



**Final Drainage Report
for
Compark Village South Multi-Family**

***Compark Village South, Filing No.1, Amendment 2
Parker, Colorado***

P.N. CLCPKC3

Prepared For:
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ENGINEER'S CERTIFICATE

This final drainage report amendment for the Compark Village South project was prepared by me or under my direct supervision in accordance with the provisions of the *Town of Parker Storm Drainage and Environmental Criteria Manual*. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

Prepared By:

Kristofer K. Wiest, P.E.
State of Colorado No. 46080
For and on Behalf of Merrick & Company

I. GENERAL LOCATION AND DESCRIPTION

A. Scope

This project is part of the Compark Village South development. The following previously filed drainage reports apply to our site: “Final Drainage Report, Compark Village South, Filing No. 1” and “Final Drainage Report, Compark Village South, Filing No. 1 - Belford Ave Site Plan Amendment” , both prepared by Manhard Consulting, dated July 31, 2020 and June 18, 2021 respectively.

The intent of this report is to demonstrate the feasibility of the proposed storm drainage system planned to control the storm water associated with portions of the previously filed drainage reports. This report was prepared in accordance with the *Town of Parker Storm Drainage and Environmental Criteria Manual (Town Criteria)* and the *Mile High Flood District Criteria Manual*.

B. Location

Compark Village South (CVS) Filing No. 1, Amendment 2 lies in what was previously referred to as Tract G. All of Compark Village South Multi-Family (CVS-MF) is located in the South Half of Section 6, Township 6 South, Range 66 West of the Sixth Principle Meridian, Town of Parker, County of Douglas, State of Colorado, Tract 2. General project boundaries include Belford Avenue to the north, Happy Canyon Creek to the east, Grandview Estates to the south, and CVS Filing 1, Amendment 1 to the east. The project lies within the Future Multi-Family portion of the “Final Drainage Report, Compark Village South, Filing No. 1” and the future development portion (drainage basin F3 and POND) of the “Final Drainage Report, Compark Village South, Filing No. 1 - Belford Ave Site Plan Amendment”.

C. Description of Property

The site consists of approximately 16 acres and is currently being mass graded by others. Onsite soils consist of Newlin Gravelly Sandy Loam, Satanta Loam and Loamy alluvial land. These soils are classified as hydrologic group B. Refer to Appendix A of this report for excerpts of the SCS soil survey summary. For consistency in reporting between the various drainage reports, the storm pipes and inlets were sized assuming soil type C/D, which is conservative relative to soil type B.

D. Floodplain Information

is located within the Happy Canyon Creek major drainage basin which has a regulatory 100-year floodplain. Firm map 08035C0062H, Effective date: September 4, 2020 indicates that the site is located in Zone X which poses a minimal flood hazard.

II. DRAINAGE BASINS AND SUB-BASINS

A. Basin Description

The entirety of this project lies within the Happy Canyon Creek drainage basin, which has been studied by the Mile High Flood District (MHFD) (previously known as Urban Drainage Flood Control District (UDFCD)) under the following:

- UDFCD - Outfall System Planning - Happy Canyon Creek Watershed within Douglas County, prepared by Kiowa Consultants, June 1993. MHFD, in conjunction with sponsor partners Town of Parker and Douglas County, are planning on updating the Happy Canyon Creek OSP.
- Green Acres Tributary is a part of the Happy Canyon Creek watershed. There are several existing drainage studies covering the upstream area of the Green Acres Tributary development projects. See the Meridian Office Park, Filings 4 & 5 master drainage analysis for further detail.
- Happy Canyon Creek Major Drainageway Plan, prepared by Muller Engineering Company, March 2014.
- Amendment to Happy Canyon Creek Major Drainageway Plan, March 2014, prepared by Manhard Consulting, February 2016.

B. Sub-Basin Description

The site consists of two basins and 22 sub-basins. Basin A flows to existing detention pond A and Basin B flows to existing detention pond B. Runoff will be conveyed via overland and storm sewer to one of the two existing detention ponds located directly north and northeast of the site, as depicted in the drainage reports referenced above. These sub-basins have been determined based on land use, area, roadway slopes, storm sewer locations, and inlet capacities. The drainage basins from previous reports that are impacted by this project are described in detail below:

F3 - Belford Ave Drainage Report

Drainage Basin F3 in its existing state is composed of undeveloped land that drains directly into Happy Canyon Creek. The developed conditions of this 6.5 acre basin were assumed to be 75% impervious over the 6.5 acres and 61% over the entire 14.77 acres. This drainage basin flows into existing detention pond B located northeast of the site. This detention pond will be constructed by others. Please see Appendix A for the drainage map depicting this drainage area.

CVS-18, CVS-17, CVS-17A, CVS-23 - Compark Village South F1 Report

The drainage basins listed above are part of the 11.5 Ac of the CVS Filing No. 3 Multi-family. The listed basins are 75% impervious and will be conveyed to the existing detention pond described in the CVS F1 report (this is referred to on our drainage map as existing detention pond A). The proposed site will not exceed the 75% impervious percentages set by the CVS F1 drainage report and, as a result, will not exceed the required detention parameters set forth in this report. See Appendix A for the drainage map depicting this drainage area.

III. DRAINAGE CHANNELS

A. Happy Canyon Creek

Happy Canyon Creek is a major basin that is tributary to Cherry Creek. The portion of Happy Canyon Creek thalweg that extends through the proposed site is a natural sandy bottom channel. The thalweg has an existing natural meander bend located near the southeast corner of the site. No apparent head cutting exists within this channel reach. The active channel is a dry stream bed that experiences active flows during wet seasonal conditions.

As previously stated, the site is located within the Zone X floodplain adjacent to Happy Canyon Creek. It is anticipated that bank stabilization will be required along the outer edges of the existing meander bends by others. No major channel improvements are anticipated for Happy Canyon Creek with this project.

IV. DRAINAGE DESIGN CRITERIA

A. Regulations

This final drainage report is prepared in accordance with the *Town of Parker Storm Drainage Design (Addendum to the Urban Storm Drainage Criteria Manuals Volumes 1, 2, and 3)* and the *MHFD*.

No detention pond improvements are included as part of this project. Per the previously stated drainage reports, the detention pond to the north and the detention pond located onsite are sufficiently sized to accommodate the water quality and detention pond volumes for the CVS-MF site.

Based on the CVS F1 – Belford Avenue drainage report, it was assumed that 6.5 acres at 75% imperviousness would be draining to detention pond described in the report. This corresponds to the proposed basin B of the CVS-MF project. With the CVS-MF project, the B basin consists of 6.25 acres at 74% impervious that contribute flows to the existing detention pond B, therefore no additional detention will need to be provided onsite.

Based on the CVS-F1 Report, the proposed A basins consist of a portion of the 11.5 Ac at 75% impervious. These basins will be detained by existing detention pond A. The A basin improvements proposed with this project are a total 5.28 acres at 62% impervious. Since there is less area with a lower imperviousness, no additional onsite detention will be required for this project.

B. Development Criteria Reference and Constraints

The site is situated within Basin F3 in the CVS F1-Belford Ave drainage report and the future Multi Family portion of the Compark Village South drainage report. According to the addendum, the fully developed percent imperviousness for the entire parcel was assumed to be 75% percent.

C. Hydrological Criteria

The minor storm design rainfall is the 5-year event, and the major storm design rainfall is the 100-year event. Runoff conveyance coefficients were calculated using the equations found in Table 6-4 of the *Urban Storm Drainage Criteria Manual*. Time of concentration calculations were based on land use as well as distance and slope of travel.

5-year and 100-year event storm flows are calculated using the Rational Method. Percent imperviousness values are from Town of Parker Storm Drainage and Environmental *Criteria* and are summarized below:

<u>Description</u>	<u>Percent Impervious (%)</u>
Parking lot: Paved	100
Roof Area	90
Lawns, Clayey Soil	2

Runoff coefficients are from Town of Parker *Criteria* using hydrologic Soil Group C.

Rainfall intensities (I) for the area are approximated by the equation:

$$I = \frac{28.5P_1}{(10+T_c)^{0.786}}$$

The 1-hour design point rainfall values (P_1) used are 1.39 for the 5-year rainfall and 2.60 for the 100-year rainfall per the Town of Parker Storm Drainage and Environmental *Criteria Manual*. T_c represents the time of concentration in minutes and consists of overland flow time plus travel time.

All hydrological calculations including a summary of the calculated minor and major rainfall event flows are provided in Appendix B. Basin maps are included in Appendix A.

D. Hydraulic Criteria

On-site storm sewer inlets were sized using the *Urban Storm Drainage Criteria Manual* UD-Inlet spreadsheet version 5.01 as well as Hydraflow Express Extension for AutoCAD Civil 3D. On-site final storm sewer pipes were sized using the Hydraflow software to determine hydraulic grade lines (HGL).

All proposed storm sewer is sized to carry the 5-year storm event without surcharging the sewer and the 100-year storm event with the hydraulic grade line a minimum of 1 foot below the proposed ground surface. Based on the Hydraflow results, the 100-year pipe flows are contained inside the pipe. 5-year HGLs are assumed to be contained within the pipe as well.

Inlets are sized to capture the 5-year storm event and inlets in a sump are designed for the 100-yr event. Calculations are included in Appendix C.

V. DRAINAGE FACILITY DESIGN

A. General Concept

The overall intent of the drainage design for the Site is to comply with the previous drainage reports and tie-in to the two existing detention ponds.

The proposed drainage design conveys developed runoff via sheet flow and gutter flow to inlets with sizing in appendix C. Developed runoff is then conveyed northeast via storm sewer to the existing storm sewer infrastructure.

Offsite public improvements for conveyance of minor and major flows are considered as part of Basin A-2 (see further explanation in the next section).

Based on the CVS-F1-Belford Avenue drainage report, it was assumed that 6.5 acres at 75% imperviousness would be draining to the detention pond. This corresponds to the B basin of CVS-MF. The B basin is contributing a total area of 6.25 acres at 74% impervious so no additional detention will need to be provided onsite.

Based on the CVS-F1 Report, the A basins consist of 11.5 Ac at 75% impervious. The A basin improvements proposed with this project are a total 5.28 acres at 62% impervious. Since there is less area with a lower imperviousness, no additional onsite detention will be required for this project.

Water quality will be provided by a forebay and a rip rap section at the outfall locations at each pond. Further coordination with Manhard will be needed for connection to the pond located northeast of the Site.

Developed Sub-Basins

Basin A-1 (1.44 acres) includes the park area, parking lot, and a portion of the area around building 10. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow east to a double Type 16 inlet (A3). Runoff coefficients calculated are $C_5=0.28$ and $C_{100}=0.61$; total developed flows are calculated as $Q_5=1.4$ cfs and $Q_{100}=7.5$ cfs.

Basin A-2 (2.21 acres) is situated in the southwest corner of the Site and includes a portion of the offsite drainage from the future single family development (shown as OS-4, this area is included in this drainage basin). It consists of parking lot coverage, hardscaping, and landscaping area. Drainage will sheet flow east into a proposed 10' Type R inlet (A1) southwest of the building. Runoff coefficients calculated are $C_5=0.45$ and $C_{100}=0.69$; total developed flows are calculated as $Q_5=2.2$ cfs and $Q_{100}=8.5$ cfs.

Basin A-3 (0.38 acres) is located between building 7 and building 10. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow to a 5' Type R inlet (A2) and into the storm main. Runoff coefficients calculated are $C_5=0.63$ and $C_{100}=0.78$; total developed flows are calculated as $Q_5=0.8$ cfs and $Q_{100}=2.6$ cfs.

Basin A-4 (0.30 acres) is a building area associated with building 7. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff

coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.8$ cfs and $Q_{100}=2.3$ cfs.

Basin A-5 (0.20 acres) is a building area associated with building 8. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.5$ cfs and $Q_{100}=1.5$ cfs.

Basin A-6 (0.30 acres) is a building area associated with building 9. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.8$ cfs and $Q_{100}=2.3$ cfs.

Basin A-7 (0.20 acres) is a building area associated with building 10. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.5$ cfs and $Q_{100}=1.5$ cfs.

Basin B-1 (1.03 acres) is located interior to the site in between buildings 1, 6, 7, and 8. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow and channel flow northeast to a proposed 5' Type R inlet (B1). Runoff coefficients calculated are $C_5=0.61$ and $C_{100}=0.77$; total developed flows are calculated as $Q_5=1.8$ cfs and $Q_{100}=5.8$ cfs.

Basin B-2 (1.02 acres) is located interior to the site in between buildings 1, 2, 6, and the clubhouse. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow and channel flow southeast to a proposed 5' Type R inlet (B2). Runoff coefficients calculated are $C_5=0.67$ and $C_{100}=0.80$; total developed flows are calculated as $Q_5=2.0$ cfs and $Q_{100}=5.9$ cfs.

Basin B-3 (1.47 acres) is located interior to the site in between buildings 2, 3, 5, and the clubhouse. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow and channel flow southeast to a proposed 5' Type R inlet (B3). Runoff coefficients calculated are $C_5=0.50$ and $C_{100}=0.72$; total developed flows are calculated as $Q_5=1.7$ cfs and $Q_{100}=6.1$ cfs.

Basin B-4 (0.84 acres) is located interior to the site in between buildings 3, 4, and 5. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow and channel flow southeast to a proposed 5' Type R inlet (B4). Runoff coefficients calculated are $C_5=0.63$ and $C_{100}=0.78$; total developed flows are calculated as $Q_5=1.5$ cfs and $Q_{100}=4.8$ cfs.

Basin B-5 (0.23 acres) is located interior to the site in between building 4 and the entrance to Belford Ave. It consists of parking lot coverage, hardscaping and landscaping area. Drainage will sheet flow and channel flow northeast to a proposed type 16 combination inlet (B5). Runoff coefficients calculated are $C_5=0.68$ and $C_{100}=0.81$; total developed flows are calculated as $Q_5=0.5$ cfs and $Q_{100}=1.6$ cfs.

Basin B-6 (0.20 acres) is a building area associated with building 6. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.6$ cfs and $Q_{100}=1.6$ cfs.

Basin B-7 (0.30 acres) is a building area associated with building 1. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.8$ cfs and $Q_{100}=2.3$ cfs.

Basin B-8 (0.30 acres) is a building area associated with building 2. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.6$ cfs and $Q_{100}=2.3$ cfs.

Basin B-9 (0.18 acres) is a building area associated with the clubhouse. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.5$ cfs and $Q_{100}=1.4$ cfs.

Basin B-10 (0.20 acres) is a building area associated with the building 3. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.6$ cfs and $Q_{100}=1.5$ cfs.

Basin B-11 (0.20 acres) is a building area associated with the building 5. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.5$ cfs and $Q_{100}=1.5$ cfs.

Basin B-12 (0.30 acres) is a building area associated with the building 4. It consists of roof area. Drainage will sheet flow to a roof drain collection system and into the storm main. Runoff coefficients calculated are $C_5=0.77$ and $C_{100}=0.85$; total developed flows are calculated as $Q_5=0.8$ cfs and $Q_{100}=2.3$ cfs.

Basin B-13 (0.38 acres) is a landscape area surrounding the north end of buildings 1, 2, and 3. It consists of landscape area. Drainage will sheet flow to landscape drains and into the storm main. Runoff coefficients calculated are $C_5=0.05$ and $C_{100}=0.49$; total developed flows are calculated as $Q_5=0.1$ cfs and $Q_{100}=1.6$ cfs.

Basin OS-1 (4.92 acres) is located along the east edge of the development and flows into Happy Canyon Creek. Drainage will sheet flow east into Happy Canyon Creek or into the detention pond. Runoff coefficients calculated are $C_5=0.05$ and $C_{100}=0.49$; total developed flows are calculated as $Q_5=0.7$ cfs and $Q_{100}=17.3$ cfs.

Basin OS-2 (0.16 acres) is located along the north entrance, west of building 7. Drainage will sheet flow north into Bunny Hop Lane. Runoff coefficients calculated are $C_5=0.55$ and $C_{100}=0.74$; total developed flows are calculated as $Q_5=0.3$ cfs and $Q_{100}=1.1$ cfs.

Basin OS-3 (0.25 acres) is located along the north side of the site near the entrance from Belfort Ave. Drainage will sheet flow north into the ROW. Runoff coefficients calculated are $C_5=0.15$ and $C_{100}=0.54$; total developed flows are calculated as $Q_5=0.1$ cfs and $Q_{100}=1.2$ cfs.

Basin OS-4 (1.19 acres) is located along the west side of the site in the future single family homes area. Drainage will sheet flow west onto our site and into drainage basin A-2 (This area was accounted for in A-2). Runoff coefficients calculated are $C_5=0.36$ and $C_{100}=0.65$; total developed flows are calculated as $Q_5=1.0$ cfs and $Q_{100}=6.6$ cfs.

B. Specific Details

As mentioned previously in this report, the site will be divided into multiple drainage sub-basins. The onsite runoff will be routed through the site via gutters and sheet flow and intercepted by inlets in sump condition. Flows captured by the inlets will be routed via the storm sewer directly to the existing detention/water quality ponds. The detention ponds have been sized to accommodate the flows resulting from the areas shown on the drainage map.

Water Quality and Maintenance

Stormwater quality is provided by the existing detention ponds designed by Manhard and described within the previously stated drainage reports.

Temporary sediment and erosion control will be provided with silt fence, diversion ditches, and (2) temporary sediment basins. Inlet protection and rock socks will also be used to protect existing storm infrastructure and provide water quality measures during construction.

Appendices

Tables, figures, charts and drawings used for references and calculations can be found in the Appendices of this report.

- A provides a vicinity map, topographic map, soils maps, FEMA floodplain maps, and drainage basin maps;
- B provides the hydrologic calculations;
- C provides the hydraulic calculations;
- D provides stormwater quality baffle system details;
- E provides the excerpts from drainage studies referenced in this report.

VI. Environmental Protection Criteria

A. General

Site Drainage improvements are intended to minimize the impact to the environment. The previously installed improvements to the Happy Canyon Creek required permitting through FEMA. As part of this permitting process, requirements regarding potential impacts to wetland areas and to threatened and endangered species were identified and the proper permitting was obtained. Specifics can be found in the CLOMR for Happy Canyon Creek.

B. Construction BMP Plan

Construction BMPs shall be placed during construction to minimize soil erosion and the movement of sediment offsite. Construction BMPs shall be placed during the initial and interim phases of construction. The intent of the initial BMPs are to fulfill water quality objectives during the overlot and roadway rough grading phase of the project. Once the initial phase of earthmoving and rough grading is complete, interim BMP placement can be made. Interim BMPs are in place for fine grading, utility construction, and street construction. Construction plans will contain all appropriate Stormwater Management Details. In addition, a stormwater Management Plan will be prepared to meet the Town of Parker, State of Colorado, and EPA criteria.

VII. CONCLUSIONS

A. Compliance with the LSDC

The on-site drainage design complies with the Mile High Flood Control District's *Urban Storm Drainage Criteria Manual* and *Town of Parker Storm Drainage Design (Addendum to the Urban Storm Drainage Criteria Manuals Volumes 1, 2, and 3)*. The design is consistent with the drainage design proposed in the previously mentioned drainage reports

B. Drainage Concept

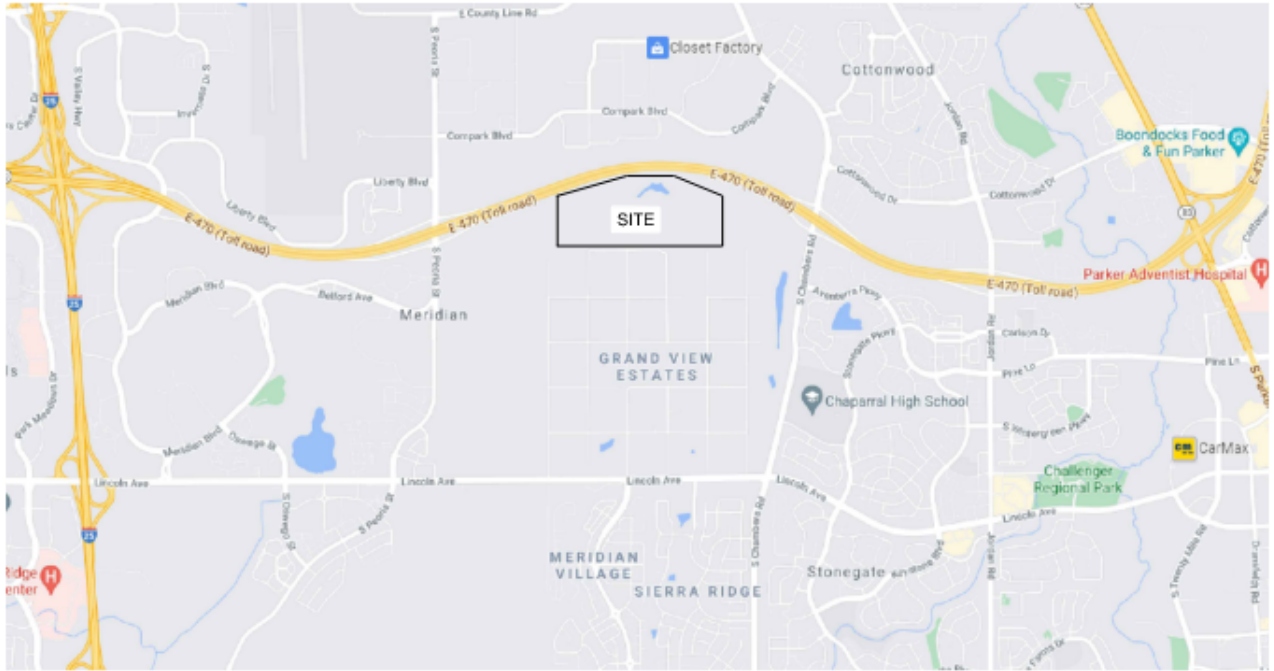
The drainage design will convey storm flows without causing damage. The site is not located within a FEMA designated floodplain.

REFERENCES

1. Town of Parker Storm Drainage and Environmental Criteria Manual (Addendum to Urban Storm Drainage Criteria Manuals Volumes 1, 2, and 3), Town of Parker – Stormwater, Town of Parker, Colorado, Revised February 2014.
2. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at <http://websoilsurvey.nrcs.usda.gov/> accessed [July 24, 2021].
3. Mile High Flood Control District. Urban Storm Drainage Criteria Manual. Volume 1. Revised August 2018.
4. Mile High Flood Control District. Urban Storm Drainage Criteria Manual. Volume 2. Revised September 2017.
5. Urban Drainage and Flood Control District. Urban Storm Drainage Criteria Manual. Volume 3. Updated January 2021.
6. Manhard Consulting, LTD. Final Drainage Report Amendment Compark Village South, Filing No. 1. Prepared for 470 Compark, LLC. July 31, 2020.
7. Manhard Consulting, LTD. Final Drainage Report Compark Village South, Filing No. 1 - Belford Ave Site Plan Amendment. Prepared for Belford North Metropolitan District. June 18, 2021.

APPENDICES

Appendix A: Maps



Vicinity Map
(N.T.S.)

National Flood Hazard Layer FIRMette



104°49'30"W 39°33'23"N



Legend

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

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

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

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

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

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

MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

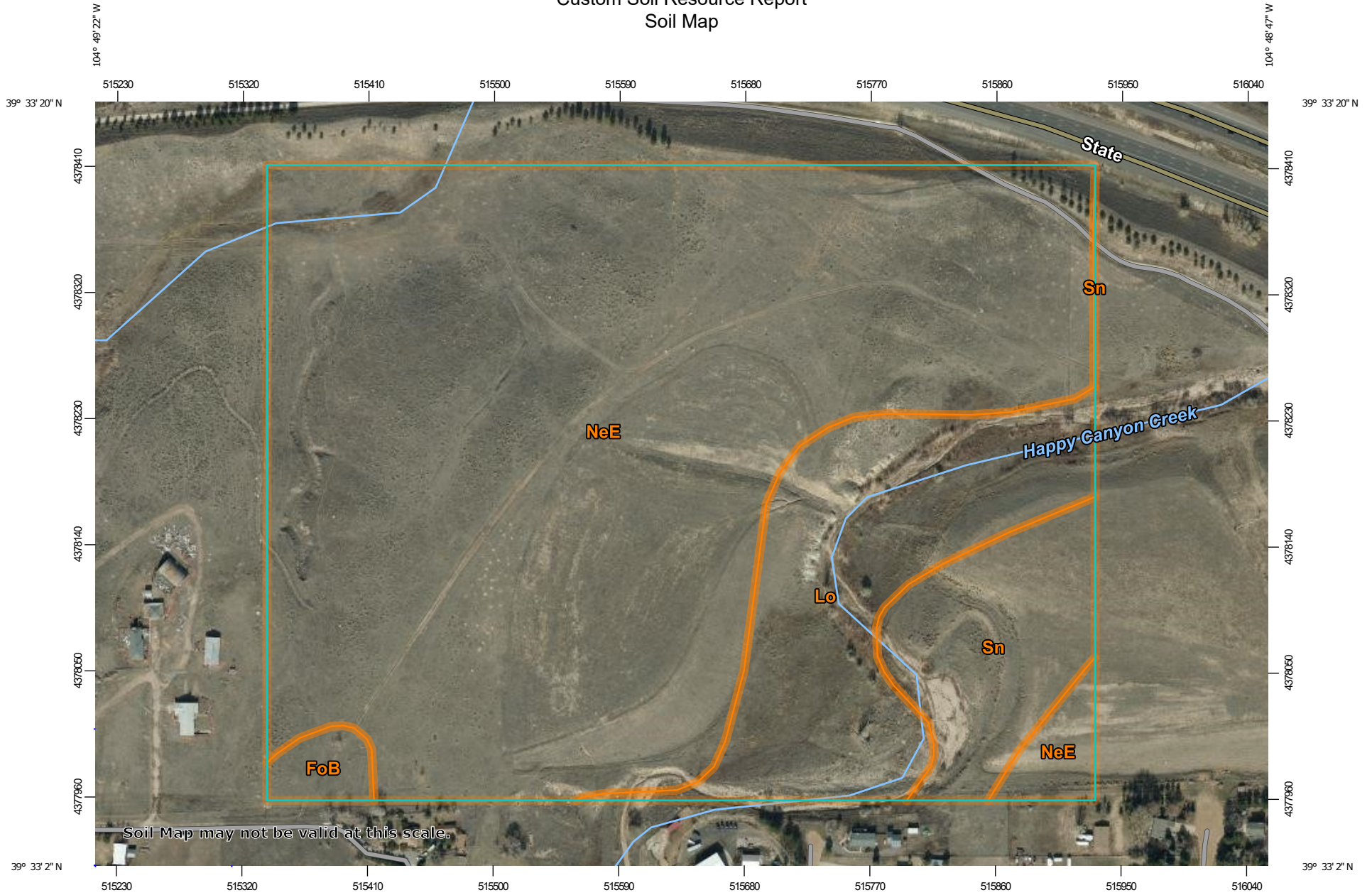
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

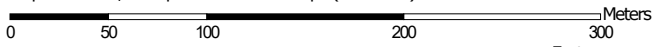
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/18/2021 at 4:19 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Custom Soil Resource Report Soil Map



Map Scale: 1:3,840 if printed on A landscape (11" x 8.5") sheet.




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 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Castle Rock Area, Colorado
 Survey Area Data: Version 13, Jun 5, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 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
FoB	Fondis clay loam, 1 to 3 percent slopes	0.8	1.3%
Lo	Loamy alluvial land	10.6	15.9%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	49.9	74.8%
Sn	Satanta loam	5.4	8.0%
Totals for Area of Interest		66.8	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

Custom Soil Resource Report

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Castle Rock Area, Colorado

FoB—Fondis clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: jqyn

Elevation: 5,500 to 6,800 feet

Mean annual precipitation: 15 to 19 inches

Mean annual air temperature: 47 to 50 degrees F

Frost-free period: 120 to 135 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Fondis and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Landform: Buttes, hills, ridges, mesas

Landform position (three-dimensional): Crest

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Eolian deposits over sedimentary rock coarse-silty outwash derived from arkose

Typical profile

H1 - 0 to 7 inches: clay loam

H2 - 7 to 24 inches: clay

H3 - 24 to 60 inches: sandy clay loam

Properties and qualities

Slope: 1 to 3 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 low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: C

Ecological site: R049XY208CO - Clayey Foothill DRAFT (1-2018) MLRA 49

Hydric soil rating: No

Minor Components

Kutch

Percent of map unit: 7 percent
Hydric soil rating: No

Buick

Percent of map unit: 6 percent
Hydric soil rating: No

Satanta

Percent of map unit: 6 percent
Hydric soil rating: No

Aquic haplustolls

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Lo—Loamy alluvial land

Map Unit Setting

National map unit symbol: jqzb
Elevation: 7,000 to 8,000 feet
Mean annual precipitation: 17 to 19 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 115 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Loamy alluvial land: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loamy Alluvial Land

Setting

Landform: Flood plains, swales
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

H1 - 0 to 20 inches: sandy loam
H2 - 20 to 40 inches: stratified loamy sand to clay loam
H3 - 40 to 60 inches: sand and gravel

Properties and qualities

Slope: 1 to 5 percent
Drainage class: Well drained
Runoff class: Very low

Custom Soil Resource Report

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 6.00 in/hr)

Depth to water table: About 48 to 72 inches

Frequency of flooding: FrequentNone

Calcium carbonate, maximum content: 5 percent

Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: C

Ecological site: R049XY036CO - Overflow

Hydric soil rating: No

Minor Components

Bresser

Percent of map unit: 7 percent

Hydric soil rating: No

Sampson

Percent of map unit: 7 percent

Hydric soil rating: No

Sandy alluvial land

Percent of map unit: 5 percent

Fluvaquentic haplustolls

Percent of map unit: 1 percent

Landform: Terraces

Hydric soil rating: Yes

NeE—Newlin gravelly sandy loam, 8 to 30 percent slopes

Map Unit Setting

National map unit symbol: jqzg

Elevation: 5,500 to 6,600 feet

Mean annual precipitation: 15 to 19 inches

Mean annual air temperature: 49 to 51 degrees F

Frost-free period: 120 to 135 days

Farmland classification: Not prime farmland

Map Unit Composition

Newlin and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newlin

Setting

Landform: Terraces, mesas, plateaus

Custom Soil Resource Report

Landform position (three-dimensional): Riser

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Unconformable sandy and gravelly and/or mixed source alluvium

Typical profile

H1 - 0 to 8 inches: gravelly sandy loam

H2 - 8 to 17 inches: gravelly sandy clay loam

H3 - 17 to 22 inches: gravelly sandy loam

H4 - 22 to 60 inches: very gravelly sand

Properties and qualities

Slope: 8 to 30 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
(0.20 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 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Ecological site: R049XB215CO - Gravelly Foothill

Hydric soil rating: No

Minor Components

Bresser

Percent of map unit: 5 percent

Hydric soil rating: No

Satanta

Percent of map unit: 4 percent

Hydric soil rating: No

Stapleton

Percent of map unit: 4 percent

Hydric soil rating: No

Aquic haplustolls

Percent of map unit: 2 percent

Landform: Swales

Hydric soil rating: Yes

Sn—Satanta loam

Map Unit Setting

National map unit symbol: jr05
Elevation: 5,400 to 6,200 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Satanta and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Satanta

Setting

Landform: Terraces, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed source eolian deposits

Typical profile

H1 - 0 to 9 inches: loam
H2 - 9 to 30 inches: clay loam
H3 - 30 to 60 inches: loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
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
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XC202CO - Loamy Foothill 14-19 P.Z.
Hydric soil rating: No

Minor Components

Fondis

Percent of map unit: 5 percent
Hydric soil rating: No

Sampson

Percent of map unit: 5 percent
Hydric soil rating: No

Englewood

Percent of map unit: 2 percent
Hydric soil rating: No

Buick

Percent of map unit: 2 percent
Hydric soil rating: No

Aquic haplustolls

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

September 3, 2021

Appendix B: Hydrologic Computations



MERRICK & COMPANY
Developed Composite C-Factor and Impervious Analysis

Compark Village South

Calculated by: PO

Checked by: KW

Date: 7/27/2020

UDFCD - TABLE 6-4, SOIL GROUP C/D						
Basin	Land Use	Area (acres)	I value	C5	C10	C100
A-1	PROPOSED LANDSCAPE	1.02	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.42	1.00	0.86	0.87	0.89
		1.44	0.30	0.28	0.36	0.61
A-2	PROPOSED LANDSCAPE	0.84	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.90	1.00	0.86	0.87	0.89
	SINGLE FAMILY LOT	0.48	0.45	0.40	0.47	0.67
		2.21	0.51	0.45	0.51	0.69
OS-4	PROPOSED LANDSCAPE	0.46	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.25	1.00	0.86	0.87	0.89
	SINGLE FAMILY LOT	0.48	0.45	0.40	0.47	0.67
		1.19	0.40	0.36	0.43	0.65
A-3	PROPOSED LANDSCAPE	0.10	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.28	1.00	0.86	0.87	0.89
		0.38	0.73	0.63	0.67	0.78
A-4	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.30	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.30	0.90	0.77	0.80	0.85
A-5	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.20	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.20	0.90	0.77	0.80	0.85
A-6	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.30	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.30	0.90	0.77	0.80	0.85
A-7	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.20	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.20	0.90	0.77	0.80	0.85
OS-2	PROPOSED LANDSCAPE	0.06	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.10	1.00	0.86	0.87	0.89
		0.16	0.63	0.55	0.60	0.74
B-1	PROPOSED LANDSCAPE	0.32	0.02	0.05	0.15	0.49



MERRICK & COMPANY
Developed Composite C-Factor and Impervious Analysis

Compark Village South

Calculated by: PO

Checked by: KW

Date: 7/27/2020

		UDFCD - TABLE 6-4, SOIL GROUP C/D				
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.71	1.00	0.86	0.87	0.89
		1.03	0.70	0.61	0.65	0.77
B-2	PROPOSED LANDSCAPE	0.24	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.78	1.00	0.86	0.87	0.89
		1.02	0.77	0.67	0.70	0.80
B-3	PROPOSED LANDSCAPE	0.65	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.82	1.00	0.86	0.87	0.89
		1.47	0.57	0.50	0.55	0.72
B-4	PROPOSED LANDSCAPE	0.23	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.61	1.00	0.86	0.87	0.89
		0.84	0.73	0.63	0.67	0.78
B-5	PROPOSED LANDSCAPE	0.05	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.18	1.00	0.86	0.87	0.89
		0.23	0.79	0.68	0.71	0.81
B-6	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.20	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.20	0.90	0.77	0.80	0.85
B-7	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.30	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.30	0.90	0.77	0.80	0.85
B-8	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.30	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.30	0.90	0.77	0.80	0.85
B-9	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.18	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.18	0.90	0.77	0.80	0.85
B-10	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.20	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.20	0.90	0.77	0.80	0.85



MERRICK & COMPANY
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Compark Village South

Calculated by: PO
 Checked by: KW
 Date: 7/27/2020

UDFCD - TABLE 6-4, SOIL GROUP C/D

B-11	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.19	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.19	0.90	0.77	0.80	0.85
B-12	PROPOSED LANDSCAPE	0.00	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.30	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.30	0.90	0.77	0.80	0.85
OS-3	PROPOSED LANDSCAPE	0.22	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.03	1.00	0.86	0.87	0.89
		0.25	0.14	0.15	0.24	0.54
OS-1	PROPOSED LANDSCAPE	4.92	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		4.92	0.02	0.05	0.15	0.49
B-13	PROPOSED LANDSCAPE	0.38	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	0.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	0.00	1.00	0.86	0.87	0.89
		0.38	0.02	0.05	0.15	0.49
A Total	PROPOSED LANDSCAPE	1.96	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	1.00	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	2.32	1.00	0.86	0.87	0.89
		5.28	0.62	0.54	0.59	0.74
B Total	PROPOSED LANDSCAPE	1.49	0.02	0.05	0.15	0.49
	PROPOSED BUILDING AND WALKS	1.66	0.90	0.77	0.80	0.85
	PROPOSED PAVEMENT	3.10	1.00	0.86	0.87	0.89
		6.25	0.74	0.64	0.68	0.79



STANDARD FORM SF-2
TIME OF CONCENTRATION

9/9/2021

CALCULATED BY:
CHECKED BY:

PO
KW

PROJECT: **Compark Village South**
BASIN:

JOB NO: **65119686**
LOCATION: **Town of Parker, CO**

SUB-BASIN DATA				INITIAL/OVERLAND TIME (Tc)			TRAVEL TIME Gutter (Tt)					Tc CHECK (Urbanized Basins)			FINAL Tc	CONVEYANCE REMARKS	
DESIGNATION	AREA (acres)	IMPERVIOUS %	Cs	LENGTH (ft)	SLOPE (%)	Ti (min)	LENGTH (ft)	AVG. SLOPE ΔY (%)	Conv. Type*	VEL (fps)	Tt (min)	COMP Tc (min)	TOTAL LENGTH (ft)	Tc=(26-17i)+L/(60*(14i+9)*sqrt(S)) (min)	(min)**		
A-1	1.44	30%	0.28	66	1.9	9.7	448	1.3	0.3	6	1.1	6.9	16.5	514	21.4	16.5	Building Roof
A-2	2.21	51%	0.45	203	6.1	9.2	650	1.9	0.3	6	1.1	10.0	19.2	853	18.0	18.0	Paved Gutter
OS-4	1.19	40%	0.36	197	3.5	12.3	279	0.5	0.2	6	0.8	5.5	17.8	476	19.9	17.8	Paved Gutter
A-3	0.38	73%	0.63	62	2.7	4.8	130	1.4	1.1	6	2.1	1.0	5.8	192	13.7	5.8	Paved Gutter
A-4	0.30	90%	0.77	10	2.6	1.4	10	1.5	15.0	6	7.7	0.0	1.4	20	10.7	5.0	Paved Gutter
A-5	0.20	90%	0.77	10	2.5	1.4	10	2.0	20.0	6	8.9	0.0	1.4	20	10.7	5.0	Paved Gutter
A-6	0.30	90%	0.77	10	4.0	1.2	10	3.0	30.0	6	11.0	0.0	1.2	20	10.7	5.0	Paved Gutter
A-7	0.20	90%	0.77	1	3.5	0.4	1	1.7	170.0	6	26.1	0.0	0.4	2	10.7	5.0	Paved Gutter
OS-2	0.16	63%	0.55	1	6.1	0.5	1	1.9	190.0	6	27.6	0.0	0.5	2	15.3	5.0	Paved Gutter
B-1	1.03	70%	0.61	158	1.9	9.1	114	1.7	1.5	6	2.4	0.8	9.9	272	14.4	9.9	Paved Gutter
B-2	1.02	77%	0.67	202	3.8	7.2	108	1.0	0.9	3	0.7	2.7	9.8	310	13.2	9.8	Pasture
B-3	1.47	57%	0.50	92	2.9	7.3	348	1.9	0.5	3	0.5	11.2	18.5	440	16.7	16.7	Pasture
B-4	0.84	73%	0.63	90	2.7	5.7	351	1.7	0.5	6	1.4	4.2	9.9	441	13.9	9.9	Paved Gutter
B-5	0.23	79%	0.68	138	4.8	5.3	65	4.9	7.5	6	5.5	0.2	5.5	203	12.7	5.5	Paved Gutter
B-6	0.20	90%	0.77	85	3.0	3.8	45	2.0	4.4	6	4.2	0.2	4.0	130	10.8	5.0	Paved Gutter
B-7	0.30	90%	0.77	67	8.0	2.4	196	4.0	2.0	6	2.9	1.1	3.6	263	10.8	5.0	Paved Gutter
B-8	0.30	90%	0.77	12	2.0	1.6	0	40.0		6	0.0		1.6	12	10.7	5.0	Paved Gutter
B-9	0.18	90%	0.77	12	2.0	1.6	0	40.0		6	0.0		1.6	12	10.7	5.0	Paved Gutter
B-10	0.20	90%	0.77	12	2.0	1.6	0	40.0		6	0.0		1.6	12	10.7	5.0	Paved Gutter
B-11	0.19	90%	0.77	12	2.0	1.6	0	2.0		6	0.0		1.6	12	10.7	5.0	Paved Gutter
B-12	0.30	90%	0.77	12	2.0	1.6	0	2.0		6	0.0		1.6	12	10.7	5.0	Paved Gutter
OS-3	0.25	14%	0.15	20	2.0	6.1	0	2.0		6	0.0		6.1	20	23.6	6.1	Paved Gutter
OS-1	4.92	2%	0.05	300	33.0	10.3	0	2.0		6	0.0		10.3	300	26.0	10.3	Paved Gutter
B-13	0.38	2%	0.05	20	2.0	6.7	30	2.0	6.7	6	5.2	0.1	6.8	50	25.7	6.8	Paved Gutter

\\merrick.com\ces\IDEN\Projects\0950-00 Compark South\DESIGN\Drainage\Hydrology\Rational\0950_Rational Calculations Drainage_Combined.xls|tc1

Merrick & Company

* Note: Conveyance Coefficients - Type 1-Heavy Meadow, Type 2-Tillage/Field, Type 3-Short Pasture and lawns, Type 4-Nearly Bare Soil, Type 5-Grassed Waterway, Type 6-Paved areas and shallow paved swales. The maximum initial/overland length shall not exceed 300 feet.

** Based on Assumption that Building roofs will take 5 min to fully contribute to storm system



**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: PO
DATE: 9/9/2021
CHECKED BY: KW

JOB NO: 65110570
PROJECT: Compark Village South
DESIGN STORM: 5 Year

DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME			
	AREA DESIG.	AREA (Acres)	RUNOFF COEFF	Tc (min)	C A (Acres)	I (in/hour)	Q (cfs)	Tc (min)	(C-A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	Tt (min)
	A-1	1.44	0.28	16.5	0.41	2.3	0.9												
	A-2	2.21	0.45	18.0	1.00	2.2	2.2												
	OS-4	1.19	0.36	17.8	0.43	2.2	1.0												
	A-3	0.38	0.63	5.8	0.24	3.4	0.8												
	A-4	0.30	0.77	5.0	0.23	3.6	0.8												
	A-5	0.20	0.77	5.0	0.15	3.6	0.6												
	A-6	0.30	0.77	5.0	0.23	3.6	0.8												
	A-7	0.20	0.77	5.0	0.15	3.6	0.6												
	OS-2	0.16	0.55	5.0	0.09	3.6	0.3												
	B-1	1.03	0.61	9.9	0.62	2.9	1.8												
	B-2	1.02	0.67	9.8	0.68	2.9	1.96												
	B-3	1.47	0.50	16.7	0.73	2.3	1.68												
	B-4	0.84	0.63	9.9	0.53	2.9	1.5												
	B-5	0.23	0.68	5.5	0.16	3.5	0.5												
	B-6	0.20	0.77	5.0	0.16	3.6	0.6												
	B-7	0.30	0.77	5.0	0.23	3.6	0.8												
	B-8	0.30	0.77	5.0	0.23	3.6	0.8												
	B-9	0.18	0.77	5.0	0.14	3.6	0.5												
	B-10	0.20	0.77	5.0	0.15	3.6	0.6												
	B-11	0.19	0.77	5.0	0.15	3.6	0.5												
	B-12	0.30	0.77	5.0	0.23	3.6	0.8												
	OS-3	0.20	0.15	6.1	0.03	3.4	0.1												
	OS-1	4.92	0.05	10.3	0.25	2.8	0.7												
	B-13	0.38	0.05	6.8	0.02	3.3	0.1												

5-YEAR RAINFALL = 1.39 IN/HR., 100-YEAR RAINFALL = 2.60 IN/HR.
*value known from Master Drainage Report

MERRICK & COMPANY



**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY: PO
DATE: 9/9/2021
CHECKED BY: KW

JOB NO: 65110570
PROJECT: Compark Village South
DESIGN STORM: 100 Year

DESIGN POINT	AREA DESIG.	DIRECT RUNOFF						TOTAL RUNOFF				STREET	PIPE		TRAVEL TIME			
		AREA (Acres)	RUNOFF COEFF	T _c (min)	C A (Acres)	I (in/hour)	Q (cfs)	T _c (min)	(C A) (Acres)	I (in/hour)	Q (cfs)	SLOPE (%)	STREET FLOW (cfs)	DESIGN FLOW (cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	T_{t} (min)
	A-1	1.44	0.61	16.5	0.87	5.8	5.1											
	A-2	2.21	0.69	18.0	1.53	5.6	8.5											
	OS-4	1.19	0.65	6.2	0.77	8.5	6.6											
	A-3	0.38	0.78	5.8	0.30	8.7	2.6											
	A-4	0.30	0.85	5.0	0.26	9.1	2.3											
	A-5	0.20	0.85	5.0	0.17	9.1	1.5											
	A-6	0.30	0.85	5.0	0.26	9.1	2.3											
	A-7	0.20	0.85	5.0	0.17	9.1	1.5											
	OS-2	0.16	0.74	5.0	0.12	9.1	1.1											
	B-1	1.03	0.77	9.9	0.79	7.3	5.8											
	B-2	1.02	0.80	9.8	0.82	7.3	5.9											
	B-3	1.47	0.72	16.7	1.05	5.8	6.1											
	B-4	0.84	0.78	9.9	0.66	7.2	4.8											
	B-5	0.23	0.81	5.5	0.19	8.8	1.6											
	B-6	0.20	0.85	5.0	0.17	9.1	1.6											
	B-7	0.30	0.85	5.0	0.25	9.1	2.3											
	B-8	0.30	0.85	5.0	0.25	9.1	2.3											
	B-9	0.18	0.85	5.0	0.16	9.1	1.4											
	B-10	0.20	0.85	5.0	0.17	9.1	1.5											
	B-11	0.19	0.85	5.0	0.16	9.1	1.5											
	B-12	0.30	0.85	5.0	0.25	9.1	2.3											
	OS-3	0.25	0.54	6.1	0.14	8.6	1.2											
	OS-1	4.92	0.49	10.3	2.42	7.1	17.3											
	B-13	0.38	0.49	6.8	0.19	8.3	1.6											

5-YEAR RAINFALL = 1.39 IN/HR., 100-YEAR RAINFALL = 2.60 IN/HR.
*value known from Master Drainage Report

MERRICK & COMPANY

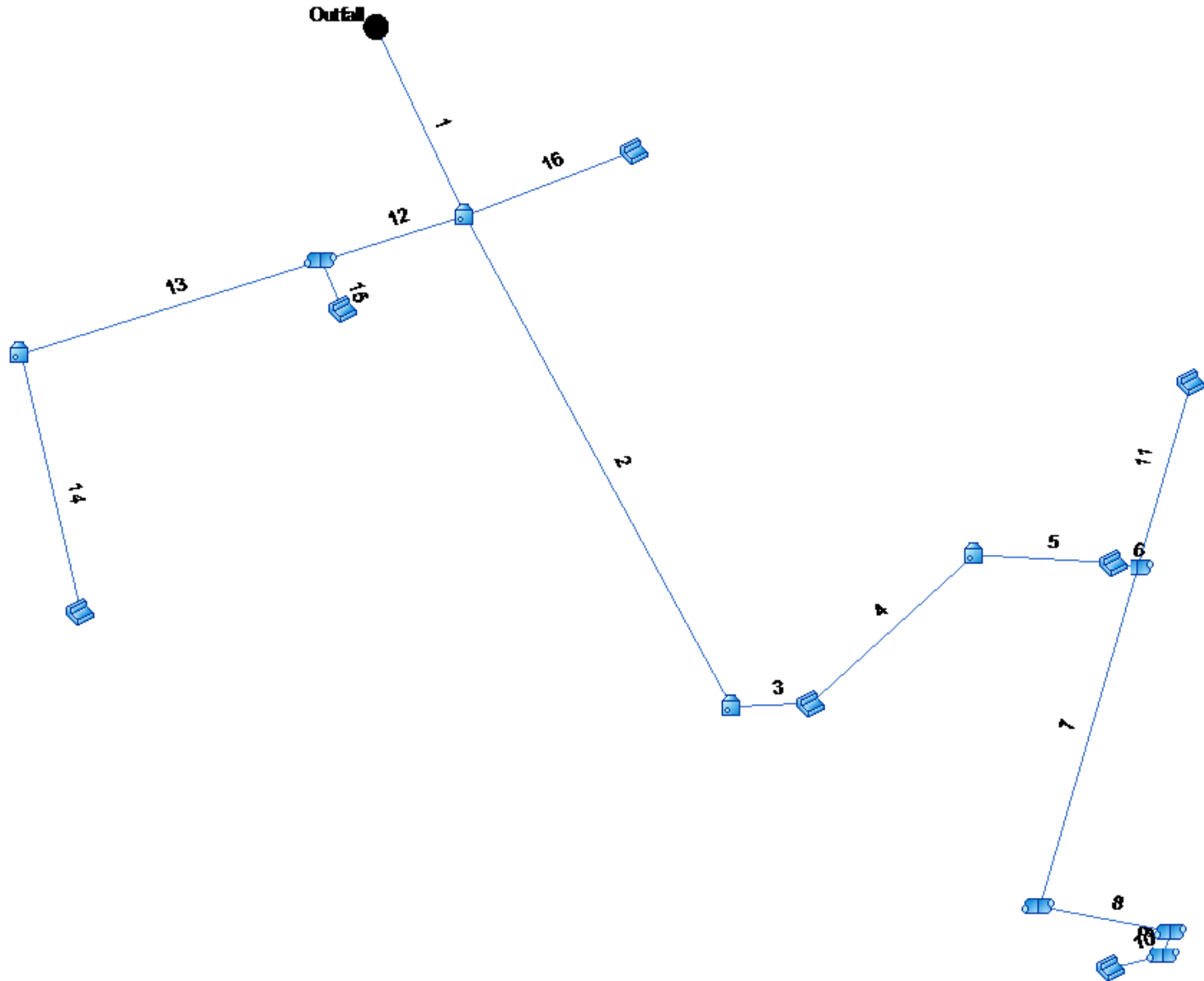
September 3, 2021

Appendix C: Hydraulic Computations

September 3, 2021

StormCAD Analysis Output

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross SI, Sw (ft/ft)	Cross SI, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)
1	2.63	1.74	n/a	0.20	0.50	0.90	33.43	1.57	....	....	....	69.038	1.56	1.09 s	Outfall	0.00	3193208.37	5817.69	5818.40
2	2.03	2.03	n/a	0.20	0.50	0.90	17.35	1.25	....	....	....	-2.664	1.23	1.23 s	1	0.00	3193275.53	5817.42	5818.26
3	2.03	2.03	Offsite	0.20	0.50	0.90	17.33	1.25	0.050	0.020	....	-69.642	1.23	1.23 s	2	0.38	3193295.50	5818.46	5818.56
4	1.82	1.82	n/a	0.20	0.50	0.90	17.30	1.16	....	....	....	-45.038	1.13	1.13 s	3	0.00	3193336.81	5818.62	5818.93
5	1.45	1.45	Offsite	0.20	0.50	0.90	11.30	1.25	0.050	0.020	....	52.232	1.15	1.15 s	4	2.21	3193372.18	5819.75	5820.10
6	0.67	0.67	n/a	0.20	0.50	0.90	3.86	0.82	....	....	....	9.197	0.79	0.79 s	5	0.00	3193378.02	5819.91	5819.97
7	0.53	0.44	n/a	0.20	0.50	0.90	3.86	0.64	....	....	....	90.008	0.79	0.55 s	6	0.00	3193353.25	5819.89	5820.73
8	0.44	0.44	n/a	0.20	0.50	0.90	3.86	0.64	....	....	....	-90.008	0.55	0.55 s	7	0.00	3193386.35	5820.73	5821.07
9	0.44	0.44	n/a	0.20	0.50	0.90	3.92	0.64	....	....	....	90.009	0.55	0.54 s	8	0.00	3193384.58	5821.08	5821.16
10	0.45	0.45	Offsite	0.20	0.50	0.90	3.76	0.64	0.050	0.020	....	60.616	0.56	0.56 s	9	0.30	3193371.45	5821.15	5821.28
11	0.41	0.33	Offsite	0.20	0.50	0.90	3.84	0.52	0.050	0.020	....	-90.000	0.79	0.43 s	6	0.20	3193391.53	5819.81	5820.04
12	0.91	0.91	n/a	0.20	0.50	0.90	11.38	0.94	....	....	....	89.949	0.77	0.77 s	1	0.00	3193172.00	5817.35	5817.74
13	0.91	0.80	n/a	0.20	0.50	0.90	11.36	0.86	....	....	....	0.000	0.77	0.69 s	12	0.00	3193096.14	5817.69	5818.42
14	0.80	0.80	Offsite	0.20	0.50	0.90	11.37	0.86	0.050	0.020	....	-79.593	0.69	0.69 s	13	1.44	3193111.25	5818.62	5819.44
15	0.41	0.33	Offsite	0.20	0.50	0.90	3.87	0.52	0.050	0.020	....	-88.208	0.69	0.43 s	12	0.20	3193177.25	5817.42	5817.32
16	0.74	0.65	Offsite	0.20	0.50	0.90	2.75	0.64	0.050	0.020	....	-94.557	0.90	0.78	1	0.30	3193251.08	5816.66	5816.82

Project File: 0950_Storm A 100.stm

Number of lines: 16

Date: 9/17/2021

NOTES: ** Critical depth

MyReport

Energy Loss	Flow Rate	Sf Ave	Sf Dn	Grate Area	Grate Len	Grate Width	Gnd/Rim EI Dn	Gnd/Rim EI Up	Gutter Depth	Gutter Slope	Gutter Spread	Gutter Width	HGL Dn	HGL Up	HGL Jnct	HGL Jmp Dn	HGL Jmp Up	Incr CxA	Incr Q
(ft)	(cfs)	(ft/ft)	(ft/ft)	(sqft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)		(cfs)
0.000	19.17	0.000	0.000	....	....	....	5822.01	5823.06	....	....	....	....	5815.81	5816.52	5816.52	....	....	0.00	0.00
0.000	12.13	0.000	0.000	....	....	....	5823.06	5823.12	....	....	....	....	5816.86	5817.70	5817.70	....	....	0.00	0.00
0.000	12.13	0.000	0.000	....	....	....	5823.12	5823.17	0.17	0.083	5.50	2.00	5817.90	5818.00	5818.00	....	....	0.30	2.51
0.000	10.53	0.000	0.000	....	....	....	5823.17	5822.37	....	....	....	....	5818.10	5818.41	5818.41	....	....	0.00	0.00
0.000	10.53	0.000	0.000	....	....	....	5822.37	5822.04	0.25	0.083	9.37	2.00	5818.93	5819.28	5819.28	....	....	1.52	8.23
0.000	3.75	0.000	0.000	....	....	....	5822.04	5819.85	....	....	....	....	5819.43	5819.49	5819.49	....	....	0.00	0.00
0.000	2.25	0.000	0.000	....	....	....	5819.85	5820.94	....	....	....	....	5819.49	5820.33 j	5820.33	5819.44	5819.32	0.00	0.00
0.000	2.25	0.000	0.000	....	....	....	5820.94	5821.28	....	....	....	....	5820.33	5820.67	5820.67	....	....	0.00	0.00
0.000	2.25	0.000	0.000	....	....	....	5821.28	5821.36	....	....	....	....	5820.67	5820.74	5820.74	....	....	0.00	0.00
0.000	2.25	0.000	0.000	....	....	....	5821.36	5821.50	0.16	0.083	5.21	2.00	5820.76	5820.89	5820.89	....	....	0.26	2.25
0.000	1.50	0.000	0.000	....	....	....	5819.85	5820.45	0.14	0.083	4.20	2.00	5819.49	5819.71 j	5819.71	5819.47	5819.27	0.17	1.50
0.000	5.91	0.000	0.000	....	....	....	5823.06	5823.20	....	....	....	....	5816.70	5817.09	5817.09	....	....	0.00	0.00
0.000	4.95	0.000	0.000	....	....	....	5823.20	5823.49	....	....	....	....	5817.09	5817.82	5817.82	....	....	0.00	0.00
0.000	4.95	0.000	0.000	....	....	....	5823.49	5822.82	0.21	0.083	7.54	2.00	5818.02	5818.84	5818.84	....	....	0.88	4.95
0.000	1.50	0.000	0.000	....	....	....	5823.20	5817.88	0.14	0.083	4.20	2.00	5817.09	5816.99 j	5816.99	5817.08	5816.86	0.17	1.50
0.161	2.25	0.339	0.300	....	....	....	5823.06	5818.06	0.16	0.083	5.21	2.00	5816.52	5816.64	5816.82	....	....	0.26	2.25

Project File: 0950_Storm A 100.stm Number of lines: 16 Date: 9/17/2021

NOTES: ** Critical depth

Inlet Depth	Inlet Eff	Inlet ID	Inlet Loc		Inlet Time	i Sys	i Inlet	Invert Dn	Invert Up	Jump Loc	Jump Len	Vel Hd Jmp Dn	Vel Hd Jmp Up	J-Loss Coeff	Junct Type	Known Q	Cost RCP	Cost CMP	
(ft)	(%)			(ft)	(min)	(in/hr)	(in/hr)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)			(cfs)			
....	....	A-1	On Grade		0.0	5.40	0.00	5814.25	5815.43	....	....	0.00	0.00	1.00 z	MH	0.00	3,406	3,065	
....	....	A-2	On Grade		0.0	5.40	0.00	5815.63	5816.47	....	....	0.00	0.00	0.95 z	MH	0.00	8,840	7,956	
0.17	100	A-3	On Grade		5.8	5.40	8.47	5816.67	5816.77	....	....	0.00	0.00	1.13 z	Generic	0.00	1,170	1,053	
....	....	A-4	On Grade		0.0	5.40	0.00	5816.97	5817.28	....	....	0.00	0.00	0.82 z	MH	0.00	2,936	2,642	
0.25	100	A-5	On Grade		18.0	5.40	5.40	5817.78	5818.13	....	....	0.00	0.00	0.50 z	Generic	0.00	1,464	1,318	
....	....	Structure - (136)	On Grade		0.0	8.82	0.00	5818.63	5818.69	....	....	0.00	0.00	1.00 z	None	0.00	268	241	
....	....	Structure - (135)	On Grade		0.0	8.82	0.00	5818.69	5819.78	10.90	3.23	0.27	0.53	1.00 z	None	0.00	3,152	2,837	
....	....	Structure - (134)	On Grade		0.0	8.82	0.00	5819.78	5820.12	....	....	0.00	0.00	1.00 z	None	0.00	1,038	934	
....	....	Structure - (133)	On Grade		0.0	8.82	0.00	5820.12	5820.20	....	....	0.00	0.00	0.89 z	None	0.00	310	279	
0.16	100	Structure - (131)	On Grade		5.0	8.82	8.82	5820.20	5820.33	....	....	0.00	0.00	1.00 z	Generic	0.00	478	430	
0.14	100	Structure - (137)	On Grade		5.0	8.82	8.82	5818.69	5819.28	11.90	3.33	0.11	0.33	1.00 z	Generic	0.00	1,752	1,577	
....	....	Structure - (128)	On Grade		0.0	5.64	0.00	5815.93	5816.32	....	....	0.00	0.00	1.00 z	None	0.00	1,863	1,676	
....	....	A-1A	On Grade		0.0	5.64	0.00	5816.32	5817.13	....	....	0.00	0.00	0.99 z	MH	0.00	3,775	3,398	
0.21	100	A-1B	On Grade		16.5	5.64	5.64	5817.33	5818.15	....	....	0.00	0.00	1.00 z	Generic	0.00	3,443	3,098	
0.14	100	Structure - (129)	On Grade		5.0	8.82	8.82	5816.40	5816.56	1.59	3.34	0.11	0.39	1.00 z	Generic	0.00	560	504	
0.16	100	Structure - (94)	On Grade		5.0	8.82	8.82	5815.62	5815.86	....	....	0.00	0.00	1.00	Generic	0.00	1,543	1,389	

Project File: 0950_Storm A 100.stm

Number of lines: 16

Date: 9/17/2021

NOTES: Intensity = 74.10 / (Inlet time + 10.00) ^ 0.79 -- Return period = 100 Yrs. ; ** Critical depth

Cost PVC	Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)
2,895	Pipe - (10)	63.386	24	1.86	Cir	....	....	0.012	n/a	1627485.22	0.00	....	....	....	24	0.00	24	0.00	0.00	0.00
7,514	Pipe - (6)	167.569	24	0.50	Cir	....	....	0.012	n/a	1627331.70	0.00	....	....	....	24	0.00	24	0.00	0.00	0.00
995	Pipe - (7)	20.004	24	0.50	Cir	0.0	0.013	0.012	n/a	1627332.84	0.00	0.00	2.51	0.00	24	0.78	24	0.00	0.00	0.00
2,496	Pipe - (7) (1)	62.099	24	0.50	Cir	....	....	0.012	n/a	1627379.21	0.00	....	....	....	24	0.00	24	0.00	0.00	0.00
1,244	Pipe - (8)	35.456	18	0.99	Cir	0.0	0.013	0.012	n/a	1627376.78	0.00	0.00	8.23	0.00	18	0.69	18	0.00	0.00	0.00
228	Pipe - (90)	6.000	12	1.00	Cir	....	....	0.012	n/a	1627375.42	0.00	....	....	....	12	0.00	12	0.00	0.00	0.00
2,679	Pipe - (89)	109.023	12	1.00	Cir	....	....	0.012	n/a	1627269.24	0.00	....	....	....	12	0.00	12	0.00	0.00	0.00
882	Pipe - (88)	33.979	12	1.00	Cir	....	....	0.012	n/a	1627261.53	0.00	....	....	....	12	0.00	12	0.00	0.00	0.00
264	Pipe - (87)	7.772	12	1.03	Cir	....	....	0.012	n/a	1627253.96	0.00	....	....	....	12	0.00	12	0.00	0.00	0.00
406	Pipe - (86)	13.672	12	0.95	Cir	0.0	0.013	0.012	n/a	1627250.13	0.00	0.00	2.25	0.00	12	0.85	12	0.00	0.00	0.00
1,489	Pipe - (91)	59.494	12	0.99	Cir	0.0	0.013	0.012	n/a	1627433.36	0.00	0.00	1.50	0.00	12	0.85	12	0.00	0.00	0.00
1,583	Pipe - (20)	38.963	18	1.00	Cir	....	....	0.012	n/a	1627471.25	0.00	....	....	....	18	0.00	18	0.00	0.00	0.00
3,209	Pipe - (20) (1)	81.263	18	1.00	Cir	....	....	0.012	n/a	1627442.11	0.00	....	....	....	18	0.00	18	0.00	0.00	0.00
2,926	Pipe - (21)	82.068	18	1.00	Cir	0.0	0.013	0.012	n/a	1627361.44	0.00	0.00	4.95	0.00	18	0.61	18	0.00	0.00	0.00
476	Pipe - (81)	15.938	12	1.00	Cir	0.0	0.013	0.012	n/a	1627456.20	0.00	0.00	1.50	0.00	12	0.85	12	0.00	0.00	0.00
1,312	Pipe - (67)	47.317	12	0.51	Cir	0.0	0.013	0.012	0.18	1627505.60	0.00	0.00	2.25	0.00	12	0.85	12	0.00	0.00	0.00

Project File: 0950_Storm A 100.stm

Number of lines: 16

Date: 9/17/2021

NOTES: ** Critical depth

Tc	Throat Ht	Total Area	Total CxA	Total Runoff	Vel Ave	Vel Dn	Vel Hd Dn	Vel Hd Up	Vel Up	Cover Dn	Cover Up	Storage	
(min)	(in)	(ac)		(cfs)	(ft/s)	(ft/s)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(cft)	
18.0	5.03	3.55	19.17	9.15	7.29	1.88	1.88	11.01	5.76	5.63	139.38	
18.0	3.09	2.25	12.13	5.97	5.97	0.55	0.55	5.97	5.43	4.65	340.34	
18.0	3.09	2.25	12.13	5.97	5.97	0.55	0.55	5.97	4.45	4.40	40.67	
18.0	2.71	1.95	10.53	5.77	5.77	0.52	0.52	5.77	4.20	3.09	113.27	
18.0	2.71	1.95	10.53	7.26	7.26	0.82	0.82	7.26	3.09	2.41	51.38	
5.0	0.50	0.43	3.75	5.60	5.60	0.49	0.49	5.60	2.41	0.16	4.02	
5.0	0.30	0.26	2.25	4.23	3.36	0.40	0.40	5.10	0.16	0.16	60.93	
5.0	0.30	0.26	2.25	5.10	5.10	0.40	0.40	5.10	0.16	0.16	14.97	
5.0	0.30	0.26	2.25	5.13	5.10	0.41	0.41	5.16	0.16	0.16	3.41	
5.0	0.30	0.26	2.25	5.00	5.00	0.39	0.39	5.00	0.16	0.17	6.15	
5.0	0.20	0.17	1.50	3.41	2.24	0.33	0.33	4.59	0.16	0.17	29.97	
16.5	1.64	1.05	5.91	6.50	6.50	0.66	0.66	6.50	5.63	5.38	35.45	
16.5	1.44	0.88	4.95	5.82	5.44	0.60	0.60	6.21	5.38	4.86	69.41	
16.5	1.44	0.88	4.95	6.21	6.21	0.60	0.60	6.21	4.66	3.17	65.42	
5.0	0.20	0.17	1.50	3.61	2.60	0.33	0.33	4.61	5.80	0.32	7.20	
5.0	0.30	0.26	2.25	3.23	3.03	0.14	0.18	3.44	6.44	1.20	33.13	

Project File: 0950_Storm A 100.stm	Number of lines: 16	Date: 9/17/2021
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NOTES: ** Critical depth

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
1	24	19.17	5814.25	5815.81	1.56	2.63	7.29	1.88	5817.69	0.000	63.386	5815.43	5816.52	1.09	1.74	11.01	1.88	5818.40	0.000	0.000	0.000	1.00	n/a
2	24	12.13	5815.63	5816.86	1.23*	2.03	5.97	0.55	5817.42	0.000	167.569	5816.47	5817.70	1.23	2.03	5.97	0.55	5818.26	0.000	0.000	0.000	0.95	n/a
3	24	12.13	5816.67	5817.90	1.23*	2.03	5.97	0.55	5818.46	0.000	20.004	5816.77	5818.00	1.23	2.03	5.97	0.55	5818.56	0.000	0.000	0.000	1.13	n/a
4	24	10.53	5816.97	5818.10	1.13*	1.82	5.77	0.52	5818.62	0.000	62.099	5817.28	5818.41	1.13	1.82	5.77	0.52	5818.93	0.000	0.000	0.000	0.82	n/a
5	18	10.53	5817.78	5818.93	1.15*	1.45	7.26	0.82	5819.75	0.000	35.456	5818.13	5819.28	1.15	1.45	7.26	0.82	5820.10	0.000	0.000	0.000	0.50	n/a
6	12	3.75	5818.63	5819.43	0.79*	0.67	5.60	0.49	5819.91	0.000	6.000	5818.69	5819.49	0.79	0.67	5.60	0.49	5819.97	0.000	0.000	0.000	1.00	n/a
7	12	2.25	5818.69	5819.49	0.79	0.53	3.36	0.40	5819.89	0.000	109.023	5819.78	5820.33 j	0.55	0.44	5.10	0.40	5820.73	0.000	0.000	0.000	1.00	n/a
8	12	2.25	5819.78	5820.33	0.55*	0.44	5.10	0.40	5820.73	0.000	33.979	5820.12	5820.67	0.55	0.44	5.10	0.40	5821.07	0.000	0.000	0.000	1.00	n/a
9	12	2.25	5820.12	5820.67	0.55	0.44	5.10	0.41	5821.08	0.000	7.772	5820.20	5820.74	0.54	0.44	5.16	0.41	5821.16	0.000	0.000	0.000	0.89	n/a
10	12	2.25	5820.20	5820.76	0.56*	0.45	5.00	0.39	5821.15	0.000	13.672	5820.33	5820.89	0.56	0.45	5.00	0.39	5821.28	0.000	0.000	0.000	1.00	n/a
11	12	1.50	5818.69	5819.49	0.79	0.41	2.24	0.33	5819.81	0.000	59.494	5819.28	5819.71 j	0.43	0.33	4.59	0.33	5820.04	0.000	0.000	0.000	1.00	n/a
12	18	5.91	5815.93	5816.70	0.77*	0.91	6.50	0.66	5817.35	0.000	38.963	5816.32	5817.09	0.77	0.91	6.50	0.66	5817.74	0.000	0.000	0.000	1.00	n/a
13	18	4.95	5816.32	5817.09	0.77	0.91	5.44	0.60	5817.69	0.000	81.263	5817.13	5817.82	0.69	0.80	6.21	0.60	5818.42	0.000	0.000	0.000	0.99	n/a
14	18	4.95	5817.33	5818.02	0.69*	0.80	6.21	0.60	5818.62	0.000	82.068	5818.15	5818.84	0.69	0.80	6.21	0.60	5819.44	0.000	0.000	0.000	1.00	n/a
15	12	1.50	5816.40	5817.09	0.69	0.41	2.60	0.33	5817.42	0.000	15.938	5816.56	5816.99 j	0.43	0.33	4.61	0.33	5817.32	0.000	0.000	0.000	1.00	n/a
16	12	2.25	5815.62	5816.52	0.90	0.74	3.03	0.14	5816.66	0.300	47.317	5815.86	5816.64	0.78	0.65	3.44	0.18	5816.82	0.378	0.339	0.161	1.00	0.18

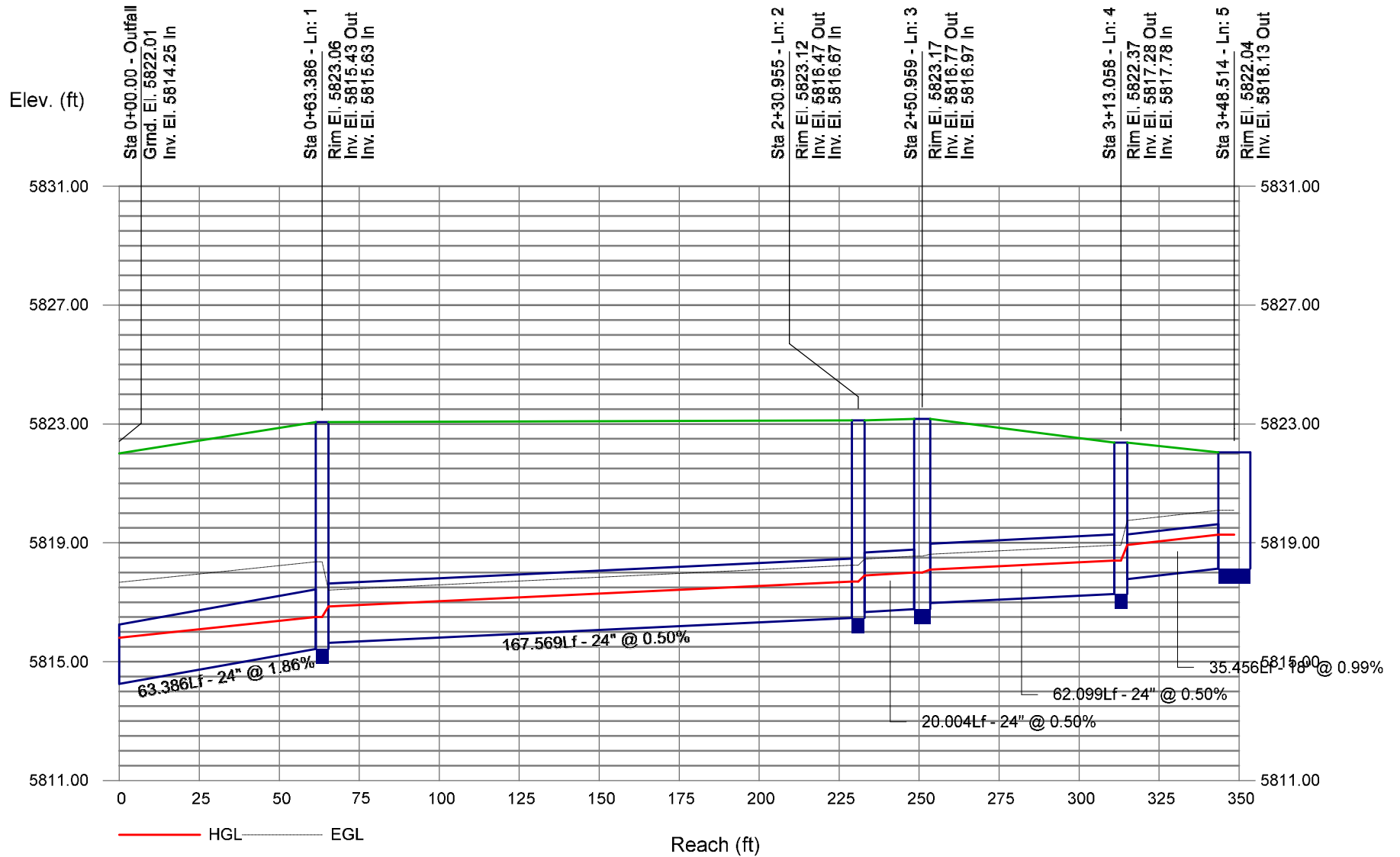
Project File: 0950_Storm A 100.stm

Number of lines: 16

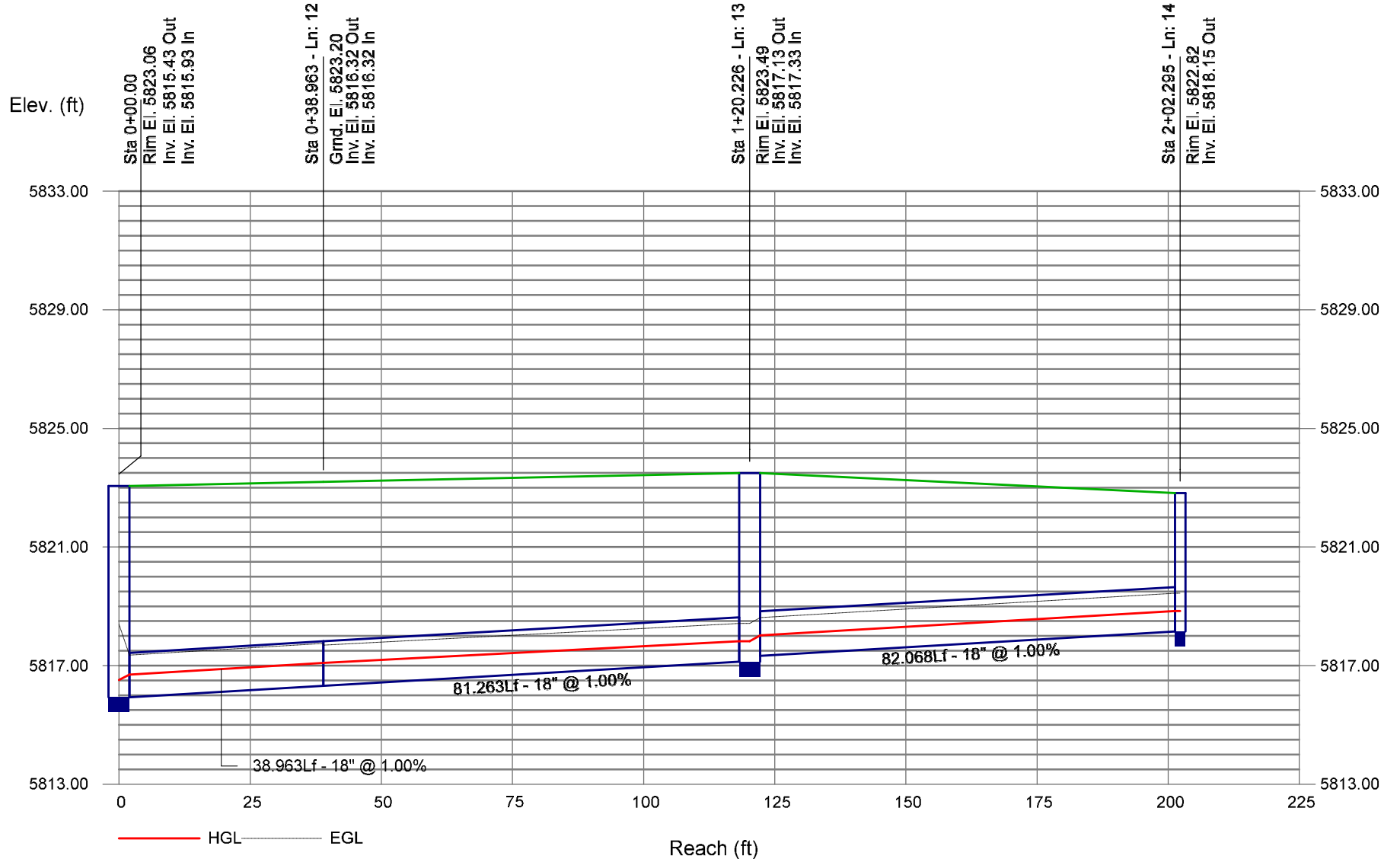
Run Date: 9/17/2021

Notes: * Normal depth assumed; j-Line contains hyd. jump ; c = cir e = ellip b = box

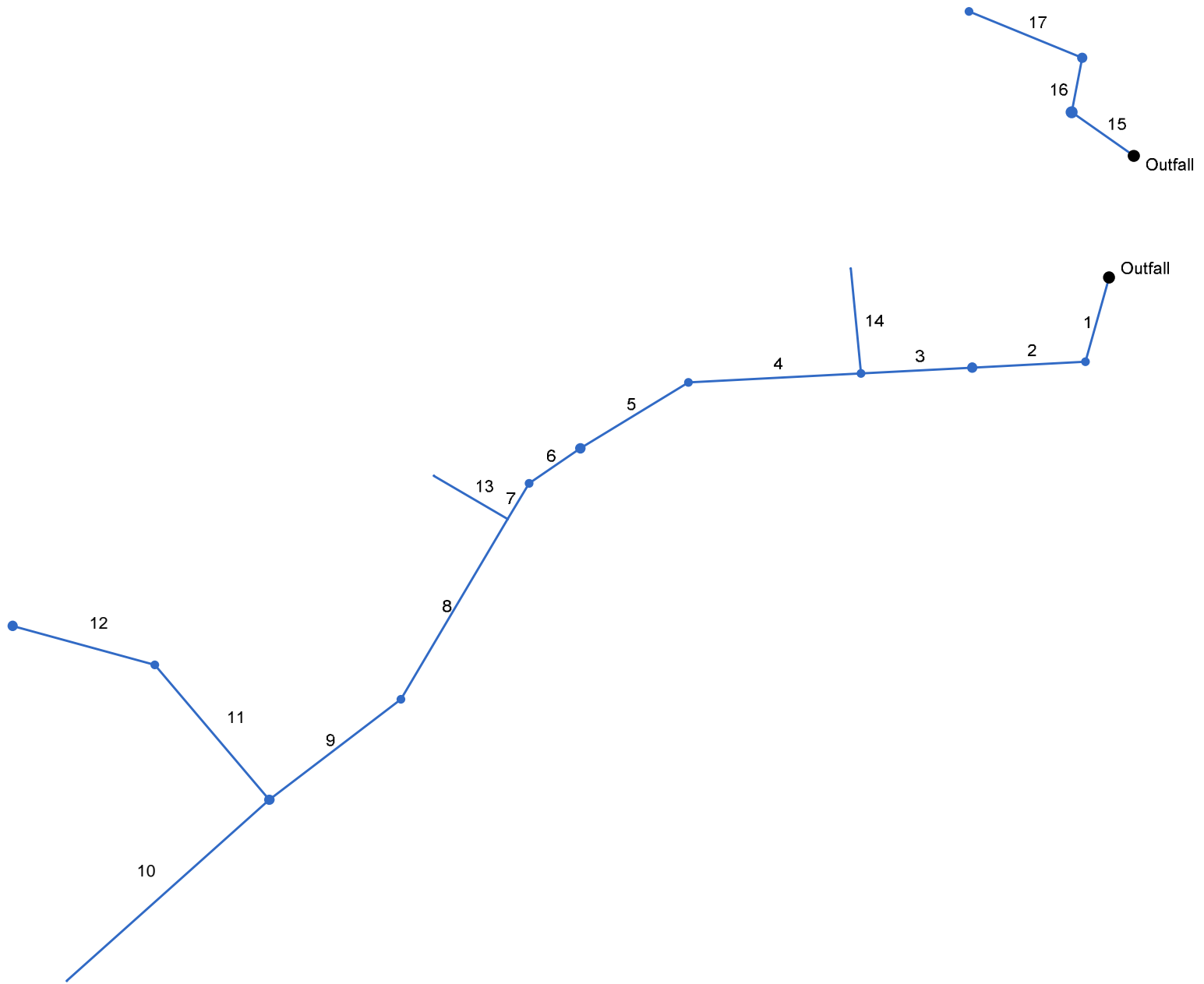
Storm Sewer Profile



Storm Sewer Profile



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 0950_Storm line B - 100.stm

Number of lines: 17

Date: 9/9/2021

Line No.	Area Dn (sqft)	Area Up (sqft)	By Ln No	Coef C1 (C)	Coef C2 (C)	Coef C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross SI, Sw (ft/ft)	Cross SI, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Eastng X (ft)	EGL Dn (ft)	EGL Up (ft)
1	1.76	1.56	n/a	0.20	0.50	0.90	21.27	1.47	....	....	....	105.693	1.48	1.24 s	Outfall	0.00	3194094.14	5781.91	5783.55
2	1.56	1.56	Offsite	0.20	0.50	0.90	21.30	1.47	0.050	0.020	....	71.325	1.23	1.23 s	1	0.84	3194024.38	5784.56	5787.01
3	1.32	1.32	n/a	0.20	0.50	0.90	21.27	1.45	....	....	....	-0.021	1.05	1.05 s	2	0.00	3193956.11	5791.21	5793.60
4	1.62	1.62	n/a	0.20	0.50	0.90	16.09	1.44	....	....	....	0.000	1.29	1.29 s	3	0.00	3193849.81	5796.24	5798.37
5	1.62	1.62	Offsite	0.20	0.50	0.90	16.07	1.44	0.050	0.020	....	-28.432	1.30	1.30 s	4	1.47	3193783.14	5798.56	5800.12
6	1.38	1.34	n/a	0.20	0.50	0.90	16.05	1.37	....	....	....	-2.976	1.10	1.06 s	5	0.00	3193751.64	5800.08	5800.81
7	1.33	1.33	n/a	0.20	0.50	0.90	16.17	1.37	....	....	....	-25.050	1.06	1.06 s	6	0.00	3193738.56	5801.02	5801.54
8	1.33	1.25	n/a	0.20	0.50	0.90	16.07	1.33	....	....	....	0.002	1.06	1.00 s	7	0.00	3193672.84	5801.48	5804.00
9	1.25	1.25	Offsite	0.20	0.50	0.90	16.11	1.33	0.050	0.020	....	22.081	1.00	1.00 s	8	1.02	3193591.65	5804.21	5806.26
10	0.33	0.33	Offsite	0.20	0.50	0.90	3.86	0.52	0.050	0.020	....	-4.523	0.43	0.43 s	9	0.20	3193466.94	5805.69	5807.37
11	0.95	0.68	n/a	0.20	0.50	0.90	16.09	0.91	....	....	....	87.216	0.80	0.61 s	9	0.00	3193521.37	5805.74	5807.74
12	0.68	0.68	Offsite	0.20	0.50	0.90	16.09	0.91	0.050	0.020	....	-34.454	0.61	0.61 s	11	1.03	3193433.66	5807.94	5809.76
13	0.38	0.30	Offsite	0.20	0.50	0.90	3.86	0.49	0.050	0.020	....	89.915	0.81	0.41 s	7	0.18	3193693.05	5800.22	5800.35
14	0.41	0.33	Offsite	0.20	0.50	0.90	3.86	0.52	0.050	0.020	....	87.505	0.55	0.43 s	3	0.20	3193949.87	5791.10	5791.64
15	2.08	1.23	n/a	0.20	0.50	0.90	128.32	0.94	....	....	....	-144.895	0.94	0.65 s	Outfall	0.00	3194085.67	5778.02	5778.38
16	1.06	1.06	Offsite	0.20	0.50	0.90	101.87	0.98	0.050	0.020	....	65.905	0.62	0.62 s	15	0.23	3194092.20	5783.18	5783.86
17	0.91	0.91	Offsite	0.20	0.50	0.90	34.69	1.02	0.050	0.020	....	-78.642	0.66	0.66 s	16	1.10	3194022.53	5785.50	5787.01

Project File: 0950_Storm B 100.stm

Number of lines: 17

Date: 9/13/2021

NOTES: ** Critical depth

Energy Loss (ft)	Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)
0.000	21.39	0.000	0.000	...	...	...	0.00	5784.99	...	...	...	...	5778.98	5780.63	5780.63	...	...	0.00	0.00
0.000	21.39	0.000	0.000	...	...	...	5784.99	5800.03	0.21	0.083	7.32	2.00	5781.63	5784.08	5784.08	...	...	0.66	4.63
0.000	17.71	0.000	0.000	...	...	...	5800.03	5801.48	...	...	...	...	5788.39	5790.78	5790.78	...	...	0.00	0.00
0.000	16.76	0.000	0.000	...	...	...	5801.48	5803.64	...	...	...	...	5794.57	5796.71	5796.71	...	...	0.00	0.00
0.000	16.76	0.000	0.000	...	...	...	5803.64	5805.10	0.22	0.083	8.16	2.00	5796.91	5798.47	5798.47	...	...	1.06	5.93
0.000	13.64	0.000	0.000	...	...	...	5805.10	5806.29	...	...	...	...	5798.47	5799.19	5799.19	...	...	0.00	0.00
0.000	13.64	0.000	0.000	...	...	...	5806.29	5807.60	...	...	...	...	5799.39	5799.91	5799.91	...	...	0.00	0.00
0.000	12.56	0.000	0.000	...	...	...	5807.60	5808.87	...	...	...	...	5799.91	5802.43	5802.43	...	...	0.00	0.00
0.000	12.56	0.000	0.000	...	...	...	5808.87	5810.17	0.22	0.083	8.07	2.00	5802.63	5804.68	5804.68	...	...	0.82	5.79
0.000	1.50	0.000	0.000	...	...	...	5810.17	5808.00	0.14	0.083	4.20	2.00	5805.36	5807.04	5807.04	...	...	0.17	1.50
0.000	5.60	0.000	0.000	...	...	...	5810.17	5811.29	...	...	...	...	5804.68	5806.67	5806.67	...	...	0.00	0.00
0.000	5.60	0.000	0.000	...	...	...	5811.29	5813.13	0.22	0.083	7.95	2.00	5806.87	5808.69	5808.69	...	...	0.79	5.60
0.000	1.35	0.000	0.000	...	...	...	5807.60	5800.79	0.14	0.083	3.95	2.00	5799.91	5800.04	5800.04	5799.89	5799.69	0.15	1.35
0.000	1.50	0.000	0.000	...	...	...	5801.48	5792.17	0.14	0.083	4.20	2.00	5790.78	5791.31	5791.31	5790.82	5790.71	0.17	1.50
0.000	9.64	0.000	0.000	...	...	...	5779.51	5797.13	...	...	...	...	5777.07	5777.43	5777.43	5777.13	5776.84	0.00	0.00
0.000	9.64	0.000	0.000	...	...	...	5797.13	5795.53	0.15	0.083	4.36	2.00	5781.90	5782.58	5782.58	...	...	0.19	1.60
0.000	8.25	0.000	0.000	...	...	...	5795.53	5797.63	0.25	0.083	9.38	2.00	5784.22	5785.73	5785.73	...	...	0.94	8.25

Project File: 0950_Storm B 100.stm Date: 9/13/2021

Number of lines: 17

NOTES: ** Critical depth

Inlet Depth (ft)	Inlet Eff (%)	Inlet ID	Inlet Loc	(ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jump Dn (ft)	Vel Hd Jump Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP	Cost CMP	Cost PVC
0.21	100	B-10	On Grade		0.0	5.61	0.00	5777.50	5779.39	...	...	0.00	0.00	0.96 z	MH	0.00	1,848	1,663	1,571
0.22	100	B-9	On Grade		9.9	5.61	7.06	5780.39	5782.84	...	...	0.00	0.00	0.50 z	Generic	0.00	3,988	3,589	3,389
0.22	100	B-8	On Grade		0.0	5.61	0.00	5787.34	5789.73	...	...	0.00	0.00	1.00 z	MH	0.00	4,140	3,726	3,519
0.22	100	B-7	On Grade		0.0	5.61	0.00	5793.28	5795.41	...	...	0.00	0.00	0.53 z	MH	0.00	5,440	4,896	4,624
0.22	100	B-6	On Grade		16.7	5.61	5.61	5795.61	5797.17	...	...	0.00	0.00	0.50 z	Generic	0.00	3,755	3,360	3,192
0.22	100	B-5	On Grade		0.0	7.06	0.00	5797.37	5798.13	...	...	0.00	0.00	0.48 z	MH	0.00	1,923	1,730	1,634
0.22	100	Structure - (43)	On Grade		0.0	7.06	0.00	5798.33	5798.85	...	...	0.00	0.00	1.00 z	None	0.00	1,410	1,269	1,199
0.22	100	B-4	On Grade		0.0	7.06	0.00	5798.85	5801.43	...	...	0.00	0.00	0.43 z	MH	0.00	6,303	5,672	5,357
0.14	100	B-3	On Grade		9.8	7.06	7.09	5801.63	5803.68	...	...	0.00	0.00	1.50 z	Generic	0.00	4,720	4,248	4,012
0.14	100	Structure - (33)	On Grade		5.0	8.82	8.82	5804.93	5806.61	...	...	0.00	0.00	1.00 z	Generic	0.00	4,897	4,407	4,162
0.22	100	B-2	On Grade		0.0	7.06	0.00	5803.88	5806.06	...	...	0.00	0.00	0.62 z	MH	0.00	4,608	4,147	3,916
0.14	100	B-1	On Grade		9.9	7.06	7.06	5806.26	5808.08	...	...	0.00	0.00	1.00 z	Generic	0.00	3,740	3,366	3,179
0.14	100	Structure - (44)	On Grade		5.0	8.82	8.82	5799.10	5799.63	15.84	3.17	0.10	0.32	1.00 z	Generic	0.00	1,739	1,565	1,478
0.15	100	Structure - (48)	On Grade		5.0	8.82	8.82	5790.23	5790.88	6.51	2.62	0.20	0.44	1.00 z	Generic	0.00	2,329	2,096	1,980
0.25	100	C-3	On Grade		0.0	8.59	0.00	5776.13	5776.78	4.69	4.69	0.34	1.31	0.93 z	MH	0.00	3,782	3,403	3,214
0.25	100	C-2	On Grade		5.5	8.59	8.59	5781.28	5781.96	...	...	0.00	0.00	1.48 z	Generic	0.00	3,236	2,912	2,751
0.25	100	C-1	On Grade		5.0	8.82	8.82	5783.56	5785.07	...	...	0.00	0.00	1.00 z	Generic	0.00	5,393	4,853	4,584

Project File: 0950_Storm B 100.stm Number of lines: 17 Date: 9/13/2021

NOTES: Intensity = 74.10 / (Inlet time + 10.00) ^ 0.79 -- Return period = 100 Yrs. ; ** Critical depth

Line ID	Line Length (ft)	Line Size (in)	Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)
Pipe - (19)	54.095	18	3.49	Cir	...	...	0.012	n/a	1627910.38	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	16.7
Pipe - (18)	69.851	18	3.51	Cir	0.0	0.013	0.012	n/a	1627906.75	0.00	0.00	4.63	0.00	18	0.78	18	0.00	0.00	0.00	16.7
Pipe - (17) (2) (1)	68.367	18	3.50	Cir	...	...	0.012	n/a	1627903.17	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	16.7
Pipe - (17)	106.447	18	2.00	Cir	...	...	0.012	n/a	1627897.59	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	16.7
Pipe - (16)	78.136	18	2.00	Cir	0.0	0.013	0.012	n/a	1627856.84	0.00	0.00	5.93	0.00	18	0.72	18	0.00	0.00	0.00	16.7
Pipe - (15)	38.185	18	1.99	Cir	...	...	0.012	n/a	1627835.26	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	9.9
Pipe - (14) (1)	25.741	18	2.02	Cir	...	...	0.012	n/a	1627813.09	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	9.9
Pipe - (14)	129.316	18	2.00	Cir	...	...	0.012	n/a	1627701.72	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	9.9
Pipe - (13)	102.179	18	2.01	Cir	0.0	0.013	0.012	n/a	1627639.69	0.00	0.00	5.79	0.00	18	0.80	18	0.00	0.00	0.00	9.9
Pipe - (22)	167.541	12	1.00	Cir	0.0	0.013	0.012	n/a	1627527.80	0.00	0.00	1.50	0.00	12	0.85	12	0.00	0.00	0.00	5.0
Pipe - (12)	108.963	18	2.00	Cir	...	...	0.012	n/a	1627722.96	0.00	...	...	...	18	0.00	18	0.00	0.00	0.00	9.9
Pipe - (11)	90.968	18	2.00	Cir	0.0	0.013	0.012	n/a	1627747.09	0.00	0.00	5.60	0.00	18	0.77	18	0.00	0.00	0.00	9.9
Pipe - (34)	52.792	12	1.00	Cir	0.0	0.013	0.012	n/a	1627839.85	0.00	0.00	1.35	0.00	12	0.85	12	0.00	0.00	0.00	5.0
Pipe - (35)	65.089	12	1.00	Cir	0.0	0.013	0.012	n/a	1627967.96	0.00	0.00	1.50	0.00	12	0.85	12	0.00	0.00	0.00	5.0
Pipe - (50)	46.888	42	1.39	Cir	...	...	0.012	n/a	1628064.61	0.00	...	...	...	42	0.00	42	0.00	0.00	0.00	5.5
Pipe - (49)	34.216	36	1.99	Cir	0.0	0.013	0.012	n/a	1628098.20	0.00	0.00	1.60	0.00	36	0.81	36	0.00	0.00	0.00	5.5
Pipe - (39)	75.340	24	2.00	Cir	0.0	0.013	0.012	n/a	1628126.87	0.00	0.00	8.25	0.00	24	0.85	24	0.00	0.00	0.00	5.0

Project File: 0950_Storm B 100.stm Number of lines: 17 Date: 9/13/2021

NOTES: ** Critical depth

Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)	Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)
...	4.94	3.82	21.39	12.93	12.13	2.93	2.93	13.72	n/a	4.10	90.63
...	4.94	3.82	21.39	13.74	13.74	2.94	2.94	13.74	3.10	15.69	108.69
...	4.10	3.16	17.71	13.46	13.46	2.82	2.82	13.46	11.19	10.25	89.94
...	3.90	2.99	16.76	10.34	10.34	1.66	1.66	10.34	6.70	6.73	172.62
...	3.90	2.99	16.76	10.33	10.33	1.66	1.66	10.33	6.53	6.43	126.86
...	2.43	1.93	13.64	10.02	9.86	1.61	1.61	10.19	6.23	6.66	51.99
...	2.43	1.93	13.64	10.26	10.26	1.64	1.64	10.26	6.46	7.25	34.24
...	2.25	1.78	12.56	9.75	9.44	1.57	1.57	10.06	7.25	5.94	166.86
...	2.25	1.78	12.56	10.08	10.08	1.58	1.58	10.08	5.74	4.99	127.31
...	0.20	0.17	1.50	4.61	4.61	0.33	0.33	4.61	4.24	0.39	54.54
...	1.03	0.79	5.60	7.08	5.88	1.07	1.07	8.28	4.79	3.73	88.77
...	1.03	0.79	5.60	8.28	8.28	1.07	1.07	8.28	3.53	3.55	61.50
...	0.18	0.15	1.35	3.24	1.99	0.31	0.31	4.48	7.50	0.16	26.18
...	0.20	0.17	1.50	4.01	3.42	0.33	0.33	4.60	10.25	0.29	24.89
...	1.33	1.12	9.64	6.23	4.63	0.95	0.95	7.83	-0.12	16.85	77.15
...	1.33	1.12	9.64	9.05	9.05	1.27	1.27	9.05	12.85	10.57	36.42
...	1.10	0.94	8.25	9.04	9.04	1.27	1.27	9.04	9.97	10.56	68.69

Project File: 0950_Storm B 100.stm Number of lines: 17 Date: 9/13/2021

NOTES: ** Critical depth

Hydraulic Grade Line Computations

Line Size (in)	Q (cfs)	Downstream						Len (ft)	Upstream						Check		JL coeff (K)	Minor loss (ft)					
		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)		EGL elev (ft)	Sf (%)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)			EGL elev (ft)	Sf (%)	Ave Sf (%)	Energy loss (ft)	
1	18	21.39	5777.50	5778.98	1.48	1.76	12.13	2.93	5781.91	0.000	54.095	5779.39	5780.63	1.24	1.56	13.72	2.93	5783.55	0.000	0.000	0.000	0.96	n/a
2	18	21.39	5780.39	5781.63	1.23*	1.56	13.74	2.94	5784.56	0.000	69.851	5782.84	5784.08	1.23	1.56	13.74	2.94	5787.01	0.000	0.000	0.000	0.50	n/a
3	18	17.71	5787.34	5788.39	1.05*	1.32	13.46	2.82	5791.21	0.000	68.367	5789.73	5790.78	1.05	1.32	13.46	2.82	5793.60	0.000	0.000	0.000	1.00	n/a
4	18	16.76	5793.28	5794.57	1.29*	1.62	10.34	1.66	5796.24	0.000	106.447	5795.41	5796.71	1.29	1.62	10.34	1.66	5798.37	0.000	0.000	0.000	0.53	n/a
5	18	16.76	5795.61	5796.91	1.30*	1.62	10.33	1.66	5798.56	0.000	78.136	5797.17	5798.47	1.30	1.62	10.33	1.66	5800.12	0.000	0.000	0.000	0.50	n/a
6	18	13.64	5797.37	5798.47	1.10	1.38	9.86	1.61	5800.08	0.000	38.185	5798.13	5799.19	1.06	1.34	10.19	1.61	5800.81	0.000	0.000	0.000	0.48	n/a
7	18	13.64	5798.33	5799.39	1.06*	1.33	10.26	1.64	5801.02	0.000	25.741	5798.85	5799.91	1.06	1.33	10.26	1.64	5801.54	0.000	0.000	0.000	1.00	n/a
8	18	12.56	5798.85	5799.91	1.06	1.33	9.44	1.57	5801.48	0.000	129.315	5801.43	5802.43	1.00	1.25	10.06	1.57	5804.00	0.000	0.000	0.000	0.43	n/a
9	18	12.56	5801.63	5802.63	1.00*	1.25	10.08	1.58	5804.21	0.000	102.175	5803.68	5804.68	1.00	1.25	10.08	1.58	5806.26	0.000	0.000	0.000	1.50	n/a
10	12	1.50	5804.93	5805.36	0.43*	0.33	4.61	0.33	5805.69	0.000	167.541	5806.61	5807.04	0.43	0.33	4.61	0.33	5807.37	0.000	0.000	0.000	1.00	n/a
11	18	5.60	5803.88	5804.68	0.80	0.95	5.88	1.07	5805.74	0.000	108.963	5806.06	5806.67	0.61	0.68	8.28	1.07	5807.74	0.000	0.000	0.000	0.62	n/a
12	18	5.60	5806.26	5806.87	0.61*	0.68	8.28	1.07	5807.94	0.000	90.968	5808.08	5808.69	0.61	0.68	8.28	1.07	5809.76	0.000	0.000	0.000	1.00	n/a
13	12	1.35	5799.10	5799.91	0.81	0.38	1.99	0.31	5800.22	0.000	52.792	5799.63	5800.04	0.41	0.30	4.48	0.31	5800.35	0.000	0.000	0.000	1.00	n/a
14	12	1.50	5790.23	5790.78	0.55	0.41	3.42	0.33	5791.10	0.000	65.089	5790.88	5791.31	0.43	0.33	4.60	0.33	5791.64	0.000	0.000	0.000	1.00	n/a
15	42	9.64	5776.13	5777.07	0.94	2.08	4.63	0.95	5778.02	0.000	46.888	5776.78	5777.43	0.65	1.23	7.83	0.95	5778.38	0.000	0.000	0.000	0.93	n/a
16	36	9.64	5781.28	5781.90	0.62*	1.06	9.05	1.27	5783.18	0.000	34.216	5781.96	5782.58	0.62	1.06	9.05	1.27	5783.86	0.000	0.000	0.000	1.48	n/a
17	24	8.25	5783.56	5784.22	0.66*	0.91	9.04	1.27	5785.50	0.000	75.340	5785.07	5785.73	0.66	0.91	9.04	1.27	5787.01	0.000	0.000	0.000	1.00	n/a

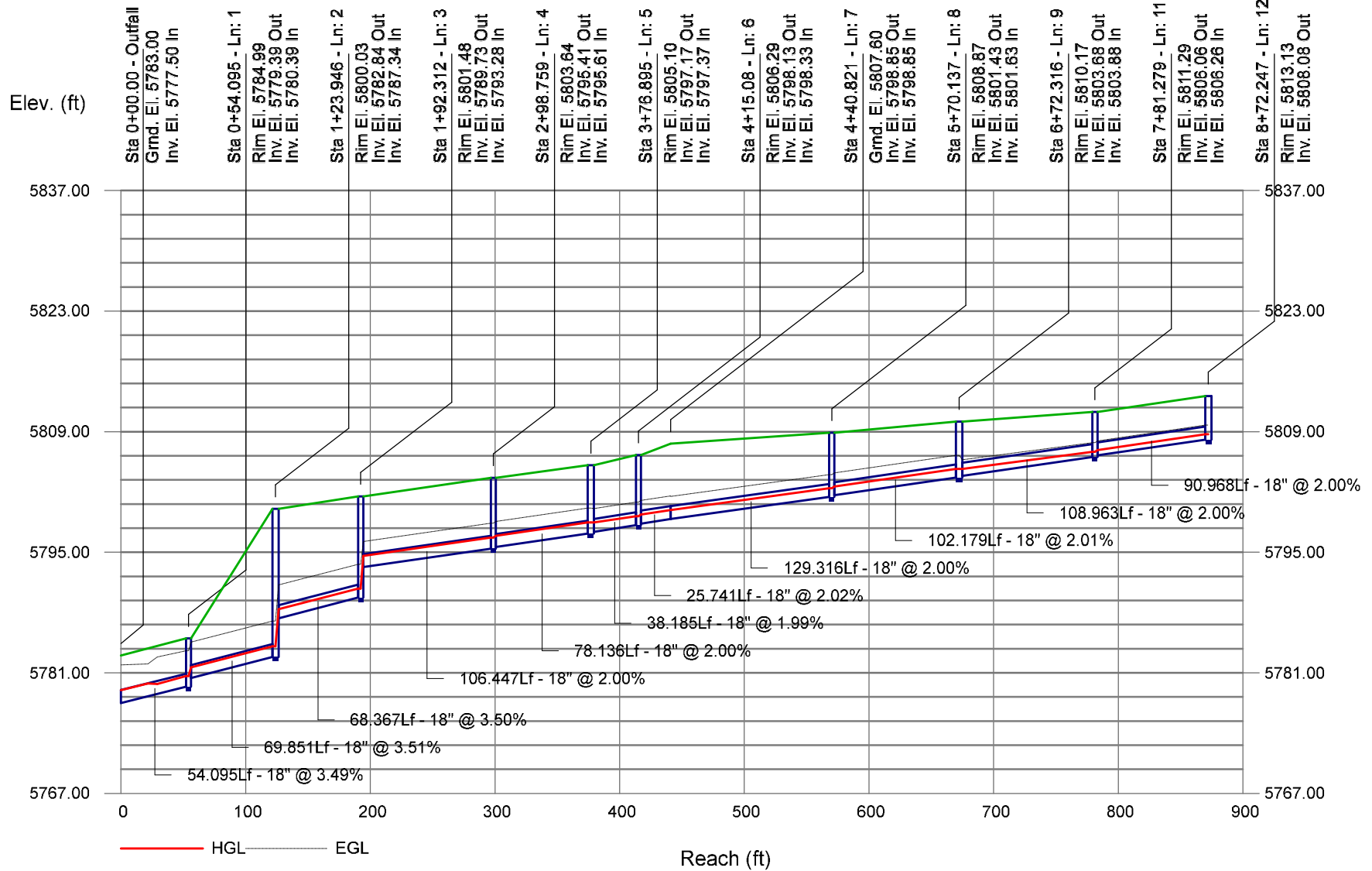
Project File: 0950_Storm B 100.stm

Number of lines: 17

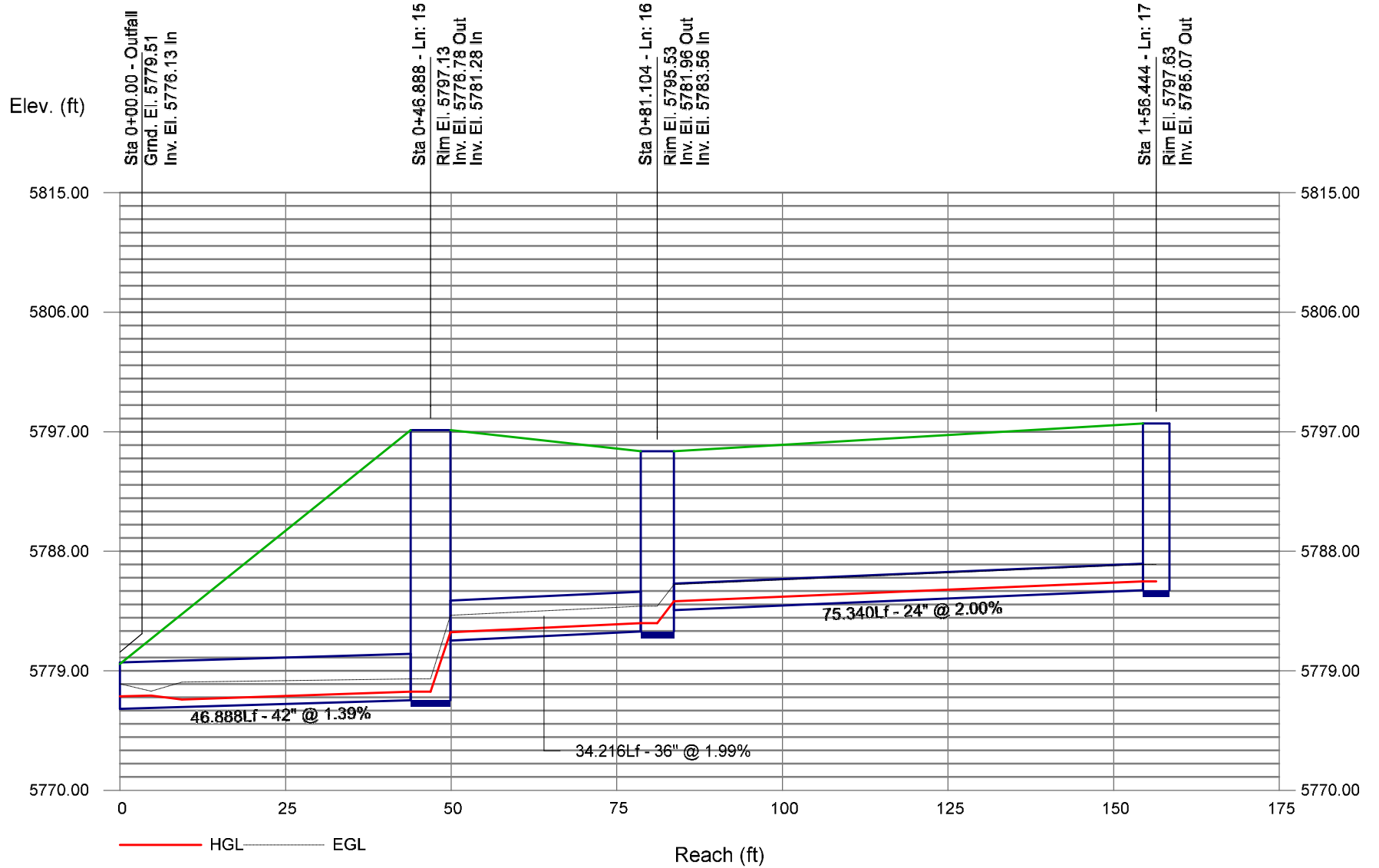
Run Date: 9/13/2021

Notes: * Normal depth assumed; j-Line contains hyd. jump ; c = cir e = ellip b = box

Storm Sewer Profile



Storm Sewer Profile



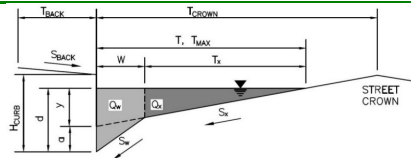
September 3, 2021

Inlet Sizing
UD-Inlet Calculations

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

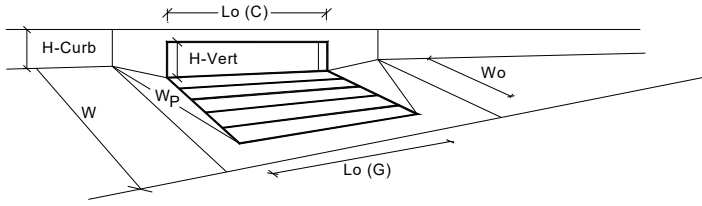
Inlet ID: **A-1B**



Gutter Geometry:	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 18.0$ 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	$T_{CROWN} = 31.0$ ft
Gutter Width	$W = 2.00$ ft
Street Transverse Slope	$S_x = 0.020$ ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.020$
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 31.0 & 31.0 \end{matrix}$ ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 6.0 & 6.0 \end{matrix}$ inches
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>
MINOR STORM Allowable Capacity is based on Depth Criterion	
MAJOR STORM Allowable Capacity is based on Depth Criterion	
$Q_{allow} =$	$\begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ \text{SUMP} & \text{SUMP} \end{matrix}$ cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

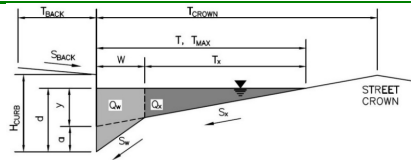


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
Grate Information			
Length of a Unit Grate	3.00	3.00	feet
Width of a Unit Grate	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	0.60	0.60	
Curb Opening Information			
Length of a Unit Curb Opening	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.66	0.66	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	0.523	0.523	ft
Depth for Curb Opening Weir Equation	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	5.3	5.3	cfs
Q PEAK REQUIRED	0.9	5.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

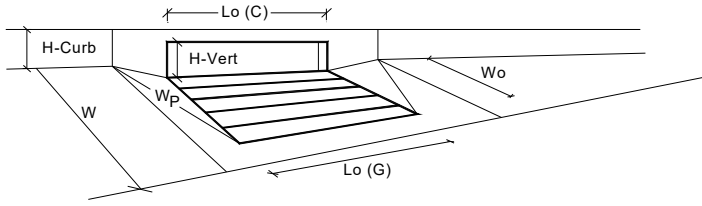
Inlet ID: **A-3**



Gutter Geometry:									
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 20.0$ 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	$T_{CROWN} = 31.0$ ft								
Gutter Width	$W = 2.00$ ft								
Street Transverse Slope	$S_x = 0.020$ ft/ft								
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft								
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft								
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.020$								
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> <tr> <td>$T_{MAX} =$</td> <td>31.0</td> <td>31.0</td> <td>ft</td> </tr> </table>		Minor Storm	Major Storm		$T_{MAX} =$	31.0	31.0	ft
	Minor Storm	Major Storm							
$T_{MAX} =$	31.0	31.0	ft						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>6.0</td> <td>inches</td> </tr> </table>		Minor Storm	Major Storm		$d_{MAX} =$	6.0	6.0	inches
	Minor Storm	Major Storm							
$d_{MAX} =$	6.0	6.0	inches						
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>								
MINOR STORM Allowable Capacity is based on Depth Criterion									
MAJOR STORM Allowable Capacity is based on Depth Criterion									
Q_{allow} =	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> <tr> <td></td> <td>SUMP</td> <td>SUMP</td> <td>cfs</td> </tr> </table>		Minor Storm	Major Storm			SUMP	SUMP	cfs
	Minor Storm	Major Storm							
	SUMP	SUMP	cfs						

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

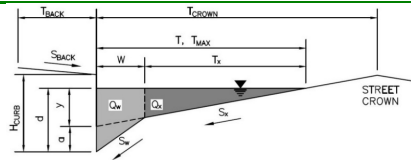


		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		1	1	
Water Depth at Flowline (outside of local depression)		6.0	6.0	inches
Grate Information				
Length of a Unit Grate		N/A	N/A	feet
Width of a Unit Grate		N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		N/A	N/A	
Curb Opening Information				
Length of a Unit Curb Opening		5.00	5.00	feet
Height of Vertical Curb Opening in Inches		6.00	6.00	inches
Height of Curb Orifice Throat in Inches		6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		0.67	0.67	
Low Head Performance Reduction (Calculated)				
Depth for Grate Midwidth		N/A	N/A	ft
Depth for Curb Opening Weir Equation		0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)				
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		5.4	5.4	cfs
Q PEAK REQUIRED		0.8	2.6	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

Inlet ID: **A-5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} =$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} =$ inches
 $T_{CROWN} =$ ft
 $W =$ ft
 $S_x =$ ft/ft
 $S_w =$ ft/ft
 $S_o =$ ft/ft
 $n_{STREET} =$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	<input type="text" value="31.0"/>	<input type="text" value="31.0"/>	ft
$d_{MAX} =$	<input type="text" value="6.0"/>	<input type="text" value="6.0"/>	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

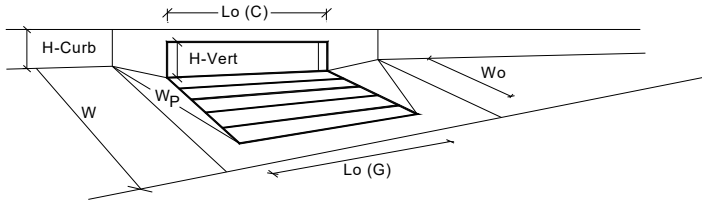
[MINOR STORM Allowable Capacity is based on Depth Criterion](#)
[MAJOR STORM Allowable Capacity is based on Depth Criterion](#)

$Q_{allow} =$

Minor Storm	Major Storm	
<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

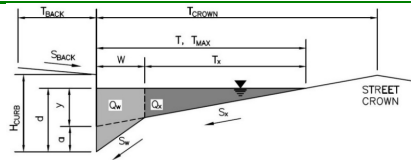


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	10.5	10.5	cfs
Q PEAK REQUIRED	2.2	8.5	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

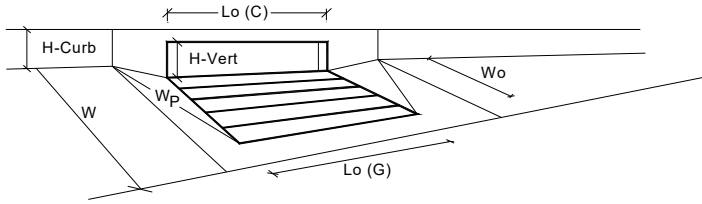
Inlet ID: **B-1**



Gutter Geometry:									
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 13.0$ ft								
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.040$ ft/ft								
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$								
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches								
Distance from Curb Face to Street Crown	$T_{CROWN} = 31.0$ ft								
Gutter Width	$W = 2.00$ ft								
Street Transverse Slope	$S_x = 0.025$ ft/ft								
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft								
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft								
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.020$								
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <td></td> <td>Minor Storm</td> <td>Major Storm</td> <td></td> </tr> <tr> <td>$T_{MAX} =$</td> <td>31.0</td> <td>31.0</td> <td>ft</td> </tr> </table>		Minor Storm	Major Storm		$T_{MAX} =$	31.0	31.0	ft
	Minor Storm	Major Storm							
$T_{MAX} =$	31.0	31.0	ft						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <td></td> <td>Minor Storm</td> <td>Major Storm</td> <td></td> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>7.0</td> <td>inches</td> </tr> </table>		Minor Storm	Major Storm		$d_{MAX} =$	6.0	7.0	inches
	Minor Storm	Major Storm							
$d_{MAX} =$	6.0	7.0	inches						
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>								
MINOR STORM Allowable Capacity is based on Depth Criterion									
MAJOR STORM Allowable Capacity is based on Depth Criterion									
Q_{allow} =	<table border="1"> <tr> <td></td> <td>Minor Storm</td> <td>Major Storm</td> <td></td> </tr> <tr> <td></td> <td>SUMP</td> <td>SUMP</td> <td>cfs</td> </tr> </table>		Minor Storm	Major Storm			SUMP	SUMP	cfs
	Minor Storm	Major Storm							
	SUMP	SUMP	cfs						

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

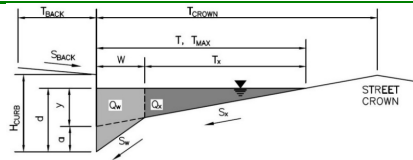


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	5.5	5.5	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.29	0.29	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.52	0.52	
Curb Opening Performance Reduction Factor for Long Inlets	0.90	0.90	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	8.2	8.2	cfs
Q PEAK REQUIRED	2.0	5.9	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

Inlet ID: **B-2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} = 2.0 ft
 S_{BACK} = 0.005 ft/ft
 n_{BACK} = 0.020

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} = 6.00 inches
 T_{CROWN} = 31.0 ft
 W = 2.00 ft
 S_x = 0.010 ft/ft
 S_w = 0.083 ft/ft
 S_o = 0.000 ft/ft
 n_{STREET} = 0.020

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	31.0	31.0	ft
d_{MAX}	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

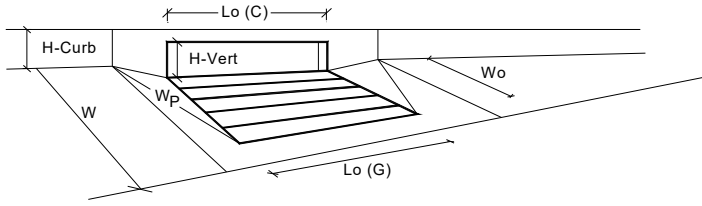
MINOR STORM Allowable Capacity is based on Depth Criterion
 MAJOR STORM Allowable Capacity is based on Depth Criterion

Q_{allow} =

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

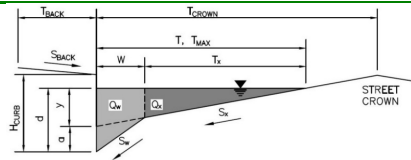


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	7.0	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.42	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.77	0.90	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	5.4	7.5	cfs
Q PEAK REQUIRED =	1.8	5.8	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

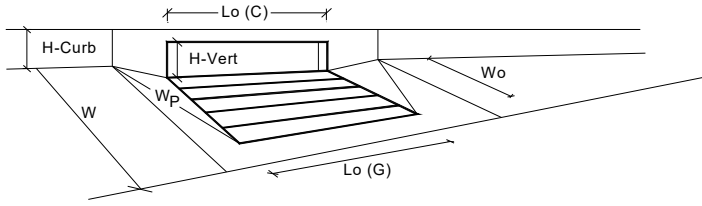
Inlet ID: **B-3**



Gutter Geometry:	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 2.0$ ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.010$ ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches
Distance from Curb Face to Street Crown	$T_{CROWN} = 30.0$ 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	$S_o = 0.000$ ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.020$
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 30.0 & 30.0 \end{matrix}$ ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 6.0 & 6.1 \end{matrix}$ inches
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>
MINOR STORM Allowable Capacity is based on Depth Criterion	
MAJOR STORM Allowable Capacity is based on Depth Criterion	
$Q_{allow} =$	$\begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ \text{SUMP} & \text{SUMP} \end{matrix}$ cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

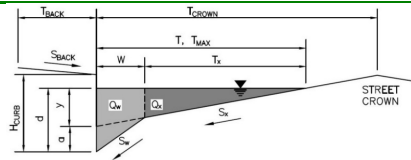


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	6.0	6.1	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.34	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	0.58	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	0.94	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	10.5	10.9	cfs
Q PEAK REQUIRED	1.7	6.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

Inlet ID: **B-4**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} =$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} =$ inches
 $T_{CROWN} =$ ft
 $W =$ ft
 $S_x =$ ft/ft
 $S_w =$ ft/ft
 $S_o =$ ft/ft
 $n_{STREET} =$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	<input type="text" value="30.0"/>	<input type="text" value="30.0"/>	ft
$d_{MAX} =$	<input type="text" value="6.0"/>	<input type="text" value="6.0"/>	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

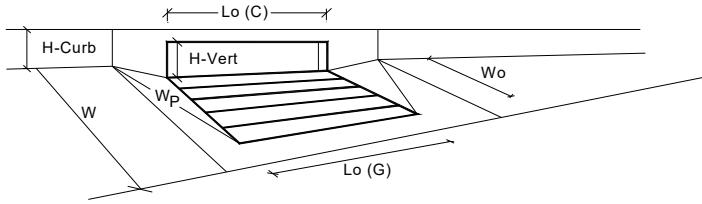
[MINOR STORM Allowable Capacity is based on Depth Criterion](#)
[MAJOR STORM Allowable Capacity is based on Depth Criterion](#)

$Q_{allow} =$

Minor Storm	Major Storm	
<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

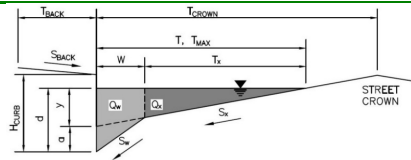


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	2	2	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
Grate Information	MINOR	MAJOR	<input type="checkbox"/> Override Depths
Length of a Unit Grate	3.00	3.00	feet
Width of a Unit Grate	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	0.60	0.60	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.66	0.66	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	0.523	0.523	ft
Depth for Curb Opening Weir Equation	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	0.71	0.71	
Total Inlet Interception Capacity (assumes clogged condition)	5.3	5.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	1.5	4.8	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: _____

Inlet ID: **B-5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} = ft
 S_{BACK} = ft/ft
 n_{BACK} =

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} = inches
 T_{CROWN} = ft
 W = ft
 S_x = ft/ft
 S_w = ft/ft
 S_o = ft/ft
 n_{STREET} =

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T _{MAX}	<input type="text" value="20.0"/>	<input type="text" value="20.0"/>	ft
d _{MAX}	<input type="text" value="6.0"/>	<input type="text" value="6.0"/>	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

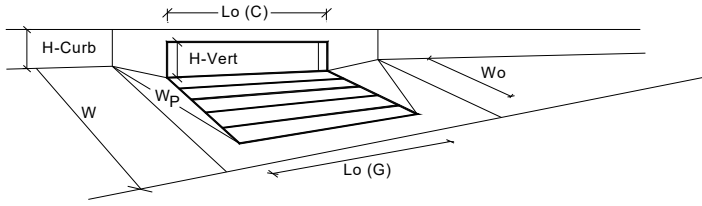
[MINOR STORM Allowable Capacity is based on Depth Criterion](#)
[MAJOR STORM Allowable Capacity is based on Depth Criterion](#)

Q_{allow} =

Minor Storm	Major Storm	
<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
Grate Information			
Length of a Unit Grate	3.00	3.00	feet
Width of a Unit Grate	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	0.60	0.60	
Curb Opening Information			
Length of a Unit Curb Opening	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.66	0.66	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	0.523	0.523	ft
Depth for Curb Opening Weir Equation	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.94	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	0.94	0.94	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	3.6	3.6	cfs
Q PEAK REQUIRED	0.5	1.6	cfs

September 3, 2021

Appendix D: Stormwater Quality Information and Details

September 3, 2021

Appendix E: Excerpts from Referenced Drainage Studies



Final Drainage Report Amendment

***Compark Village South, Filing No. 1
Parker, Colorado***

P.N. CLCPKC3

Prepared for:
470 Compark, LLC
1001 Bannock Street, Suite 240
Denver, CO 80204

Prepared by:
Manhard Consulting
7600 E Orchard Road, Suite 150N
Greenwood Village, Colorado 80111
Contact: Rick Moore, P.E.
303-708-0500

Initially Submitted September 30, 2019
Revised March 2, 2020
Revised May 5, 2020
Revised July 31, 2020

July 31, 2020

I. GENERAL LOCATION AND DESCRIPTION

A. Scope

This is an amendment to the “Final Drainage Report, Compark Village South, Filing No. 1”, prepared by Manhard Consulting, dated November 20, 2015, last revised October 21, 2016. The original scope of this project included realignment of the Green Acres Tributary and construction of an on-line regional detention pond. Since preparation of the previous design, it has been determined by a consultant for Mile High Flood Control District that the on-line regional detention basin is not required for this area. The realignment and improvements to the Green Acres Tributary will now be designed and permitted by RESPEC, the MHFD’s consultant.

This amendment is to design an off-line detention basin to control the runoff and provide water quality treatment for the proposed stormwater runoff from Compark Village South Filing No. 1 Belford Avenue improvements and the Compark Village South Filing No. 2 residential subdivision, as well as, a portion of the Compark Village South Filing No. 3 project. Drainage criteria utilized for the design are in accordance with the *Town of Parker Storm Drainage and Environmental Criteria Manual and Urban Drainage and Flood Control District*.

II. DRAINAGE BASINS AND SUB-BASINS

A. Basin Description

The basins and sub-basins utilized to size the proposed detention basin were taken from the “Final Drainage Report, Compark Village South Filing No. 1”, prepared by Manhard Consulting, dated November 20, 2015, last revised October 21, 2016. The areas include Belford Avenue from a high point at station 35+15 to the next high point at station 77+41, the 47 acres that comprise the CVS F2 project 11.5 acres of future multi-family development in CVS F3, the 15 acres of future commercial land between the Green Acres Tributary and Belford Avenue and 20 acres of off-site Grand View Estates property that currently drains through this property (H180).

In the original design, there were three direct discharges to the Green Acres Tributary and one discharge to the regional detention pond. The direct

July 31, 2020

discharge into the proposed arch culvert crossing of Belford Avenue will remain unchanged with this amendment. The other direct discharges into the Green Acres Tributary will remain, but baffle walls will be added to the structures upstream of the GAT to direct the 2 year storm runoff to a drainage pipe that will convey the runoff to the proposed off-line detention basin for water quality treatment. The elevations of the tops of the baffle walls were set at the 2 yr design storm HGL taken from the StormCAD model. The model includes rating tables in the diversion manholes to reflect the proposed diversion of the 2 yr storm flows from the pipes to the GAT. Flows greater than the 2 year storm will overtop the baffle walls and directly discharge to the Green Acres Tributary. The previous discharge to the regional detention pond will be upsized from a 42" RCP to a 60" RCP to convey the runoff from the original design plus the flows from a 2 year storm from the upstream drainage basins that previously discharged directly to the GAT. The drainage system has been revised to route the runoff from STMH 11-12 across the future commercial tract, along Green Acres Tributary and into the proposed off-line detention basin. Although runoff from portions of Belford Avenue and CVS F2 will be directly discharged to the GAT, storage and water quality treatment for these areas will be provided in the proposed detention basin. That is, compensatory storage and treatment will be provided in the proposed detention basin.

Sizing of the proposed Forebay A includes 40 acres of Grandview Estates in addition to the 93.5 acres utilized to size the detention basin. This property drains into the CVS system and was included in the calculations for the 2 year runoff being directed to the detention basin. Flows greater than the 2 year design storm will pass over the baffle wall in the diversion manhole and will discharge directly to the Green Acres Tributary, therefore, this area was not included in the sizing of the proposed detention basin.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

The regulations, guidelines, and drainage design criteria to be used are those contained within the *Town of Parker Storm Drainage Design and Environmental Criteria* and the *Urban Storm Drainage Criteria Manual*. The general drainage concept is to construct a full spectrum extended detention

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basin to provide detention and water quality treatment for the proposed stormwater runoff from a portion of Belford Avenue, the entire Compark Village South Filing No. 2 subdivision, a portion of the Compark Village South Filing No. 3 tract and the portion of the commercial tract between the Green Acres Tributary and Belford Avenue.

B. Hydrologic Criteria

The stormwater system associated with Belford Avenue (major collector) was designed for a 5 yr minor storm and the 100 yr major storm. Detailed design information for the system can be found in “Final Drainage Report, Compark Village South, Filing No. 1”, prepared by Manhard Consulting, dated November 20, 2015, last revised October 21, 2016. The UDFCD UD Detention worksheet was utilized to design the proposed extended detention basin, the proposed outlet structure, emergency overflow weir, as well as, to calculate the direct runoff from the Grand View Estates property that currently drains across this property.

The UD Detention workbook was completed for the portions of Belford Avenue, all of Compark Village South Filing No. 2, an 11.5 acre portion of Compark Village South Filing No. 3 and 15 acres of commercial area north of Belford Avenue to calculate the allowable release rates for the proposed development without the Grand View Estates area. Then the workbook was utilized to calculate the runoff from the Grand View Estates drainage basin. The 100-year runoff from Grand View Estates will be “passed through” the detention basin, i.e. the allowable 90% of the 100-year discharge from the CVS F2 basin, 42.7 cfs, was increased to include the runoff of 26.8 cfs as calculated by the UD Worksheet for the 20 acre drainage basin.

Drainage Areas to Proposed Detention Basin (See Appendix A):

- 15 ac Commercial (South of Green Acres Trib) @ 90% Impervious (assumed)
 - 47 ac CVS Filing No. 2 Residential @ 48% Impervious (calculated)
 - 11.5 ac CVS Filing No. 3 Multi-Family @ 75% Impervious (assumed)
 - 20 ac Grandview Estates (H180) @ 15% Impervious
- Total DA=93.5 ac @ 51% Impervious

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Use UD Detention to Calculate Allowable Release of Developed Areas (No Grandview Estates)

Total DA=73.5 ac @ 61% Impervious

From Spreadsheet 100 yr Predeveloped = 65.3 cfs

90% Predeveloped = 58.8 cfs

Direct Discharge to GAT $\frac{-26 \text{ cfs}}{32.8 \text{ cfs}}$ (Calculated using UD Detention)

Allowable 100 yr Release from Detention Basin:

32.8 cfs (Developed runoff) + 26.8 cfs (H180 Undetained Grand View runoff) = **59.6 cfs**

Summary of Predeveloped vs. Postdeveloped Discharges to Green Acres Tributary:

Design Storm Event	Predeveloped Flows to GAT (cfs) H170 + H180 (Grand View Estates)	Predeveloped Flows to GAT (cfs) CVS	Total Predeveloped Flow to GAT (cfs)	Developed Detained Flows (cfs)	Bypass Flows to GAT (cfs)	Total Postdeveloped Flow to GAT (cfs)
2 year	6.2	0.5	6.7	0.9	0.0	0.9
5 year	11.6	1.8	13.4	1.1	12.1	13.2
10 year	21.8	9.7	31.5	7.4	23.1	30.5
25 year	48.9	32.9	81.8	43.5	49.5	93.0
50 year	67.8	46.9	114.7	53.4	68.1	121.5
100 year	92.2	65.3	157.5	57.3	92.0	149.3
500 year	144.9	104.1	249.0	187.8	144.3	332.1

*See Appendix C for supporting runoff calculations

C. Variance from Criteria

No variance is required.

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IV. CONCLUSION

This final drainage report amendment complies with all major standards of the Town of Parker and the Urban Drainage Flood Control District. This overall plan for the site's drainage design is effective and economical for controlling damage due to excess storm runoff and minimizing erosive discharges.

Final Drainage Report

Compark Village South, Filing No. 1 – Belford Ave Site Plan Amendment Parker, Colorado

P.N. CLCPKC3

Prepared for:
Belford North Metropolitan District
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Greenwood Village, CO 80111

Prepared By:



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303-708-0500

Submitted: March 15, 2021
Revised: June 18, 2021

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I. GENERAL LOCATION AND DESCRIPTION

A. Scope

This project is part of the Compark Village South development. The purpose of this report is to demonstrate the feasibility of the proposed storm drainage system planned to control the stormwater associated with a portion of Belford Avenue and a future development. Drainage criteria are in accordance with the *Town of Parker Storm Drainage and Environmental Criteria Manual (Town Criteria)* and *Urban Drainage and Flood Control District Criteria Manual (Urban Drainage Criteria)*.

B. Location

Compark Village South Filing No. 3 – Belford Ave East lies within the south half of Section 6, Township 6 South, Range 66 West of the Sixth Principal Meridian, Town of Parker, Colorado. General project area boundaries include Highway E-470 to the north, the future Compark Village South Filing No. 3 residential development to the south, Compark Village South Filing No. 1 to the north, and Happy Canyon Creek to the east (see vicinity map in Appendix A). The project lies within drainage basin F as described in the Compark Village South Filing No. 1 drainage report (see map in Appendix D). The project includes a 1,585-foot continuation of a major collector road, Belford Avenue, running east-west connecting South Peoria Street to South Chambers Road.

C. Description of Property

The Compark Village South Filing No. 3 – Belford Ave Development Site consists of approximately 5.5 acres, and is mostly vacant with ground cover consisting of native grasses and shrubs. Onsite soils consist of Newlin gravelly sandy loam, Satanta loam and Loamy alluvial land in the area of the proposed bridge crossing. These soils are classified as hydrologic group B. Refer to Appendix A of this report for excerpts of the SCS soil survey summary.

D. Floodplain Information

Compark Village South Filing No. 3 – Belford Ave is located within the Happy Canyon Creek major drainage basin which has a regulatory 100-year floodplain. Firm Map No 08035C0062G, Effective date: March 16, 2016 reflects a Zone AE and Zone X floodplain across the eastern edge of the site. Refer to Appendix A for FIRMETTE copies of the FIRM Map. A

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Floodplain Development Permit from the Town of Parker will be required for any construction within the documented floodplains on the property.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The entirety of this project lies within the Happy Canyon Creek drainage basin, which has been studied by the Urban Drainage and Flood Control District under the following studies:

- UDFCD – Outfall System Planning – Happy Canyon Creek Watershed within Douglas County, prepared by Kiowa Consultants, June 1993. Urban Drainage in conjunction with sponsor partners Town of Parker and Douglas County are planning on updating the Happy Canyon Creek OSP.
- Green Acres Tributary is a part of the Happy Canyon Creek watershed. The upstream area of the Green Acres Tributary contains several existing and proposed development projects that contain features for which drainage studies have been prepared. All current upstream drainage features are part of the Meridian Office Park, Filings 4 & 5 (reference 5) master drainage analysis.
- Happy Canyon Creek Major Drainageway Plan, prepared by Muller Engineering Company, March 2014.
- Amendment to Happy Canyon Creek Major Drainageway Plan, March 2014, prepared by Manhard Consulting, February 2016.

The project area has further been described in the Compark Village Filing No. 1 Drainage Report as Basin F, comprised of 45 total acres. See Appendix D for the drainage map of this area.

B. Sub-Basin Description

The proposed site will be divided into several drainage sub-basins. These sub-basins have been determined based on land use, area, roadway slopes, storm sewer locations and inlet capacities. The developed site will generally follow the existing drainage patterns and runoff will be conveyed via overland flow and storm sewer to a proposed detention basin located directly south of the east side of the site.

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BEL-E1

Drainage basin BEL-E1 is composed of landscaped area, sidewalk, and the south half of a portion of Belford Avenue. Storm water will flow northeast toward Design Point 1 where it will be collected by Inlet A. This is an on grade 10' Type R inlet with the capacity to handle the runoff from a 5 year storm event. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek. In the 100 year storm event, 0.08 cfs excess runoff will bypass Inlet A and Inlet B and flow into sub basin BEL-E3 where it will be intercepted by Inlet C at Design Point 3.

BEL-E2

Drainage basin BEL-E2 is composed of landscaped area, sidewalk, and the south half of a portion of Belford Avenue. Storm water will flow east toward Design Point 2 where it will be collected by Inlet B. This is an on grade 10' Type R inlet with the capacity to handle the runoff from a 5 year storm event. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek. In the 100 year storm event, 0.21 cfs excess runoff will bypass Inlet B and flow into sub basin BEL-E3 where it will be intercepted by Inlet C at Design Point 3.

BEL-E3

Drainage basin BEL-E3 is composed of landscaped area, sidewalk, and a continuation of the south half of Belford Avenue. Storm water will flow from the northwest and southeast towards Design Point 3 where it will be collected by Inlet C. This is a 10' Type R inlet in sump with the capacity to handle the runoff from a 100 year storm event plus the bypass from basins BEL-E1 and BEL-E2. Inlet C is in a 500-foot sag vertical curve. Street capacity for this inlet has been analyzed at 100-feet from the low point, showing adequate street capacity and conformance to section 6.3.2 of the Town Criteria. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek.

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BEL-E4

Drainage basin BEL-E4 is composed of landscaped area, sidewalk, and a continuation of the south half of Belford Avenue, as well as, the south half of the proposed bridge over Happy Canyon Creek. This drainage basin also includes approximately 150' of Belford Avenue located within the proposed Chambers Highpoint project. Storm water will flow from the southeast towards Design Point 3 where it will be collected by Inlet C. This is a 10' Type R inlet in sump with the capacity to handle the runoff from a 100 year storm event for BEL-E3 and BEL-E4 plus the bypass from basins BEL-E1 and BEL-E2. This inlet will also collect 0.1 cfs from Chambers Highpoint in the 5 yr storm and 3.0 cfs in the 100 yr storm. Inlet C is in a 500-foot sag vertical curve. Street capacity for this inlet has been analyzed at 100-feet from the low point, showing adequate street capacity and conformance to section 6.3.2 of the Town Criteria. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek.

BEL-E5

Drainage basin BEL-E5 is composed of future landscaped area, sidewalk, and the north half of a portion of Belford Avenue. Storm water will flow northeast toward Design Point 4 where it will be collected by Inlet D. This is an on grade 10' Type R inlet with the capacity to handle the runoff from a 5 year storm event. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek. In the 100 year storm event, 0.36 cfs excess runoff will bypass Inlet D and flow into sub basin BEL-E6 where it will be intercepted by Inlet E at Design Point 5.

BEL-E6

Drainage basin BEL-E6 is composed of future landscaped area, sidewalk, and the north half of a portion of Belford Avenue. Storm water will flow east toward Design Point 5 where it will be collected by Inlet E. This is an on grade 10' Type R inlet with the capacity to handle the runoff from a 5 year storm event. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek. In the 100 year storm event, 0.67 cfs excess runoff will bypass Inlet E and flow

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into sub basin BEL-E7 where it will be intercepted by Inlet F at Design Point 6.

BEL-E7

Drainage basin BEL-E7 is composed of future landscaped area, sidewalk, and the north half of a portion of Belford Avenue. Storm water will flow from the northwest towards Design Point 6 where it will be collected by Inlet F. This is a 10' Type R inlet in sump with the capacity to handle the runoff from a 100 year storm event plus the bypass from basin BEL-E5 and BEL-E6. Inlet F is in a 500-foot sag vertical curve. Street capacity for this inlet has been analyzed at 100-feet from the low point, showing adequate street capacity and conformance to section 6.3.2 of the Town Criteria. From there, storm water will be conveyed to the proposed detention/water quality pond just southeast of Belford Avenue via storm sewer. This pond discharges directly to Happy Canyon Creek.

BEL-E8

Drainage basin BEL-E8 is composed of landscaped area, sidewalk, and a continuation of the north half of Belford Avenue, as well as, the north half of the proposed bridge over Happy Canyon Creek. This drainage basin also includes approximately 150' of Belford Avenue located within the proposed Chambers Highpoint project. Storm water will flow from the southeast towards Design Point 6 where it will be collected by Inlet F. This is a 10' Type R inlet in sump with the capacity to handle the runoff from a 100 year storm event for BEL-E3 and BEL-E4. Inlet F is in a 500-foot sag vertical curve. Street capacity for this inlet has been analyzed at 100-feet from the low point, showing adequate street capacity and conformance to section 6.3.2 of the Town Criteria. From there, storm water will be conveyed to the proposed detention/water quality basin just southeast of Belford Avenue via storm sewer. This detention basin discharges directly to Happy Canyon Creek.

POND

The drainage for the portion of Belford Avenue being constructed, as well as, future construction of Belford Avenue, and a future residential development, will all drain to the proposed detention basin. The pond is comprised of landscape area with drainage features such as a trickle channel, forebays, and an outlet structure. The detention basin has been designed with the 7.2 acres of Belford Avenue drainage, 1.08 acres from the pond area itself, and 6.5 acres of drainage from the development that will

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follow in the future, indicated by basin F3. The detention basin has been designed for the areas described and shown on the attached drainage map in appendix D. Any areas outside of the basins shown have not been included in the detention basin volume calculation. The detention basin discharges directly to Happy Canyon Creek.

F3

Drainage basin F3 in its existing state is composed of undeveloped land and drains directly to Happy Canyon Creek. In developed conditions, it was assumed that the drainage basin would be 6.5 acres, making the total drainage area to the pond 14.77 acres. The imperviousness of the F3 subbasin was assumed to be 75%. The imperviousness of the basin was assumed to be 61% over the entire 14.77 acres. In developed conditions, there will be a need for an inlet to capture the runoff from basin F3. Since walls are being constructed inside the detention basin, an inlet will be installed with pipe to the detention basin that will be used in the future development of the basin. The drainage for the development of this basin will be addressed by a separate drainage report.

The Compark Village Filing No. 1 Drainage Report identifies the area as Basin F, which totals 45 acres. The detention basin has been designed to accommodate the 14.77 acres tributary to the detention basin, leaving the remaining 30+/- acres draining to Happy Canyon Creek as it had in the existing condition.

III. DRAINAGE CHANNELS

A. Happy Canyon Creek

Happy Canyon Creek is a major basin that is tributary to Cherry Creek. The portion of Happy Canyon Creek thalweg that extends through the proposed site is a natural sandy bottom channel. The thalweg has an existing natural meander bend located near the southwest corner of the site. No apparent head cutting exists within this channel reach. The active channel is a dry stream bed that experiences active flows during wet seasonal conditions.

As discussed earlier, a Zone AE and Zone X floodplain exist along Happy Canyon Creek. It is anticipated that bank stabilization will be required along the outer edges of the existing meander bends. No major channel improvements are contemplated for Happy Canyon Creek, except the construction of a roadway bridge crossing needed for Belford Avenue and installation of grade control structures. This bridge structure will span the

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existing floodplain. Floodplain mitigation is anticipated through the thalweg. Felsburg Holt & Ullevig (FHU) has been contracted to perform the proposed bridge design and floodplain mitigation. All proposed improvements to Happy Canyon Creek are addressed in the “Conditional Letter of Map Revision (CLOMR) for Happy Canyon Creek at Belford Avenue” found in Appendix E.

A CLOMR has been obtained from FEMA to construct the proposed bridge crossing and proposed improvements to Happy Canyon Creek. The CLOMR was issued November 20, 2019 and the Case No. is 19-08-0690R.(See Appendix E)

Verification has been obtained from the USACOE that the proposed Happy Canyon improvements are authorized by Nationwide Permit (NWP) 29, Residential Developments.(See Appendix E for verification letter)

A floodplain development permit will be required from the Town of Parker for the proposed bridge and channel improvements.

UDFCD and the Town of Parker have sponsored an update to the existing Happy Canyon Creek Outfall Systems Plan (OSP) and the 2014 Happy Canyon Creek Major Drainageway Plan (MDP). Any recommendations to channel upgrades to this reach of Happy Canyon Creek need to meet the recommendations of the OSP and 2014 MDP. Channel design and the Happy Canyon Creek bridge design must be reviewed and approved by UDFCD prior to the approval of associated drawings.

Note: All channel improvement design and construction shall meet the minimum requirements of the UDFCD maintenance eligibility program.

IV. DRAINAGE DESIGN CRITERIA

A. Regulations

The regulations, guidelines, and drainage design criteria to be used are those contained within the *Town of Parker Storm Drainage Design and Environmental Criteria* and the *Urban Storm Drainage Criteria Manual*. The general drainage concept is to construct a full spectrum detention basin to provide detention and water quality before releasing runoff from Belford Avenue and future residential development into Happy Canyon Creek.

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The Town's Stream Preservation Standards will be met by providing a natural, undisturbed buffer between the proposed improvements and the Happy Canyon Creek, providing a maintenance road for the length of Happy Canyon Creek within this project and constructing grade control structures within Happy Canyon Creek to minimize erosion of the channel and thereby provide a more stable channel to minimize water pollution, enhance vegetation communities and thereby provide wildlife habitats.

B. Hydrologic Criteria

The Town of Parker *Storm Drainage and Environmental Criteria Manual* and the Urban Drainage and Flood Control District (UDFCD) *Urban Storm Drainage Criteria Manual* were used for the storm drainage system design.

The following criteria was utilized in developing the proposed drainage system:

- The proposed drainage system is designed to match, as best as possible, the historic drainage patterns occurring at the site.
- The proposed drainage system attempts to limit the diversion of storm runoff from one basin to another (basin transfer).
- Runoff generated from drainage sub-basins is conveyed via the proposed storm sewer system into the proposed detention and water quality pond.

Design Rainfall: UDFCD rainfall data is used to determine peak runoff values. The 5-year and 100-year frequency storms are used as the minor and major design storms respectively.

Runoff Calculation: Peak storm runoff is determined using the rational formula,

$$Q = CIA \text{ (CFS)}$$

C = Runoff coefficient based on surface impermeability

I = Rainfall intensity in inches per hour


A = Drainage basin area in acres

UDFCD Imperviousness Values (Table 6-3) and Runoff Coefficients (Table 6-5) were used to develop basin runoff coefficients. These tables can be found in Appendix B. The runoff coefficients are weighted for each applicable sub-basin to more accurately reflect the runoff characteristics of the site.

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Time of Concentration is determined using the criteria in Sections 3.4.1 and 3.4.2 of the UDFCD Criteria Manual. These calculations are included in Appendix B.

Rainfall intensities are determined using the Town of Parker’s *Storm Drainage and Environmental Criteria Manual* Point Rainfall data and Intensity-Duration curves. The rainfall intensities utilized were:

ONE HOUR RAINFALL DEPTH TABLE							
PROJECT NAME: Compark Village South - Belford Avenue East							
PROJECT NO: CLCPKC3							
LOCATION: Town of Parker, Colorado							
*Calculations on this sheet come from UDFCD: Urban Storm Drainage Criteria Manual (V.1) (2017)							
2 year		5 year		10 year		100 year	
Time (min.)	Intensity P ₁ (in/hr)	Time (min.)	Intensity P ₁ (in/hr)	Time (min.)	Intensity P ₁ (in/hr)	Time (min.)	Intensity P ₁ (in/hr)
60	0.83	60	1.09	60	1.33	60	2.31

C. Hydraulic Criteria

The following *Town Criteria* were utilized in determining allowable street flow.

Minor Storm (5-yr) from Table 2.4

- Collector Street – No curb overtopping. Flow Spread must leave at least a 10 foot width free of water. (5-feet on each side of crown for roads without median. 10-feet on each side of median for roads with a median.)

Major Storm (100-yr) from table 2.5

- Local and Collector Streets – The depth of water at the gutter flowline shall not exceed 12 inches. A minimum of 18-inches must be provided from the water surface elevation to the lowest floor elevation or window well opening elevation for structures that are adjacent to the roadway (this includes residential dwellings, public, commercial and industrial buildings).

For the major and minor storm events, allowable capacity was determined using UD-Inlet version 4.06 by UDFCD.

The following *Town Criteria* were utilized in determining proposed drainage system pipe sizes:

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Minor Storm (5-yr)

- the hydraulic grade line must be located below the crown of the pipe

Major Storm (100-yr)

- the hydraulic grade must be located 12-inches below finished grade as a maximum condition.

For the major and minor storm events, HGL's were calculated utilizing Bentley StormCAD modelling software.

V. DRAINAGE FACILITY DESIGN

A. General Concept

Stormwater runoff from the proposed improvements will generally follow existing drainage patterns from northwest to southeast on the site. Overland flow and a proposed storm sewer system will route the runoff to the proposed detention and water quality basin. This detention basin will release restricted flows directly into Happy Canyon Creek.

B. Specific Details

As mentioned previously in this report, the site will be divided into several drainage sub-basins. The onsite runoff will be routed through the site via the proposed roadways and gutters where it will be intercepted by a number of on-grade inlets and inlets located in roadway sumps. This runoff will be routed, via storm sewer, directly to the proposed detention/water quality basin. The detention basin has been sized to accommodate the flows resulting from the areas shown on the drainage map. Any area outside of the basins depicted on the drainage map and described in this report have not been considered as tributary to the proposed detention basin.

The proposed full spectrum detention/water quality basin has been sized to intercept surface runoff from a portion of Belford Avenue, as shown on the drainage map, and a developed residential area, referred to as F3 in the sub-basin descriptions, for a total of approximately 14.77 acres (Full Buildout). The detention basin will release attenuated flows into the existing natural drainageway of Happy Canyon Creek via an outlet structure. The outlet structure has been designed to release controlled WQCV, EURV, and 100-year volume flows, allowing for sediment and trash removal and decreasing adverse downstream impacts. The detention basin will restrict 100 year flows from the developed project to 90% of the historic flows of the project area. Required detention volumes were calculated using the MHFD-Detention

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spreadsheet v4.04 as described in the Town of Parker Storm Drainage and Environmental Criteria Manual. Basin tables and charts used in the rational method analysis, along with calculation sheets, are provided in Appendix B.

C. Variance from Criteria

No variances will be required for this project.

VI. ENVIRONMENTAL PROTECTION CRITERIA

A. General

Site drainage improvements are intended to minimize the impact to the environment. The proposed improvements to the Happy Canyon Creek required permitting through FEMA. As part of this permitting process, requirements regarding potential impacts to wetland areas and to threatened and endangered species were identified and the proper permitting was obtained. Specifics are included in the “Conditional Letter of Map Revision (CLOMR) for Happy Canyon Creek at Belford Avenue”, page 14. (See Appendix E).

B. Construction BMP Plan

Construction BMPs shall be placed during the appropriate construction phases to minimize soil erosion and the movement of sediment offsite. Construction BMPs shall be placed in two phases (Phase A and Phase B). The intent of the Phase A BMPs are to fulfill water quality objectives during the overlot and roadway rough grading phase of the project. Once Phase A rough grading and earthmoving is completed, Phase B BMP placement will commence. Phase B includes fine grading, utility construction, and street construction. Construction Plans will contain all appropriate Stormwater Management Details. In addition, a Stormwater Management Plan will be prepared to meet the town of Parker, State of Colorado, and Environmental Protection Agency criteria.

VII. CONCLUSION

This drainage report is intended to comply with all major standards of the Town of Parker and the Urban Drainage Flood Control District. This overall plan for the site’s drainage design is effective and economical for controlling damage due to excess storm runoff and minimizing erosive discharges. This plan is intended to

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integrate into the future basin planning efforts by UDFCD, Douglas County and the Town of Parker when the Happy Canyon Creek Outfall System Planning study is updated.