



## STRUTHERS RANCH SUBDIVISION, FILING NO. 5

### EL PASO COUNTY, COLORADO

### DRAINAGE LETTER REPORT

Prepared for:  
**T-Bone Construction, Inc.**  
1310 Ford Street  
Colorado Springs, Colorado 80915

phone: (719) 570-1456

Prepared by:  
**CIVAS Engineering, LLC**  
10056 Brisbane Lane  
Littleton, Colorado 80130

phone: (720) 240-5882

October 26, 2020  
Project No. 20-288

Please add the  
following: "PCD File  
No. VR211"

**I. DESIGN ENGINEER'S STATEMENT:**

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

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Steven M. Strickling, P.E.  
Colorado Number 31237  
For and On Behalf of CIVAS Engineering, LLC

**II. OWNER/DEVELOPER'S STATEMENT:**

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

---

[Name, Title] ←

Clark Family Trust  
3585 Hill Circle  
Colorado Springs, Colorado 80906

type the name and  
title

---

Date

**III. EL PASO COUNTY:**

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

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Jennifer Irvine, P.E.  
County Engineer / ECM Administrator

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Date

Please reference the original drainage report in order to justify the submission of a drainage letter for this project.

## **INTRODUCTION**

This report represents a “Letter Type” drainage report for Struthers Ranch Subdivision Filing No. 5 and was prepared in accordance the El Paso County Drainage Criteria Manual (DCM) and satisfies the El Paso County subdivision submittal requirements. This report was also prepared using portions of the City of Colorado Springs DCM and the Mile High Flood District (MHFD) "Urban Storm Drainage Criteria Manual", latest editions.

This report addresses post-development storm peak runoff rates for the 5-year and 100-year storm events. Stormwater detention is provided for the project by an existing regional facility located southwest of the subject property. Water quality is addressed in this report.

## **PROPERTY LOCATION AND DESCRIPTION**

Struthers Ranch Filing No. 5 is a proposed replat of the 4.16 Struthers Ranch Filing No. 4 and will combine Lots 1, 2, 3 and 4 into one 4.16 acre commercial lot. The planned use for Struthers Ranch Filing No. 5 is for a three building commercial / retail development. The property is surrounded by existing platted and developed residential lots on the northeast and east, by Struthers Road, a public right-of-way, to the south and the southwest, and by Struthers Ranch Road, a public right-of-way, to the northwest. Access to the site is from an existing driveway cut in Struthers Ranch Road and a proposed right-in right-out driveway cut in Struthers Road, if allowed by El Paso County.

FIGURE 1 - VICINITY MAP



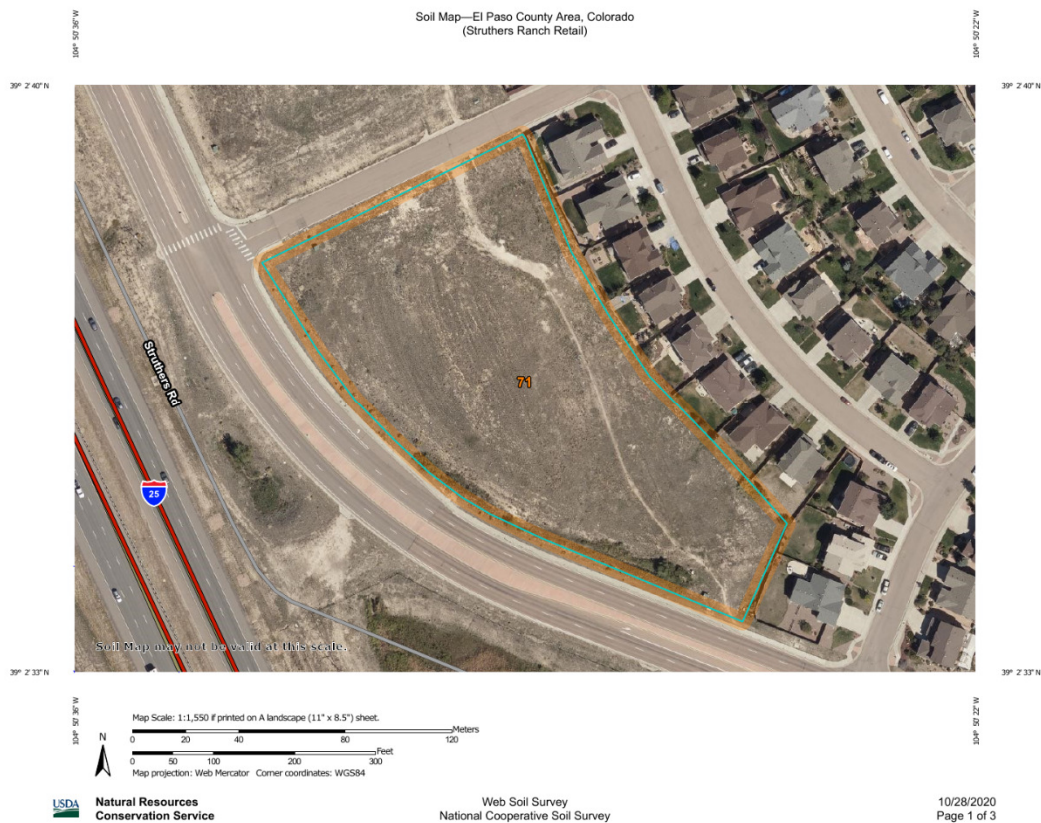
## VICINITY MAP

$1'' = 2,000'$

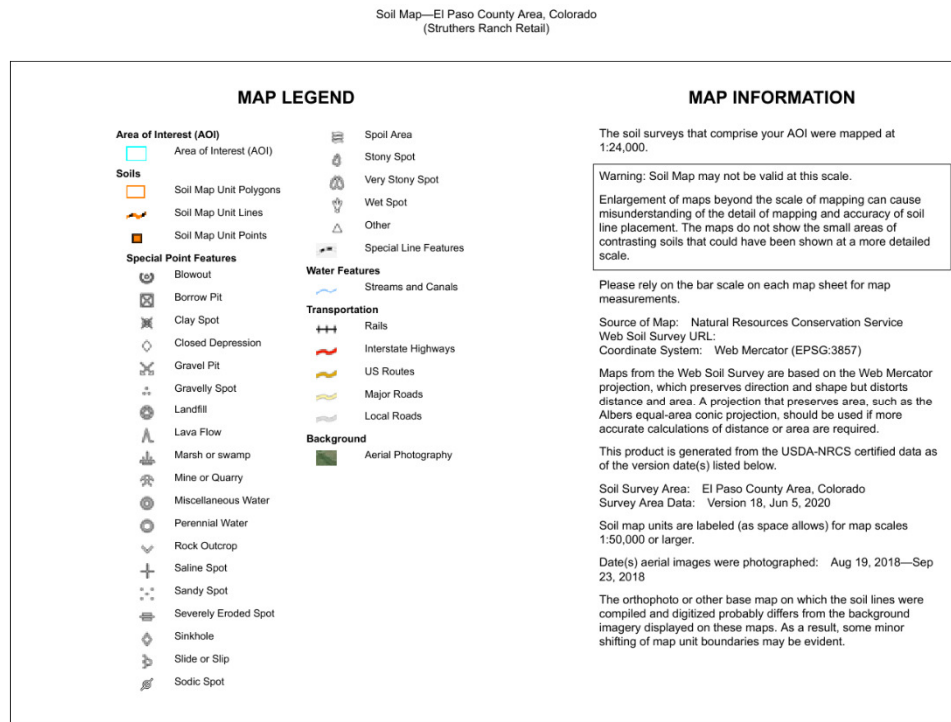


Soil on the majority of the site, as classified by the Soil Conservation Services of the U.S. Department of Agriculture in the Soil Survey for the El Paso County Area (refer to figures 2, 3 and 4), is Pring coarse sandy loam (71). This soil type has a slow runoff rate and a rapid permeability rate. Pring coarse sandy loam (71) is part of hydrologic soil group B (refer to figure 5).

**FIGURE 2 – SCS SOIL SURVEY MAP**



## FIGURE 3 – SCS SOIL SURVEY MAP LEGEND



## FIGURE 4 – SCS SOIL SURVEY SOIL MAP UNITS

Soil Map—El Paso County Area, Colorado

Struthers Ranch Retail

### Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	4.1	100.0%
<b>Totals for Area of Interest</b>		<b>4.1</b>	<b>100.0%</b>

## FIGURE 5 – SCS SOIL SURVEY HYDROLOGIC SOIL GROUP

Hydrologic Soil Group---El Paso County Area, Colorado

Struthers Ranch Retail

### Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	4.1	100.0%
Totals for Area of Interest			4.1	100.0%

### Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

The project site is part of the Black Forest Drainage Basin (FOM04200) and is tributary to Black Forest Creek, located approximately 0.1 miles to the south, which outfalls in Monument Creek, located approximately 0.5 miles to the west.

### DRAINAGE CRITERIA

The El Paso County Drainage Criteria Manual (DCM), the City of Colorado Springs DCM and the Mile High Flood District (MHFD) "Urban Storm Drainage Criteria Manual, latest editions were used in the preparation of this report. The Rational Method was used to calculate the post-development storm peak flows for the 5-year and 100-year storm events

### FLOODPLAIN IMPACTS

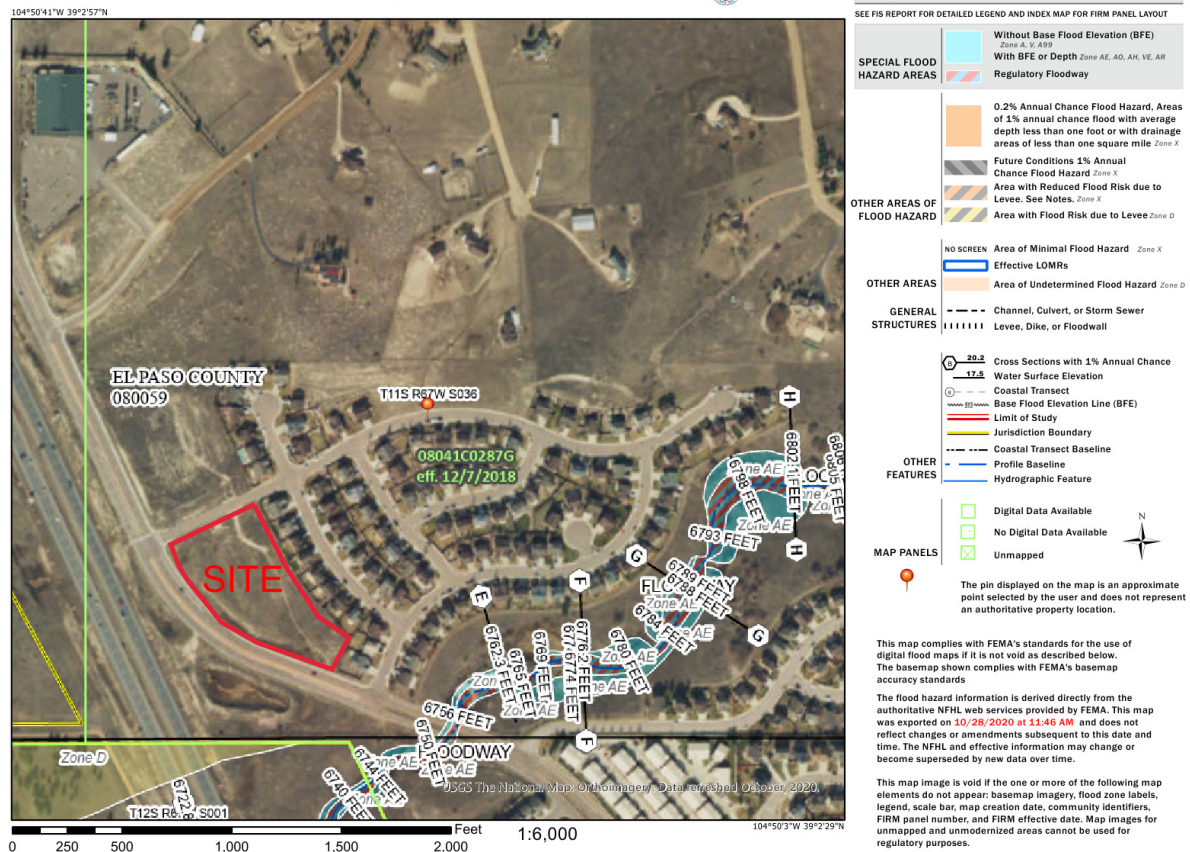
The FEMA Flood Insurance Rate Map (FIRM) firmette for Community Panel 08041C0287G, revised March 16, 2016 (refer to figure 6) shows that no portion of this development lies within the 100-year flood plain of Black Forest Creek, nor its

Please update panel revision date to 12/7/2018.

tributaries.

**FIGURE 6 – FIRM FIRMETTE FOR COMMUNITY PANEL 08041C0287G**

### National Flood Hazard Layer FIRMette



### EXISTING DRAINAGE BASINS

Please provide an existing conditions drainage map placed before the developed conditions map.

The project site is located in Drainage Basin D6A (3.05 ac.) and Drainage Basin D9A (3.18 ac.) as shown on the Developed Drainage Plan for Struthers Ranch Subdivision, located in the appendix of this report. Off-site flows from the back half of the adjacent single family residential lots flow onto the project site and are a part of both Drainage Basin D6A and Drainage Basin D9A. Drainage Basin D6A surface flows to an existing grated area inlet located in the low point of the basin, adjacent to Struthers Road. Drainage Basin D9A surface flows to an existing drainage channel along the



Coordinate with Struthers Ranch HOA and update the drainage letter to identify how this is going to be corrected.

Be aware: A condition of approval may need to be included on the subsequent site development plan for the developer to conduct maintenance on the pond ensure the pond is functioning as designed when the retail center is being constructed.

flows flow to an existing 30" RCP culvert that  
Drainage Basin D6A. An existing 30" RCP  
Lane outfalls into the drainage channel in  
conveys developed runoff to an existing

regional detention pond in Tract C, Struthers Ranch Subdivision Filing No. 2, located southwest of the project site on the west side of Struthers Road. The regional detention pond does not appear to have been properly maintained and is overgrown with grass/reeds. This condition should be corrected so that it functions as designed and so that the proposed Struthers Ranch Subdivision Filing No. 5 project does not create any negative drainage impacts on downstream properties.

## DEVELOPED DRAINAGE BASINS

The proposed Struthers Ranch Subdivision Filing No. 5 commercial development has been divided into 11 on-site basins (A1, A2, B - J) and 4 off-site basins (OS1-OS4) from the back half of the adjacent single family residential lots. Off-site basin OS1 sheet flows into basin A1, off-site basin OS2 sheet flows into basin A2, off-site basin OS3 sheet flows into basin C and off-site basin OS4 sheet flows into basin E. Runoff from basins A1, A2, B, C, D and E surface flow across the pavement to concrete pans and catch curb and gutter to inlets located in the low point of the basin. A storm sewer system conveys developed runoff from the inlets to the water quality Extended Detention Basin (EDB) in basin G. Runoff from basin F is collected by a roof drain system and discharges into the inlet on basin E. Basins H, I and perimeter landscape areas and are part of the existing drainage channel on the southwest part of the site. Basin J is the perimeter landscape area on the north and northwest portion of the project site and surface drains to the existing grated area inlet on the west side of the site. The basins, design points, inlets, pipes and developed flows are shown on the developed drainage plan in the appendix. The developed flows for the basins and for the design points are summarized on the following pages.

discuss where  
stormwater goes from  
either the drainage  
channel or the inlet.

Basin Summary Table							
Basin Name	Area (ac)	Percent Imperviousness	Time of Concentration tc (min)	Rainfall Intensity I (in/hr)		Peak Flow Q (cfs)	
				5-yr	100-yr	5-yr	100-yr
A1	0.63	80.0%	5.73	4.97	8.34	2.18	4.20
A2	0.34	76.0%	6.73	4.72	7.93	1.08	2.11
B	0.13	95.1%	5.00	5.17	8.68	0.54	0.98
C	0.32	93.1%	5.30	5.08	8.53	1.37	2.51
D	0.83	89.4%	5.00	5.17	8.68	3.49	6.45
E	0.85	73.9%	11.32	3.94	6.62	2.30	4.51
F	0.27	90.0%	5.00	5.17	8.68	1.01	1.89
G	0.17	16.0%	11.10	3.97	6.67	0.13	0.48
OS1	0.41	40.0%	7.08	4.65	7.80	0.57	1.59
OS2	0.33	40.0%	7.08	4.65	7.80	0.46	1.29
OS3	0.16	40.0%	7.92	4.48	7.52	0.22	0.61
OS4	0.20	40.0%	8.67	4.34	7.29	0.26	0.72
H	0.13	0.0%	5.00	5.17	8.68	0.05	0.39
I	0.16	0.0%	5.00	5.17	8.68	0.07	0.50
J	0.29	0.0%	10.14	4.11	6.90	0.10	0.70

Design Point Summary Table								
Design Point	Tributary Basin(s)	Total Area (ac)	Composite Percent Imperviousness	Time of Concentration tc (min)	Rainfall Intensity I (in/hr)		Peak Flow Q (cfs)	
					5-yr	100-yr	5-yr	100-yr
1	OS1, A1, OS2, A2	1.70	61.9%	6.73	4.72	7.93	4.20	9.03
2	OS1, A1, OS2, A2, B	1.83	64.2%	7.08	4.65	7.80	4.62	9.77
3	OS3, C	0.48	75.2%	8.96	4.29	7.21	1.37	2.70
4	D	0.83	89.4%	5.00	5.17	8.68	3.49	6.45
5	OS1, A1, OS2, A2, B, C, D	3.14	72.5%	8.07	4.45	7.47	8.84	17.70
6	E, F	1.12	77.8%	11.13	3.97	6.66	3.09	5.99
7	OS1, A1, OS2, A2, B, C, D, E, F	4.26	73.9%	13.29	3.70	6.22	10.25	20.32
8	OS1, A1, OS2, A2, B, C, D, E, F, G	4.43	71.7%	14.00	3.62	6.08	10.14	20.32
D9A*	D9A*	14.45	40.0%	9.00	4.29	7.20	18.58	52.01
9	D9A*, H	14.58	39.6%	9.00	4.29	7.20	18.63	52.33
10	D9A*, H, I	14.74	39.2%	9.00	4.29	7.20	18.69	52.74
11	OS1, A1, OS2, A2, B, C, D, E, F, G, D9A*, H, I	19.47	46.0%	18.67	3.19	5.36	22.92	57.72
* PER THE FINAL DRAINAGE REPORT FOR STRUTHERS RANCH FILING NO. 2								

## WATER QUALITY

Water quality capture volume is provided for the proposed project in the Extended Detention Basin (EDB) in basin G and has been designed using the MHFD-Detention\_v4.00 spreadsheet. The on-site tributary drainage area to the EDB, for determining the water quality capture volume (WQCV), is 3.53 acres (basins A1, A2, B, C, D, E, F and G) and has a calculated composite imperviousness of 79.8%. The EDB will provide 0.096 ac-ft of WQCV storage volume with a water surface elevation of 6757.84. An orifice plate with 1 column and 3 rows of 3/4" dia. holes spaced at 0.8 ft on center, located in the EDB outlet structure, will provide the release of the water quality capture volume in 40 hours. The forebay, located in the upper end of the EDB, will provide additional water quality enhancement by providing an initial sediment storage volume of 84 c.f., which is 2% of the water quality capture volume. The forebay release flows into a concrete low flow channel designed to convey 0.38 cfs, which is 2% of the 100-year inflow rate into the EDB. The total tributary drainage area to the EDB (including the 4 off-site basins) is 4.43 ac. and has a calculated composite

Please reference ECM I.7.1.C regarding water quality exclusions for basins that will not be included in WQ treatment. Please contact Review Engineer Lupe Packman at lupepackman@elpasoco.com or 719-313-6215

update to match the MHFD-Detention computation or vise versa.

imperviousness of 71.7%. Flows in excess of the WQCV will flow through the top of the grated outlet structure to a 24" RCP outfall pipe. The 24" RCP storm sewer will convey the 100-year developed flows from the outlet structure to the existing grated area inlet in basin J. Should the outlet structure become clogged, a 25 ft. wide buried rip rap emergency overflow weir at elevation 6758.60 will convey the 100 year developed peak inflow rate of 19.1 cfs (as calculated in the MHFD-Detention\_v4.00 spreadsheet) from the detention pond at a depth of 0.38 feet and with a freeboard

Per DCM 11.2.2, access ramps shall be a minimum of 15 feet wide. Please revise.

of 1.02 feet to the top of the 8' wide EDB berm. Maintenance access to the pond provided by an 11' wide gravel access ramp with a slope of 7%, and will extend from the paved parking lot down to the bottom of the EDB.

Inspection and maintenance of the water quality storage volume area and orifice plate, as well as for the forebay, will be performed as described in the "Standard Operation Procedure (SOP) For Extended Detention Basin (EDB) Inspection and Maintenance" manual prepared for this project. The maintenance and repair of the water quality features of the EDB will be performed as described in the "Standard Operation

Update the narrative to provide a comparison to the original Final Drainage Report to summarize whether the 5 year and 100 year release flows are in conformance with the original drainage report.

## **DRAINAGE FEES**

This project site lies within the Black Forest Creek Drainage Basin. All applicable drainage basin fees were paid at the time of platting for Struthers Ranch Subdivision Filing No. 2.

Add a section regarding the four step process (see ECM Appendix I Section I.7.2). List each step and within each step explain how the step was implemented or considered in your drainage design.

## **CONCLUSIONS**

### A. Compliance with Standards

This report has been prepared in accordance with the El Paso County Drainage Criteria Manual guideline for a "Letter Type" Drainage Report. The storm sewer and water quality improvements provide adequate protection to this site without adverse impacts on adjoining upstream or downstream properties.



## B. Drainage Concept

The proposed drainage patterns and drainage design for the Struthers Ranch Subdivision Filing No. 5 commercial development project conforms to the approved developed drainage plan for Struthers Ranch Subdivision Filing No. 2. Developed runoff from this subdivision will be conveyed by an existing public drainage system to an existing regional detention pond located on Tract C, Struthers Ranch subdivision Filing No. 2, which releases flows at historic rates, mitigating the impacts of the upstream development on downstream properties.

## **REFERENCES**

1. "El Paso County Drainage Criteria Manual" and updates.
2. Mile High Flood District Urban Storm Drainage Criteria Manual, latest editions.
3. The United States Department of Agriculture, Natural Resources Conservation Service, "Web Soil Survey" data for the project site, retrieved from <http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.asp>.
4. Federal Emergency Management Agency Firmette for Flood Insurance Rate Map Number 08041C0287G, dated 12/7/2018.
5. Final Drainage Report for Struthers Ranch Filing No. 2, prepared by JPS Engineering, October 14, 2004 (revised).

Please revise reference manual list to include  
EPC ECM revision year 2020.

Add the Drainage Letter for Struthers Ranch  
Subdivision Filing No. 4.  
(document is available on eDARP under PCD  
File No VR05015)

## **APPENDIX**

Hydrologic Calculations

Hydraulic Calculations

Existing Conditions Drainage Plan

Developed Drainage Plan

Please highlight runoff coefficients used.

**Table 6-6. Runoff Coefficients for Rational Method**  
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

### 3.2 Time of Concentration

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

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

### Calculation of Imperviousness and Runoff Coefficient Values

**Designer:** SMS  
**Company:** CIVAS Engineering, LLC  
**Date:** 10/26/2020  
**Project Name:** Struthers Ranch Retail  
**Project Number:** 20-288

	Hydrological Soil Group: B Land Use: Imperviousness: C <sub>2</sub> : C <sub>5</sub> : C <sub>100</sub> :	Paved	Drives	Concrete/ Walks	Roofs	Gravel Roads	Lawns/ Native	Residential 1/4 ac.			Sub-Basin Composite Imperviousness and Runoff Coefficient Values			
		100%	90%	100%	80%	0%	40%							
		0.89	0.89	0.71	0.57	0.02	0.23							
		0.90	0.90	0.73	0.59	0.08	0.30							
		0.96	0.96	0.81	0.70	0.35	0.50							
Design Point	Subcatchment Basin(s)	Area (s.f.)	Area (s.f.)	Area (s.f.)	Area (s.f.)	Area (s.f.)	Area (s.f.)	Total Area (s.f.)	Total Area (ac.)	Imp. %	C <sub>2</sub>	C <sub>5</sub>	C <sub>100</sub>	
	A1	11,380	1,085	10,400	0	4,405	0	27,270	0.63	80.0%	0.68	0.70	0.80	
	A2	6,110	365	5,340	0	3,025	0	14,840	0.34	76.0%	0.65	0.67	0.78	
	B	2,670	180	2,700	0	0	0	5,550	0.13	95.1%	0.80	0.82	0.89	
	C	12,090	885	0	0	960	0	13,935	0.32	93.1%	0.83	0.84	0.92	
	D	28,845	3,460	0	0	3,840	0	36,145	0.83	89.4%	0.80	0.81	0.90	
	E	24,265	3,115	0	0	9,675	0	37,055	0.85	73.9%	0.66	0.69	0.80	
	F	0	0	11,700	0	0	0	11,700	0.27	90.0%	0.71	0.73	0.81	
	G	0	135	0	1,310	5,970	0	7,415	0.17	16.0%	0.13	0.19	0.42	
	TOTAL (for WQCV)	85,360	9,225	30,140	1,310	27,875	0	153,910	3.53	79.8%	0.69	0.72	0.82	
	OS1	0	0	0	0	0	17,720	17,720	0.41	40.0%	0.23	0.30	0.50	
	OS2	0	0	0	0	0	14,425	14,425	0.33	40.0%	0.23	0.30	0.50	
	OS3	0	0	0	0	0	7,065	7,065	0.16	40.0%	0.23	0.30	0.50	
	OS4	0	0	0	0	0	8,640	8,640	0.20	40.0%	0.23	0.30	0.50	
	TOTAL (tributary to EDB)	85,360	9,225	30,140	1,310	27,875	47,850	201,760	4.63	70.3%	0.58	0.62	0.74	
	H	0	0	0	0	5,590	0	5,590	0.13	0.0%	0.02	0.08	0.35	
	I	0	0	0	0	7,160	0	7,160	0.16	0.0%	0.02	0.08	0.35	
	J	0	0	0	0	12,635	0	12,635	0.29	0.0%	0.02	0.08	0.35	
1	OS1, A1, OS2, A2	17,490	1,450	15,740	0	7,430	32,145	74,255	1.70	61.9%	0.48	0.52	0.67	
2	OS1, A1, OS2, A2, B	20,160	1,630	18,440	0	7,430	32,145	79,805	1.83	64.2%	0.50	0.54	0.68	
3	OS3, C	12,090	885	0	0	960	7,065	21,000	0.48	75.2%	0.63	0.66	0.78	
4	D	28,845	3,460	0	0	3,840	0	36,145	0.83	89.4%	0.80	0.81	0.90	
5	OS1, A1, OS2, A2, B, C, D	61,095	5,975	18,440	0	12,230	39,210	136,950	3.14	72.5%	0.60	0.63	0.75	
6	E, F	24,265	3,115	11,700	0	9,675	0	48,755	1.12	77.8%	0.67	0.70	0.80	
7	OS1, A1, OS2, A2, B, C, D, E, F	85,360	9,090	30,140	0	21,905	39,210	185,705	4.26	73.9%	0.62	0.65	0.77	
8	OS1, A1, OS2, A2, B, C, D, E, F, G	85,360	9,225	30,140	1,310	27,875	39,210	193,120	4.43	71.7%	0.60	0.63	0.75	
D9A*	D9A*	0	0	0	0	0	629,440	629,440	14.45	40.0%	0.23	0.30	0.50	
9	D9A*, H	0	0	0	0	5,590	629,440	635,030	14.58	39.6%	0.23	0.30	0.50	
10	D9A*, H, I	0	0	0	0	12,750	629,440	642,190	14.74	39.2%	0.23	0.30	0.50	
11	OS1, A1, OS2, A2, B, C, D, E, F, G, D9A*, H, I	85,360	9,225	30,140	1,310	53,260	668,650	847,945	19.47	46.0%	0.31	0.37	0.55	
* PER THE FINAL DRAINAGE REPORT FOR STRUTHERS RANCH FILING NO. 2														



Calculation of Peak Runoff using Rational Method	
Area (A)	1000000
Runoff Coefficient (C)	0.8
Intensity (I)	100
Time of Concentration (Tc)	10
Peak Runoff (Qp)	1000000

Designer: SMS

**Company:** CIVAS Engineering, LLC

Date: 10/26/2020

**Project Name:** Struthers Ranch Retail

Undeveloped or Urbanized Area?	Urbanized	$t_c$ minimum = 5
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$$I_2 = -1.19 \times \ln(t_c) + 6.035$$

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

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

[illegible]

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

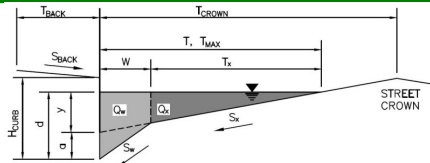
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Struthers Ranch Retail

Inlet ID:

Inlet DP 1

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 5.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.020$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 20.0$  ft

Gutter Width

 $W = 2.00$  ft

Street Transverse Slope

 $S_X = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.014$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	6.0	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

 $d_{MAX} = 6.0$  inches

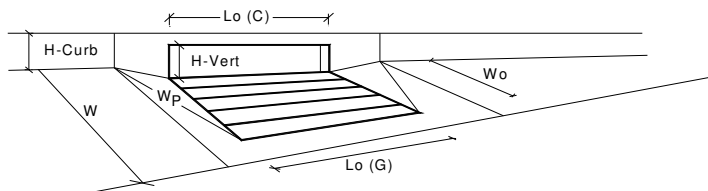
Check boxes are not applicable in SUMP conditions

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

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet: **CDOT Type R Curb Opening**

Local Depression (additional to continuous gutter depression 'a' from above)

Number of Unit Inlets (Grate or Curb Opening)

Water Depth at Flowline (outside of local depression)

**Grate Information**

Length of a Unit Grate

Width of a Unit Grate

Area Opening Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 2.15 - 3.60)

Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat (see USDCM Figure ST-5)

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.3-3.7)

Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth

Depth for Curb Opening Weir Equation

Combination Inlet Performance Reduction Factor for Long Inlets

Curb Opening Performance Reduction Factor for Long Inlets

Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

**Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)**

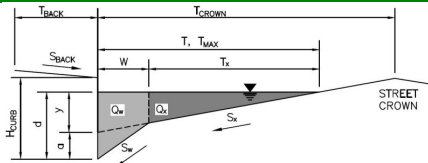
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	2	2	
Ponding Depth =	6.0	6.0	inches
	MINOR	MAJOR	Override Depths
$L_o (G)$ =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r (G)$ =	N/A	N/A	
$C_w (G)$ =	N/A	N/A	
$C_o (G)$ =	N/A	N/A	
	MINOR	MAJOR	
$L_o (C)$ =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r (C)$ =	0.10	0.10	
$C_w (C)$ =	3.60	3.60	
$C_o (C)$ =	0.67	0.67	
	MINOR	MAJOR	
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.33	0.33	ft
$RF_{Combination}$ =	0.57	0.57	
$RF_{Curb}$ =	0.93	0.93	
$RF_{Grate}$ =	N/A	N/A	
	MINOR	MAJOR	
$Q_a$ =	10.5	10.5	cfs
$Q_{PEAK REQUIRED}$ =	4.2	9.0	cfs

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

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

Project: **Struthers Ranch Retail**

Inlet ID: **Inlet DP 2**

**Gutter Geometry (Enter data in the blue cells)**

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)

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)

 $T_{BACK} = 3.0$  ft $S_{BACK} = 0.020$  ft/ft $n_{BACK} = 0.020$  $H_{CURB} = 6.00$  inches $T_{CROWN} = 20.0$  ft $W = 2.00$  ft $S_X = 0.020$  ft/ft $S_W = 0.083$  ft/ft $S_O = 0.000$  ft/ft $n_{STREET} = 0.014$ 

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

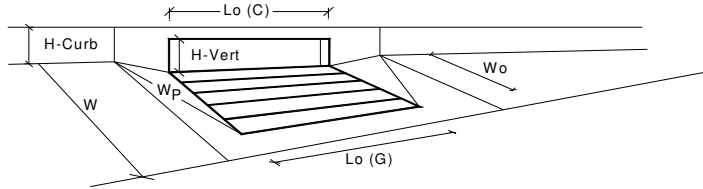
**MINOR STORM Allowable Capacity is based on Depth Criterion****MAJOR STORM Allowable Capacity is based on Depth Criterion**

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



# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



According to developed conditions drainage map, proposed grate is type 16 inlet. Please update to remove inconsistencies.

Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT/Denver 13 Valley Grate	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a <sub>local</sub> =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
<b>Grate Information</b>		MINOR		MAJOR	
Length of a Unit Grate		L <sub>g</sub> (G) =	3.00	3.00	feet
Width of a Unit Grate		W <sub>o</sub> =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A <sub>ratio</sub> =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C <sub>r</sub> (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C <sub>w</sub> (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C <sub>o</sub> (G) =	0.60	0.60	
<b>Curb Opening Information</b>		MINOR		MAJOR	
Length of a Unit Curb Opening		L <sub>c</sub> (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H <sub>vert</sub> =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H <sub>throat</sub> =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W <sub>p</sub> =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C <sub>r</sub> (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C <sub>w</sub> (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C <sub>o</sub> (C) =	N/A	N/A	
<b>Low Head Performance Reduction (Calculated)</b>		MINOR		MAJOR	
Depth for Grate Midwidth		d <sub>grate</sub> =	0.523	0.523	ft
Depth for Curb Opening Weir Equation		d <sub>curb</sub> =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets		RF <sub>Combination</sub> =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF <sub>Curb</sub> =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets		RF <sub>Grate</sub> =	0.94	0.94	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>		MINOR		MAJOR	
		Q <sub>a</sub> =	2.6	2.6	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		Q <sub>PEAK REQUIRED</sub> =	0.5	1.0	cfs

Per developed conditions drainage map, design point 2 flows do not match. Please update to remove inconsistencies.

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

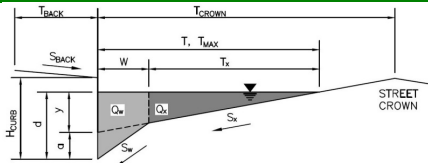
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Struthers Ranch Retail

Inlet ID:

Inlet DP 3

**Gutter Geometry (Enter data in the blue cells)**

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)

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)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM Allowable Capacity is based on Depth Criterion****MAJOR STORM Allowable Capacity is based on Depth Criterion** $T_{BACK} = 5.0$  ft $S_{BACK} = 0.020$  ft/ft $n_{BACK} = 0.020$  $H_{CURB} = 6.00$  inches $T_{CROWN} = 20.0$  ft $W = 2.00$  ft $S_X = 0.020$  ft/ft $S_W = 0.083$  ft/ft $S_O = 0.000$  ft/ft $n_{STREET} = 0.014$ 

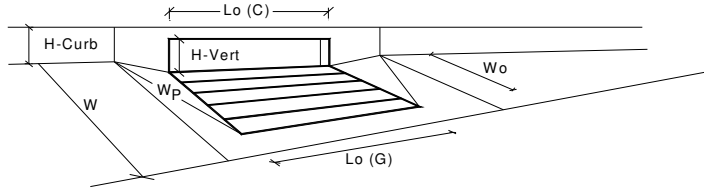
	Minor Storm	Major Storm	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	6.0	inches

☐☐

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)  
**Grate Information**  
Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

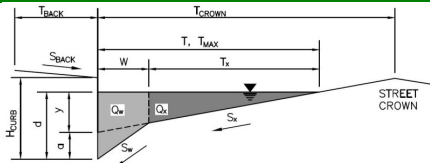
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	6.0	6.0	inches
	MINOR	MAJOR	<input type="checkbox"/> Override Depths
$L_o (G)$ =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r (G)$ =	N/A	N/A	
$C_w (G)$ =	N/A	N/A	
$C_o (G)$ =	N/A	N/A	
	MINOR	MAJOR	
$L_o (C)$ =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r (C)$ =	0.10	0.10	
$C_w (C)$ =	3.60	3.60	
$C_o (C)$ =	0.67	0.67	
	MINOR	MAJOR	
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.33	0.33	ft
$RF_{Combination}$ =	0.77	0.77	
$RF_{Curb}$ =	1.00	1.00	
$RF_{Grate}$ =	N/A	N/A	
	MINOR	MAJOR	
$Q_a$ =	5.4	5.4	cfs
$Q_{PEAK REQUIRED}$ =	1.4	2.7	cfs

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

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

Project: **Struthers Ranch Retail**

Inlet ID: **Inlet DP 4**

**Gutter Geometry (Enter data in the blue cells)**

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)

$T_{BACK} = 5.0$  ft

$S_{BACK} = 0.020$  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

$T_{CROWN} = 20.0$  ft

$W = 2.00$  ft

$S_X = 0.050$  ft/ft

$S_W = 0.083$  ft/ft

$S_O = 0.000$  ft/ft

$n_{STREET} = 0.014$

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	
$T_{MAX} =$	10.0	10.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

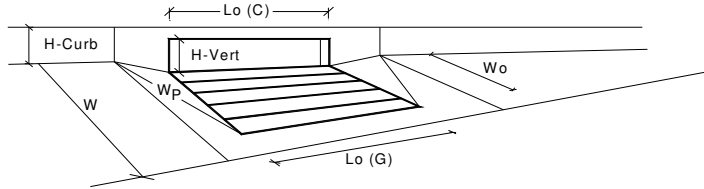
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



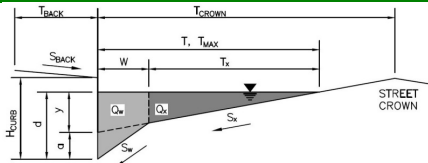
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		a <sub>local</sub> =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
<b>Grate Information</b>		MINOR		MAJOR	
Length of a Unit Grate		L <sub>g</sub> (G) =	N/A	N/A	feet
Width of a Unit Grate		W <sub>o</sub> =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A <sub>ratio</sub> =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C <sub>r</sub> (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C <sub>w</sub> (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C <sub>o</sub> (G) =	N/A	N/A	
<b>Curb Opening Information</b>		MINOR		MAJOR	
Length of a Unit Curb Opening		L <sub>o</sub> (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H <sub>vert</sub> =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H <sub>throat</sub> =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W <sub>p</sub> =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C <sub>r</sub> (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C <sub>w</sub> (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C <sub>o</sub> (C) =	0.67	0.67	
<b>Low Head Performance Reduction (Calculated)</b>		MINOR		MAJOR	
Depth for Grate Midwidth		d <sub>grate</sub> =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d <sub>curb</sub> =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		RF <sub>Combination</sub> =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets		RF <sub>Curb</sub> =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF <sub>Grate</sub> =	N/A	N/A	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>		MINOR		MAJOR	
		Q <sub>a</sub> =	10.5	10.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		Q <sub>PEAK REQUIRED</sub> =	3.5	6.5	cfs

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

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

Project: **Struthers Ranch Retail**

Inlet ID: **Inlet DP 6**

**Gutter Geometry (Enter data in the blue cells)**

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)

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)

$T_{BACK} = 5.0$  ft

$S_{BACK} = 0.020$  ft/ft

$n_{BACK} = 0.020$

$H_{CURB} = 6.00$  inches

$T_{CROWN} = 20.0$  ft

$W = 2.00$  ft

$S_X = 0.020$  ft/ft

$S_W = 0.083$  ft/ft

$S_O = 0.000$  ft/ft

$n_{STREET} = 0.014$

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	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

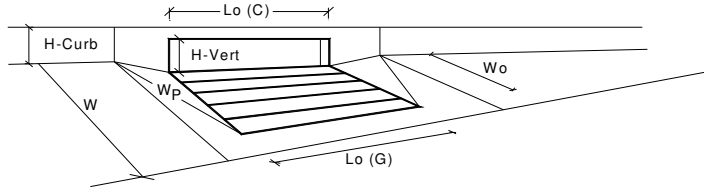
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		$a_{local} = 3.00$	$a_{local} = 3.00$	inches	
Number of Unit Inlets (Grate or Curb Opening)		$N_o = 1$	$N_o = 1$		
Water Depth at Flowline (outside of local depression)		Ponding Depth = 6.0	Ponding Depth = 6.0	inches	
<b>Grate Information</b>		MINOR		MAJOR	
Length of a Unit Grate		$L_o (G) = N/A$	$L_o (G) = N/A$	feet	
Width of a Unit Grate		$W_o = N/A$	$W_o = N/A$	feet	
Area Opening Ratio for a Grate (typical values 0.15-0.90)		$A_{ratio} = N/A$	$A_{ratio} = N/A$		
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		$C_r (G) = N/A$	$C_r (G) = N/A$		
Grate Weir Coefficient (typical value 2.15 - 3.60)		$C_w (G) = N/A$	$C_w (G) = N/A$		
Grate Orifice Coefficient (typical value 0.60 - 0.80)		$C_o (G) = N/A$	$C_o (G) = N/A$		
<b>Curb Opening Information</b>		MINOR		MAJOR	
Length of a Unit Curb Opening		$L_o (C) = 5.00$	$L_o (C) = 5.00$	feet	
Height of Vertical Curb Opening in Inches		$H_{vert} = 6.00$	$H_{vert} = 6.00$	inches	
Height of Curb Orifice Throat in Inches		$H_{throat} = 6.00$	$H_{throat} = 6.00$	inches	
Angle of Throat (see USDCM Figure ST-5)		Theta = 63.40	Theta = 63.40	degrees	
Side Width for Depression Pan (typically the gutter width of 2 feet)		$W_p = 2.00$	$W_p = 2.00$	feet	
Clogging Factor for a Single Curb Opening (typical value 0.10)		$C_r (C) = 0.10$	$C_r (C) = 0.10$		
Curb Opening Weir Coefficient (typical value 2.3-3.7)		$C_w (C) = 3.60$	$C_w (C) = 3.60$		
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		$C_o (C) = 0.67$	$C_o (C) = 0.67$		
<b>Low Head Performance Reduction (Calculated)</b>		MINOR		MAJOR	
Depth for Grate Midwidth		$d_{Grate} = N/A$	$d_{Grate} = N/A$	ft	
Depth for Curb Opening Weir Equation		$d_{Curb} = 0.33$	$d_{Curb} = 0.33$	ft	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination} = 0.77$	$RF_{Combination} = 0.77$		
Curb Opening Performance Reduction Factor for Long Inlets		$RF_{Curb} = 1.00$	$RF_{Curb} = 1.00$		
Grated Inlet Performance Reduction Factor for Long Inlets		$RF_{Grate} = N/A$	$RF_{Grate} = N/A$		
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>		MINOR		MAJOR	
		$Q_a = 5.4$	$Q_a = 5.4$	cfs	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK REQUIRED} = 2.3$	$Q_{PEAK REQUIRED} = 4.5$	cfs	

Per developed conditions  
drainage map, design point  
6 flows do not match. Please  
update to remove  
inconsistencies.



# **HYDRAULIC GRADE** **CALCULATIONS - 5 year storm**

**CALCULATED BY:** SMS  
**DATE:** 10/26/2020  
**CHECKED BY:** SMS

**PROJECT NAME:** Struthers Ranch Retail  
**PROJECT NO.:** 20-288

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	23	24	
STA	INVERT	D in.	W.S.	Pipe Slope ft./ft.	Rough Coeff.	Q cfs	Qfull cfs	Flow Depth in.	V fps	A sf	R	Dm ft.	Froude	Hv ft.	E.G. E.G.	c*	Sr St	Ave. Sr St	L L	Hr Hr	Hb Kb Hb	Hj Kj Hj	Hm Km Hm	Ht Kt Ht	Total Loss Loss	
Storm Line 1																										
30" FES	6755.95	30	6757.05	0.0040	0.013	10.30	25.94	13.20	4.95	2.08	0.57	0.84	0.95	0.38	6757.43	0.00492	0.0039	Open Channel Flow								0.00
5' Dia. Storm MH out - DP 7	6756.01	30	6757.11	0.0040	0.013	10.30	25.94	13.20	4.95	2.08	0.57	0.84	0.95	0.38	6757.49	0.00492	0.0039	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 7	6756.06	30	6757.14	0.0030	0.013	8.80	22.47	12.90	4.36	2.02	0.57	0.82	0.85	0.30	6757.43	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH out - DP 5	6756.62	30	6757.70	0.0030	0.013	8.80	22.47	12.90	4.36	2.02	0.57	0.82	0.85	0.30	6757.99	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6756.77	24	6757.70	0.0040	0.013	4.60	14.31	9.36	4.20	1.10	0.41	0.56	0.99	0.27	6757.97	0.00492	0.0044	Open Channel Flow								0.00
Single Type 16 Area Inlet out - DP	6757.35	24	6758.13	0.0040	0.013	4.60	14.31	9.36	4.20	1.10	0.41	0.56	0.99	0.27	6758.40	0.00492	0.0044	Open Channel Flow								0.00
Single Type 16 Area Inlet in - DP	6757.40	24	6758.14	0.0040	0.013	4.20	14.31	8.88	4.12	1.02	0.40	0.53	1.00	0.26	6758.40	0.00492	0.0045	Open Channel Flow								0.00
10' Type R Inlet out - DP 1	6757.62	24	6758.36	0.0040	0.013	4.20	14.31	8.88	4.12	1.02	0.40	0.53	1.00	0.26	6758.62	0.00492	0.0045	Open Channel Flow								0.00
Storm Line 2																										
5' Dia. Storm MH out - DP 7	6756.01	30	6757.11	0.0040	0.013	10.30	25.94	13.20	4.95	2.08	0.57	0.84	0.95	0.38	6757.49	0.00492	0.0039	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 7	6757.50	12	6757.96	0.0400	0.013	3.10	7.13	5.52	8.79	0.35	0.24	0.35	2.60	1.20	6759.16	0.00492	0.0403	Open Channel Flow								0.00
5' Type R Inlet out	6758.50	12	6758.96	0.0400	0.013	3.10	7.13	5.52	8.79	0.35	0.24	0.35	2.60	1.20	6760.16	0.00492	0.0403	Open Channel Flow								0.00
5' Type R Inlet in	6758.70	10	6759.09	0.0100	0.013	1.00	2.19	4.70	3.97	0.25	0.20	0.30	1.27	0.24	6759.34	0.00492	0.0103	Open Channel Flow								0.00
Roof Drain Connection 3	6760.30	10	6760.69	0.0100	0.013	1.00	2.19	4.70	3.97	0.25	0.20	0.30	1.27	0.24	6760.94	0.00492	0.0103	Open Channel Flow								0.00
Roof Drain Connection 2	6760.90	10	6761.22	0.0100	0.013	0.67	2.19	3.80	3.65	0.18	0.17	0.23	1.35	0.21	6761.42	0.00492	0.0109	Open Channel Flow								0.00
Roof Drain Connection 1	6761.50	10	6761.71	0.0100	0.013	0.33	2.19	2.50	3.10	0.11	0.12	0.15	1.42	0.15	6761.86	0.00492	0.0120	Open Channel Flow								0.00
Storm Line 3																										
5' Dia. Storm MH out - DP 5	6756.62	30	6757.70	0.0030	0.013	8.80	22.47	12.90	4.36	2.02	0.57	0.82	0.85	0.30	6757.99	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6756.77	18	6757.54	0.0040	0.013	3.50	6.64	9.18	3.86	0.91	0.38	0.60	0.87	0.23	6757.77	0.00492	0.0041	Open Channel Flow								0.00
5' Type R Inlet out	6756.90	18	6757.67	0.0040	0.013	3.50	6.64	9.18	3.86	0.91	0.38	0.60	0.87	0.23	6757.90	0.00492	0.0041	Open Channel Flow								0.00
Storm Line 4																										
5' Dia. Storm MH out - DP 5	6756.62	30	6757.70	0.0030	0.013	8.80	22.47	12.90	4.36	2.02	0.57	0.82	0.85	0.30	6757.99	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6757.77	12	6758.25	0.0050	0.011	1.40	2.98	5.76	3.76	0.37	0.24	0.37	1.08	0.22	6758.47	0.00353	0.0051	Open Channel Flow								0.00
5' Type R Inlet out	6758.20	12	6758.68	0.0050	0.011	1.40	2.98	5.76	3.76	0.37	0.24	0.37	1.08	0.22	6758.90	0.00353	0.0051	Open Channel Flow								0.00
Storm Line 5																										
30" FES out	6755.50	36	6756.70	0.0065	0.013	18.60	53.77	14.40	7.04	2.64	0.64	0.90	1.31	0.77	6757.47	0.00492	0.0068	Open Channel Flow								0.00
30" FES in - DP 9	6754.50	36	6755.70	0.0065	0.013	18.60	53.77	14.40	7.04	2.64	0.64	0.90	1.31	0.77	6756.47	0.00492	0.0068	Open Channel Flow								0.00

**NOTES:**

$$c^*=2g(n^2)/2.21$$

$$Sf = c^*Hv/R^{1.33}$$

# **HYDRAULIC GRADE** **CALCULATIONS - 100 year storm**

**CALCULATED BY:** SMS

**DATE:** 10/26/2020

**CHECKED BY:** SMS

**PROJECT NAME:** Struthers Ranch Retail

**PROJECT NO.:** 20-288

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	23	24	
STA	INVERT	D in.	W.S.	Pipe Slope ft./ft.	Rough Coeff.	Q cfs	Qfull cfs	Flow Depth in.	V fps	A sf	R	Dm ft.	Froude	Hv ft.	E.G. E.G.	c*	Sr Sr	Ave. Sr Sr	L L	Hr Hr	Hb Kb Hb	Hj Kj Hj	Hm Km Hm	Ht Kt Ht	Total Loss Loss	
Storm Line 1																										
30" FES	6755.95	30	6757.60	0.0040	0.013	20.30	25.94	19.80	5.91	3.44	0.73	1.45	0.86	0.54	6758.14	0.00492	0.0041	Open Channel Flow								0.00
5' Dia. Storm MH out - DP 7	6756.01	30	6757.66	0.0040	0.013	20.30	25.94	19.80	5.91	3.44	0.73	1.45	0.86	0.54	6758.20	0.00492	0.0041	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 7	6756.06	30	6757.71	0.0030	0.013	17.70	22.47	19.80	5.15	3.44	0.73	1.45	0.75	0.41	6758.12	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH out - DP 5	6756.62	30	6758.27	0.0030	0.013	17.70	22.47	19.80	5.15	3.44	0.73	1.45	0.75	0.41	6758.68	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6756.77	24	6758.27	0.0040	0.013	9.80	14.31	14.40	4.98	1.97	0.56	1.00	0.88	0.39	6758.66	0.00492	0.0041	Open Channel Flow								0.00
Single Type 16 Area Inlet out - DP 2	6757.35	24	6758.55	0.0040	0.013	9.80	14.31	14.40	4.98	1.97	0.56	1.00	0.88	0.39	6758.94	0.00492	0.0041	Open Channel Flow								0.00
Single Type 16 Area Inlet in - DP 2	6757.40	24	6758.55	0.0040	0.013	9.00	14.31	13.68	4.87	1.85	0.54	0.93	0.89	0.37	6758.92	0.00492	0.0041	Open Channel Flow								0.00
10' Type R Inlet out - DP 1	6757.62	24	6758.76	0.0040	0.013	9.00	14.31	13.68	4.87	1.85	0.54	0.93	0.89	0.37	6759.13	0.00492	0.0041	Open Channel Flow								0.00
Storm Line 2																										
5' Dia. Storm MH out - DP 7	6756.01	30	6757.66	0.0040	0.013	20.30	25.94	19.80	5.91	3.44	0.73	1.45	0.86	0.54	6758.20	0.00492	0.0041	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 7	6757.50	12	6758.20	0.0400	0.013	6.00	7.13	8.40	10.38	0.58	0.30	0.63	2.31	1.67	6759.87	0.00492	0.0418	Open Channel Flow								0.00
5' Type R Inlet out	6758.50	12	6759.20	0.0400	0.013	6.00	7.13	8.40	10.38	0.58	0.30	0.63	2.31	1.67	6760.87	0.00492	0.0418	Open Channel Flow								0.00
5' Type R Inlet in	6758.70	10	6759.29	0.0100	0.013	1.90	2.19	7.10	4.59	0.41	0.25	0.55	1.09	0.33	6759.62	0.00492	0.0103	Open Channel Flow								0.00
Roof Drain Connection 3	6760.30	10	6760.89	0.0100	0.013	1.90	2.19	7.10	4.59	0.41	0.25	0.55	1.09	0.33	6761.22	0.00492	0.0103	Open Channel Flow								0.00
Roof Drain Connection 2	6760.90	10	6761.35	0.0100	0.013	1.26	2.19	5.40	4.19	0.30	0.22	0.36	1.23	0.27	6761.62	0.00492	0.0102	Open Channel Flow								0.00
Roof Drain Connection 1	6761.50	10	6761.80	0.0100	0.013	0.63	2.19	3.60	3.70	0.17	0.16	0.21	1.41	0.21	6762.01	0.00492	0.0119	Open Channel Flow								0.00
Storm Line 3																										
5' Dia. Storm MH out - DP 5	6756.62	30	6758.27	0.0030	0.013	17.70	22.47	19.80	5.15	3.44	0.73	1.45	0.75	0.41	6758.68	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6756.77	18	6757.96	0.0040	0.013	6.50	6.64	14.22	4.34	1.50	0.46	1.23	0.69	0.29	6758.25	0.00492	0.0041	Open Channel Flow								0.00
5' Type R Inlet out	6756.90	18	6758.09	0.0040	0.013	6.50	6.64	14.22	4.34	1.50	0.46	1.23	0.69	0.29	6758.38	0.00492	0.0041	Open Channel Flow								0.00
Storm Line 4																										
5' Dia. Storm MH out - DP 5	6756.62	30	6758.27	0.0030	0.013	17.70	22.47	19.80	5.15	3.44	0.73	1.45	0.75	0.41	6758.68	0.00492	0.0031	Open Channel Flow								0.00
5' Dia. Storm MH in - DP 5	6757.77	12	6758.51	0.0050	0.011	2.70	2.98	8.88	4.40	0.61	0.30	0.69	0.93	0.30	6758.81	0.00353	0.0053	Open Channel Flow								0.00
5' Type R Inlet out	6758.20	12	6758.94	0.0050	0.011	2.70	2.98	8.88	4.40	0.61	0.30	0.69	0.93	0.30	6759.24	0.00353	0.0053	Open Channel Flow								0.00
Storm Line 5																										
30" FES out	6755.50	36	6757.87	0.0065	0.013	52.30	53.77	28.44	8.73	5.99	0.91	2.45	0.98	1.18	6759.05	0.00492	0.0066	Open Channel Flow								0.00
30" FES in - DP 9	6754.50	36	6756.87	0.0065	0.013	52.30	53.77	28.44	8.73	5.99	0.91	2.45	0.98	1.18	6758.05	0.00492	0.0066	Open Channel Flow								0.00

**NOTES:**

$$c^*=2g(n^2)/2.21$$

$$Sf = c^*Hv/R^{1.33}$$

## Storage Volume

Project Name: Struthers Ranch Retail  
Project No. 20-288  
By: SMS  
Checked By: SMS  
Date: 10/26/2020

### Forebay

WQCV volume = 0.096 ac-ft  
Forebay volume = 2% of WQCV volume = 0.0019 ac-ft  
84 cu-ft

Elev.	<i>h</i> ft	Area sf	Volume cu-ft	Total cu-ft
6755.85		0		
	0.25		10	10
6756.10		120		
	0.25		30	40
6756.35		120		
	0.50		60	100
6756.85		120		

Top Storage El = 6756.72  
height = 0.87 ft  
= 10.4 in  
**USE 12 in curb**

## ORIFICE /WEIR SIZING

Project Name: Struthers Ranch Retail

Project No. 20-288

By: SMS

Checked By: SMS

Date: 10/26/2020

### Water Quality EDB

Orifice Discharge rate  $Q = C \cdot A \cdot (2gh)^{0.5}$

Where:

C = 0.65 orifice coefficient for square-edged openings

A = orifice opening

h = head on orifice measured from centerline

g = 32.2 ft<sup>2</sup>/sec gravitational constant

### Forebay orifice

Discharge = 2% of 100-year EDB inflow

= 2% of 19.1 cfs

= 0.38 cfs

W. Surf = 6756.72

Invert = 6755.85

Height = 0.87 ft

Area = 0.08 sf

Width = 0.09 ft

= 1.09 in

**USE 1.1 in**

See UD-Detention Calculations Outlet Structure orifice sizing.

# FLOW CAPACITY CALCULATION WORKSHEET FOR

## EDB Low Flow Channel with

0.00 ft bottom width  
9.009 : 1 left side slope  
9.009 : 1 right side slope

---

### Input Data

---

Channel Depth: 0.17 ft.  
Material: conc  
Mannings Coefficient: 0.013  
Bottom Width: 0.00 ft.  
Left Side Slope: 11.1 %  
Right Side Slope: 11.1 %  
Channel Top Width: 3.0 ft.  
Longitudinal Slope: 0.50 %  
Assumed Depth of Flow: 0.17 ft.

---

### Calculation Results

---

cross-sectional area: 0.25 s.f.  
wetted perimeter: 3.03 ft.  
Capacity: 0.39 cfs  
Velocity: 1.54 fps  
Velocity Head: 0.04 ft.

Low Flow Channel Flow:	0.39 cfs	
2% of 100-yr EDB Inflow:	0.38	OK
(2% of 19.1 cfs)		

WQCV

## WQCV CALCULATIONS

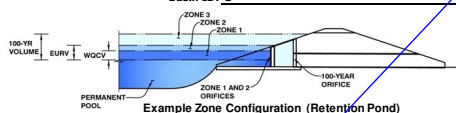
<b>Project Name:</b>	Struthers Ranch Retail
<b>Project No.:</b>	20-288
<b>Calculated By:</b>	SMS
<b>Checked By:</b>	SMS
<b>Date:</b>	10/26/2020

**WQCV = (a x (0.91i<sup>3</sup> - 1.19i<sup>2</sup> + 0.78i) / 12 x Area**  
**a = 1.0 for EDB**

[illegible]

Watershed area described in the water quality narrative is 4.43 acres. Please revise to use a consistent number.

**Basin ID: G**



### Watershed Information

Selected BMP Type =	<b>EDB</b>	
Watershed Area =	4.63	acres
Watershed Length =	500	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	70.30%	
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

Water Quality Capture Volume (WQCV) =	0.096	acre-feet
Excess Urban Runoff Volume (EURV) =	0.358	acre-feet
2-yr Runoff Volume ( $P1 = 1.1$ ) =	0.240	acre-feet
5-yr Runoff Volume ( $P1 = 1.28$ ) =	0.328	acre-feet
10-yr Runoff Volume ( $P1 = 1.55$ ) =	0.419	acre-feet
25-yr Runoff Volume ( $P1 = 1.96$ ) =	0.581	acre-feet
50-yr Runoff Volume ( $P1 = 2.32$ ) =	0.714	acre-feet
100-yr Runoff Volume ( $P1 = 2.7$ ) =	0.864	acre-feet
500-yr Runoff Volume ( $P1 = 3.74$ ) =	1.258	acre-feet
Approximate 2-yr Detention Volume =	0.235	acre-feet
Approximate 5-yr Detention Volume =	0.318	acre-feet
Approximate 10-yr Detention Volume =	0.416	acre-feet
Approximate 25-yr Detention Volume =	0.495	acre-feet
Approximate 50-yr Detention Volume =	0.541	acre-feet
Approximate 100-yr Detention Volume =	0.602	acre-feet

### Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.096	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.096	acre-feet
Initial Surge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{tota}$ ) =	user	ft
Depth of Trickle Channel ( $H_{tr}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{main}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	

Initial Surcharge Area ( $A_{SIV}$ )	=	user	ft <sup>2</sup>
Surcharge Volume Length ( $L_{SIV}$ )	=	user	ft
Surcharge Volume Width ( $W_{SIV}$ )	=	user	ft
Depth of Basin Floor ( $H_{1,0,0R}$ )	=	user	ft
Length of Basin Floor ( $L_{1,0,0R}$ )	=	user	ft
Width of Basin Floor ( $W_{1,0,0R}$ )	=	user	ft
Area of Basin Floor ( $A_{1,0,0R}$ )	=	user	ft <sup>2</sup>
Volume of Basin Floor ( $V_{1,0,0R}$ )	=	user	ft <sup>3</sup>
Depth of Main Basin ( $H_{MAIN}$ )	=	user	ft
Length of Main Basin ( $L_{MAIN}$ )	=	user	ft
Width of Main Basin ( $W_{MAIN}$ )	=	user	ft
Area of Main Basin ( $A_{MAIN}$ )	=	user	ft <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ )	=	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{T,0,0}$ )	=	user	acre-feet

## Optional User Overrides

0.096	acre-feet
	acre-feet
1.00	inches
1.28	inches
1.55	inches
1.96	inches
2.32	inches
2.70	inches
3.74	inches

**Total detention volume is less than 100-year volume.**

[illegible]

Remove the user override for WQCV. This shall be sized per the watershed area

Revise the 2yr through 100yr storm runoff volume per City DCM Table 6-2.

Pond design will be reviewed on the site development plan in conjunction with the GEC Plan.

### Table 6-2. Rainfall Depths

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth	Annual Exceedance Probability
2	1.19			
5	1.50			
10	1.75			
25	2.00			
50	2.25			
100	2.52			

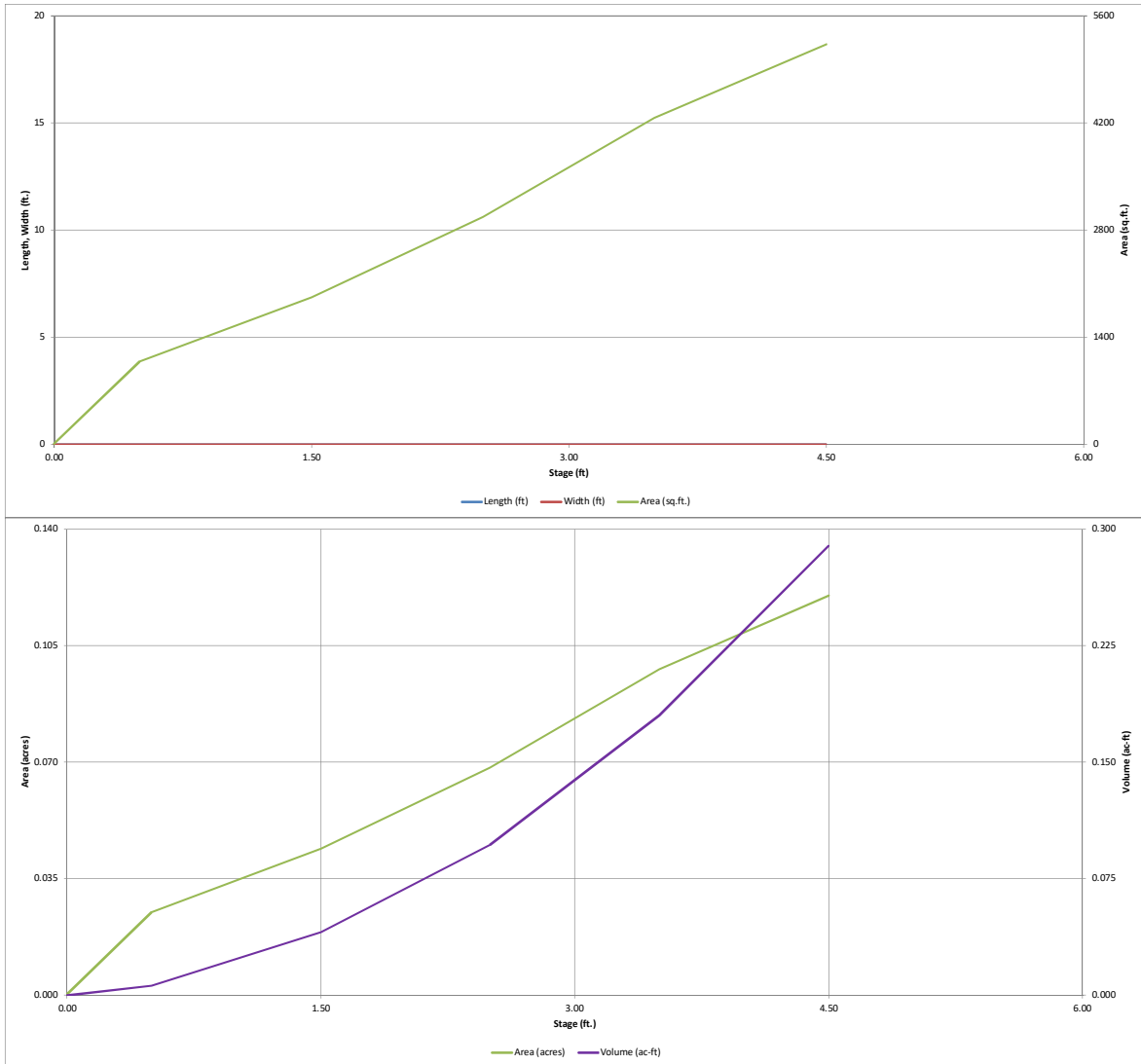
Where  $Z = 6,8$

-applied to the design storms or cor-



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

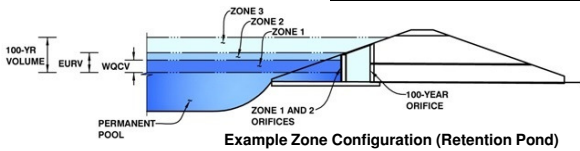


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: Struthers Ranch Subdivision Fioing No. 5

Basin ID: G



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.49	0.096	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			Not Utilized
Total (all zones)		0.096	

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

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

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	N/A ft <sup>2</sup>
Underdrain Orifice Centroid =	N/A feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.49	sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate	
WQ Orifice Area per Row =	3.403E-03 ft <sup>2</sup>
Elliptical Half-Width =	N/A feet
Elliptical Slot Centroid =	N/A feet
Elliptical Slot Area =	N/A ft <sup>2</sup>

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	0.49	0.49	0.49					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice	
Vertical Orifice Area =	N/A ft <sup>2</sup>
Vertical Orifice Centroid =	N/A feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, H <sub>o</sub> =	2.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir	
Height of Grate Upper Edge, H <sub>t</sub> =	2.60 ft
Overflow Weir Slope Length =	5.00 feet
Grate Open Area / 100-yr Orifice Area =	4.46
Overflow Grate Open Area w/o Debris =	14.00 ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	14.00 ft <sup>2</sup>

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	24.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Outlet Orifice Area =	3.14 ft <sup>2</sup>
Outlet Orifice Centroid =	1.00 feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	3.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.38 feet
Stage at Top of Freeboard =	4.63 feet
Basin Area at Top of Freeboard =	0.12 acres
Basin Volume at Top of Freeboard =	0.29 acre-ft

## Routed Hydrograph Results

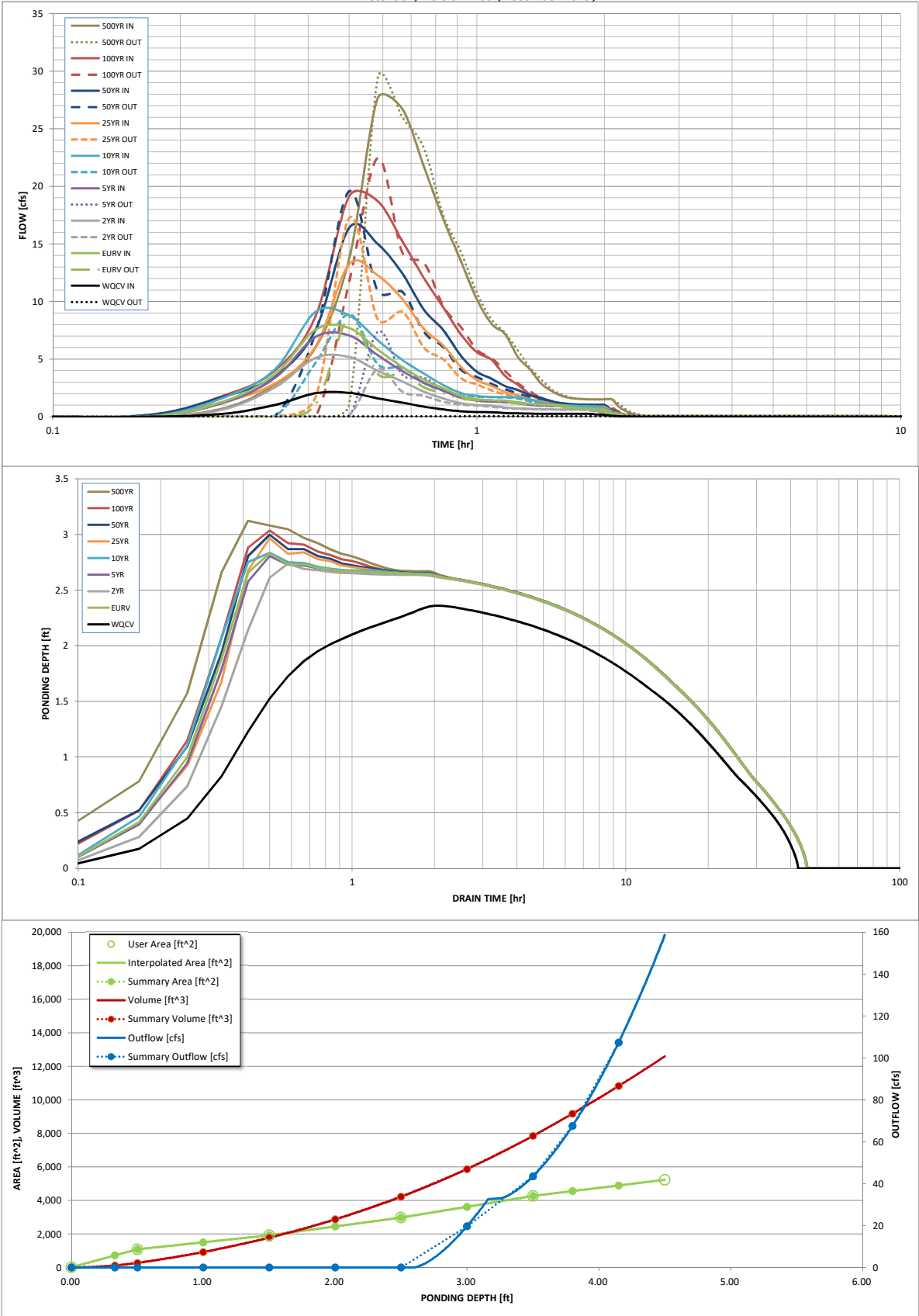
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	1.07	1.00	1.28	1.55	1.96	2.32	2.70	3.74
One-Hour Rainfall Depth (in)	N/A	1.07	1.00	1.28	1.55	1.96	2.32	2.70	3.74
CUHP Runoff Volume (acre-ft)	0.096	0.358	0.240	0.328	0.419	0.581	0.714	0.864	1.258
Inflow Hydrograph Volume (acre-ft)	0.096	0.358	0.240	0.328	0.419	0.581	0.714	0.864	1.258
CUHP Predevelopment Peak Q (cfs)	0.0	0.0	0.1	1.0	2.0	4.9	6.7	8.8	14.2
OPTIONAL Override Predevelopment Peak Q (cfs)	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre)	0.00	0.00	0.02	0.21	0.43	1.06	1.45	1.91	3.06
Peak Inflow Q (cfs)	2.1	7.7	5.2	7.1	9.1	13.2	16.4	19.1	27.6
Peak Outflow Q (cfs)	0.1	8.6	4.1	7.4	8.9	17.3	19.6	22.5	29.4
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	7.7	4.5	3.5	2.9	2.5	2.1
Structure Controlling Flow	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps)	N/A	0.61	0.29	0.5	0.6	1.2	1.4	1.6	2.1
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	38	33	36	34	31	28	25	23	19
Time to Drain 99% of Inflow Volume (hours)	40	40	42	41	39	38	36	35	31
Maximum Ponding Depth (ft)	2.36	2.83	2.74	2.81	2.83	2.97	3.00	3.04	3.12
Area at Maximum Ponding Depth (acres)	0.06	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09
Maximum Volume Stored (acre-ft)	0.088	0.120	0.114	0.119	0.121	0.132	0.134	0.137	0.145

Ratio should be less than or equal to 1.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



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

Outflow Hydrograph Workbook Filename:

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

[illegible]





STRUTHERS RANCH SUBDIVISION FILING NO. 2

TRACT A

PARCEL NO. 7136301013

LOT 26

PARCEL NO. 7136303001

LOT 27

PARCEL NO. 7136303002

LOT 28

PARCEL NO. 7136303003

LOT 29

PARCEL NO. 7136303004

LOT 30

PARCEL NO. 7136303005

LOT 31

PARCEL NO. 7136303006

LOT 32

PARCEL NO. 7136303007

LOT 33

PARCEL NO. 7136303008

LOT 35

PARCEL NO. 7136407002

LOT 36

PARCEL NO. 7136407003

STRUTHERS RANCH SUBDIVISION FILING NO. 2

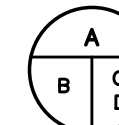
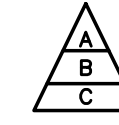


TRACT C

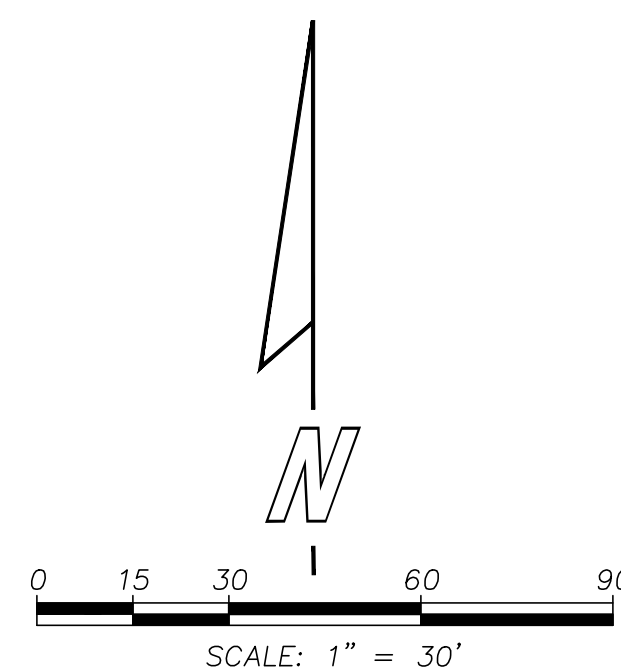
PARCEL NO. 7136304001

### PROPOSED IMPROVEMENTS NOTE

THE PROPOSED SITE AND UTILITY IMPROVEMENTS AND GRADING SHOWN ON THIS PLAN ARE PRELIMINARY ONLY AND ARE SUBJECT TO CHANGE. ANY CHANGES WILL BE REFLECTED ON THE DRAINAGE PLAN INCLUDED WITH THE SITE DEVELOPMENT PLAN SUBMITTAL FOR THE PROPOSED DEVELOPMENT.

### LEGEND:

- 5620 — EXISTING CONTOUR  
--- PROPERTY BOUNDARY
-  A = BASIN DESIGNATION  
B = AREA IN ACRES  
C = 5 YEAR RUNOFF COEFFICIENT  
D = 100 YEAR RUNOFF COEFFICIENT
-  A = DESIGN POINT  
B = 5 YEAR RUNOFF  
C = 100 YEAR RUNOFF
-  BASIN BOUNDARY
-  DRAINAGE FLOW DIRECTION



### EL PASO COUNTY NOTE:

CITY/COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH CITY/COUNTY DESIGN CRITERIA. THE CITY/COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY/COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

### WATER QUALITY EDB SUMMARY TABLE

STAGE	VOLUME ac ft	RELEASE RATE cfs	WATER SURFACE ELEVATION
WQCV	0.104	40 hrs	6757.84

Remove the access from Struthers Road. No direct lot access is allowed from Struthers Road

CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
**811**  
CALL 811 BEFORE YOU DIG. GRADE, OR EXCAVATE  
FOR THE MARKING OF UNDERGROUND  
MEMBER UTILITIES.

REVISION	DATE	BY

DATE: 10/26/2020	DESIGNED BY: SMS	DRAWN BY: SS	CHECKED BY:
------------------	------------------	--------------	-------------

STRUTHERS RANCH  
SUBDIVISION FILING NO. 5  
FINAL DRAINAGE  
PLAN

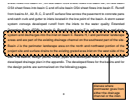
**CIVAS**  
engineering  
civil engineering solutions  
10056 Brisbane Lane  
Littleton, Colorado 80130  
720-240-5582  
civas-eng.com

STEVEN M. STRICKLING  
COLORADO P.E. NO. 31237  
FOR AND ON BEHALF OF  
CIVAS ENGINEERING, LLC



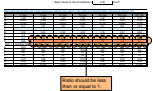
# Drainage Letter\_V1.pdf Markup Summary

## CFurchak (3)



**Subject:** Engineer  
**Page Label:** 9  
**Author:** CFurchak  
**Date:** 3/16/2021 5:13:00 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

discuss where stormwater goes from either the drainage channel or the inlet.



**Subject:** Engineer  
**Page Label:** 36  
**Author:** CFurchak  
**Date:** 3/16/2021 5:15:41 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Ratio should be less than or equal to 1.



**Subject:** Stormwater Comments Color  
**Page Label:** 1  
**Author:** CFurchak  
**Date:** 3/16/2021 5:20:57 PM  
**Status:**  
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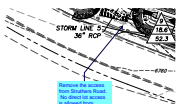
## dsdlaforce (13)



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**Author:** dsdlaforce  
**Date:** 3/10/2021 4:33:21 PM  
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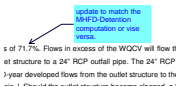
Coordinate with Struthers Ranch HOA and update the drainage letter to identify how this is going to be corrected.

Be aware: A condition of approval may need to be included on the subsequent site development plan for the developer to conduct maintenance on the pond ensure the pond is functioning as designed when the retail center is being constructed.



**Subject:** Callout  
**Page Label:** 40  
**Author:** dsdlaforce  
**Date:** 3/10/2021 4:36:03 PM  
**Status:**  
**Color:** ■  
**Layer:**  
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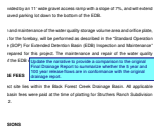
Remove the access from Struthers Road. No direct lot access is allowed from Struthers Road



**Subject:** Callout  
**Page Label:** 12  
**Author:** dsdlaforce  
**Date:** 3/10/2021 4:53:18 PM  
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**Color:** ■  
**Layer:**  
**Space:**

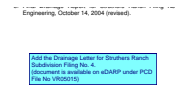
update to match the MHFD-Detention computation or vice versa.





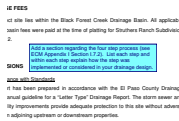
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**Page Label:** 12  
**Author:** dsdlaforce  
**Date:** 3/10/2021 4:57:09 PM  
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**Space:**

Update the narrative to provide a comparison to the original Final Drainage Report to summarize whether the 5 year and 100 year release flows are in conformance with the original drainage report.



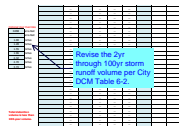
**Subject:** Text Box  
**Page Label:** 13  
**Author:** dsdlaforce  
**Date:** 3/10/2021 5:02:05 PM  
**Status:**  
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**Space:**

Add the Drainage Letter for Struthers Ranch Subdivision Filing No. 4.  
(document is available on eDARP under PCD File No VR05015)



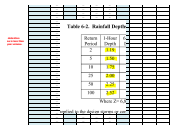
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**Date:** 3/10/2021 5:06:39 PM  
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Add a section regarding the four step process (see ECM Appendix I Section I.7.2). List each step and within each step explain how the step was implemented or considered in your drainage design.

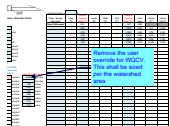


**Subject:** Callout  
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**Date:** 3/10/2021 5:29:00 PM  
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Revise the 2yr through 100yr storm runoff volume per City DCM Table 6-2.



**Subject:** Image  
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**Author:** dsdlaforce  
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**Subject:** Callout  
**Page Label:** 34  
**Author:** dsdlaforce  
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Remove the user override for WQCV. This shall be sized per the watershed area



**Subject:** Cloud+  
**Page Label:** 34  
**Author:** dsdlaforce  
**Date:** 3/10/2021 5:31:04 PM  
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Pond design will be reviewed on the site development plan in conjunction with the GEC Plan.

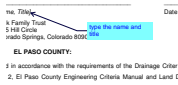


Replace with full size copy.

**Subject:** Text Box  
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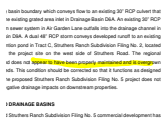
Replace with full size copy.

damage report and plan.



**Subject:** Callout  
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**Date:** 3/10/2021 8:09:12 AM  
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type the name and title



**Subject:** Highlight  
**Page Label:** 9  
**Author:** dsdlaforce  
**Date:** 3/10/2021 9:01:13 AM  
**Status:**  
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**Layer:**  
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lpackman (14)



**Subject:** Callout  
**Page Label:** 40  
**Author:** lpackman  
**Date:** 3/1/2021 1:27:51 PM  
**Status:**  
**Color:**    
**Layer:**  
**Space:**

Please label type of inlet.


Chapter 6


Please highlight runoff coefficients used.

Land Use or Surface

**Subject:** Text Box  
**Page Label:** 15  
**Author:** lpackman  
**Date:** 3/1/2021 10:49:30 AM  
**Status:**  
**Color:**    
**Layer:**  
**Space:**


Please highlight runoff coefficients used.

**Subject:** Text Box  
**Page Label:** 13  
**Author:** lpackman  
**Date:** 3/1/2021 10:50:12 AM  
**Status:**  
**Color:**   
**Layer:**  
**Space:**


**Subject:** Callout  
**Page Label:** 12  
**Author:** lpackman  
**Date:** 3/1/2021 11:20:41 AM  
**Status:**  
**Color:**   
**Layer:**  
**Space:**

	(AC)	%	UD-BMP
A.G	3.53	79.8%	0.0%

For the water quality narrative the EDB will provide treatment to offsite basins. Please update the area to accurately represent the acreage that the EDB will treat.

**Subject:** Callout  
**Page Label:** 33  
**Author:** lpackman  
**Date:** 3/1/2021 2:32:28 PM  
**Status:**  
**Color:**   
**Layer:**  
**Space:**


Transmitted data displayed in the waveform window in 4-bit groups. Please note to use a consistent number.

**Subject:** Callout  
**Page Label:** 34  
**Author:** lpacman  
**Date:** 3/1/2021 2:33:19 PM  
**Status:**  
**Color:**   
**Layer:**  
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2020  
0-268

Please add the following: "PCD File No. VR211"

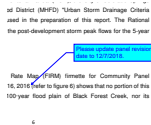
1 - Colorado - 00100  
c:\msd\csp\00100

**Subject:** Callout  
**Page Label:** 1  
**Author:** lpackman  
**Date:** 3/1/2021 8:34:53 AM  
**Status:**  
**Color:**   
**Layer:**  
**Space:**

is a "Letter Type" drainage report for Southern Ranch Subdivision prepared in accordance the El Paso County Drainage Criteria satisfies the El Paso County subdivision submittal requirements, prepared using portions of the City of Colorado Springs DCM and District (JWH)DC "Urban Storm Drainage Criteria Manual", later

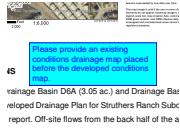
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**Author:** lpackman  
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Please reference the original drainage report in order to justify the submission of a drainage letter for this project.



**Subject:** Callout  
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**Author:** lpackman  
**Date:** 3/1/2021 9:06:43 AM  
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Please update panel revision date to 12/7/2018.



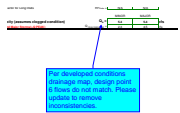
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Please provide an existing conditions drainage map placed before the developed conditions map.



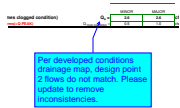
**Subject:** Callout  
**Page Label:** 11  
**Author:** lpackman  
**Date:** 3/10/2021 4:50:30 PM  
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**Space:**

Please reference ECM I.7.1.C regarding water quality exclusions for basins that will not be included in WQ treatment. Please contact Review Engineer Lupe Packman at lupepackman@elpasoco.com or 719-313-6215



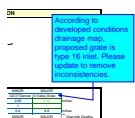
**Subject:** Callout  
**Page Label:** 27  
**Author:** lpackman  
**Date:** 3/10/2021 5:23:34 PM  
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Per developed conditions drainage map, design point 6 flows do not match. Please update to remove inconsistencies.



**Subject:** Callout  
**Page Label:** 21  
**Author:** lpackman  
**Date:** 3/10/2021 5:23:51 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Per developed conditions drainage map, design point 2 flows do not match. Please update to remove inconsistencies.



**Subject:** Callout  
**Page Label:** 21  
**Author:** lpackman  
**Date:** 3/10/2021 5:24:07 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

According to developed conditions drainage map, proposed grate is type 16 inlet. Please update to remove inconsistencies.