FINAL DRAINAGE REPORT
FOR
MONUMENT JUNCTION DEVELOPMENT
HIGHWAY 105 CORRIDOR &
JACKSON CREEK PARKWAY
INTERSECTION IMPROVEMENTS

July 2023

Prepared for:
ELITE PROPERTIES OF AMERICA, INC
2138 FLYING HORSE CLUB DR.
COLORADO SPRINGS, CO 80921

Prepared by:
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Job no. 1302.22

FINAL DRAINAGE REPORT FOR
MONUMENT JUNCTION DEVELOPMENT – HIGHWAY 105 CORRIDOR & JACKSON CREEK PARKWAY INTERSECTION IMPROVEMENTS

DRAINAGE REPORT STATEMENT

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 Town for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

____ ____________________
Marc A. Whorton, Colorado P.E. #37155 Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: ELITE PROPERTIES OF AMERICA, INC.

By: ____

Title: ____

Address: 2138 FLYING HORSE CLUB DR.
COLORADO SPRINGS, CO 80921

TOWN OF MONUMENT:
Filed in accordance with Sections 12.13.010 of the Subdivision Ordinance for the Town of Monument, revised 1997 and 13.11.160 of the Zoning Ordinance for the Town of Monument, revised 1997.

____________________________________ ____________________
For Town of Monument Date

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
(Review only for Hwy. 105 intersection design east of Jackson Creek Pkwy.)

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT FOR
MONUMENT JUNCTION DEVELOPMENT – HIGHWAY 105 CORRIDOR &
JACKSON CREEK PARKWAY INTERSECTION IMPROVEMENTS

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CLASSIC CONSULTING ENGINEERS & SURVEYORS

PURPOSE

This document is the Final Drainage Report for the Monument Junction Development and the associated adjacent off-site improvements to Highway 105 and the intersection with Jackson Creek Parkway. The purpose of this report is to identify the existing drainage patterns in this corridor, define and detail practical solutions for the conveyance and attenuation of developed flows to minimize drainage impacts further downstream resulting from these regional roadway improvements as required by Town of Monument, El Paso County and CDOT. **Two separate reports cover the on-site aspects of the Monument Junction Development. Please reference "Monument Junction East – Phase 1 PD Site Plan" and "Monument Junction West Filing No. 1", both prepared by Classic Consulting. These reports have been approved by the Town of Monument and detail and describe all the on-site drainage design for the development.**

GENERAL DESCRIPTION

This report covers the Highway 105 corridor from the I-25 off-ramp to the Knollwood Drive intersection and the Jackson Creek Parkway improvements from Highway 105 to the high point in the road approximately 750 feet south of Highway 105. This area lies within Section 14, township 11 south, range 67 west of the 6^{th} principal meridian, in El Paso County. This corridor is bounded on the north by CDOT property and private rural residential property, to the south by Monument Junction development and various commercial developments along Highway 105, to the east by existing Village Center at Woodmoor development and to the west by existing CDOT Right-of-way (Interstate-25).

The average soil condition reflects Hydrologic Group "D" (Alamosa Loam) as determined by the "Web Soil Survey of El Paso County Area," prepared by the Soil Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

This corridor is entirely within the Dirty Woman Creek drainage basin. Existing slopes range from 1% to 33% and ground cover is predominantly paved roadway with native grass sideroad ditches with some trees and wetlands within the corridor. The current drainage pattern flows generally in a westerly direction towards the intersection of Highway 105 and the I-25 off-ramp where an existing 36" RCP culvert crosses the I-25 off-ramp. This natural drainageway just upstream of this facility contains wetland area within the natural channel behind the sidewalk along the south side of Highway 105. Please reference the Jurisdictional Determination (JD) Action No. SPA-2022-00180 that finds these wetlands to be non-jurisdictional. (See Appendix) The corridor east of Jackson Creek

Parkway contains an existing storm system collecting the developed street flows and the adjacent property along the south side of Highway 105.

The following off-site basins (OS-10 thru OS-18) are all along this stretch of the Highway 105 corridor east to Knollwood Drive including the intersection with Jackson Creek Parkway:

Basin OS-10 (Q_5= 3 cfs, Q_{100}= 10 cfs) consists of the off-site property within the existing Right-of-Way for Highway 105 and the I-25 off-ramp. These flows travel as sheet flow in a northerly direction directly into the sideroad ditch along the south side of Highway 105 and the east side of the I-25 off-ramp. The flows then travel as ditch flow towards the intersection with the I-25 off-ramp. The total flows at this location are described later as Design Point H10.

Basin OS-16 (Q_5= 2 cfs, Q_{100}= 5 cfs) consists of the off-site fully developed properties east of Jackson Creek Parkway and south of Highway 105. This basin consists of existing buildings, parking lot, drive aisle and landscape area. These developed flows travel into a landscape sediment area adjacent to the buildings and then directly into Basin OS-11. **Basin OS-11 (Q_5= 3 cfs, Q_{100}= 6 cfs)** consists of the off-site partially developed property due east of Jackson Creek Parkway just south of Highway 105. This basin consists of an existing building, parking lot, driveway and native planted slope adjacent to Jackson Creek Parkway. The combined developed flows travel in a westerly direction and directly into the sideroad ditch along Jackson Creek Parkway. However, the ditch on the east side of the road seems to end and these flows appear to spillover to the westerly side of the roadway (Design Point H7) as the northbound approach to the intersection with Highway 105 is superelevated due to the grade on Highway 105. At **Design Point H7 (Q_5= 5 cfs, Q_{100}= 10 cfs)** these combined flows are partially collected by an existing 10' Type R at-grade inlet **(Q_5= 4.9 cfs, Q_{100}= 7.7 cfs)** with a flow-by of **(Q_5= 0.1 cfs, Q_{100}= 2.3 cfs)**. This minor flow-by continues around the corner and then in a westerly direction down the street within Basin OS-17. The collected flows along with the upstream flows are conveyed in an existing 30" RCP storm pipe and daylight into the sideroad ditch along the south side of Highway 105.

Basin OS-12 (Q_5= 1.2 cfs, Q_{100}= 3 cfs) consists of the most easterly portion of Highway 105 at the Knollwood Drive intersection. Portions of this basin include the existing paved roadway and naturally landscaped area within the ROW. It has been assumed that the upstream facilities (east of Knollwood Dr.) capture 100% of the minor flows but approximately 0.85 cfs bypass those facilities in the major event. *(Information taken from recent "Preliminary Drainage Report Highway 105 Project A", prepared by HDR for El Paso County, dated November 2021)* Thus, the total flows are conveyed via curb and gutter in a westerly direction towards **Design Point H4 (Q_5= 1 cfs, Q_{100}= 3.8 cfs)**. At this location, an existing 5' Type R at-grade inlet collects a portion of these flows **(Q_5= 1 cfs, Q_{100}= 2.5 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 1.3 cfs)**. This minor flow-by continues in a westerly direction down the street within Basin OS-13. The collected flows are conveyed in an existing 15" RCP storm pipe in a westerly direction under Highway 105.

Basin OS-13 (Q_5= 2 cfs, Q_{100}= 4 cfs) consists of a portion of Highway 105 west of Knollwood Drive. Portions of this basin include the existing paved roadway and naturally landscaped area within the ROW. These flows along with the minor 100 yr. flow-by from Design Point H4 are conveyed via curb and gutter in a westerly direction towards **Design Point H5**. At this location, an existing 10' Type R at-grade inlet collects a portion of these flows **(Q_5= 2 cfs, Q_{100}= 4.9 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 0.4 cfs)**. This minor flow-by continues in a westerly direction down the street within Basin OS-14. The collected flows combine with the upstream system and are conveyed in an existing 15" RCP storm pipe in a westerly direction.

Basin OS-14 (Q_5= 0.8 cfs, Q_{100}= 2 cfs) consists of a portion of Highway 105 just east of Jackson Creek Parkway. Portions of this basin include the existing paved roadway and naturally landscaped area within the ROW. These flows along with the 100 yr. flow-by from Design Point H5 are conveyed via curb and gutter in a westerly direction towards **Design Point H6**. At this location, an existing 10' Type R at-grade inlet completely collects these flows with no flow-by. The total collected flows are then conveyed in an existing 24" RCP storm pipe in a southwesterly direction.

Basin OS-15 (Q_5= 4 cfs, Q_{100}= 8 cfs) consists of the off-site partially developed property due east of Jackson Creek Parkway just south of Highway 105. This basin consists of existing buildings, parking lots, drive aisles and native undeveloped areas. These developed flows generally travel in a westerly direction towards a sediment basin up on top of the slope at the intersection with Jackson Creek Parkway. This facility does not seem to have any formal stormwater quality features but rather just a rip-rap basin with and existing 18" ADS storm outfall. This outfall conveys the flows directly into a grated inlet behind the curb along the east side of Jackson Creek Parkway. The flows are then conveyed under the roadway within an existing 30" RCP storm system. This system daylights into the sideroad ditch at the SW corner of Highway 105 and Jackson Creek Parkway.

Basin OS-17 (Q_5= 2 cfs, Q_{100}= 4 cfs) consists of a portion of Highway 105 within the intersection with Jackson Creek Parkway. The majority of this basin includes the existing paved roadway along with an area naturally landscaped slope at the SE corner of the intersection. These flows along with the by-pass flows from Design Point H7 described above are conveyed via curb and gutter in a westerly direction towards **Design Point H8 (Q_5= 2.1 cfs, Q_{100}= 6.3 cfs)**. At this location, an existing 10' Type R at-grade inlet collects a portion of these flows **(Q_5= 2.1 cfs, Q_{100}= 5.5 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 0.8 cfs)**. This minor flow-by continues in a westerly direction down the street within Basin OS-18. The collected flows are conveyed out of the back of the inlet via a 24" RCP directly into the sideroad ditch along the south side of Highway 105.

Basin OS-18 (Q_5= 1.3 cfs, Q_{100}= 2 cfs) consists of a portion of Highway 105 just east of the intersection with the I-25 off-ramp. All of this basin includes the existing paved roadway. These flows along with the by-pass flows from Design Point H8 described above are conveyed via curb and gutter in a westerly direction towards **Design Point H9 (Q_5= 1 cfs, Q_{100}= 3 cfs)**. At this location, an existing 10' Type R sump inlet completely collects these flows. The collected flows are conveyed out of the back of the inlet via a 24" RCP directly into the sideroad ditch along the south side of Highway 105.

Design Point H10 (Q_5= 14 cfs, Q_{100}= 36 cfs) consists of the total combined flows from all the tributary upstream basins described above. At this location, the natural ditch within CDOT ROW conveys the flows to an existing 36" RCP culvert under the I-25 off-ramp. This facility seems to adequately handle these current developed flows.

PROPOSED DRAINAGE CONDITIONS

Developed runoff from the proposed off-site public roadway improvements within the Highway 105 and Jackson Creek Parkway ROW corridors will be conveyed via surface drainage and public storm sewer systems to a proposed permanent storm water quality facility located at the SE corner of the intersection of the I-25 off-ramp and Highway 105. Given that these improvements span multiple jurisdictions, the proposed facilities will be designed and installed per the latest El Paso County ECM and Town of Monument drainage criteria and detailed in this report. See the following general descriptions of the anticipated developed design points and how all the developed flows will be mitigated:

Design Point D4 (Q_5= 1.4 cfs, Q_{100}= 3.9 cfs) consists of the most easterly portion of Highway 105 at the Knollwood Drive intersection within Basin OS12D. Portions of this basin include the existing paved roadway and naturally landscaped area within the ROW and new roadway improvements proposed by El Paso County. These developed flows include the minor 100 yr. flow-by of 0.85 cfs as described in the "Preliminary Drainage Report Highway 105

Project A", prepared by HDR for El Paso County, dated November 2021. The total flows are conveyed via curb and gutter in a westerly direction towards Design Point H4. At this location, a proposed 5' Type R at-grade inlet collects a portion of these flows **(Q_5= 1.4 cfs, Q_{100}= 2.5 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 1.3 cfs)**. This minor flow-by continues in a westerly direction down the street within Basin OS13D. The collected flows are conveyed in a proposed 18" RCP storm pipe in a westerly direction under Highway 105. This proposed inlet and 18" RCP storm will be constructed as a part of the El Paso County Highway 105 Project A.

Design Point D5 (Q_5= 2 cfs, Q_{100}= 5 cfs) consists of a portion of the redeveloped Highway 105 by El Paso County. At this location, a proposed 10' Type R at-grade inlet collects a portion of these flows **(Q_5= 2 cfs, Q_{100}= 4.9 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 0.4 cfs)**. This minor flow-by continues in a westerly direction down the street within Basin OS14D. The collected flows combine with the upstream system and are conveyed in a proposed 18" RCP storm pipe in a westerly direction. This proposed inlet and 24" RCP storm will be constructed as a part of the El Paso County Highway 105 Project A.

Design Point D6 (Q_5= 4 cfs, Q_{100}= 8 cfs) consists of the off-site partially developed property due east of Jackson Creek Parkway just south of Highway 105. Basin OS-15D is the upstream basin that consists of existing buildings, parking lots, drive aisles and native undeveloped areas. These developed flows generally travel in a westerly direction and will continue to be captured by a proposed CDOT Type C inlet within their property, located behind the proposed retaining wall. Appropriate easement documents and agreements will need to be granted prior to construction. The collected flows will then be routed via a proposed 18" RCP pipe routed towards the proposed storm system within Highway 105. These flows then combine with the upstream flows described earlier and are conveyed further downstream in a westerly direction.

Design Point D7 (Q_5= 6 cfs, Q_{100}= 12 cfs) consists of a portion of the proposed Jackson Creek Parkway road improvements and a few off-site basins to the east that are tributary to this location (Basins OS-16 and OS11D). Developed flows from these basins sheet flow towards Jackson Creek Parkway and enter the roadway. This portion of the road will remain superelevated and the flows sheet flow towards the median and a proposed 10' Type R at-grade inlet. This facility collects a portion of these flows **(Q_5= 5.4 cfs, Q_{100}= 8.2 cfs)** with a flow-by of **(Q_5= 0.6 cfs, Q_{100}= 3.8 cfs)**. This flow-by continues in a northerly direction down the street within Basin OS14D. The collected flows are conveyed in a proposed 18" RCP storm pipe in a northerly direction.

Design Point D8 (Q_5= 3 cfs, Q_{100}= 8 cfs) consists of a portion of the intersection including both proposed Jackson Creek Parkway and Highway 105 road improvements. Developed flow from this basin along with the flow-by described above sheet flow towards the intersection and a proposed 10' Type R sump inlet within the median. This facility completely collects these flows with a maximum ponding elevation of 6". The collected flows combine with the routed upstream flows and are conveyed in a proposed 24" RCP storm pipe in a westerly direction.

Design Point D9 (Q_5= 2 cfs, Q_{100}= 5 cfs) consists of a portion of the proposed Jackson Creek Parkway road improvements (Basin JPC7) and the on-site basin G. Developed flows from these basins sheet flow towards Jackson Creek Parkway and enter the roadway as curb and gutter flow towards a proposed 10' Type R at-grade inlet. This facility collects a portion of these flows **(Q_5= 2 cfs, Q_{100}= 4.8 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 0.2 cfs)**. This flow-by continues in a westerly direction down the street within Basin OS17D. The collected flows are conveyed in a proposed 18" RCP storm pipe in a northerly direction.

Design Point D10 (Q_5= 3 cfs, Q_{100}= 6 cfs) consists of a portion of the proposed Highway 105 road improvements within Basin OS17D. Developed flows from this basin along with the upstream flow-by sheet flow towards Highway 105. At this location a proposed 10' Type R at-grade inlet is proposed. This facility collects a portion of these flows **(Q_5= 3 cfs, Q_{100}= 5.4 cfs)** with a flow-by of **(Q_5= 0 cfs, Q_{100}= 0.8 cfs)**. This flow-by continues in a westerly direction down the street within Basin OS18D. The collected flows are conveyed in a proposed 18" RCP storm pipe towards the proposed storm system behind the curb.

Design Point D11 (Q_5= 2 cfs, Q_{100}= 4 cfs) consists of a portion of the proposed Highway 105 road improvements within Basin OS18D. Developed flows from this basin along with the minor upstream flow-by sheet flow towards Highway 105. At this location, an existing 10' Type R sump inlet completely collects these flows. The collected flows are conveyed out of the back of the inlet via an existing 24" RCP directly into the proposed SWQ facility.

Basin H (Q_5= 0.4 cfs, Q_{100}= 1.8 cfs) consists of a small portion of the proposed commercial development that will likely be landscape area and continue to sheet flow directly into Basin OS10D. **Basin OS10D (Q_5= 0.8 cfs, Q_{100}= 4 cfs)** consists of the existing vegetated slope within CDOT ROW that sheet flows to the sideroad ditch along the east side of the I-25 off-ramp. The combined flows will continue to travel as ditch flow directly into the proposed SWQ facility.

Design Point 13 (Q_5= 18 cfs, Q_{100}= 40 cfs) consists of the total combined developed flows from all the tributary upstream basins within the Highway 105 corridor and Jackson Creek Parkway intersection described above. These developed flows compare to the pre-development flows as follows:

Developed Flows at exist. 36" RCP at I-25 off-ramp: **(Q_5 = 18 cfs, Q_{100} = 40 cfs)**

Pre-developed flows at exist. 36" RCP at I-25 off-ramp: **(Q_5 = 14 cfs, Q_{100} = 36 cfs)**

A proposed SWQ/detention facility is planned within CDOT Right-of-way to help manage the additional impervious area introduced within this roadway corridor created by the public roadway improvements. This facility is designed as an Extended Detention Basin (EDB) storm water quality facility with a full spectrum outlet box and associated forebay, micro pool, well screen, orifice plate, and 100-year outlet conveyance per the current drainage criteria manual. An IGA between CDOT and the Town of Monument will describe the ownership and maintenance responsibilities. The pond design allows for the required Water Quality Capture Volume with release though an orifice plate (Top of Micropool = 7004.50) and then the other storm events up to the 100 yr. event will be handled through a 6'x3' concrete outlet box (Top of box = 7010.00).

The following represents the required design for this facility (See Appendix):

SWQ Pond

Total tributary area: 11.84 ac.

Effective Imperviousness: 53.6%

	Estimated	Provided
Zone 1 (WQCV)	0.21 Ac.-ft.	0.21 Ac.-ft.
Zone 2 (EURV)	0.39 Ac.-ft.	0.39 Ac.-ft.
Zone 3 (100-yr.)	0.52 Ac.-ft.	0.24 Ac.-ft.
Total	1.12 Ac.-ft.	0.84 Ac.-ft.

Top of Micropool elev: 7004.50

6'x3' Conc. Outlet box with top of box height of 5.5' and exist. 36" RCP outfall pipe

Orifice Plate design: Four holes = 1-3/16" dia. spaced 16.5"

Calculations per MHFD-Detention_v4.05 spreadsheet:

Pond Peak Design Release: **(Q_2 = 0.5 cfs, Q_5 = 4.6 cfs, Q_{100} = 25.2 cfs)**

Pre-developed Release: **(Q_2 = 10 cfs, Q_5 = 14 cfs, Q_{100} = 36 cfs)**

Please reference the IGA between CDOT and the Town of Monument for details on ownership and maintenance.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the Town of Monument Standards, which follow the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in May 2014. The Rational Method was used to estimate storm water runoff anticipated from design storms for the 5 year and 100-year recurrence interval for local storm inlet and pipe facility sizing. Runoff Coefficients are based on the imperviousness of the particular land use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. (See Appendix)

The UD-BMP spreadsheet (ver. 3.07) along with the MHFD-Detention spreadsheet (ver. 4.05) were used to calculate the required volume for the EURV and 100-year release. User input 1-hour precipitation values in the UD-Detention spreadsheet were taken from Table 6-2 Volume 1 Colorado Springs Drainage Criteria Manual.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C0278G effective date, December 7, 2018 (See Appendix).

SUMMARY

Construction of these proposed public roadway improvements will not adversely affect the surrounding developments. All drainage facilities were sized using the current Drainage Criteria and will safely discharge storm water runoff to adequate outfalls. Developed flows will be routed to the proposed SWQ/detention facility within CDOT ROW and slowly released at historic rates. All existing downstream facilities will not be significantly affected upon the construction of these public improvements.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

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CLASSIC CONSULTING ENGINEERS & SURVEYORS

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated May 2014.

2. "Drainage Analysis Addendum No. 2 Village Center at Woodmoor", Classic Consulting Engineers and Surveyors, dated June 2009.

3. "Drainage Letter Amendment for the Drainage Analysis Addendum Village Center at Woodmoor", Classic Consulting Engineers and Surveyors, dated October 2010.

4. "Village Center @ Woodmoor Filing No.1" Berge-Brewer and Associates, Inc., dated January 2005.

5. "Drainage Basin Planning Study Dirty Woman Creek and Crystal Creek El Paso County," Kiowa Engineering Corporation, dated September 1993.

6. "MDDP for The Village" Classic Consulting, dated February 2020

7. "Final Drainage Report for Monument Junction East (Phase 1 PD Site Plan)", Classic Consulting, dated January 2022.

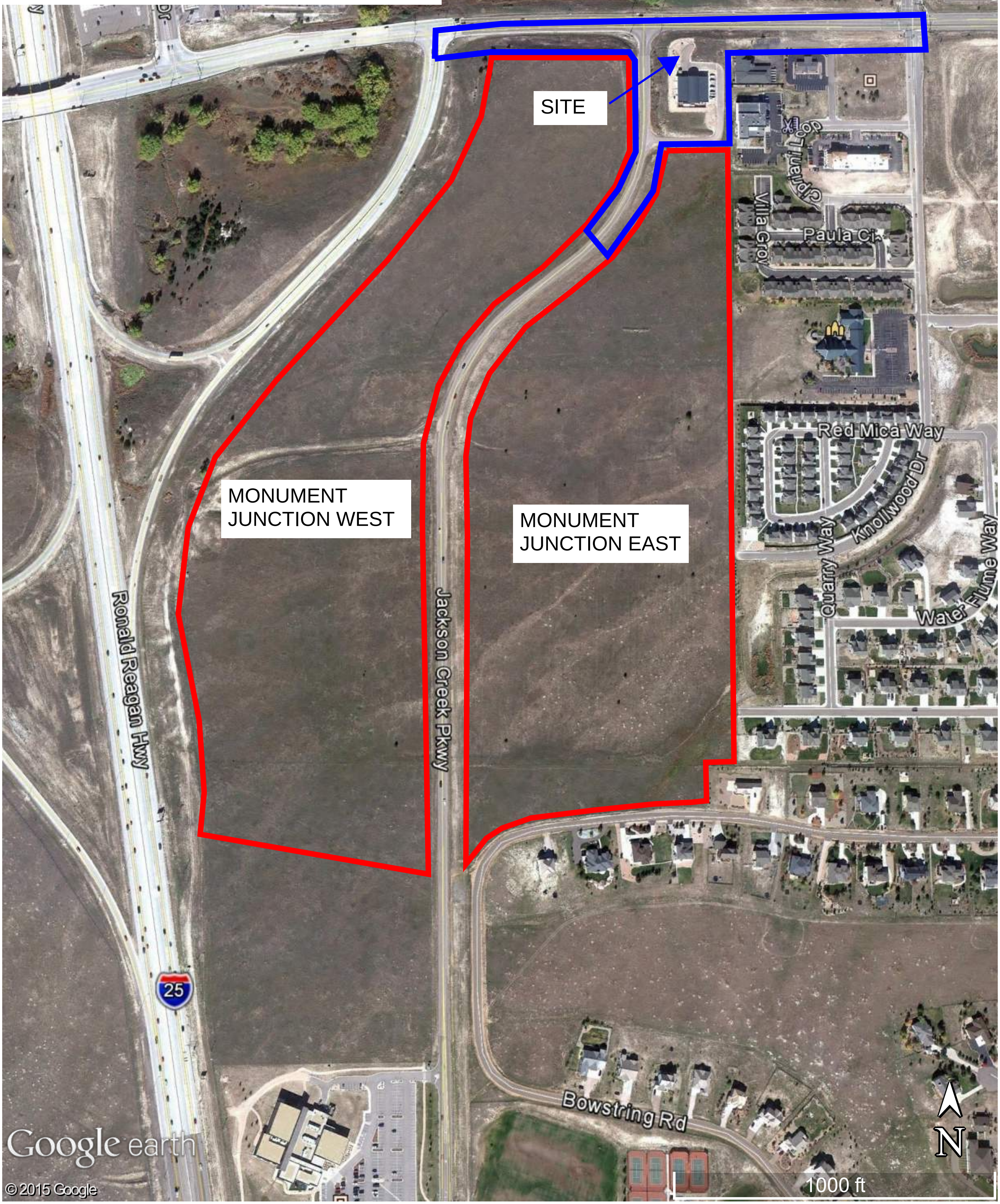
8. "Final Drainage Report for Monument Junction West Filing No. 1", Classic Consulting, dated March 2022.

9. "Preliminary Drainage Report – Highway 105 Project A for El Paso County", HDR, Inc., dated November 2021.

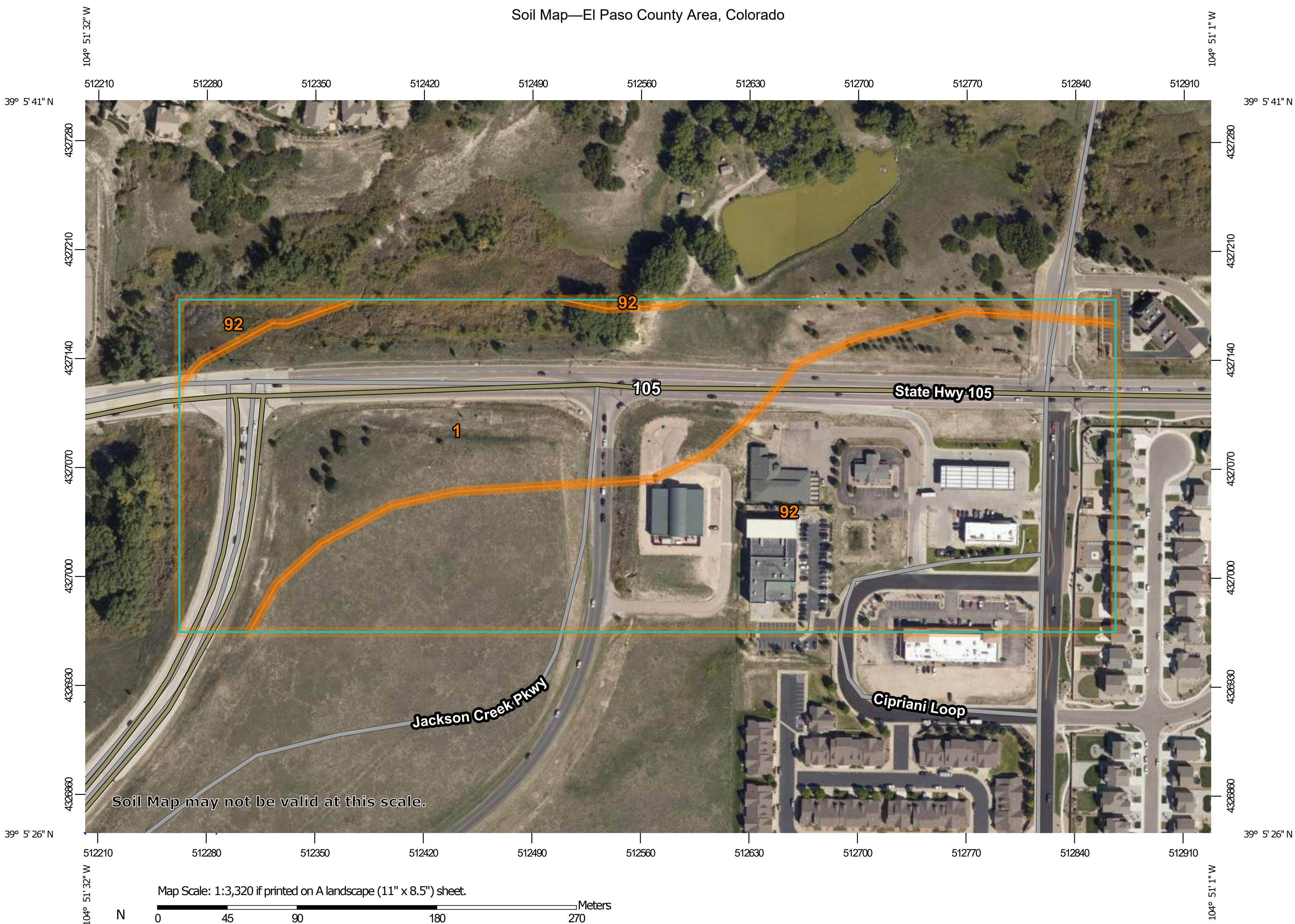
APPENDIX

VICINITY MAP

MONUMENT JUNCTION DEVELOPMENT
HIGHWAY 105 / JACKSON CREEK PKWY.
INTERSECTION IMPROVEMENTS
VICINITY MAP



SOILS MAP (S.C.S SURVEY)



Map Scale: 1:3,320 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

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 Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	13.3	41.7%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	18.6	58.3%
Totals for Area of Interest		**32.0**	**100.0%**

El Paso County Area, Colorado

1—Alamosa loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3670
Elevation: 7,200 to 7,700 feet
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Alamosa and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alamosa

Setting

Landform: Flood plains, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 6 inches: loam
Bt - 6 to 14 inches: clay loam
Btk - 14 to 33 inches: clay loam
Cg1 - 33 to 53 inches: sandy clay loam
Cg2 - 53 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

El Paso County Area, Colorado

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

F.E.M.A. MAP

NOTES TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

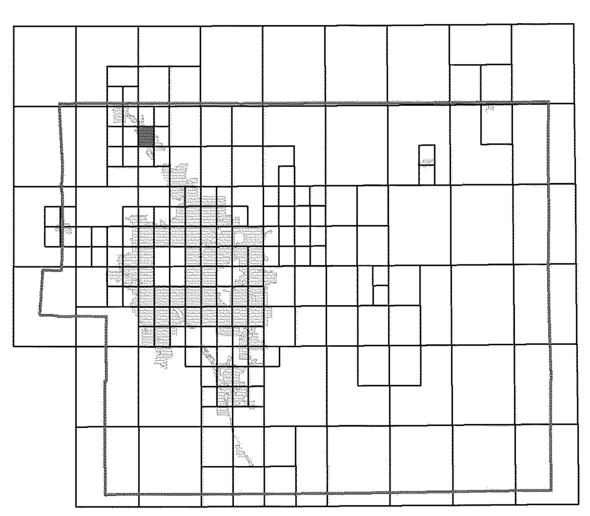
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

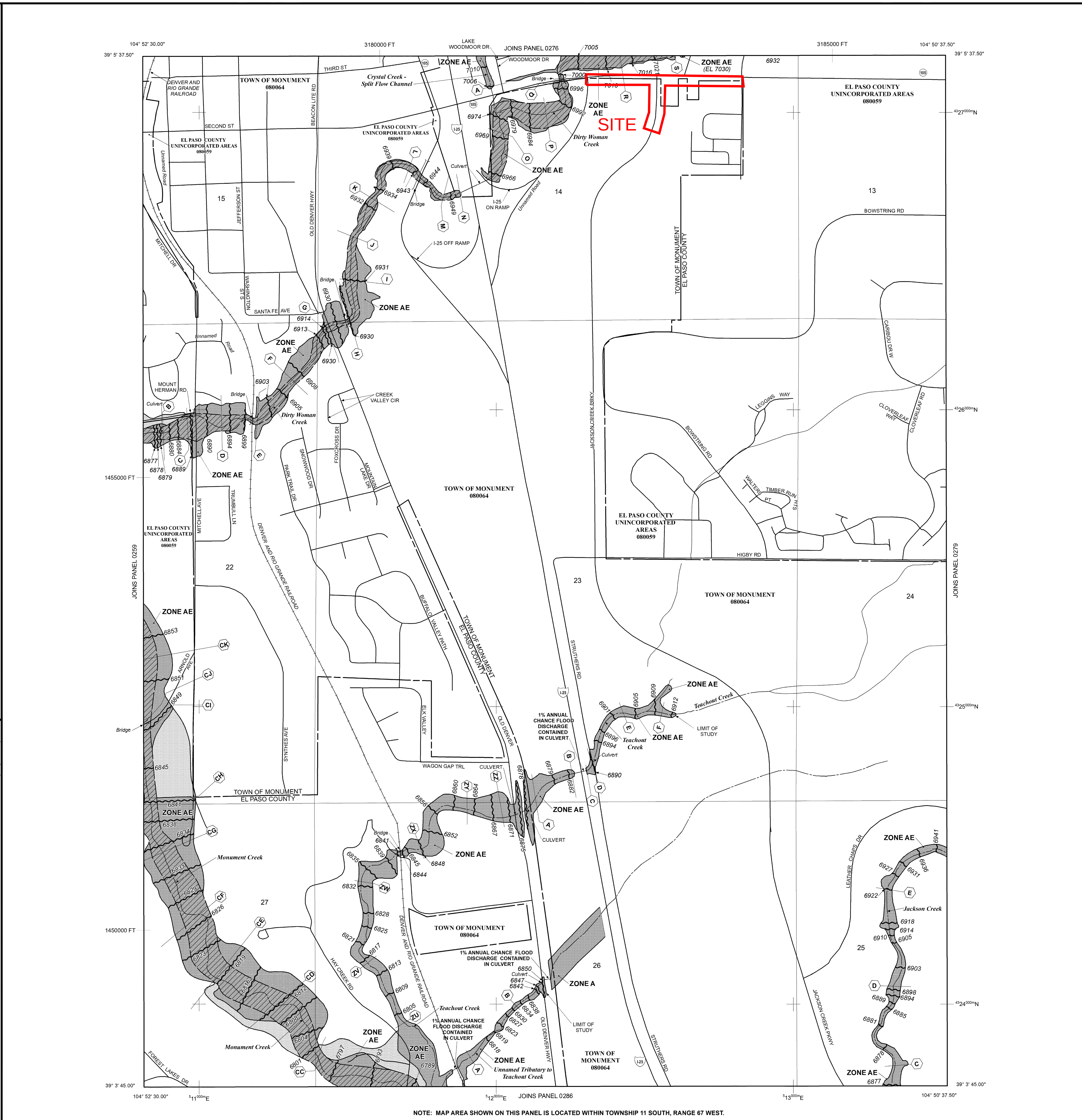
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0278G

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 278 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0278	G
MONUMENT, TOWN OF	080064	0278	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
08041C0278G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

JURISDICTIONAL DETERMINATION

CLASSIC CONSULTING ENGINEERS & SURVEYORS

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, ALBUQUERQUE DISTRICT
SOUTHERN COLORADO REGULATORY BRANCH
201 WEST 8TH STREET, SUITE 350
PUEBLO, COLORADO 81003

June 23, 2022

Regulatory Division

SUBJECT: Jurisdictional Determination- Action No.SPA-2022-00180

Classic Communities
Attn: Steve Schlosser
2138 Flying Horse Club Drive
Colorado Springs, Colorado 80921
sschlosser@classichomes.com

Dear Mr. Schlosser:

This letter responds to your request for a jurisdictional determination (JD) for multiple aquatic resources associated with the Monument Junction-Highway 105 improvement Project. The project site is located near Dirty Woman Creek, centered at latitude 39.092991°, longitude -104.856431°, Colorado Springs, El Paso County, Colorado. We have assigned Action No. SPA-2022-00180 to your request. Please reference this number in all future correspondence concerning the site.

Based on the information provided, we concur with your aquatic resource delineation for the site, as depicted on the enclosed drawing labeled, *SPA-2022-00180, Figure 1*, prepared by Core Consultants, Inc. (enclosure 1). We have determined that the site does not contain waters of the United States that are subject to regulation under Section 404 of the Clean Water Act. The aquatic resources identified as *WT-A1 (0.169 acres), WT-A2 (0.006 acre), ST-A1 (0.003 acre), ST-A2 (0.001 acre), ST-A3 (0.001 acre), and ST-A4 (0.001 acre),* on the above drawing are man-made wetland and ditch features that were constructed in uplands, drain only uplands, and do not have relatively permanent flow. As such, these aquatic resources are not regulated by the U.S. Army Corps of Engineers. This disclaimer of jurisdiction is only for Section 404 of the Federal Clean Water Act.

We are enclosing a copy of the *Approved Jurisdictional Determination Form* for your site (enclosure 2). A copy of this JD is also available at http://www.spa.usace.army.mil/reg/JD. This approved JD is valid for five years unless new information warrants revision of the determination before the expiration date.

You may accept or appeal this approved JD or provide new information in accordance with the attached Notification of Administration Appeal Options and Process and Request for Appeal (NAAOP-RFA) (enclosure 3). If you elect to appeal this approved JD, you must complete Section II of the form and return it to the Army Engineer Division, South Pacific, CESPD-PDS-O, Attn: Tom Cavanaugh, Administrative

Appeal Review Officer, P.O. Box 36023, 450 Golden Gate Ave, San Francisco, CA 94102 within 60 days of the date of this notice. Failure to notify the Corps within 60 days of the date of this notice means that you accept the approved JD in its entirety and waive all rights to appeal the approved JD.

If you have any questions, please contact Senior Project Manager Kyle Zibung by email at kyle.d.zibung@usace.army.mil, or telephone at (651) 290-5877. For program information or to complete our Customer Survey, visit our website at https://www.spa.usace.army.mil/Missions/Regulatory-Program-and-Permits/.

Sincerely,

Kyle Zibung
Senior Project Manager
Southern Colorado Branch

Enclosures

cc:
Natalie Graves, Core Consultants, Inc. (ngraves@liveyourcore.com)

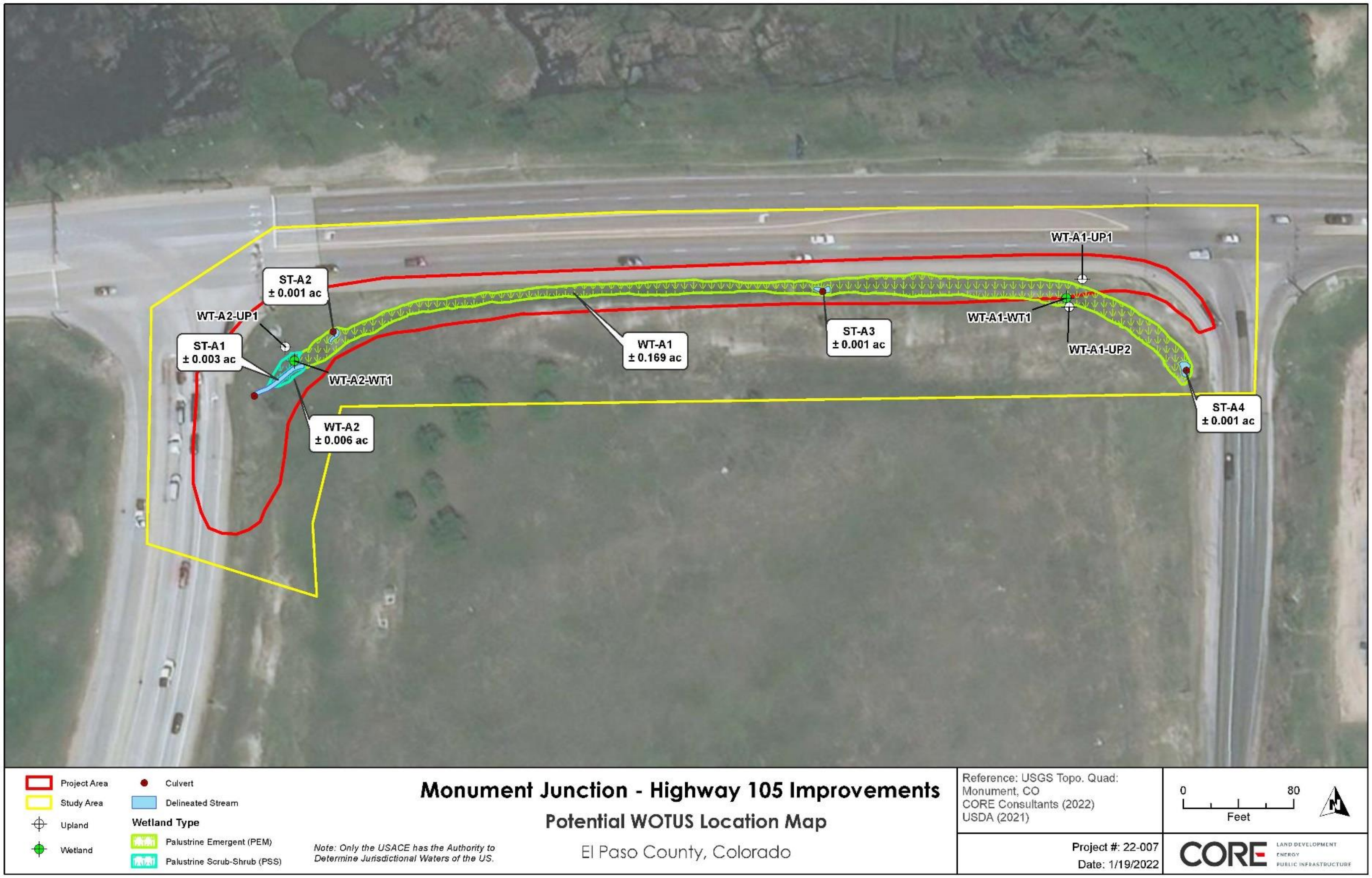


Figure 4.4 Potential WOTUS Location Map

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Classic Communities c/o Steve Schlosser		File No.: SPA-2022-00180	Date: June 23, 2022
Attached is:			See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)		A
	PROFFERED PERMIT (Standard Permit or Letter of permission)		B
	PERMIT DENIAL		C
→	APPROVED JURISDICTIONAL DETERMINATION		D
	PRELIMINARY JURISDICTIONAL DETERMINATION		E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at *http://www.usace.army.mil/cecw/pages/reg_materials.aspx* or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
Kyle Zibung U.S. Army Corps of Engineers 201 West 8th Street, Suite 350 Pueblo, Colorado 81003 Phone: 651-290-5877 Email: kyle.d.zibung@usace.army.mil	Thomas J. Cavanaugh Administrative Appeal Review Officer U.S. Army Corps of Engineers South Pacific Division P.O. Box 36023, 450 Golden Gate Ave San Francisco, California 94102 Phone: 415-503-6574, FAX:415-503-6646 Email: Thomas.J.Cavanaugh@usace.army.mil

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation and will have the opportunity to participate in all site investigations.

______________________________ Signature of appellant or agent.	Date:	Telephone number:

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): June 23, 2022

B. ST PAUL, MN DISTRICT OFFICE, FILE NAME, AND NUMBER: SPA-2022-00180, Classic Communities Highway 105 AJD

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: Colorado County/parish/borough: El Paso County City: Monument

Center coordinates of site (lat/long in degree decimal format): Lat. 39.092991° **N**, Long. -104.856431° **W**.

Universal Transverse Mercator: 15

Name of nearest waterbody:

Name of watershed or Hydrologic Unit Code (HUC): 07020007

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: June 22, 2022

☒ Field Determination. Date(s): June 8, 2022

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There are no "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area.

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There are no"*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area.

1. **Waters of the U.S.:** N/A

2. **Non-regulated waters/wetlands (check if applicable):**[1]

☒ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **The review area for this determination is comprised of two linear wetlands labeled as WT-A1 (0.169 acres) and WT-A2 (0.006 acre) and four linear stream segments labeled as ST-A1 (0.003 acre), ST-A2 (0.001 acre), ST-A3 (0.001 acre), and ST-A4 (0.001 acre) in the February 2022, Core Consultants, Inc. Wetland Delineation Report. In 2005, the entire review area was graded for roadway improvements to Highway 105 and the I-25 interchange, thereby creating all six linear aquatic resources evaluated by this determination. Based on an analysis of multiple years of aerial photography, USDA web soil survey data, USGS topographic maps, USGS NHD, NWI mapping, February 2022, Core Consultants, Inc. Wetland Delineation Report, and a June 22, 2002 site visit, the Corps has determined that all six aquatic resources are linear roadside drainage features constructed in uplands during grading for the Highway 105 and the I-25 interchange projects. In accordance with Corps Regulations at 33 CFR Part 328.3(b) and associated Rapanos Guidance, the aforementioned aquatic features are not within the Corps jurisdiction because they were constructed in uplands, drain only uplands, and do not have relatively permanent flow.**

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs: N/A

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY): N/A

C. SIGNIFICANT NEXUS DETERMINATION: N/A

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY): N/A

[1] Supporting documentation is presented in Section III.F.

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY): N/A

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain:
☐ Other (explain, if not covered above):

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: February 2022, Core Consultants, Inc. Wetland Delineation Report
☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☒ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps:
☐ Corps navigable waters' study:
☒ U.S. Geological Survey Hydrologic Atlas:
  ☒ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: 1:24k-Monument
☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Web Soil Survey
☒ National wetlands inventory map(s). Cite name: National Wetland Inventory
☐ State/Local wetland inventory map(s):
☐ FEMA/FIRM maps:
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): Site Photos contained in Feb 2022 Core Consultants, Inc. Wetland Delineation Report
  or ☒ Other (Name & Date): Google Earth- 1999, 2004, 2005, 2006, 2008, 2010, 2011, 2015, 2017, 2019, 2020
☐ Previous determination(s). File no. and date of response letter:
☐ Applicable/supporting case law:
☐ Applicable/supporting scientific literature:
☐ Other information (please specify):

B. ADDITIONAL COMMENTS TO SUPPORT JD:

HYDROLOGIC / HYDRAULIC CALCULATIONS

CLASSIC CONSULTING ENGINEERS & SURVEYORS

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

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													
1/8 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
1/4 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
1/3 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
1/2 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.

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.

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.

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

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

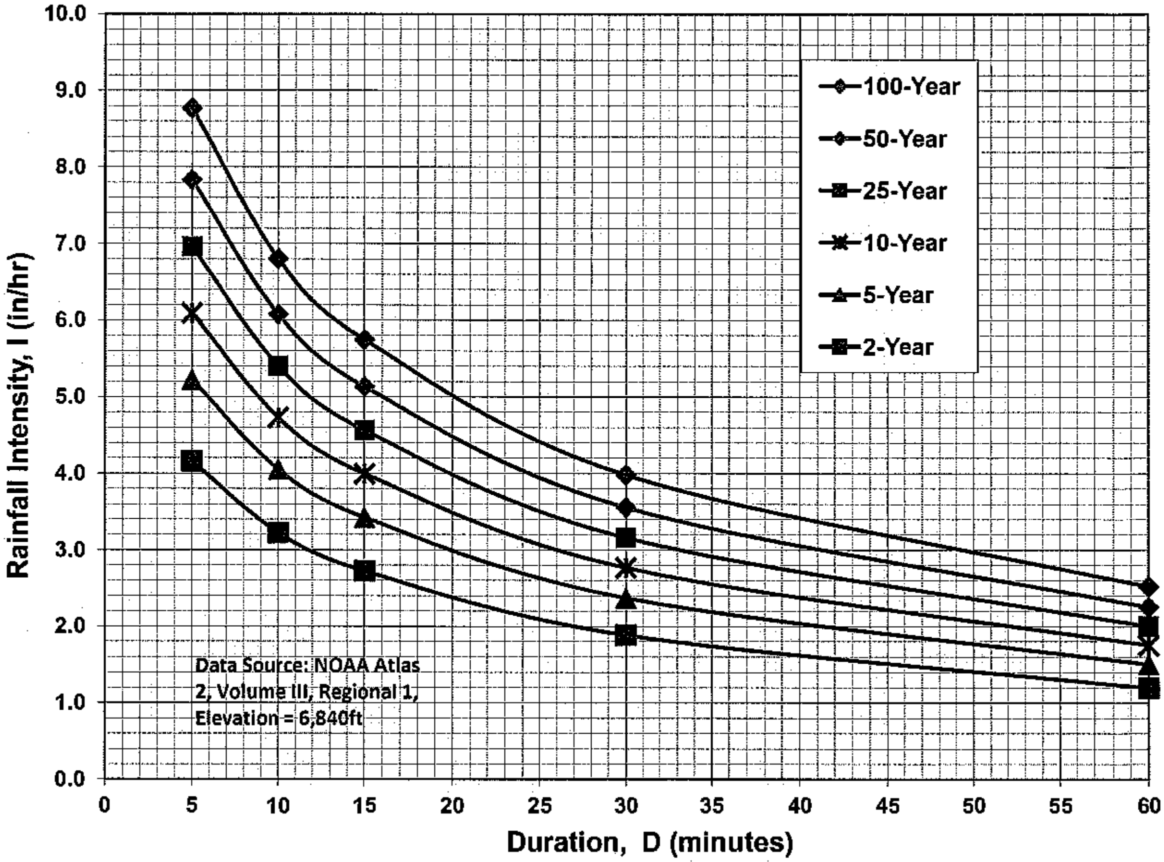
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER: *1302.22*
DATE: *02/24/23*
CALCULATED BY: *MAW*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	DEVELOPED AREA/IMPERVIOUS AREA				LANDSCAPE/UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA			IMPERVIOUSNESS
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**	%
G	0.20	0.05	0.79	0.81	0.88	0.15	0.03	0.09	0.36	0.22	0.27	0.49	**0.04**	**0.05**	**0.10**	25%
H	0.57	0.05	0.79	0.81	0.88	0.52	0.03	0.09	0.36	0.10	0.15	0.41	**0.06**	**0.09**	**0.23**	10%
OS-10	4.10	0.60	0.89	0.90	0.96	3.50	0.03	0.09	0.36	0.16	0.21	0.45	**0.64**	**0.86**	**1.84**	16%
OS10D	2.00	0.10	0.89	0.90	0.96	1.90	0.03	0.09	0.36	0.07	0.13	0.39	**0.15**	**0.26**	**0.78**	7%
OS-11	1.70	0.80	0.89	0.90	0.96	0.90	0.02	0.08	0.35	0.43	0.47	0.64	**0.73**	**0.79**	**1.08**	45%
OS11D	1.70	1.20	0.89	0.90	0.96	0.50	0.03	0.09	0.36	0.64	0.66	0.78	**1.08**	**1.13**	**1.33**	71%
OS-12	0.51	0.27	0.89	0.90	0.96	0.24	0.03	0.09	0.36	0.49	0.52	0.68	**0.25**	**0.26**	**0.35**	54%
OS12D	0.58	0.31	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.49	0.52	0.68	**0.28**	**0.30**	**0.39**	54%
OS-13	0.67	0.40	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.54	0.57	0.72	**0.36**	**0.38**	**0.48**	61%
OS13D	0.67	0.40	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.54	0.57	0.72	**0.36**	**0.38**	**0.48**	61%
OS-14	0.28	0.15	0.89	0.90	0.96	0.13	0.03	0.09	0.36	0.49	0.52	0.68	**0.14**	**0.15**	**0.19**	55%
OS14D	0.86	0.72	0.89	0.90	0.96	0.14	0.03	0.09	0.36	0.75	0.77	0.86	**0.65**	**0.66**	**0.74**	84%
OS-15	1.60	1.20	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.68	0.70	0.81	**1.08**	**1.12**	**1.30**	76%
OS15D	1.60	1.20	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.68	0.70	0.81	**1.08**	**1.12**	**1.30**	76%
OS-16	1.00	0.70	0.89	0.90	0.96	0.30	0.02	0.08	0.35	0.63	0.65	0.78	**0.63**	**0.65**	**0.78**	67%
OS-17	0.53	0.43	0.89	0.90	0.96	0.10	0.03	0.09	0.36	0.73	0.75	0.85	**0.39**	**0.40**	**0.45**	82%
OS17D	1.00	0.60	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.55	0.58	0.72	**0.55**	**0.58**	**0.72**	61%
OS-18	0.30	0.30	0.89	0.90	0.96	0.00	0.03	0.09	0.36	0.89	0.90	0.96	**0.27**	**0.27**	**0.29**	100%
OS18D	0.78	0.43	0.89	0.90	0.96	0.35	0.03	0.09	0.36	0.50	0.54	0.69	**0.39**	**0.42**	**0.54**	56%
OS-19	0.18	0.00	0.89	0.90	0.96	0.18	0.03	0.09	0.36	0.03	0.09	0.36	**0.01**	**0.02**	**0.06**	2%
OS-20	0.11	0.01	0.89	0.90	0.96	0.10	0.03	0.09	0.36	0.11	0.16	0.41	**0.01**	**0.02**	**0.05**	10%
JCP7	0.59	0.50	0.89	0.90	0.96	0.09	0.03	0.09	0.36	0.76	0.78	0.87	**0.45**	**0.46**	**0.51**	85%
EX2	0.56	0.56	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.02**	**0.05**	**0.20**	2%
EX3	1.80	1.80	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.05**	**0.16**	**0.65**	2%
Exist. Trib. to Pond	**13.05**															**37.5%**
Dev. Trib. to Pond	**11.84**															**53.6%**
Dev. Trib. to Forebay	**8.49**															**67.2%**

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*

JOB NUMBER: *1302.22*

DATE: *02/24/23*

CALC'D BY: *MAW*

Return Period	1-Hour Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

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

$$V = C_v S_w^{0.5}$$

Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

$$t_c = \frac{L}{180} + 10$$

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.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
G	0.04	0.05	0.10	0.09	30	1.5	5.9					5.9	3.93	4.93	8.27	0.17	**0.3**	**0.8**
H	0.06	0.09	0.23	0.09	40	2	6.8					6.8	3.76	4.71	7.91	0.2	**0.4**	**1.8**
OS-10	0.64	0.86	1.84	0.09	65	2	10.1	950	3.5%	1.9	8.5	18.6	2.56	3.20	5.37	2	**3**	**10**
OS10D	0.15	0.26	0.78	0.09	65	2	10.1	950	3.5%	1.9	8.5	18.6	2.56	3.20	5.37	0.4	**0.8**	**4**
OS-11	0.73	0.79	1.08	0.08	100	2	14.7	500	4.0%	2.0	4.2	18.8	2.54	3.18	5.34	1.9	**3**	**6**
OS11D	1.08	1.13	1.33	0.09	100	2	14.5	300	4.0%	2.0	2.5	17.0	2.66	3.33	5.59	3	**4**	**7**
OS-12	0.25	0.26	0.35	0.09	40	2	6.8	200	3.5%	3.7	0.9	7.7	3.61	4.53	7.60	0.9	**1.2**	**3**
OS12D	0.28	0.30	0.39	0.09	40	2	6.8	200	3.5%	3.7	0.9	7.7	3.61	4.53	7.60	1.0	**1.4**	**3.0**
OS-13	0.36	0.38	0.48	0.09	25	3	4.0	240	5.5%	4.7	0.9	5.0	4.12	5.17	8.68	1.5	**2**	**4**
OS13D	0.36	0.38	0.48	0.09	25	3	4.0	250	3.5%	3.7	1.1	5.1	4.09	5.13	8.61	1.5	**2**	**4**
OS-14	0.14	0.15	0.19	0.09	30	10	3.1	170	5.5%	4.7	0.6	5.0	4.12	5.17	8.68	0.6	**0.8**	**2**
OS14D	0.65	0.66	0.74	0.09	30	10	3.1	190	5.5%	4.7	0.7	5.0	4.12	5.17	8.68	3	**3**	**6**
OS-15	1.08	1.12	1.30	0.09	180	12	13.1	100	3.0%	1.7	1.0	14.0	2.89	3.62	6.08	3	**4**	**8**
OS15D	1.08	1.12	1.30	0.09	180	12	13.1	80	3.0%	3.5	0.4	13.5	2.94	3.68	6.18	3	**4**	**8**
OS-16	0.63	0.65	0.78	0.08	100	4	11.7	130	1.5%	1.2	1.8	13.4	2.94	3.69	6.19	1.9	**2**	**5**

JOB NAME:	*MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER:	*1302.22*
DATE:	*02/24/23*
CALC'D BY:	*MAW*

Return Period	1-Hour Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

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

$$V = C_v S_w^{0.5}$$

Tc=L/V

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

$$t_c = \frac{L}{180} + 10$$

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
OS-17	0.39	0.40	0.45	0.09	60	14	5.0	380	5.0%	4.5	1.4	6.4	3.82	4.80	8.05	1.5	**2**	**4**
OS17D	0.55	0.58	0.72	0.09	60	14	5.0	380	5.0%	4.5	1.4	6.4	3.82	4.80	8.05	2	**3**	**6**
OS-18	0.27	0.27	0.29	0.09	15	0.5	4.7	280	2.0%	2.8	1.6	6.4	3.83	4.80	8.06	1.0	**1.3**	**2**
OS18D	0.39	0.42	0.54	0.09	90	4	10.6	260	2.0%	2.8	1.5	12.1	3.07	3.84	6.45	1.2	**1.6**	**3**
OS-19	0.01	0.02	0.06	0.09	80	3.2	10.3	380	5.0%	4.5	1.4	11.7	3.10	3.89	6.53	0.02	**0.1**	**0.4**
OS-20	0.01	0.02	0.05	0.09	50	3	7.1					7.1	3.70	4.63	7.78	0.0	**0.1**	**0.4**
JCP7	0.45	0.46	0.51	0.09	20	0.6	5.7	300	4.5%	4.2	1.2	6.9	3.74	4.70	7.88	2	**2**	**4**
EX2	0.02	0.05	0.20	0.09	50	2	8.2					8.2	3.54	4.43	7.44	0.1	**0.2**	**1.5**
EX3	0.05	0.16	0.65	0.09	260	5	23.7					23.7	2.27	2.84	4.76	0.1	**0.5**	**3**

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER: *1302.22*
DATE: *07/20/23*
CALCULATED BY: *MAW*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Inlet Size
H1	OS-1 thru OS-8	6.48	15.46	33.4	2.32	3.89	15	60	EXIST. 60" RCP CULVERT
H2	DP H1, OS-9, EX-1	9.17	25.43	39.4	2.07	3.48	19	88	EXIST. CDOT OUTFALL
H3	EX4	1.49	5.98	35.7	2.22	3.73	3	22	EXIST. SIDE ROAD DITCH
H4	OS-12	0.26	0.46	7.7	4.53	7.60	1	3	EXIST. 5' TYPE R AT-GRADE INLET
H5	OS-13, Flow-by from H4	0.38	0.63	5.0	5.17	8.68	2	5	EXIST. 10' TYPE R AT-GRADE INLET
H6	OS-14, Flow-by from H5	0.15	0.24	5.0	5.17	8.68	1	2	EXIST. 10' TYPE R AT-GRADE INLET
H7	OS-11 and OS-16	1.45	1.86	18.8	3.18	5.34	5	10	EXIST. 10' TYPE R AT-GRADE INLET
H8	OS-17, Flow-by from H7	0.42	0.73	6.4	4.80	8.05	2	6	EXIST. 10' TYPE R AT-GRADE INLET
H9	OS-18, Flow-by from H8	0.27	0.41	6.4	4.80	8.06	1	3	EXIST. 10' TYPE R AT-GRADE INLET
H10	**EX2, EX3, OS-10 thru OS-18**	**5.09**	**7.60**	**23.7**	**2.84**	**4.76**	**14**	**36**	**EXIST. 36" RCP CDOT CULVERT**

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER: *1302.22*
DATE: *07/20/23*
CALCULATED BY: *MAW*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Inlet Size
D4	OS12D, 0.85 CFS 100Yr Flow-by from upstream	0.30	0.51	7.7	4.53	7.60	1.4	3.9	PROP. 5' TYPE R AT-GRADE INLET
D5	OS13D, Flow-by from D4	0.38	0.63	5.0	5.17	8.68	2	5	PROP. 10' TYPE R AT-GRADE INLET
D6	OS15D	1.12	1.30	13.5	3.68	6.18	4	8	PROP. CDOT TYPE C INLET
D7	OS11D, OS-16, OS-19, OS-20	1.81	2.22	17.0	3.33	5.59	6	12	PROP. 10' TYPE R AT-GRADE INLET
D8	OS14D, Flow-by from D5&D7	0.84	1.47	17.0	3.33	5.59	3	8	PROP. 10' TYPE R SUMP INLET
D9	JCP7, G	0.51	0.61	6.9	4.70	7.88	2	5	PROP. 10' TYPE R AT-GRADE INLET
D10	OS17D, Flow-by from D9	0.58	0.74	6.4	4.80	8.05	3	6	PROP. 10' TYPE R AT-GRADE INLET
D11	OS18D, Flow-by from D10	0.42	0.64	12.1	3.84	6.45	2	4	EXIST. 10' TYPE R SUMP INLET
13	**G, H, JCP7, OS10D thru OS15D, OS-16, OS17D, OS18D, OS-19, OS-20**	**5.87**	**8.01**	**21.1**	**3.01**	**5.05**	**18**	**40**	**SWQ FACILITY in CDOT ROW**

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER: *1302.22*
DATE: *07/20/23*
CALCULATED BY: *MAW*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
H1	Inlet Capture at DP-H4	0.26	0.24	7.7	4.53	7.60	1	2	Exist. 15" RCP
H2	PR-H1, Inlet Capture at DP-H5	0.65	0.77	7.8	4.51	7.57	3	6	Exist. 15" RCP
H3	PR-H2, Inlet Capture at DP-H6	0.80	1.01	7.9	4.49	7.54	4	8	Exist. 24" RCP
H4	OS-15	1.12	1.30	14.0	3.62	6.08	4	8	Exist. 18" ADS
H5	PR-H3, PR-H4, Portion of OS-11 and OS-16	3.20	3.95	18.8	3.18	5.34	10	21	Exist. 30" RCP
H6	Inlet Capture at DP-H8	0.42	0.64	6.4	4.80	8.05	2	5	Exist. 24" RCP
H7	Inlet Capture at DP-H9	0.27	0.41	6.4	4.80	8.06	1	3	Exist. 24" RCP

JOB NAME: *MONUMENT JUNCTION DEVELOPMENT (HWY. 105 & JCP INT. IMPS.)*
JOB NUMBER: *1302.22*
DATE: *07/20/23*
CALCULATED BY: *MAW*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
1	Inlet Capture at D4	0.30	0.33	7.7	4.53	7.60	1.4	2.5	PROP. 18" RCP
2	PR-1, Inlet Capture at D5	0.69	0.92	7.7	4.53	7.60	3	7	PROP. 24" RCP
3	CDOT Type C Inlet Capture at D6	1.12	1.30	13.5	3.68	6.18	4	8	PROP. 18" RCP
4	PR-2, PR-3	1.80	2.22	13.7	3.66	6.15	7	14	PROP. 24" RCP
5	Inlet Capture at D7	1.63	1.51	17.0	3.33	5.59	5	8	PROP. 18" RCP
6	PR-5, Inlet Capture at D8	2.47	2.98	17.0	3.33	5.59	8	17	PROP. 24" RCP
7	PR-6, Inlet Capture at D9	2.98	3.56	17.0	3.33	5.59	10	20	PROP. 24" RCP
8	PR-4, PR-7	4.79	5.77	17.2	3.32	5.56	16	32	PROP. 30" RCP
9	Inlet Capture at D10	0.58	0.66	6.4	4.80	8.05	3	5	PROP. 18" RCP
10	PR-8, PR9	5.36	6.43	17.4	3.30	5.54	18	36	PROP. 30" RCP
11	Inlet Capture at D11	0.42	0.64	12.1	3.84	6.45	2	4	EXIST. 18" RCP

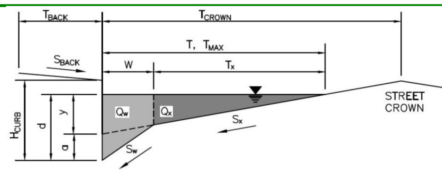
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H4



Gutter Geometry (Enter data in the blue cells)

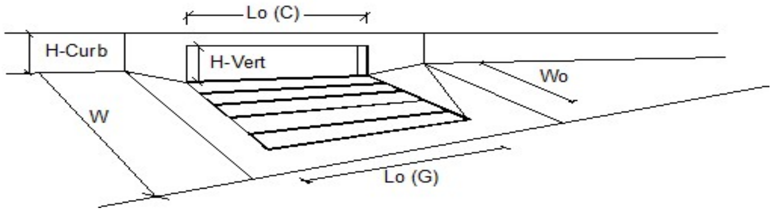
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0		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 =	0.035		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**3.6**	**13.7**	**cfs**

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

Verify Inlet Calculations have been updated per new storm layout

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



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')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.0**	**2.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**66**	**%**

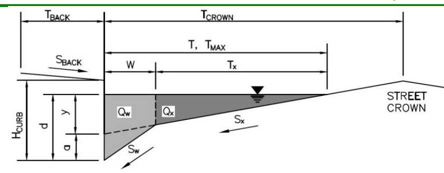
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H5



Gutter Geometry (Enter data in the blue cells)

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} =	0.250	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 =	0.020	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 =	0.056	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

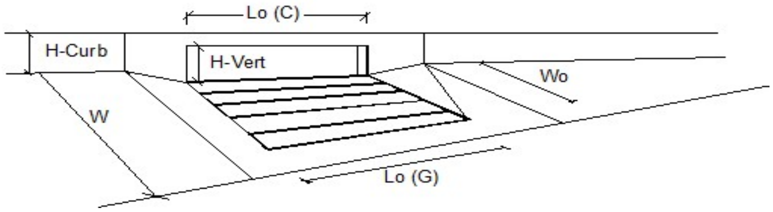
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.5**	**11.9**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.0**	**4.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**93**	**%**

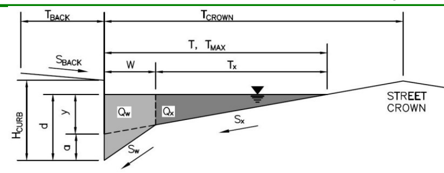
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H6



Gutter Geometry (Enter data in the blue cells)

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} =	0.250	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} =	28.0	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 =	0.057	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

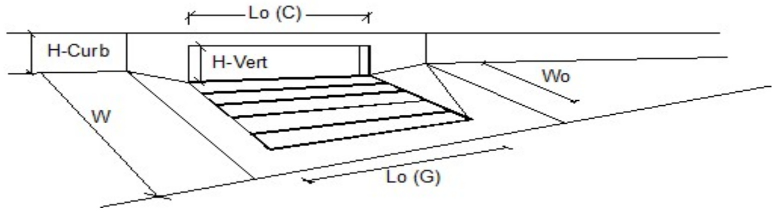
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.5**	**11.9**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**2.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

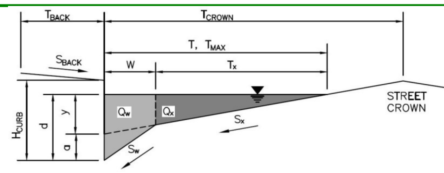
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H7



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

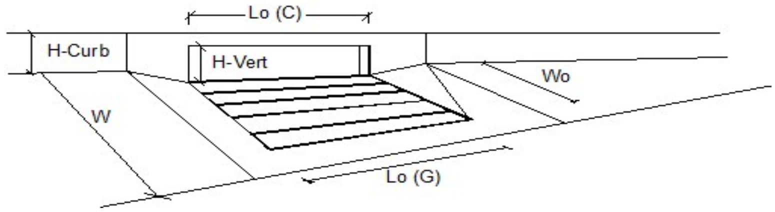
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**7.4**	**10.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



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')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**4.9**	**7.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.1**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**97**	**77**	**%**

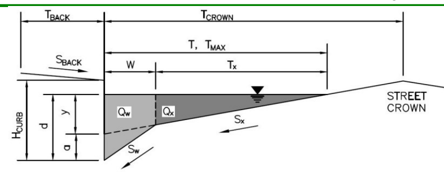
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H8



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
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 =	0.020	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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

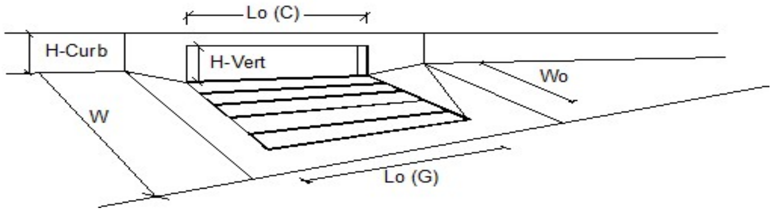
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**2.8**	**15.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.1**	**5.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**87**	**%**

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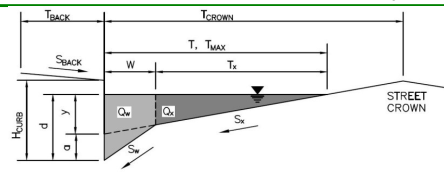
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: H9



Gutter Geometry (Enter data in the blue cells)

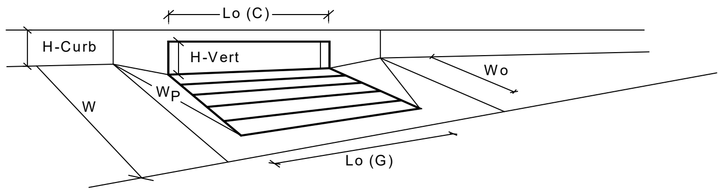
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLEET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	3.8	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
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (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} =	0.15	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.36	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.77	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

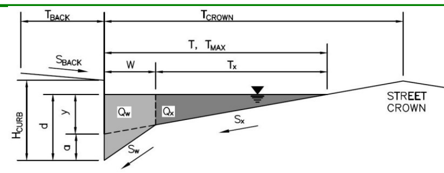
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.1**	**8.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.8	cfs

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D4



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	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 =	0.035	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

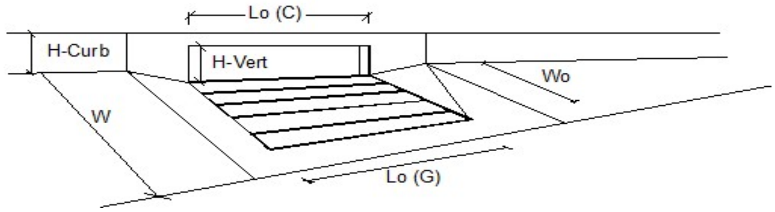
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**3.6**	**13.7**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



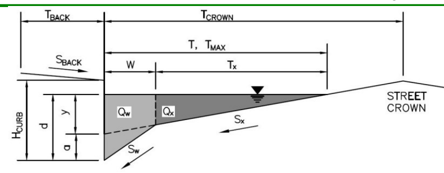
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.4**	**2.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**97**	**66**	**%**

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D5



Gutter Geometry (Enter data in the blue cells)

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} =	0.250	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} =	42.0	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 =	0.056	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

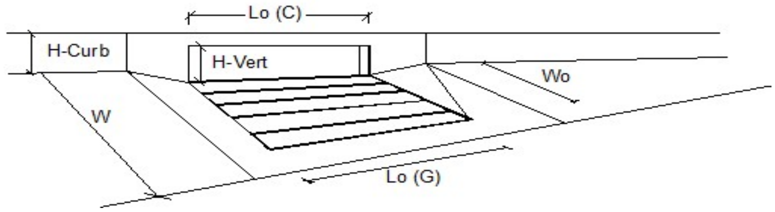
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**4.5**	**11.9**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018

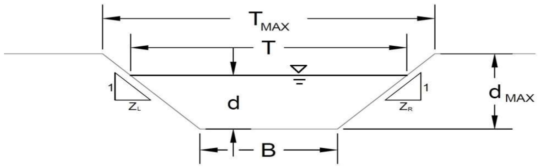


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.0**	**4.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**93**	**%**

AREA INLET IN A SWALE

MONUMENT JUNCTION WEST FILING NO. 1

D6



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	5.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ **Non-Cohesive**
- ◉ **Cohesive**
- ○ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**10.00**	**10.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.50**	**1.50**	**feet**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**16.9**	**16.9**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.63**	**0.63**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**4.0**	**8.0**	**cfs**
Water Depth	d =	**0.28**	**0.42**	**feet**

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

Version 4.06 Released August 2018

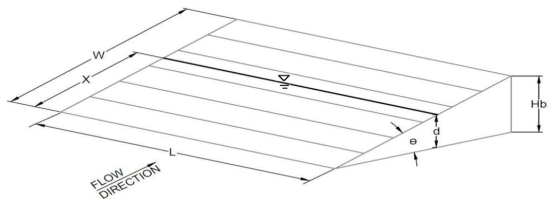
AREA INLET IN A SWALE

MONUMENT JUNCTION WEST FILING NO. 1

D6

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.28	1.42	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.1**	**16.9**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

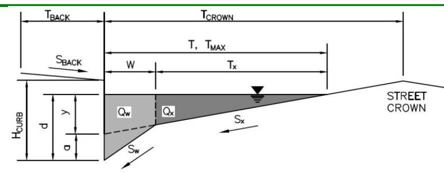
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D7



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	3.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	42.0	ft
Gutter Width	W =	1.00	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 =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

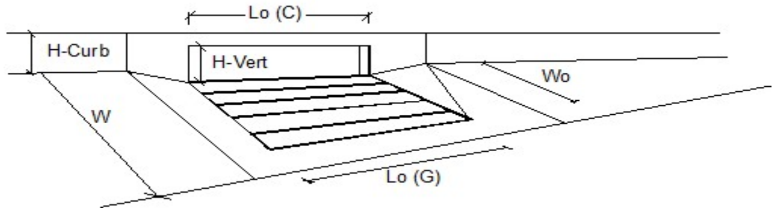
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**4.5**	**11.7**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



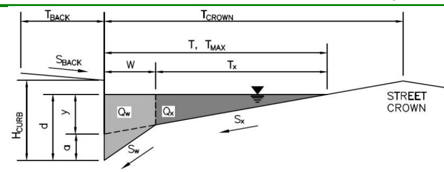
Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR & MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.4**	**8.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**3.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**68**	**%**

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

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

Project: MONUMENT JUNCTION WEST FILING NO. 1

Inlet ID: D8



Gutter Geometry (Enter data in the blue cells)

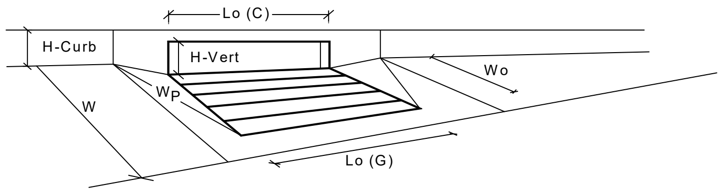
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	3.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	42.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.045	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	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 based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



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 =	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
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (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 =	1.00	1.00	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} =	0.42	0.42	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.0**	**10.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.6	9.8	cfs

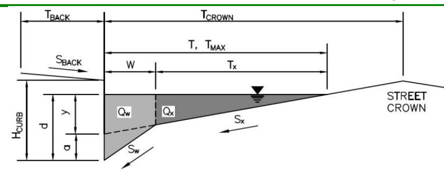
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D9



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

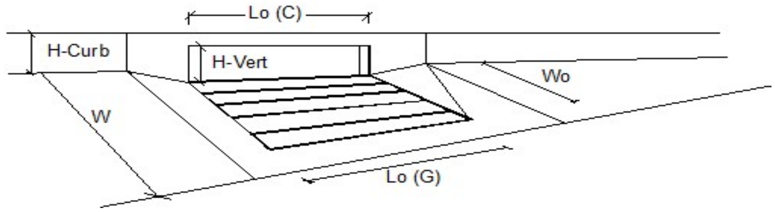
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**3.6**	**11.4**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.0**	**4.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**95**	**%**

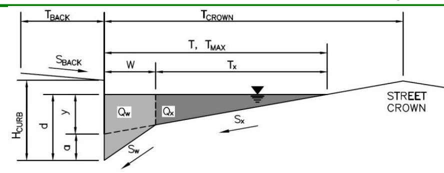
Dropdown selection: CDOT Type R Curb Opening

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	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 =	0.030	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

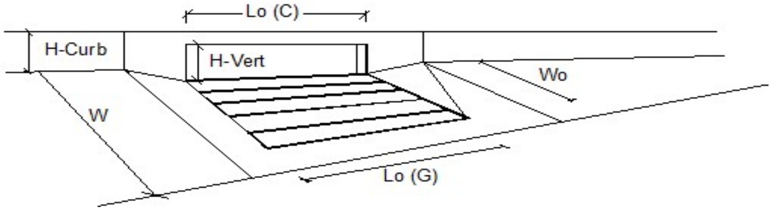
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**3.3**	**14.4**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



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')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.0**	**5.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.8**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**88**	**%**

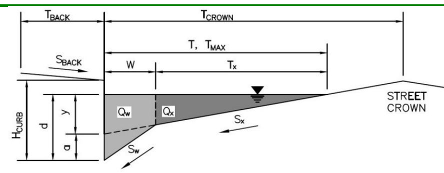
Version 4.06 Released August 2018

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

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

Project: MONUMENT JUNCTION - HWY. 105/JCP INT. IMPS.

Inlet ID: D11



Gutter Geometry (Enter data in the blue cells)

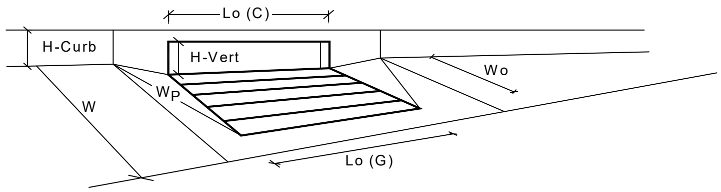
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.4	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	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
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (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
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

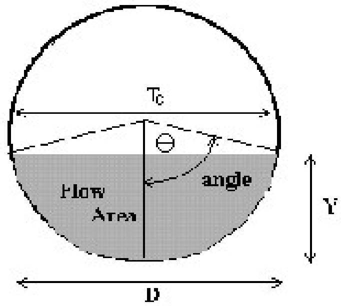
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**8.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.8	cfs

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 1



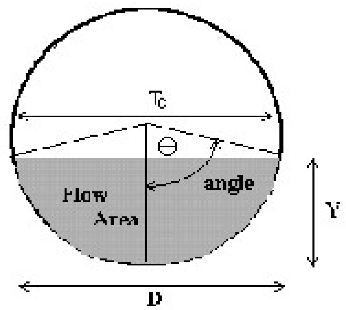
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	2.50	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.53	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.23	radians
Flow area	An =	0.51	sq ft
Top width	Tn =	1.41	ft
Wetted perimeter	Pn =	1.84	ft
Flow depth	Yn =	0.50	ft
Flow velocity	Vn =	4.88	fps
Discharge	Qn =	2.50	cfs
Percent of Full Flow	Flow =	23.7%	of full flow
Normal Depth Froude Number	Fr_n =	1.43	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.37	radians
Critical flow area	Ac =	0.66	sq ft
Critical top width	Tc =	1.47	ft
Critical flow depth	Yc =	0.60	ft
Critical flow velocity	Vc =	3.80	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 1



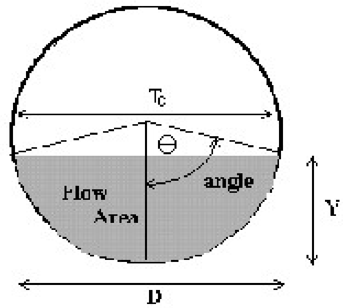
Design Information (Input)			
Pipe Invert Slope	So =	0.0536	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	2.50	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	24.38	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	0.97	radians
Flow area	An =	0.28	sq ft
Top width	Tn =	1.24	ft
Wetted perimeter	Pn =	1.45	ft
Flow depth	Yn =	0.32	ft
Flow velocity	Vn =	8.89	fps
Discharge	Qn =	2.50	cfs
Percent of Full Flow	Flow =	10.3%	of full flow
Normal Depth Froude Number	Fr_n =	3.28	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.37	radians
Critical flow area	Ac =	0.66	sq ft
Critical top width	Tc =	1.47	ft
Critical flow depth	Yc =	0.60	ft
Critical flow velocity	Vc =	3.80	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 2



Design Information (Input)			
Pipe Invert Slope	So =	0.0568	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	7.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	54.06	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.03	radians
Flow area	An =	0.59	sq ft
Top width	Tn =	1.72	ft
Wetted perimeter	Pn =	2.06	ft
Flow depth	Yn =	0.49	ft
Flow velocity	Vn =	11.86	fps
Discharge	Qn =	7.00	cfs
Percent of Full Flow	Flow =	12.9%	of full flow
Normal Depth Froude Number	Fr_n =	3.56	supercritical

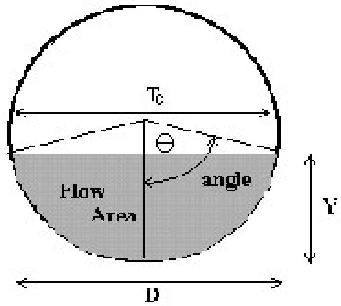
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.51	radians
Critical flow area	Ac =	1.45	sq ft
Critical top width	Tc =	2.00	ft
Critical flow depth	Yc =	0.94	ft
Critical flow velocity	Vc =	4.83	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 3



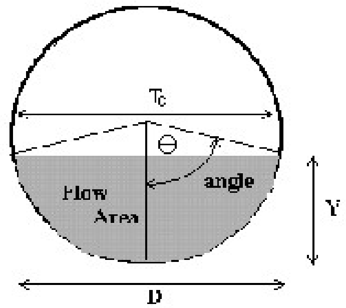
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	8.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.53	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.88	radians
Flow area	An =	1.22	sq ft
Top width	Tn =	1.43	ft
Wetted perimeter	Pn =	2.82	ft
Flow depth	Yn =	0.98	ft
Flow velocity	Vn =	6.56	fps
Discharge	Qn =	8.00	cfs
Percent of Full Flow	Flow =	76.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.25	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.05	radians
Critical flow area	Ac =	1.38	sq ft
Critical top width	Tc =	1.33	ft
Critical flow depth	Yc =	1.10	ft
Critical flow velocity	Vc =	5.78	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 4



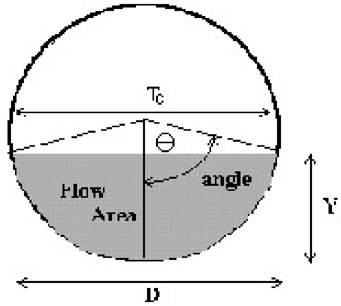
Design Information (Input)			
Pipe Invert Slope	So =	0.0763	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	14.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	62.66	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.21	radians
Flow area	An =	0.87	sq ft
Top width	Tn =	1.87	ft
Wetted perimeter	Pn =	2.41	ft
Flow depth	Yn =	0.64	ft
Flow velocity	Vn =	16.07	fps
Discharge	Qn =	14.00	cfs
Percent of Full Flow	Flow =	22.3%	of full flow
Normal Depth Froude Number	Fr_n =	4.15	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.93	radians
Critical flow area	Ac =	2.25	sq ft
Critical top width	Tc =	1.88	ft
Critical flow depth	Yc =	1.35	ft
Critical flow velocity	Vc =	6.22	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 5



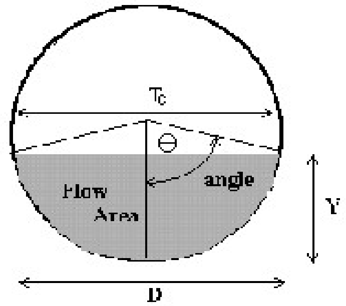
Design Information (Input)			
Pipe Invert Slope	So =	0.0448	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	8.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	22.29	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.40	radians
Flow area	An =	0.69	sq ft
Top width	Tn =	1.48	ft
Wetted perimeter	Pn =	2.10	ft
Flow depth	Yn =	0.62	ft
Flow velocity	Vn =	11.58	fps
Discharge	Qn =	8.00	cfs
Percent of Full Flow	Flow =	35.9%	of full flow
Normal Depth Froude Number	Fr_n =	2.98	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.05	radians
Critical flow area	Ac =	1.38	sq ft
Critical top width	Tc =	1.33	ft
Critical flow depth	Yc =	1.10	ft
Critical flow velocity	Vc =	5.78	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 6



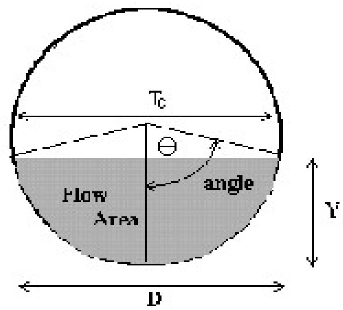
Design Information (Input)			
Pipe Invert Slope	So =	0.0307	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	17.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	39.74	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.48	radians
Flow area	An =	1.40	sq ft
Top width	Tn =	1.99	ft
Wetted perimeter	Pn =	2.97	ft
Flow depth	Yn =	0.91	ft
Flow velocity	Vn =	12.16	fps
Discharge	Qn =	17.00	cfs
Percent of Full Flow	Flow =	42.8%	of full flow
Normal Depth Froude Number	Fr_n =	2.56	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.08	radians
Critical flow area	Ac =	2.50	sq ft
Critical top width	Tc =	1.75	ft
Critical flow depth	Yc =	1.49	ft
Critical flow velocity	Vc =	6.79	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 7



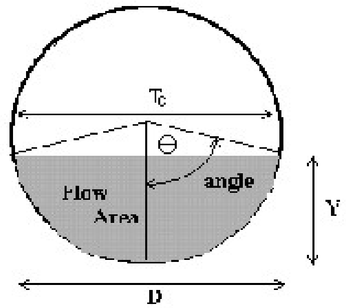
Design Information (Input)			
Pipe Invert Slope	So =	0.1140	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	20.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	76.59	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.26	radians
Flow area	An =	0.98	sq ft
Top width	Tn =	1.91	ft
Wetted perimeter	Pn =	2.53	ft
Flow depth	Yn =	0.70	ft
Flow velocity	Vn =	20.51	fps
Discharge	Qn =	20.00	cfs
Percent of Full Flow	Flow =	26.1%	of full flow
Normal Depth Froude Number	Fr_n =	5.05	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.22	radians
Critical flow area	Ac =	2.70	sq ft
Critical top width	Tc =	1.59	ft
Critical flow depth	Yc =	1.61	ft
Critical flow velocity	Vc =	7.40	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 8



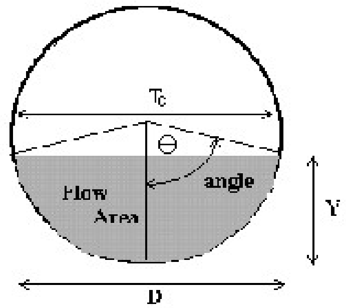
Design Information (Input)			
Pipe Invert Slope	So =	0.0065	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	Q =	32.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	33.16	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.19	radians
Flow area	An =	4.16	sq ft
Top width	Tn =	2.04	ft
Wetted perimeter	Pn =	5.47	ft
Flow depth	Yn =	1.97	ft
Flow velocity	Vn =	7.69	fps
Discharge	Qn =	32.00	cfs
Percent of Full Flow	Flow =	96.5%	of full flow
Normal Depth Froude Number	Fr_n =	0.95	subcritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.14	radians
Critical flow area	Ac =	4.06	sq ft
Critical top width	Tc =	2.10	ft
Critical flow depth	Yc =	1.93	ft
Critical flow velocity	Vc =	7.88	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 9



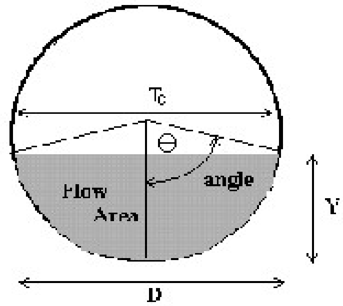
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	5.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.53	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.54	radians
Flow area	An =	0.85	sq ft
Top width	Tn =	1.50	ft
Wetted perimeter	Pn =	2.31	ft
Flow depth	Yn =	0.73	ft
Flow velocity	Vn =	5.88	fps
Discharge	Qn =	5.00	cfs
Percent of Full Flow	Flow =	47.5%	of full flow
Normal Depth Froude Number	Fr_n =	1.38	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.72	radians
Critical flow area	Ac =	1.05	sq ft
Critical top width	Tc =	1.48	ft
Critical flow depth	Yc =	0.86	ft
Critical flow velocity	Vc =	4.77	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 10

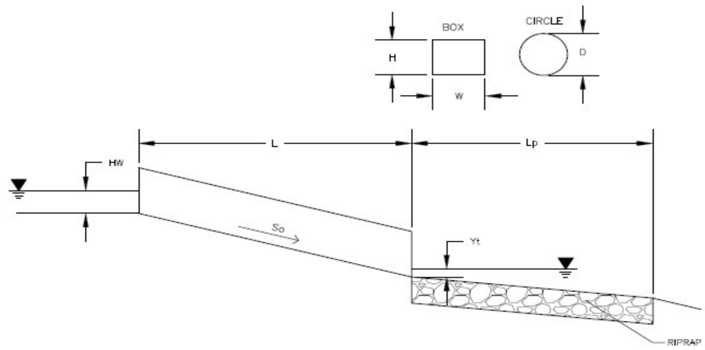


Design Information (Input)			
Pipe Invert Slope	So =	0.0080	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	Q =	36.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	36.79	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.22	radians
Flow area	An =	4.21	sq ft
Top width	Tn =	2.00	ft
Wetted perimeter	Pn =	5.54	ft
Flow depth	Yn =	2.00	ft
Flow velocity	Vn =	8.54	fps
Discharge	Qn =	36.00	cfs
Percent of Full Flow	Flow =	97.9%	of full flow
Normal Depth Froude Number	Fr_n =	1.04	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.25	radians
Critical flow area	Ac =	4.28	sq ft
Critical top width	Tc =	1.95	ft
Critical flow depth	Yc =	2.03	ft
Critical flow velocity	Vc =	8.41	fps
Critical Depth Froude Number	Fr_c =	1.00	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION - HWY. 105 / JCP INT. IMPROVEMENTS
ID: 30" RCP STORMWATER QUALITY OUTFALL



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

Design Information:			
Design Discharge	Q =	36	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)	Square 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 =	7013.25	ft
Outlet Elevation **OR** Slope	Elev OUT =	7012.75	ft
Culvert Length	L =	100	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 =	7	ft/s

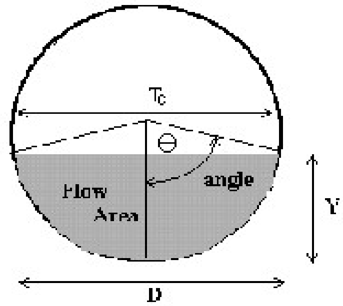
Calculated Results:			
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Culvert Normal Depth	Y_n =	2.50	ft
Culvert Critical Depth	Y_c =	2.03	ft
Froude Number	Fr =	-	**Pressure flow!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.92	
Sum of All Loss Coefficients	k_s =	2.12	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.85	ft
Outlet Control Headwater	HW_O =	3.54	ft
Design Headwater Elevation	**HW =**	**7017.10**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.54**	**HW/D > 1.5!**
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.64	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.00	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	3.82	
Flow Area at Max Channel Velocity	A_t =	5.14	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**11**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**6**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	-	ft
Minimum Theoretical Riprap Size	d_{50} min=	8	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.

Pipe ID: Pipe Run 11

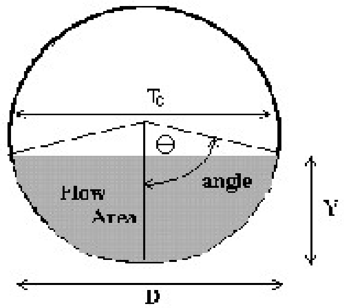


Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	4.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.53	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.42	radians
Flow area	An =	0.72	sq ft
Top width	Tn =	1.48	ft
Wetted perimeter	Pn =	2.14	ft
Flow depth	Yn =	0.64	ft
Flow velocity	Vn =	5.55	fps
Discharge	Qn =	4.00	cfs
Percent of Full Flow	Flow =	38.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.40	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.59	radians
Critical flow area	Ac =	0.91	sq ft
Critical top width	Tc =	1.50	ft
Critical flow depth	Yc =	0.77	ft
Critical flow velocity	Vc =	4.41	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION DEVELOPMENT - HWY. 105 & JCP INT. IMPS.
Pipe ID: EXIST. 36" RCP CULVERT



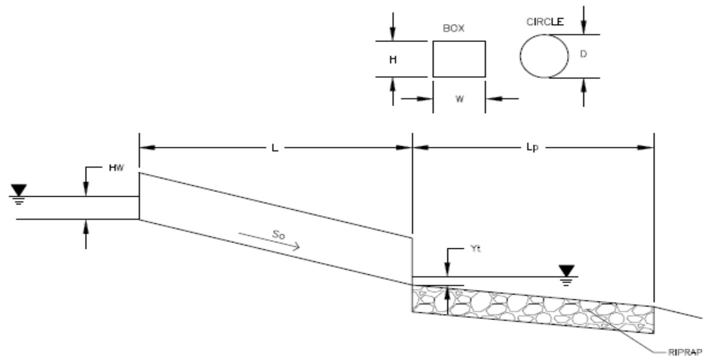
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	36.00	inches
Design discharge	Q =	40.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	66.88	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.69	radians
Flow area	An =	4.05	sq ft
Top width	Tn =	2.98	ft
Wetted perimeter	Pn =	5.06	ft
Flow depth	Yn =	1.67	ft
Flow velocity	Vn =	9.88	fps
Discharge	Qn =	40.00	cfs
Percent of Full Flow	Flow =	59.8%	of full flow
Normal Depth Froude Number	Fr_n =	1.49	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.95	radians
Critical flow area	Ac =	5.17	sq ft
Critical top width	Tc =	2.78	ft
Critical flow depth	Yc =	2.06	ft
Critical flow velocity	Vc =	7.73	fps
Critical Depth Froude Number	Fr_c =	1.00	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: MONUMENT JUNCTION - HWY. 105 / JCP INT. IMPROVEMENTS

ID: Exist. 36" RCP CDOT Outfall



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

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	25.2	cfs

Circular Culvert:

Barrel Diameter in Inches	D =	36	inches
Inlet Edge Type (Choose from pull-down list)		Square 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 =	7003.8	ft
Outlet Elevation **OR** Slope	So =	0.01	ft/ft
Culvert Length	L =	116	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 =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	7.07	ft^2
Culvert Normal Depth	Y_n =	1.28	ft
Culvert Critical Depth	Y_c =	1.62	ft
Froude Number	Fr =	1.58	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.83	
Sum of All Loss Coefficients	k_s =	2.03	ft

Headwater:

Inlet Control Headwater	HW_I =	2.40	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**7006.20**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.80**	

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

Outlet Protection:

Flow/(Diameter^2.5)	Q/D^2.5 =	1.62	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.20	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	6.11	
Flow Area at Max Channel Velocity	A_t =	3.60	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p **=**	**9**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**5**	**ft**

Adjusted Diameter for Supercritical Flow	Da =	2.14	ft
Minimum Theoretical Riprap Size	d_{50} min=	4	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

100-yr HGL Calculations
Map Layout

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Table

Time	Intensity
5	8.68
10	6.93
20	5.19
30	4.16
40	3.44
60	2.42
120	0.67

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90

Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 7013.75

Manhole Input Summary:

		Given Flow		Sub Basin Information							
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1	7016.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	7020.91	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 5 SWR 5 - 1	7017.60	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	7026.36	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	7036.03	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 4 SWR 4 - 1	7044.17	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 9 SWR 9 - 1	7059.12	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 10 SWR 10 - 1	7059.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 6 SWR 6 - 1	7026.36	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 7 SWR 7 - 1	7030.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 8 SWR 8 - 1	7037.20	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	54.92	0.66	0.38	36.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.00	
MH 5 SWR 5 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	
MH 4 SWR 4 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
MH 9 SWR 9 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	
MH 10 SWR 10 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	
MH 6 SWR 6 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	
MH 7 SWR 7 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	
MH 8 SWR 8 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	166.16	7012.75	0.5	7013.58	0.013	0.03	1.00	CIRCULAR	30.00 in	30.00 in

MH 5 SWR 5 - 1	3.17	7014.58	1.0	7014.61	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
MH 2 SWR 2 - 1	256.17	7014.08	0.5	7015.36	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
MH 3 SWR 3 - 1	187.50	7015.87	7.6	7030.16	0.013	0.05	1.00	CIRCULAR	24.00 in	24.00 in
MH 4 SWR 4 - 1	145.36	7030.66	5.7	7038.92	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in
MH 9 SWR 9 - 1	275.71	7039.42	5.4	7054.20	0.013	0.83	0.00	CIRCULAR	18.00 in	18.00 in
MH 10 SWR 10 - 1	7.53	7054.70	1.1	7054.78	0.013	0.38	1.00	CIRCULAR	18.00 in	18.00 in
MH 6 SWR 6 - 1	41.85	7015.86	11.4	7020.63	0.013	0.83	1.00	CIRCULAR	24.00 in	24.00 in
MH 7 SWR 7 - 1	69.88	7021.13	3.1	7023.28	0.013	0.94	1.00	CIRCULAR	24.00 in	24.00 in
MH 8 SWR 8 - 1	200.00	7023.78	4.5	7032.73	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in

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Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
MH 1 SWR 1 - 1	29.08	5.92	30.00	7.33	30.00	7.33	0.00	Pressurized	36.00	166.16	
MH 5 SWR 5 - 1	10.53	5.96	10.32	4.77	8.73	5.88	1.38	Pressurized	5.00	3.17	
MH 2 SWR 2 - 1	29.08	5.92	30.00	6.52	30.00	6.52	0.00	Pressurized	32.00	256.17	

MH 3 SWR 3 - 1	62.62	19.93	16.17	6.22	7.71	16.06	4.14	Supercritical Jump	14.00	18.03	
MH 4 SWR 4 - 1	25.11	14.21	12.29	5.45	6.50	12.17	3.40	Supercritical	7.00	0.00	
MH 9 SWR 9 - 1	24.39	13.80	7.18	3.80	3.89	8.89	3.28	Supercritical	2.50	0.00	
MH 10 SWR 10 - 1	10.83	6.13	7.18	3.80	5.88	4.98	1.47	Supercritical	2.50	0.00	
MH 6 SWR 6 - 1	76.58	24.38	19.27	7.40	8.37	20.51	5.05	Supercritical Jump	20.00	11.11	Velocity is Too High
MH 7 SWR 7 - 1	39.79	12.66	17.83	6.79	10.96	12.17	2.56	Supercritical	17.00	0.00	
MH 8 SWR 8 - 1	22.28	12.61	13.15	5.78	7.46	11.57	2.98	Supercritical	8.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
MH 1 SWR 1 - 1	36.00	CIRCULAR	30.00 in	30.00 in	33.00 in	33.00 in	30.00 in	30.00 in	4.91	Existing height is smaller than the suggested height.

										Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 5 SWR 5 - 1	5.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
MH 2 SWR 2 - 1	32.00	CIRCULAR	30.00 in	30.00 in	33.00 in	33.00 in	30.00 in	30.00 in	4.91	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 3 SWR 3 - 1	14.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 4 SWR 4 - 1	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
MH 9 SWR 9 - 1	2.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
MH 10 SWR 10 - 1	2.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
MH 6 SWR 6 - 1	20.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 7 SWR 7 - 1	17.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 8 SWR 8 - 1	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 7013.75

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	7012.75	7013.58	0.00	0.00	7015.25	7016.52	7016.08	1.27	7017.36
MH 5 SWR 5 - 1	7014.58	7014.61	0.16	0.00	7017.40	7017.40	7017.52	0.01	7017.53
MH 2 SWR 2 - 1	7014.08	7015.36	0.03	0.18	7016.91	7018.46	7017.57	1.55	7019.12
MH 3 SWR 3 - 1	7015.87	7030.16	0.02	0.35	7019.18	7031.51	7019.48	12.62	7032.11
MH 4 SWR 4 - 1	7030.66	7038.92	0.01	0.06	7031.58	7039.94	7033.50	6.90	7040.40
MH 9 SWR 9 - 1	7039.42	7054.20	0.03	0.00	7039.97	7054.80	7040.97	14.05	7055.02
MH 10 SWR 10 - 1	7054.70	7054.78	0.01	0.00	7055.19	7055.38	7055.58	0.03	7055.60
MH 6 SWR 6 - 1	7015.86	7020.63	0.52	0.03	7019.04	7022.24	7019.67	3.42	7023.09
MH 7 SWR 7 - 1	7021.13	7023.28	0.43	0.17	7022.84	7024.77	7024.34	1.14	7025.48
MH 8 SWR 8 - 1	7023.78	7032.73	0.02	0.14	7024.92	7033.83	7026.48	7.87	7034.35

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

STORMWATER QUALITY CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: July 20, 2023
Project: Monument Junction Development - Hwy. 105 & JCP Int. Imps.
Location: SWQ Facility in CDOT ROW

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 53.6 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.536

C) Contributing Watershed Area — Area = 11.840 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 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}= ______ 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) — $V_{DESIGN\ USER}$= 0.121 ac-ft

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

J) Excess Urban Runoff Volume (EURV) Design Volume — $EURV_{DESIGN}$ = ______ 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: Concrete Forebay

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.004 ac-ft

B) Actual Forebay Volume — V_F = 0.004 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} = 36.00 cfs
- ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.72 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 = 5.0 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**July 20, 2023**
Project:	**Monument Junction Development - Hwy. 105 & JCP Int. Imps.**
Location:	**SWQ Facility in CDOT ROW**

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ○ Concrete
- ◉ Soft Bottom

F) Slope of Trickle Channel — S = 0.0200 ft / ft

PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED.
MINIMUM DEPTH OF 1.5 FEET

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 = 48 sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.19 inches

E) Total Outlet Area — A_{ot} = 4.36 square inches

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = 6 in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = 16 cu ft

C) Initial Surcharge Provided Above Micropool — V_s= 24.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = 150 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.) — *S.S. Well Screen with 60% Open Area*

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} = 250 sq. in.

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= 5.5 feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= 94 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: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: July 20, 2023
Project: Monument Junction Development - Hwy. 105 & JCP Int. Imps.
Location: SWQ Facility in CDOT ROW

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	Buried Rip-Rap
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Ze = 50.00 ft / ft
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: July 20, 2023
Project: Monument Junction Development - Hwy. 105 & JCP Int. Imps.
Location: SWQ Facility - Forebay Sizing

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 67.2 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.672
C) Contributing Watershed Area	Area = 8.490 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 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}= 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)	$V_{DESIGN\ USER}$= 0.121 ac-ft
I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils	HSG_A = % HSG_B = % $HSG_{C/D}$ = %
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = ac-f t
K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)	$EURV_{DESIGN\ USER}$= ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.004 ac-ft
B) Actual Forebay Volume	V_F = 0.004 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} = 36.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 0.72 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 = 5.0 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**July 20, 2023**
Project:	**Monument Junction Development - Hwy. 105 & JCP Int. Imps.**
Location:	**SWQ Facility - Forebay Sizing**

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ( ) Concrete
- (•) Soft Bottom

F) Slope of Trickle Channel — S = 0.0200 ft / ft

PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = ______ ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = ______ sq ft

C) Outlet Type

Choose One
- (•) Orifice Plate
- ( ) Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = ______ inches

E) Total Outlet Area — A_{ot} = ______ square inches

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = ______ in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = 16 cu ft

C) Initial Surcharge Provided Above Micropool — V_s= ______ cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = ______ square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)

Other (Y/N): ______

C) Ratio of Total Open Area to Total Area (only for type 'Other') — User Ratio = ______

D) Total Water Quality Screen Area (based on screen type) — A_{total} = ______ sq. in.

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= ______ feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= ______ inches

G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) — $W_{opening}$ = ______ inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**July 20, 2023**
Project:	**Monument Junction Development - Hwy. 105 & JCP Int. Imps.**
Location:	**SWQ Facility - Forebay Sizing**

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	Buried Rip-Rap
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:

DETENTION FACILITY CALCULATIONS

CLASSIC

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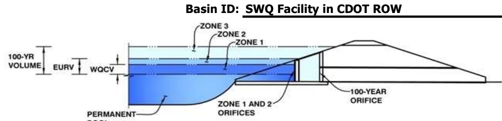
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: Monument Junction Development - Hwy. 105 & JCP Int. Imps.

Basin ID: SWQ Facility in CDOT ROW



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.84	acres
Watershed Length =	1,200	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	53.60%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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) =	0.213	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.604	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.673	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.955	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.195	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.472	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.723	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.026	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	3.392	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	0.535	acre-feet		
Approximate 5-yr Detention Volume =	0.786	acre-feet		
Approximate 10-yr Detention Volume =	0.896	acre-feet		
Approximate 25-yr Detention Volume =	0.965	acre-feet		
Approximate 50-yr Detention Volume =	0.998	acre-feet		
Approximate 100-yr Detention Volume =	1.124	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.213	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.390	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.520	acre-feet
Total Detention Basin Volume =	1.124	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	--	--	--	48	0.001		
7006	--	1.50	--	--	--	3,347	0.077	2,546	0.058
7008	--	3.50	--	--	--	5,688	0.131	11,581	0.266
7010	--	5.50	--	--	--	9,690	0.222	26,959	0.619
7012	--	7.50	--	--	--	14,548	0.334	51,197	1.175
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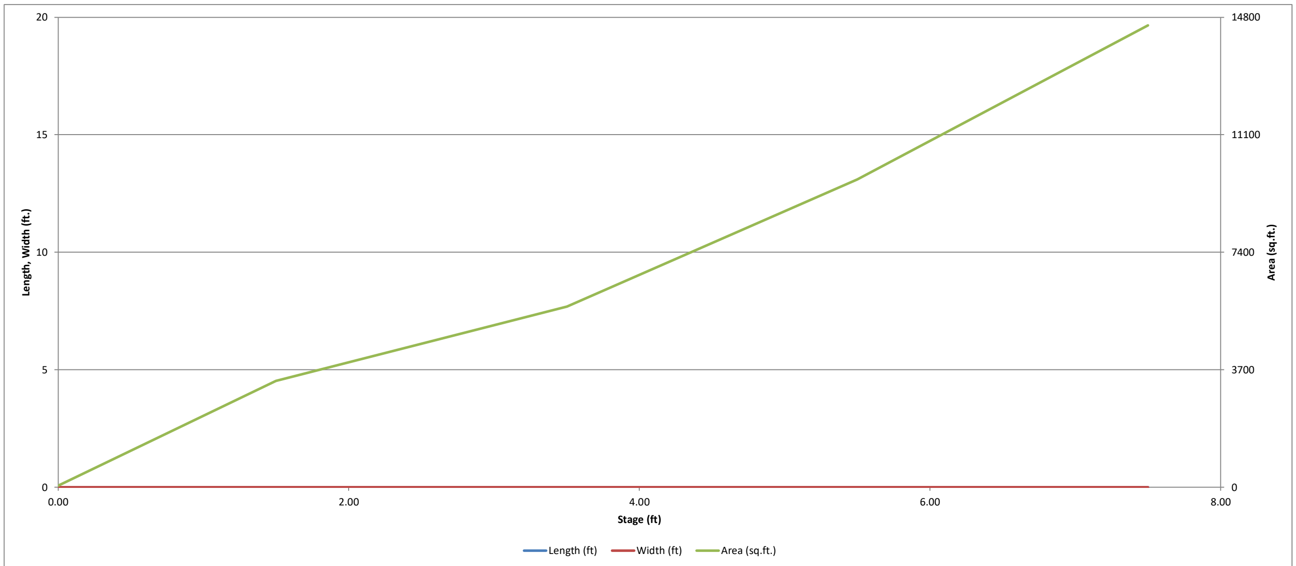
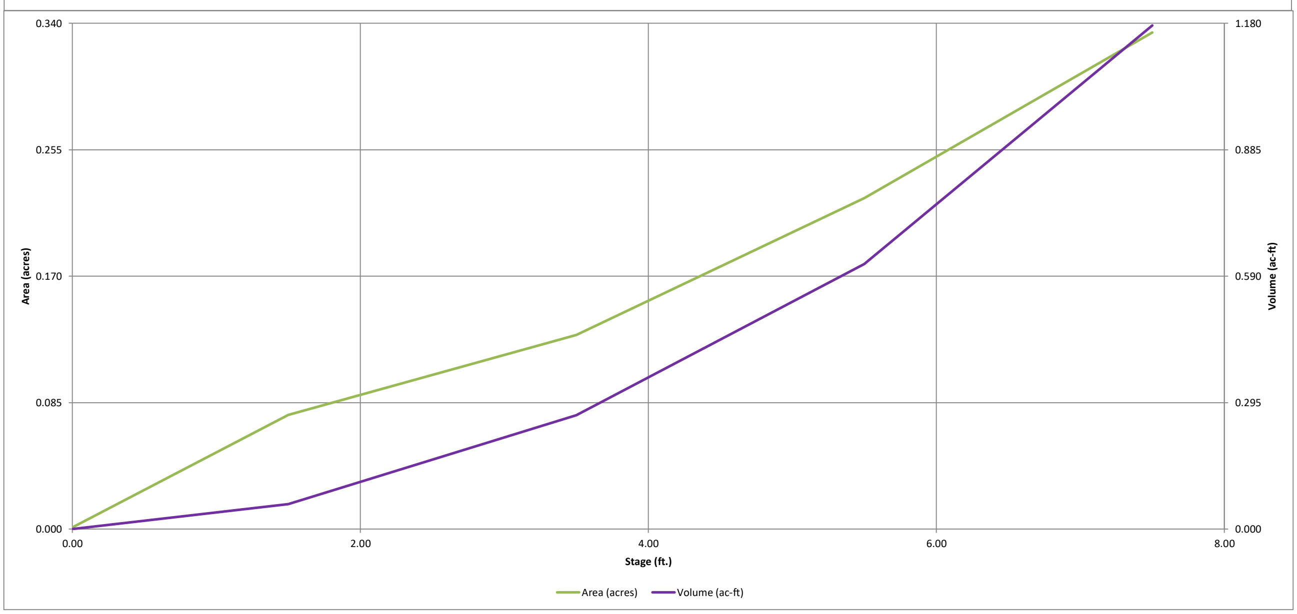
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



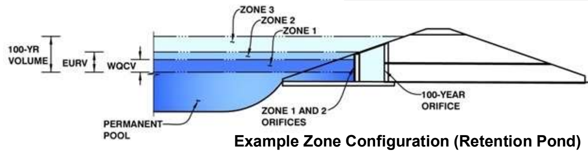


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: **Monument Junction Development - Hwy. 105 & JCP Int. Imps.**

Basin ID: **SWQ Facility in CDOT ROW**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.09	0.213	Orifice Plate
Zone 2 (EURV)	5.44	0.390	Orifice Plate
Zone 3 (100-year)	7.35	0.520	Weir&Pipe (Restrict)
	Total (all zones)	1.124	

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 =	5.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.50	inches
Orifice Plate: Orifice Area per Row =	1.09	sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	7.569E-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	1.40	2.80	4.20				
Orifice Area (sq. inches)	1.09	1.09	1.09	1.09				

	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 =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.50	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	1.77	N/A	
Overflow Grate Open Area w/o Debris =	12.53	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.26	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 =	0.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	36.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.07	N/A	ft^2
Outlet Orifice Centroid =	1.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.51	feet
Stage at Top of Freeboard =	8.01	feet
Basin Area at Top of Freeboard =	0.33	acres
Basin Volume at Top of Freeboard =	1.18	acre-ft

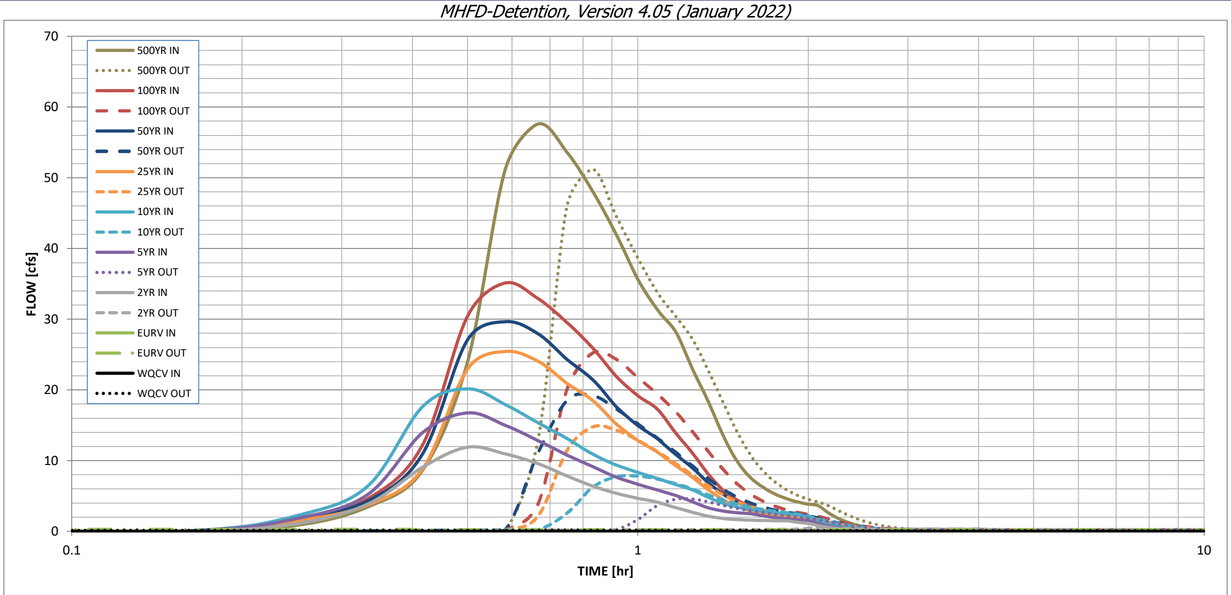
Routed Hydrograph Results

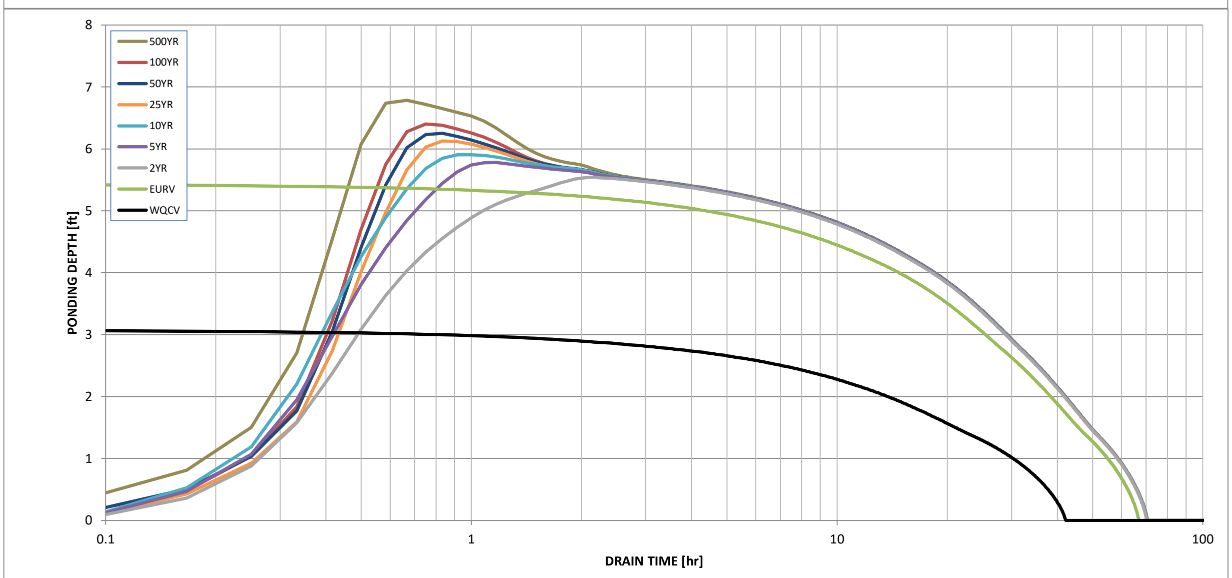
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

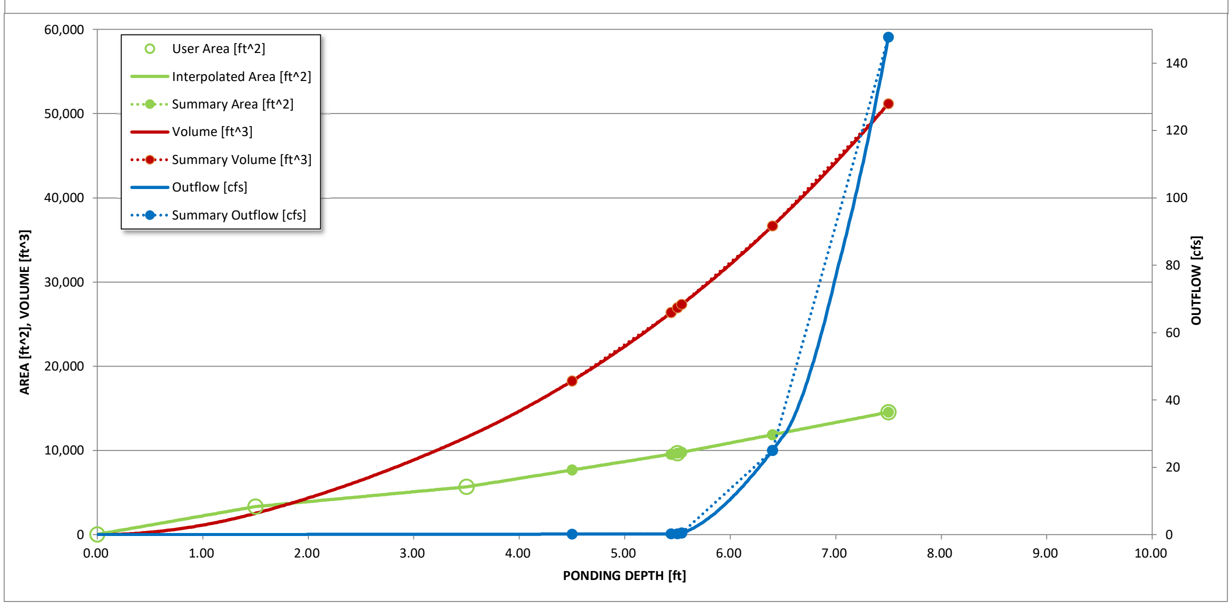
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.85
CUHP Runoff Volume (acre-ft) =	0.213	0.604	0.673	0.955	1.195	1.472	1.723	2.026	3.392
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.673	0.955	1.195	1.472	1.723	2.026	3.392
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.6	5.4	7.5	11.5	14.2	17.5	31.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	10.0	14.0	20.0	27.0	30.0	36.0	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.84	1.18	1.69	2.28	2.53	3.04	2.68
Peak Inflow Q (cfs) =	N/A	N/A	11.9	16.8	20.2	25.4	29.7	35.1	57.6
Peak Outflow Q (cfs) =	0.1	0.3	0.5	4.6	7.8	14.8	19.2	25.2	51.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.4	0.5	0.6	0.7	1.6
Structure Controlling Flow =	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.02	0.3	0.6	1.2	1.5	2.0	2.9
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	58	61	58	56	53	51	49	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	63	66	65	64	63	62	61	56
Maximum Ponding Depth (ft) =	3.08	5.44	5.54	5.78	5.91	6.13	6.25	6.40	6.79
Area at Maximum Ponding Depth (acres) =	0.12	0.22	0.22	0.24	0.24	0.26	0.26	0.27	0.29
Maximum Volume Stored (acre-ft) =	0.213	0.606	0.626	0.683	0.712	0.768	0.801	0.842	0.949

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.01	0.85
	0:15:00	0.00	0.00	1.11	1.81	2.23	1.50	1.86	1.83	3.46
	0:20:00	0.00	0.00	3.84	5.19	6.38	3.70	4.30	4.62	8.62
	0:25:00	0.00	0.00	9.05	13.93	17.60	8.81	10.91	12.17	23.92
	0:30:00	0.00	0.00	11.92	16.76	20.16	22.94	27.05	30.39	51.17
	0:35:00	0.00	0.00	10.94	15.00	17.92	25.45	29.66	35.13	57.60
	0:40:00	0.00	0.00	9.56	12.83	15.35	24.05	27.92	32.89	53.60
	0:45:00	0.00	0.00	7.81	10.80	13.12	20.93	24.30	29.53	48.00
	0:50:00	0.00	0.00	6.41	9.13	10.90	18.49	21.42	25.87	41.94
	0:55:00	0.00	0.00	5.38	7.67	9.37	15.18	17.62	21.91	35.64
	1:00:00	0.00	0.00	4.69	6.67	8.35	12.86	14.96	19.17	31.30
	1:05:00	0.00	0.00	4.13	5.84	7.48	11.21	13.06	17.26	28.20
	1:10:00	0.00	0.00	3.36	5.07	6.62	9.29	10.87	13.89	22.87
	1:15:00	0.00	0.00	2.68	4.16	5.84	7.61	8.94	11.01	18.28
	1:20:00	0.00	0.00	2.13	3.32	4.80	5.85	6.85	8.06	13.45
	1:25:00	0.00	0.00	1.81	2.87	3.97	4.46	5.23	5.78	9.81
	1:30:00	0.00	0.00	1.67	2.64	3.44	3.51	4.13	4.39	7.57
	1:35:00	0.00	0.00	1.59	2.48	3.07	2.90	3.42	3.54	6.19
	1:40:00	0.00	0.00	1.54	2.17	2.80	2.51	2.95	2.97	5.24
	1:45:00	0.00	0.00	1.51	1.94	2.62	2.24	2.63	2.58	4.60
	1:50:00	0.00	0.00	1.48	1.77	2.49	2.06	2.42	2.31	4.15
	1:55:00	0.00	0.00	1.28	1.65	2.31	1.94	2.27	2.12	3.83
	2:00:00	0.00	0.00	1.13	1.50	2.04	1.85	2.17	2.01	3.65
	2:05:00	0.00	0.00	0.83	1.10	1.48	1.36	1.59	1.47	2.67
	2:10:00	0.00	0.00	0.60	0.79	1.05	0.97	1.13	1.05	1.91
	2:15:00	0.00	0.00	0.43	0.56	0.75	0.69	0.81	0.76	1.37
	2:20:00	0.00	0.00	0.30	0.39	0.52	0.49	0.57	0.54	0.97
	2:25:00	0.00	0.00	0.21	0.26	0.36	0.33	0.39	0.37	0.67
	2:30:00	0.00	0.00	0.14	0.17	0.24	0.23	0.27	0.26	0.46
	2:35:00	0.00	0.00	0.08	0.11	0.16	0.15	0.18	0.17	0.30
	2:40:00	0.00	0.00	0.05	0.07	0.09	0.09	0.11	0.10	0.18
	2:45:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.09
	2:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
Micropool Elev.	4.50	7,689	0.177	18,270	0.419	0.21
EURV	5.44	9,570	0.220	26,381	0.606	0.26
	5.50	9,690	0.222	26,959	0.619	0.26
5-yr.	5.54	9,787	0.225	27,349	0.628	0.49
100-yr.	6.40	11,876	0.273	36,664	0.842	25.05
	7.50	14,548	0.334	51,197	1.175	147.73

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

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

DRAINAGE MAPS

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		DEVELOPED AREA/IMPERVIOUS AREA				LANDSCAPE/UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA			IMPERVIOUSNESS
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**	%
OS-10	4.10	0.60	0.89	0.90	0.96	3.50	0.03	0.09	0.36	0.16	0.21	0.45	**0.64**	**0.86**	**1.84**	16%
OS-11	1.70	0.80	0.89	0.90	0.96	0.90	0.02	0.08	0.35	0.43	0.47	0.64	**0.73**	**0.79**	**1.08**	45%
OS-12	0.51	0.27	0.89	0.90	0.96	0.24	0.03	0.09	0.36	0.49	0.52	0.68	**0.25**	**0.26**	**0.35**	54%
OS-13	0.67	0.40	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.54	0.57	0.72	**0.36**	**0.38**	**0.48**	61%
OS-14	0.28	0.15	0.89	0.90	0.96	0.13	0.03	0.09	0.36	0.49	0.52	0.68	**0.14**	**0.15**	**0.19**	55%
OS-15	1.60	1.20	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.68	0.70	0.81	**1.08**	**1.12**	**1.30**	76%
OS-16	1.00	0.70	0.89	0.90	0.96	0.30	0.02	0.08	0.35	0.63	0.65	0.78	**0.63**	**0.65**	**0.78**	67%
OS-17	0.53	0.43	0.89	0.90	0.96	0.10	0.03	0.09	0.36	0.73	0.75	0.85	**0.39**	**0.40**	**0.45**	82%
OS-18	0.30	0.30	0.89	0.90	0.96	0.00	0.03	0.09	0.36	0.89	0.90	0.96	**0.27**	**0.27**	**0.29**	100%
EX2	0.56	0.56	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.02**	**0.05**	**0.20**	2%
EX3	1.80	1.80	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.05**	**0.16**	**0.65**	2%
Exist. Trib. to Pond	**13.05**															

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
BASIN	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-10	0.64	0.86	1.84	0.09	65	2	10.1	950	3.5%	1.9	8.5	18.6	2.56	3.20	5.37	2	**3**	**10**
OS-11	0.73	0.79	1.08	0.08	100	2	14.7	500	4.0%	2.0	4.2	18.8	2.54	3.18	5.34	1.9	**3**	**6**
OS-12	0.25	0.26	0.35	0.09	40	2	6.8	200	3.5%	3.7	0.9	7.7	3.61	4.53	7.60	0.9	**1.2**	**3**
OS-13	0.36	0.38	0.48	0.09	25	3	4.0	240	5.5%	4.7	0.9	5.0	4.12	5.17	8.68	1.5	**2**	**4**
OS-14	0.14	0.15	0.19	0.09	30	10	3.1	170	5.5%	4.7	0.6	5.0	4.12	5.17	8.68	0.6	**0.8**	**2**
OS-15	1.08	1.12	1.30	0.09	180	12	13.1	100	3.0%	1.7	1.0	14.0	2.89	3.62	6.08	3	**4**	**8**
OS-16	0.63	0.65	0.78	0.08	100	4	11.7	130	1.5%	1.2	1.8	13.4	2.94	3.69	6.19	1.9	**2**	**5**
OS-17	0.39	0.40	0.45	0.09	60	14	5.0	380	5.0%	4.5	1.4	6.4	3.82	4.80	8.05	1.5	**2**	**4**
OS-18	0.27	0.27	0.29	0.09	15	0.5	4.7	280	2.0%	2.8	1.6	6.4	3.83	4.80	8.06	1.0	**1.3**	**2**
EX2	0.02	0.05	0.20	0.09	50	2	8.2					8.2	3.54	4.43	7.44	0.1	**0.2**	**1.5**
EX3	0.05	0.16	0.65	0.09	260	5	23.7					23.7	2.27	2.84	4.76	0.1	**0.5**	**3**

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Inlet Size
H4	OS-12	0.26	0.46	7.7	4.53	7.60	1	3	EXIST. 5' TYPE R AT-GRADE INLET
H5	OS-13, Flow-by from H4	0.38	0.63	5.0	5.17	8.68	2	5	EXIST. 10' TYPE R AT-GRADE INLET
H6	OS-14, Flow-by from H5	0.15	0.24	5.0	5.17	8.68	1	2	EXIST. 10' TYPE R AT-GRADE INLET
H7	OS-11 and OS-16	1.45	1.86	18.8	3.18	5.34	5	10	EXIST. 10' TYPE R AT-GRADE INLET
H8	OS-17, Flow-by from H7	0.42	0.73	6.4	4.80	8.05	2	6	EXIST. 10' TYPE R AT-GRADE INLET
H9	OS-18, Flow-by from H8	0.27	0.41	6.4	4.80	8.06	1	3	EXIST. 10' TYPE R AT-GRADE INLET
H10	**EX2, EX3, OS-10 thru OS-18**	**5.09**	**7.60**	**23.7**	**2.84**	**4.76**	**14**	**36**	**EXIST. 36" RCP CDOT CULVERT**

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Pipe Size*
H1	Inlet Capture at DP-H4	0.26	0.24	7.7	4.53	7.60	1	2	Exist. 15" RCP
H2	PR-H1, Inlet Capture at DP-H5	0.65	0.77	7.8	4.51	7.57	3	6	Exist. 15" RCP
H3	PR-H2, Inlet Capture at DP-H6	0.80	1.01	7.9	4.49	7.54	4	8	Exist. 24" RCP
H4	OS-15	1.12	1.30	14.0	3.62	6.08	4	8	Exist. 18" ADS
H5	PR-H3, PR-H4, Portion of OS-11 and OS-16	3.20	3.95	18.8	3.18	5.34	10	21	Exist. 30" RCP
H6	Inlet Capture at DP-H8	0.42	0.64	6.4	4.80	8.05	2	5	Exist. 24" RCP
H7	Inlet Capture at DP-H9	0.27	0.41	6.4	4.80	8.06	1	3	Exist. 24" RCP

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY	
DESIGN POINT	3
BASIN IDENTIFIER / AREA IN ACRES	BB / 10.0
EXISTING DIRECTION OF FLOW	
EXIST. STORM SEWER	
TRIBUTARY AREA TO 36" CULVERT	

100 50 0 100 200

SCALE: 1" = 100'

CLASSIC CONSULTING
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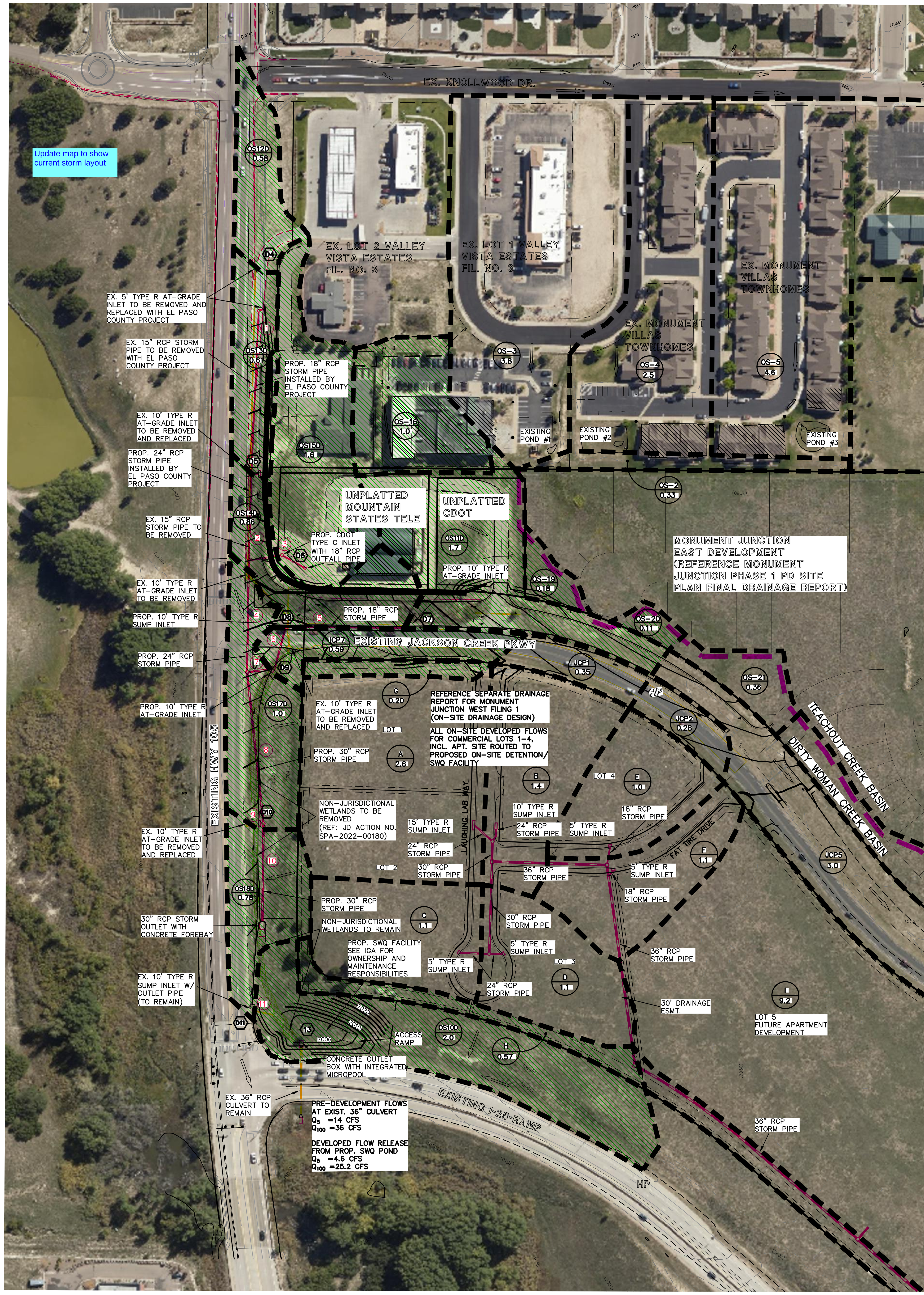
MONUMENT JUNCTION DEVELOPMENT
HWY. 105 & JACKSON CREEK INT. IMPS.
FINAL DRAINAGE REPORT
PRE-DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	03/16/22
DRAWN BY	MAW	(H) 1"= 100'	SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO.	1302.22



FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	DEVELOPED AREA/IMPERVIOUS AREA AREA (AC)	C(2)	C(5)	C(100)	LANDSCAPE/UNDEVELOPED AREAS AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED C(2)	C(5)	C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)	IMPERVIOUSNESS %
G	0.20	0.05	0.79	0.81	0.88	0.15	0.03	0.09	0.36	0.22	0.27	0.49	**0.04**	**0.05**	**0.10**	25%
H	0.57	0.05	0.79	0.81	0.88	0.52	0.03	0.09	0.36	0.10	0.15	0.41	**0.06**	**0.09**	**0.23**	10%
OS-10	4.10	0.60	0.89	0.90	0.96	3.50	0.03	0.09	0.36	0.16	0.21	0.45	**0.64**	**0.86**	**1.84**	16%
OS10D	2.00	0.10	0.89	0.90	0.96	1.90	0.03	0.09	0.36	0.07	0.13	0.39	**0.15**	**0.26**	**0.78**	7%
OS-11	1.70	0.80	0.89	0.90	0.96	0.90	0.02	0.08	0.35	0.43	0.47	0.64	**0.73**	**0.79**	**1.08**	45%
OS11D	1.70	1.20	0.89	0.90	0.96	0.50	0.03	0.09	0.36	0.64	0.66	0.78	**1.08**	**1.13**	**1.33**	71%
OS-12	0.51	0.27	0.89	0.90	0.96	0.24	0.03	0.09	0.36	0.49	0.52	0.68	**0.25**	**0.26**	**0.35**	54%
OS12D	0.58	0.31	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.49	0.52	0.68	**0.28**	**0.30**	**0.39**	54%
OS-13	0.67	0.40	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.54	0.57	0.72	**0.36**	**0.38**	**0.48**	61%
OS13D	0.67	0.40	0.89	0.90	0.96	0.27	0.03	0.09	0.36	0.54	0.57	0.72	**0.36**	**0.38**	**0.48**	61%
OS-14	0.28	0.15	0.89	0.90	0.96	0.13	0.03	0.09	0.36	0.49	0.52	0.68	**0.14**	**0.15**	**0.19**	55%
OS14D	0.86	0.72	0.89	0.90	0.96	0.14	0.03	0.09	0.36	0.75	0.77	0.86	**0.65**	**0.66**	**0.74**	84%
OS-15	1.60	1.20	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.68	0.70	0.81	**1.08**	**1.12**	**1.30**	76%
OS15D	1.60	1.20	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.68	0.70	0.81	**1.08**	**1.12**	**1.30**	76%
OS-16	1.00	0.70	0.89	0.90	0.96	0.30	0.02	0.08	0.35	0.63	0.65	0.78	**0.63**	**0.65**	**0.78**	67%
OS-17	0.53	0.43	0.89	0.90	0.96	0.10	0.03	0.09	0.36	0.73	0.75	0.85	**0.39**	**0.40**	**0.45**	82%
OS17D	1.00	0.60	0.89	0.90	0.96	0.40	0.03	0.09	0.36	0.55	0.58	0.72	**0.55**	**0.58**	**0.72**	61%
OS-18	0.30	0.30	0.89	0.90	0.96	0.00	0.03	0.09	0.36	0.89	0.90	0.96	**0.27**	**0.27**	**0.29**	100%
OS18D	0.78	0.43	0.89	0.90	0.96	0.35	0.03	0.09	0.36	0.50	0.54	0.69	**0.39**	**0.42**	**0.54**	56%
OS-19	0.18	0.00	0.89	0.90	0.96	0.18	0.03	0.09	0.36	0.03	0.09	0.36	**0.01**	**0.02**	**0.06**	2%
OS-20	0.11	0.01	0.89	0.90	0.96	0.10	0.03	0.09	0.36	0.11	0.16	0.41	**0.01**	**0.02**	**0.05**	10%
JCP7	0.59	0.50	0.89	0.90	0.96	0.09	0.03	0.09	0.36	0.76	0.78	0.87	**0.45**	**0.46**	**0.51**	85%
EX2	0.56	0.56	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.02**	**0.05**	**0.20**	2%
EX3	1.80	1.80	0.03	0.09	0.36	0.00	0.03	0.09	0.36	0.03	0.09	0.36	**0.05**	**0.16**	**0.65**	2%
Exist. Trib. to Pond	**13.05**															**37.5%**
Dev. Trib. to Pond	**11.84**															**53.6%**
Dev. Trib. to Forebay	**8.49**															**67.2%**

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
G	0.04	0.05	0.10	0.09	30	1.5	5.9					5.9	3.93	4.93	8.27	0.17	**0.3**	**0.8**
H	0.06	0.09	0.23	0.09	40	2	6.8					6.8	3.76	4.71	7.91	0.2	**0.4**	**1.8**
OS-10	0.64	0.86	1.84	0.09	65	2	10.1	950	3.5%	1.9	8.5	18.6	2.56	3.20	5.37	2	**3**	**10**
OS10D	0.15	0.26	0.78	0.09	65	2	10.1	950	3.5%	1.9	8.5	18.6	2.56	3.20	5.37	0.4	**0.8**	**4**
OS-11	0.73	0.79	1.08	0.08	100	2	14.7	500	4.0%	2.0	4.2	18.8	2.54	3.18	5.34	1.9	**3**	**6**
OS11D	1.08	1.13	1.33	0.09	100	2	14.5	300	4.0%	2.0	2.5	17.0	2.66	3.33	5.59	3	**4**	**7**
OS-12	0.25	0.26	0.35	0.09	40	2	6.8	200	3.5%	3.7	0.9	7.7	3.61	4.53	7.60	0.9	**1.2**	**3**
OS12D	0.28	0.30	0.39	0.09	40	2	6.8	200	3.5%	3.7	0.9	7.7	3.61	4.53	7.60	1.0	**1.4**	**3.0**
OS-13	0.36	0.38	0.48	0.09	25	3	4.0	240	5.5%	4.7	0.9	5.0	4.12	5.17	8.68	1.5	**2**	**4**
OS13D	0.36	0.38	0.48	0.09	25	3	4.0	250	3.5%	3.7	1.1	5.1	4.09	5.13	8.61	1.5	**2**	**4**
OS-14	0.14	0.15	0.19	0.09	30	10	3.1	170	5.5%	4.7	0.6	5.0	4.12	5.17	8.68	0.6	**0.8**	**2**
OS14D	0.65	0.66	0.74	0.09	30	10	3.1	190	5.5%	4.7	0.7	5.0	4.12	5.17	8.68	3	**3**	**6**
OS-15	1.08	1.12	1.30	0.09	180	12	13.1	100	3.0%	1.7	1.0	14.0	2.89	3.62	6.08	3	**4**	**8**
OS15D	1.08	1.12	1.30	0.09	180	12	13.1	80	3.0%	3.5	0.4	13.5	2.94	3.68	6.18	3	**4**	**8**
OS-16	0.63	0.65	0.78	0.08	100	4	11.7	130	1.5%	1.2	1.8	13.4	2.94	3.69	6.19	1.9	**2**	**5**
OS-17	0.39	0.40	0.45	0.09	60	14	5.0	380	5.0%	4.5	1.4	6.4	3.82	4.80	8.05	1.5	**2**	**4**
OS17D	0.55	0.58	0.72	0.09	60	14	5.0	380	5.0%	4.5	1.4	6.4	3.82	4.80	8.05	2	**3**	**6**
OS-18	0.27	0.27	0.29	0.09	15	0.5	4.7	280	2.0%	2.8	1.6	6.4	3.83	4.80	8.06	1.0	**1.3**	**2**
OS18D	0.39	0.42	0.54	0.09	90	4	10.6	260	2.0%	2.8	1.5	12.1	3.07	3.84	6.45	1.2	**1.6**	**3**
OS-19	0.01	0.02	0.06	0.09	80	3.2	10.3	380	5.0%	4.5	1.4	11.7	3.10	3.89	6.53	0.02	**0.1**	**0.4**
OS-20	0.01	0.02	0.05	0.09	50	3	7.1					7.1	3.70	4.63	7.78	0.0	**0.1**	**0.4**
JCP7	0.45	0.46	0.51	0.09	20	0.6	5.7	300	4.5%	4.2	1.2	6.9	3.74	4.70	7.88	2	**2**	**4**
EX2	0.02	0.05	0.20	0.09	50	2	8.2					8.2	3.54	4.43	7.44	0.1	**0.2**	**1.5**
EX3	0.05	0.16	0.65	0.09	260	5	23.7					23.7	2.27	2.84	4.76	0.1	**0.5**	**3**

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Inlet Size
13	**G, H, JCP7, OS10D thru OS15D, OS-16, OS17D, OS18D**	**5.84**	**7.90**	**21.1**	**3.01**	**5.05**	**18**	**40**	**CDOT SWQ FACILITY**
D4	OS12D, 0.85 CFS 100Yr Flow-by from upstream	0.30	0.51	7.7	4.53	7.60	1.4	3.9	PROP. 5' TYPE R AT-GRADE INLET
D5	OS13D, Flow-by from D4	0.38	0.63	5.0	5.17	8.68	2	5	PROP. 10' TYPE R AT-GRADE INLET
D6	OS15D	1.12	1.30	13.5	3.68	6.18	4	8	PROP. CDOT TYPE C INLET
D7	OS11D, OS-16, OS-19, OS-20	1.81	2.22	17.0	3.33	5.59	6	12	PROP. 10' TYPE R AT-GRADE INLET
D8	OS14D, Flow-by from D5&D7	0.84	1.47	17.0	3.33	5.59	3	8	PROP. 10' TYPE R SUMP INLET
D9	JCP7, G	0.51	0.61	6.9	4.70	7.88	2	5	PROP. 10' TYPE R AT-GRADE INLET
D10	OS17D, Flow-by from D8	0.58	0.74	6.4	4.80	8.05	3	6	PROP. 10' TYPE R AT-GRADE INLET
D11	OS18D, Flow-by from D9	0.42	0.64	12.1	3.84	6.45	2	4	EXIST. 10' TYPE R SUMP INLET

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Pipe Size*
1	Inlet Capture at D4	0.30	0.33	7.7	4.53	7.60	1.4	2.5	PROP. 15" RCP
2	PR-1, Inlet Capture at D5	0.69	0.92	7.7	4.53	7.60	3	7	PROP. 18" RCP
3	CDOT Type C Inlet Capture at D6	1.12	1.30	13.5	3.68	6.18	4	8	PROP. 18" RCP
4	PR-2, PR-3	1.80	2.22	13.7	3.66	6.15	7	14	PROP. 24" RCP
5	Inlet Capture at D7	1.63	1.51	17.0	3.33	5.59	5	8	PROP. 18" RCP
6	PR-5, Inlet Capture at D8	2.47	2.98	17.0	3.33	5.59	8	17	PROP. 24" RCP
7	PR-6, Inlet Capture at D9	2.98	3.56	17.0	3.33	5.59	10	20	PROP. 24" RCP
8	PR-4, PR-7	4.79	5.77	17.2	3.32	5.56	16	32	PROP. 30" RCP
9	Inlet Capture at D10	0.58	0.66	6.4	4.80	8.05	3	5	PROP. 18" RCP
10	PR-8, PR9	5.36	6.43	17.4	3.30	5.54	18	36	PROP. 30" RCP
11	Inlet Capture at D11	0.42	0.64	12.1	3.84	6.45	2	4	EXIST. 18" RCP

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
MAJOR BASIN BOUNDARY	
BASIN BOUNDARY	
DESIGN POINT	3
PIPE ROUTING	5
BASIN IDENTIFIER / AREA IN ACRES	BB / 10.0
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
EXIST. STORM SEWER	
PROPOSED STORM SEWER	
TRIBUTARY AREA TO CDOT FACILITY	

N

100 50 0 100 200

SCALE: 1" = 100'

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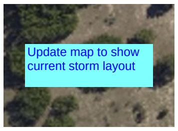
MONUMENT JUNCTION DEVELOPMENT
HWY. 105 & JACKSON CREEK INT. IMPS.
FINAL DRAINAGE REPORT
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	03/16/22
DRAWN BY	MAW	(H) 1"= 100'		SHEET 2 OF 2	
CHECKED BY		(V) 1"= N/A		JOB NO.	1302.22

CLASSIC CONSULTING

V3_Financial Assurance Form.pdf Markup Summary

Text Box (3)



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Page Label: [1] Layout1
Author: CDurham
Date: 2/7/2024 10:26:49 AM
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Update map to show current storm layout

Subject: Text Box
Page Label: 89
Author: CDurham
Date: 2/7/2024 10:56:42 AM
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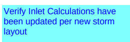
Update stormCAD with new storm layout



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Author: CDurham
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Verify Inlet Calculations have been updated per new storm layout