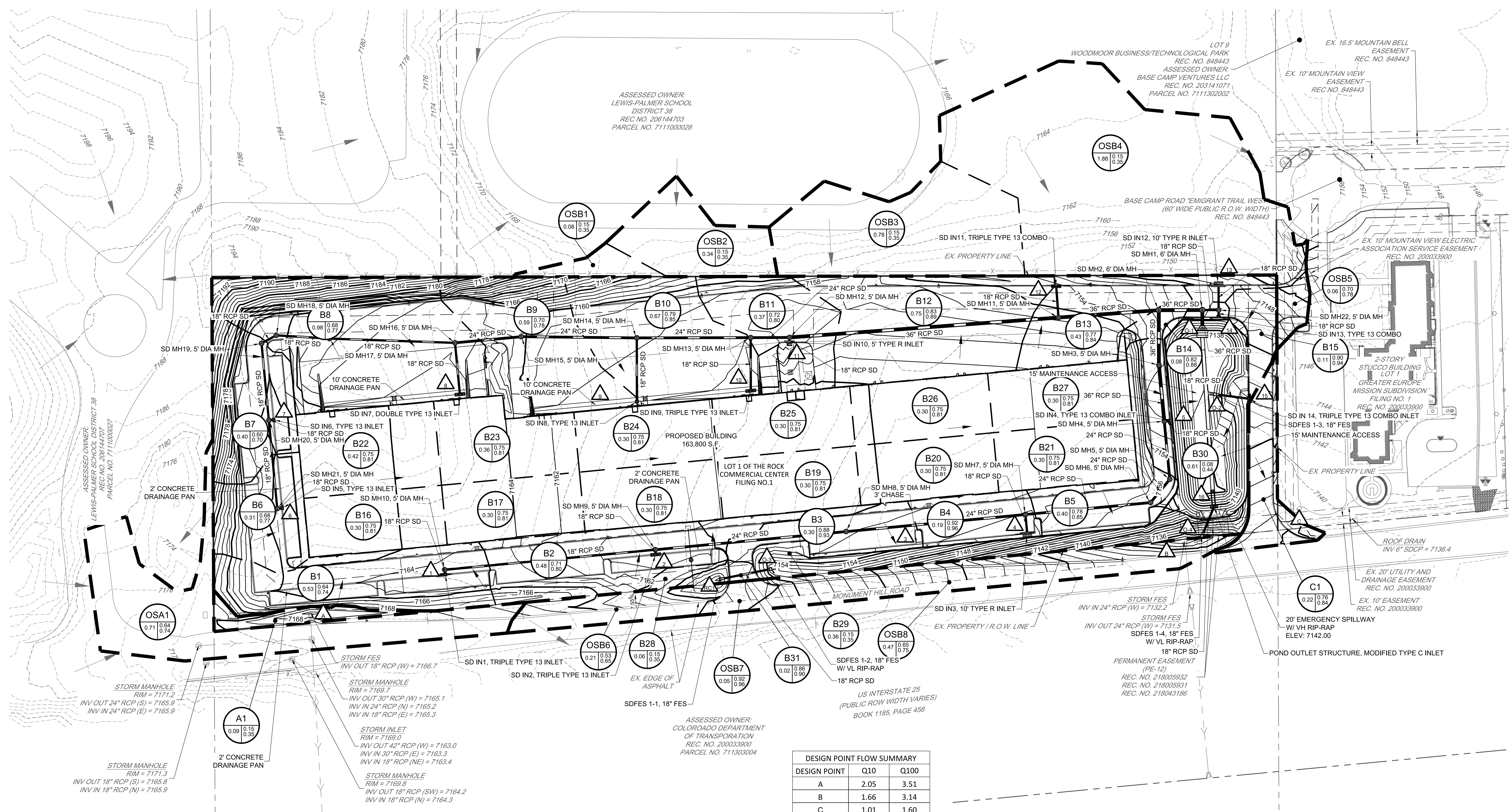
DATE	NO.	NOTES
07/28/23	1	1ST SUBMITTAL
10/20/23	2	2ND SUBMITTAL
11/17/23	3	3RD SUBMITTAL

PROJECT NO. 23009

LOT 1 OF THE ROCK COMMERCE CENTER FILING NO. 1

DRAINAGE MAPS
EXISTING DRAINAGE MAP

SHEET DNG-1



DRAINAGE LEGEND

- 5282 EXISTING MINOR CONTOUR
- 5280 EXISTING MAJOR CONTOUR
- 5281 PROPOSED MINOR CONTOUR
- 5280 PROPOSED MAJOR CONTOUR
- PHASE 2 CONSTRUCTION BOUNDARY
- EXISTING STORM SEWER LINE
- PROPOSED STORM SEWER LINE
- PROPOSED MANHOLE
- EXISTING INLET
- PROPOSED INLET
- PROPOSED FLARED END SECTION
- SUB-BASIN BOUNDARY
- MAJOR BASIN BOUNDARY
- PROPERTY LINE
- A1 — BASIN ID; 0.00 — 10 YEAR RUNOFF COEFFICIENT; 0.00 — 100 YEAR RUNOFF COEFFICIENT; 0.000 — BASIN AREA (ACRES)
- 00 PROPOSED DESIGN POINT
- EX-1 — EXISTING BASIN ID; 0.00 — EXISTING 10 YEAR RUNOFF COEFFICIENT; 0.00 — EXISTING 100 YEAR RUNOFF COEFFICIENT; 0.000 — BASIN AREA (ACRES)
- 00 EXISTING DESIGN POINT
- EXISTING GRADE FLOW ARROW
- PROPOSED GRADE FLOW ARROW

BASIN PEAK FLOW SUMMARY		
BASIN	Q10	Q100
B1	2.0	3.4
B2	2.0	3.2
B3	1.6	2.4
B4	1.0	1.5
B5	1.8	2.9
B6	1.2	2.0
B7	1.4	2.4
B8	3.9	6.4
B9	2.4	3.9
B10	3.1	4.9
B11	1.6	2.5
B12	3.6	5.6
B13	2.0	3.1
B14	0.4	0.6
B15	0.6	0.9
B16	1.3	2.1
B17	1.3	2.0
B18	1.3	2.1
B19	1.3	2.0
B20	1.3	2.1
B21	1.3	2.1

BASIN PEAK FLOW SUMMARY		
BASIN	Q10	Q100
B22	1.8	2.9
B23	1.6	2.5
B24	1.3	2.0
B25	1.3	2.1
B26	1.3	2.1
B27	1..3	2.1
B28	0.0	0.1
B29	0.2	0.8
B30	0.3	1.9
B31	0.1	0.1
OSB1	0.1	0.2
OSB2	0.2	0.8
OSB3	0.6	1.9
OSB4	1.1	3.7
OSB5	0.2	0.4
OSB6	0.6	1.0
OSB7	0.3	0.4
OSB8	1.6	2.7
A1	0.1	0.2
OSA1	2.4	4.0
C1	1.0	1.6

DESIGN POINT FLOW SUMMARY		
DESIGN POINT	Q10	Q100
A	2.05	3.51
B	1.66	3.14
C	1.01	1.60
O-1	26.71	54.14
O-2	0.85	1.31
O-3	0.61	1.15
O-4	3.4	10.4
RC1	0.61	1.15
1	3.35	5.42
2	4.46	7.04
3	2.78	4.28
4	2.63	4.03
5	3.19	4.98
6	1.24	2.02
7	1.40	2.39
8	5.76	9.26
9	4.03	6.42
10	3.85	6.13
11	2.39	4.18
12	4.63	8.16
13	3.30	7.16
14	0.38	0.58
15	0.85	1.31
16	0.26	1.92

FULL SPECTRUM POND SUMMARY		
ZONE	VOLUME (AC-FT)	WATER ELEV.
WQCV	0.294	7137.55
EURV	0.675	7140.11
100-YEAR	0.518	7141.64

PCD FILE NO. PPR2329

SCALE: 1" = 60'

15 YEARS Redland
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PROJECT NO.	23009	
DATE	NO.	NOTES
07/28/23	1	1ST SUBMITTAL
10/20/23	2	2ND SUBMITTAL
11/17/23	3	3RD SUBMITTAL

LOT 1 OF THE ROCK COMMERCE CENTER FILING NO. 1

DRAINAGE MAPS

PROPOSED DRAINAGE MAP

SHEET DNG-2

I:\2023\23009 — The Rock Commerce Center\CADD\Sheet Sets\Drainage\The Rock\23009 — Proposed Drainage Map.dwg tab: Proposed Drainage Map Nov 15, 2023 – 1:52pm csolz

V3_Drainage Report - Final.pdf Markup Summary

Christina Prete (6)

Subject: Stormwater Comments Color
Page Label: 1
Author: Christina Prete
Date: 12/6/2023 5:24:54 PM
Status:
Color:
Layer:
Space:

Subject: Contractor
Page Label: 55
Author: Christina Prete
Date: 12/6/2023 4:42:42 PM
Status:
Color:
Layer:
Space:

change to 1.35

Subject: Highlight
Page Label: 55
Author: Christina Prete
Date: 12/6/2023 4:42:47 PM
Status:
Color:
Layer:
Space:

1.30 1.30 1.30 1.30

Subject: Contractor
Page Label: 55
Author: Christina Prete
Date: 12/6/2023 4:45:15 PM
Status:
Color:
Layer:
Space:

assume 50%

Subject: Highlight
Page Label: 55
Author: Christina Prete
Date: 12/6/2023 4:45:11 PM
Status:
Color:
Layer:
Space:

0%

Subject: Contractor
Page Label: 115
Author: Christina Prete
Date: 12/6/2023 5:15:24 PM
Status:
Color:
Layer:
Space:

i dont see riprap at DP-C on the Plans. Please confirm location