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civil engineering solutions

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
Revised May 10, 2021
Project No. 20-288
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.

_____
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.

_____ _____

Vernon Clark, Trustee Date

Clark Family Trust
3585 Hill Circle
Colorado Springs, Colorado 80904

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.

_____ _____

Jennifer Irvine, P.E. Date

County Engineer / ECM Administrator

INTRODUCTION

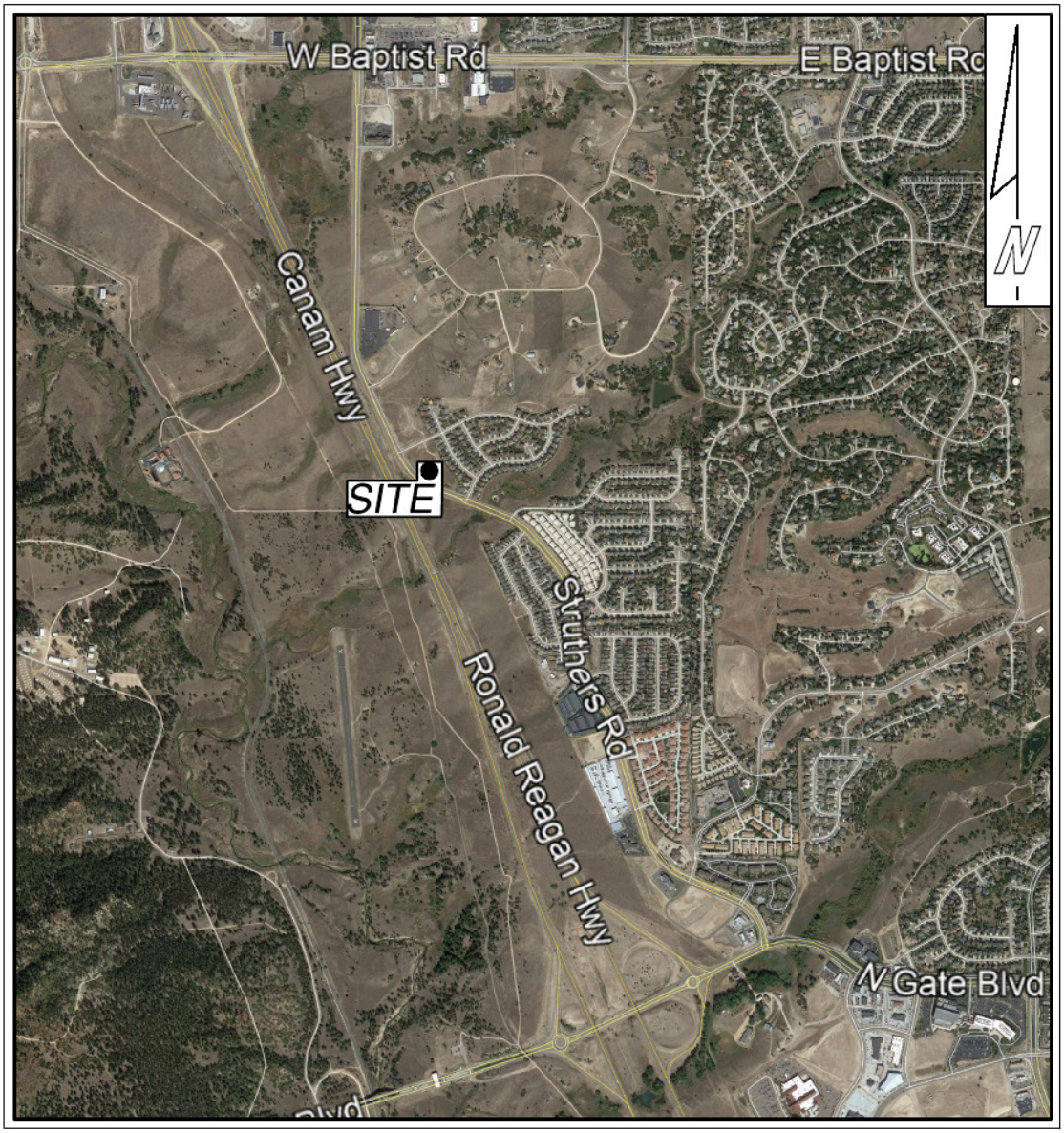
This report represents a “Letter Type” drainage report for Struthers Ranch Subdivision Filing No. 5, which is a part of the “final Drainage Report for Struthers Ranch Filing No. 2”, dated October 14, 2004 (revised), and was prepared in accordance the El Paso County Drainage Criteria Manual (DCM) and 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 and 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

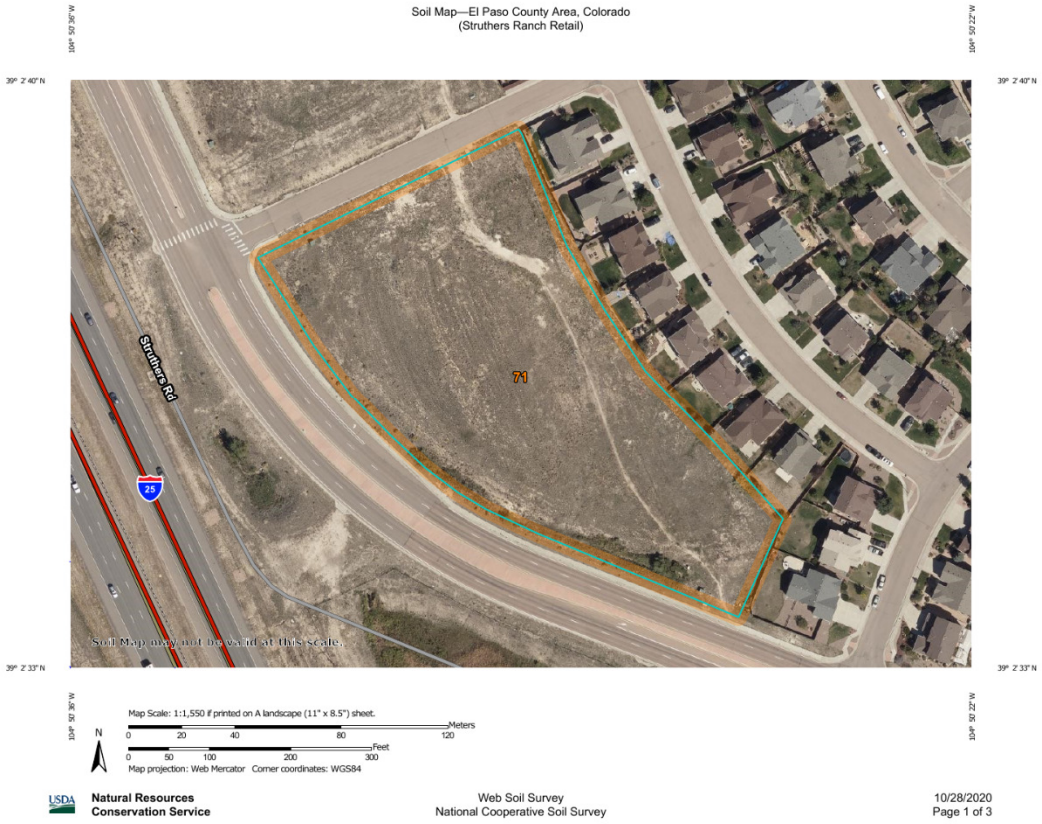


FIGURE 3 – SCS SOIL SURVEY MAP LEGEND

Soil Map—El Paso County Area, Colorado
(Struthers Ranch Retail)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, 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: Aug 19, 2018—Sep 23, 2018

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

USDA Natural Resources Conservation Service | Web Soil Survey National Cooperative Soil Survey | 10/28/2020 Page 2 of 3

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%
Totals for Area of Interest		**4.1**	**100.0%**

FIGURE 5 – SCS SOIL SURVEY HYDROLOGIC SOIL GROUP

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

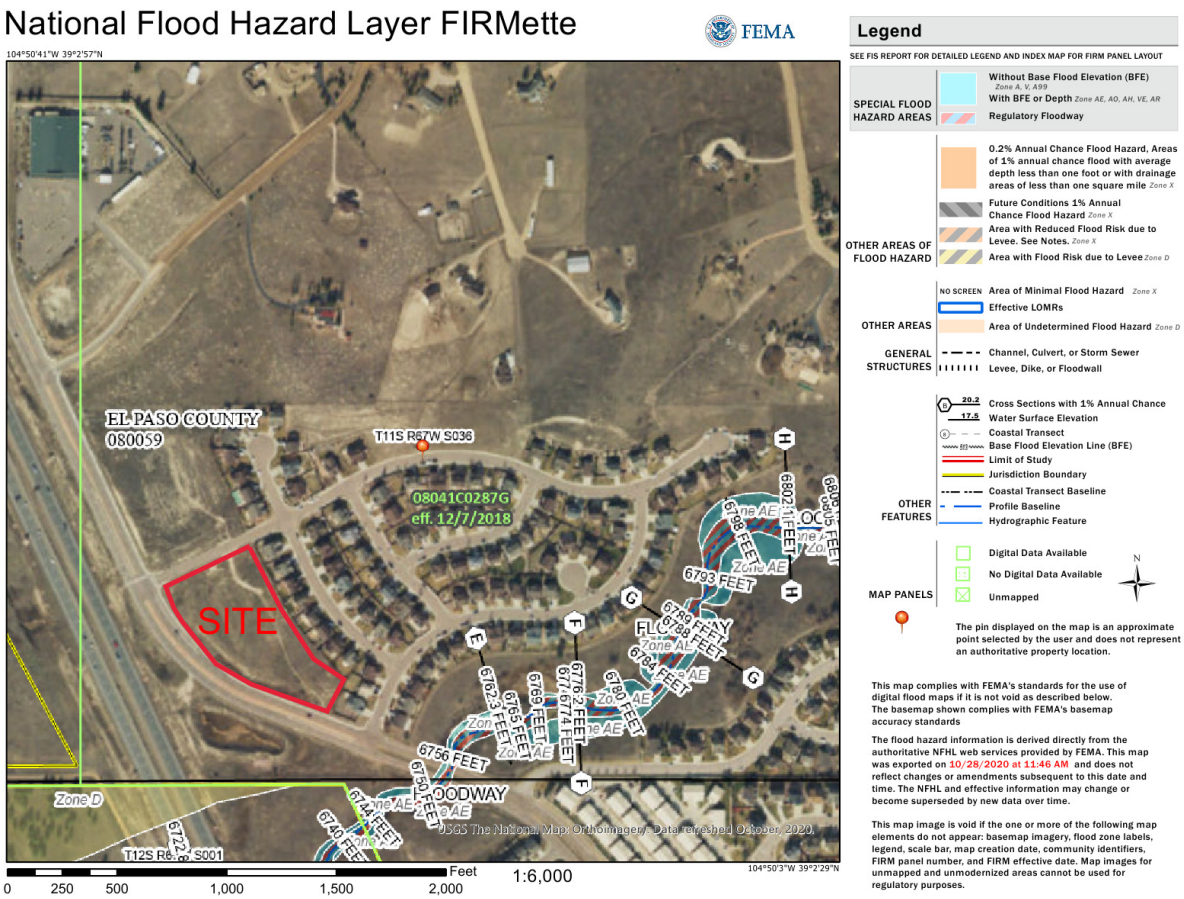
The El Paso County Drainage Criteria Manual (DCM), the City of Colorado Springs DCM and the Mile High Flood District (MHFD) "Urban Storm Drainage Criteria Manual, latest editions were used in the preparation of this report. The Rational Method was used to calculate the post-development storm peak flows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

FLOODPLAIN IMPACTS

The FEMA Flood Insurance Rate Map (FIRM) firmette for Community Panel 08041C0287G, revised December 7, 2018 (refer to figure 6) shows that no portion of this development lies within the 100·year flood plain of Black Forest Creek, nor its

tributaries.

FIGURE 6 – FIRM FIRMETTE FOR COMMUNITY PANEL 08041C0287G



EXISTING DRAINAGE BASINS

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

southwesterly basin boundary which conveys flow to an existing 30” RCP culvert that connects to the existing grated area inlet in Drainage Basin D6A. An existing 30” RCP from the storm sewer system in Air Garden Lane outfalls into the drainage channel in Drainage Basin D9A. A dual 48” RCP storm 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. The owner is aware that this condition needs to be corrected so that it functions as designed and so that the proposed Struthers Ranch Subdivision Filing No. 5 development project does not create any negative drainage impacts on downstream properties. The owner will either 1) coordinate with the Struthers Ranch HOA to get this work completed or 2) have this work done as part of the future Struthers Ranch Subdivision Filing No. 5 Site Development Plan project.

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. An existing 30” RCP culvert conveys flows from the existing drainage channel to the existing grated inlet in Basin J. 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. Existing dual 48” RCP storm sewers convey flows from the existing grated area inlet, under Struthers Road to the existing detention

pond. 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.

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%	5.7	4.97	8.35	2.2	4.2
A2	0.34	76.0%	6.7	4.73	7.94	1.1	2.1
B	0.13	95.1%	5.0	5.17	8.68	0.5	1.0
C	0.32	93.1%	5.3	5.08	8.53	1.4	2.5
D	0.83	89.4%	5.0	5.17	8.68	3.5	6.4
E	0.85	73.9%	11.3	3.95	6.62	2.3	4.5
F	0.27	90.0%	5.0	5.17	8.68	1.0	1.9
G	0.17	16.0%	10.7	4.03	6.76	0.1	0.5
OS1	0.41	40.0%	7.1	4.64	7.80	0.6	1.6
OS2	0.33	40.0%	7.1	4.64	7.80	0.5	1.3
OS3	0.16	40.0%	7.9	4.48	7.53	0.2	0.6
OS4	0.20	40.0%	8.7	4.34	7.28	0.3	0.7
H	0.13	0.0%	6.2	4.85	8.14	0.05	0.3
I	0.16	0.0%	6.2	4.85	8.14	0.05	0.5
J	0.29	0.0%	5.8	4.95	8.31	0.1	0.8

Design Point Summary Table							
Design Point	Tributary Basin(s)	Total Area (ac)	Time of Concentration tc (min)	Rainfall Intensity I (in/hr)		Peak Flow Q (cfs)	
				5-yr	100-yr	5-yr	100-yr
1a	OS1, A1	1.03	7.7	4.52	7.59	2.5	5.3
1b	OS2, A2	0.67	7.7	4.52	7.59	1.5	3.3
1	OS1, OS2, A1, A2	1.70	7.7	4.52	7.59	4.0	8.7
2	OS1, OS2, A1, A2, B	1.83	7.9	4.48	7.53	4.4	9.4
3	OS3, C	0.48	9.0	4.29	7.20	1.4	2.7
4	D	0.83	5.0	5.17	8.68	3.5	6.4
5	OS1-OS3, A1, A2, B-D	3.14	9.5	4.21	7.09	8.3	16.7
6	OS4, E	1.05	8.7	4.34	7.28	2.8	5.7
6a	OS4, E, F	1.32	11.3	3.95	6.62	3.3	6.6
7	OS1-OS4, A1, A2, B-F	4.46	11.4	3.93	6.60	11.1	22.2
8	OS1-OS4, A1, A2, B-G	4.63	11.4	3.93	6.60	11.2	22.6
D9A*	D9A*	14.45	9.0	4.29	7.20	18.6	52.0
9	D9A*, H	14.58	9.0	4.29	7.20	18.6	52.3
10	D9A*, H, I	14.74	9.0	4.29	7.20	18.6	52.8
11	OS1--OS4, D9A*, A1, A2, B-J	19.66	11.4	3.93	6.60	28.4	71.7

* PER THE FINAL DRAINAGE REPORT FOR STRUTHERS RANCH FILING NO. 2

WATER QUALITY

The four step process has been taken to select and implement stormwater quality control measures for the Struthers Ranch Subdivision Filing No. 5 project, in accordance with Section I.7.2 of the el Paso County Engineering Criteria Manual.

Step 1: Employ Runoff Reduction Practices.

The existing topography, the existing storm drainage facilities and the proposed site layout for the Struthers Ranch Subdivision Filing No. 5 project does not make it feasible to minimize the directly connected impervious areas (DCIA) by creating receiving porous areas (RPA) that would receive runoff from unconnected impervious areas (UIA).

Step 2: Stabilize Drainageways.

There are no existing streams or drainageways on this site. Therefore no stabilization is required.

Step 3: Provide Water Quality Capture Volume (WQCV).

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 drainage area tributary to the EDB, for determining the water quality capture volume (WQCV), is 4.63 acres (basins A1, A2, B, C, D, E, F, G, OS1, OS2, OS3 and OS4) and has a calculated composite imperviousness of 70.3%. The drainage area of the project site that is not tributary to the EDB is 0.58 ac. (basins H, I, and J). These areas are perimeter landscape areas downstream of the EDB and are 14% of the total site area, which is less than the 20% allowed to be excluded from the WQCV requirement, as per Section I.7.1.C of the El Paso County Engineering Criteria Manual. The EDB will provide 0.107 ac-ft of WQCV storage volume with a water surface elevation of 6758.00. An orifice plate with 1 column and 3 rows of 13/16" dia. holes spaced at 10.5 inches 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 93 c.f., which is 2% of the water quality capture volume. A 0.8" opening in the forebay curb will release flows into a concrete low flow channel designed to convey 0.32 cfs, which is 2% of the 100-year inflow rate into the EDB. 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 16.1 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 depth of 1.02 feet to the top of the 8' wide EDB berm. Maintenance access to the pond will be provided by a 15' wide gravel access ramp with a maximum slope of 10%, 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 remain the responsibility of the property owner.

Step 4: Consider Need for Industrial and Commercial BMPs.

The Struthers Ranch Subdivision Filing No. 5 project will provide source control Best Management Practices (BMP's) that include periodic sweeping of the parking lot to prevent accumulation of litter and debris, periodic inspection of the outdoor trash receptacle and enclosure to ensure that the lid and enclosure gate are functioning so that the trash is properly covered and contained, the collection and disposal of grass clippings after mowing operations and maintaining the landscaping with a minimal use of pesticides and fertilizers.

The design flows from the Struther's Ranch Subdivision Filing No. 5 project (SRS Flg 5) are in compliance with design flows calculated from the Final Drainage Report for Struther's Ranch Subdivision Filing No. 2 (SRS Flg 2) as summarized below.

		SRS Flg 2	SRS Flg 5
		Q_5/Q_{100} (CFS)	Q_5/Q_{100} (CFS)
DP9	30" F.E.S.	43.2 / 84.8	8.6 / 52.3
DP11	Inlet Grate	14.0 / 24.3	0.1 / 0.8
DP11	Inlet Box	55.0 / 105.3	28.4 / 71.7

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.

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. "El Paso County Engineering Criteria Manual", October 14, 2020 (revised).
3. Mile High Flood District Urban Storm Drainage Criteria Manual, latest editions.
4. 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.
5. Federal Emergency Management Agency Firmette for Flood Insurance Rate Map Number 08041C0287G, dated 12/7/2018.
6. Final Drainage Report for Struthers Ranch Filing No. 2, prepared by JPS Engineering, October 14, 2004 (revised).

7. Drainage Letter Report for Struthers Ranch Filing No. 4, prepared by JPS Engineering, April 16, 2006 (revised).

APPENDIX

Hydrologic Calculations

Hydraulic Calculations

Existing Conditions Drainage Plan

Developed Drainage Plan

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: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Hydrological Soil Group: B												
Land Use:	**Paved Drives**	**Concrete/ Walks**	**Roofs**	**Gravel Roads**	**Lawns/ Native**	**Residential 1/4 ac.**			**Sub-Basin Composite Imperviousness and Runoff Coefficient Values**			
Imperviousness:	100%	100%	90%	80%	0%	40%						
C_2:	0.89	0.89	0.71	0.57	0.02	0.23						
C_5:	0.90	0.90	0.73	0.59	0.08	0.30						
C_{100}:	0.96	0.96	0.81	0.70	0.35	0.50						
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_2**	**C_5**	**C_{100}**
Ex-A	0	0	0	0	6,240	0	6,240	0.14	0.0%	0.02	0.08	0.35
Ex-B	0	0	0	0	106,965	0	106,965	2.46	0.0%	0.02	0.08	0.35
Ex-C	0	0	0	0	71,550	0	71,550	1.64	0.0%	0.02	0.08	0.35
Ex-OS1	0	0	0	0	0	47,090	47,090	1.08	40.0%	0.23	0.30	0.50
Ex-OS2	0	0	0	0	0	765	765	0.02	40.0%	0.23	0.30	0.50
		0										
D9A*	0	0	0	0	0	629,440	629,440	14.45	40.0%	0.23	0.30	0.50
*Per the Final Drainage Report for Struthers Ranch Filing No. 2												

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:	**Paved Drives**	**Concrete/ Walks**	**Roofs**	**Gravel Roads**	**Lawns/ Native**	**Residential 1/4 ac.**			**Sub-Basin Composite Imperviousness and Runoff Coefficient Values**			
Imperviousness:	100%	100%	90%	80%	0%	40%						
C_2:	0.89	0.89	0.71	0.57	0.02	0.23						
C_5:	0.90	0.90	0.73	0.59	0.08	0.30						
C_{100}:	0.96	0.96	0.81	0.70	0.35	0.50						
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_2**	**C_5**	**C_{100}**
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
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 (tributrary 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
D9A*	0	0	0	0	0	629,440	629,440	14.45	40.0%	0.23	0.30	0.50
*Per the Final Drainage Report for Struthers Ranch Filing No. 2												

Standard Form SF-1, Time of Concentration

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Area Description: Urbanized Area **min. tc = 5 min.**

Notes:
T_i = (0.395*(1.1 - C_5)*(L)^0.5)/(S^0.33)
T_t=L/60V (Velocity = Cv*Sw^0.5)

Cv =	2.5	Heavy Meadow
	5.0	Tillage / Field
	6.5	Rip Rap (not buried)
	7.0	Short Pasture and Lawns
	10.0	Nearly Bare Ground
	15.0	Grassed Waterway
	20.0	Paved Areas and Shallow Paved Swales

Sub-Basin Data			Initial/Overland Time (t_i)			Travel Time (t_t)					tc	tc Check (Urbanized Basins)		Final tc	Remarks
Basin Design.	C_5	Area (A) acres	Length (L) feet	Slope (S) %	t_i minutes	Length (L) feet	Slope (S) %	C_v	Velocity (V) ft/sec	t_t minutes	tc = ti+ tt minutes	Total Length (L) feet	t_c = (L/180)+10 minutes	minutes	
Ex-A	0.08	0.14	150	3.5	14.9	0	0.0	0.0	0.00	0.0	14.9	150	10.8	10.8	tc Check
Ex-B	0.08	2.46	250	3.2	19.8	335	1.0	15.0	1.50	3.7	23.6	585	13.3	13.3	tc Check
Ex-C	0.08	1.64	300	3.4	21.3	210	1.3	15.0	1.71	2.0	23.3	510	12.8	12.8	tc Check
Ex-OS1	0.30	1.08	60	4.0	7.1	0	0.0	0.0	0.00	0.0	7.1	60	10.3	7.1	
Ex-OS2	0.30	0.02	30	4.0	5.0	0	0.0	0.0	0.00	0.0	5.0	30	10.2	5.0	

Standard Form SF-1, Time of Concentration

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Area Description: Urbanized Area **min. tc = 5 min.**

Notes:
T_i = (0.395*(1.1 - C_5)*(L)^0.5)/(S^0.33)
T_t=L/60V (Velocity = Cv*Sw^0.5)

Cv =	2.5	Heavy Meadow
	5.0	Tillage / Field
	6.5	Rip Rap (not buried)
	7.0	Short Pasture and Lawns
	10.0	Nearly Bare Ground
	15.0	Grassed Waterway
	20.0	Paved Areas and Shallow Paved Swales

Sub-Basin Data			Initial/Overland Time (t_i)			Travel Time (t_t)					tc	tc Check (Urbanized Basins)		Final tc	Remarks
Basin Design.	C_5	Area (A) acres	Length (L) feet	Slope (S) %	t_i minutes	Length (L) feet	Slope (S) %	C_v	Velocity (V) ft/sec	t_t minutes	tc = ti+ tt minutes	Total Length (L) feet	t_c = (L/180)+10 minutes	minutes	
A1	0.70	0.63	65	2.0	4.6	135	1.0	20.0	2.00	1.1	5.7	200	11.1	5.7	
A2	0.67	0.34	80	2.5	5.1	150	0.6	20.0	1.55	1.6	6.7	230	11.3	6.7	
B	0.82	0.13	60	2.0	3.1	40	2.0	20.0	2.83	0.2	5.0	100	10.6	5.0	min tc
C	0.84	0.32	80	2.5	3.1	240	0.8	20.0	1.79	2.2	5.3	320	11.8	5.3	
D	0.81	0.83	60	4.0	2.5	120	1.0	20.0	2.00	1.0	5.0	180	11.0	5.0	min tc
E	0.69	0.85	200	3.0	7.4	475	1.0	20.0	2.00	4.0	11.3	675	13.8	11.3	
F	0.73	0.27	65	2.0	4.3	10	2.0	20.0	2.83	0.1	5.0	75	10.4	5.0	min tc
G	0.19	0.17	65	2.0	10.6	60	1.0	20.0	2.00	0.5	11.1	125	10.7	10.7	tc Check
OS1	0.30	0.41	60	4.0	7.1	0	0.0	0.0	0.00	0.0	7.1	60	10.3	7.1	
OS2	0.30	0.33	60	4.0	7.1	0	0.0	0.0	0.00	0.0	7.1	60	10.3	7.1	
OS3	0.30	0.16	75	4.0	7.9	0	0.0	0.0	0.00	0.0	7.9	75	10.4	7.9	
OS4	0.30	0.20	90	4.0	8.7	0	0.0	0.0	0.00	0.0	8.7	90	10.5	8.7	
H	0.08	0.13	20	2.5	6.1	145	1.0	15.0	15.00	0.2	6.2	165	10.9	6.2	
I	0.08	0.16	20	2.5	6.1	135	1.0	15.0	15.00	0.2	6.2	155	10.9	6.2	
J	0.08	0.29	25	5.0	5.4	430	1.6	15.0	18.97	0.4	5.8	455	12.5	5.8	

Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Design Storm: **5-year**

Note:
$I_5 = -1.50 \times \ln(t_c) + 7.583$

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			REMARKS
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t_c	C*A	I	Q	t_c	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min.		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
	1	Ex-A	0.14	0.08	10.8	0.01	4.01	0.04				0.04									
Basin D9A per the Final Drainage Report for Struthers Ranch Filing No. 2	D9A	D9A	14.45	0.30	9.0	4.33	4.29	18.6				18.6									
		Ex-OS1	1.08	0.30	7.1	0.32	4.64	1.5				1.5									
	2	Ex-B	2.46	0.08	13.3	0.20	3.70	0.7	13.3	4.85	3.70	18.6									
		Ex-OS2	0.02	0.30	5.0	0.01	5.17	0.1				0.1									
	3 3a	Ex-C	1.64	0.08	12.8	0.13	3.76	0.5	12.8 13.3	0.14 4.99	3.76 3.70	0.5 18.6	at inlet grate at inlet box								

Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Design Storm: **100-year**

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

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			REMARKS
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t_c	C*A	I	Q	t_c	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min.		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
	1	Ex-A	0.14	0.35	10.8	0.05	6.74	0.3				0.3									
Basin D9A per the Final Drainage Report for Struthers Ranch Filing No. 2	D9A	D9A	14.45	0.50	9.0	7.22	7.20	52.0				52.0									
		Ex-OS1	1.08	0.50	7.1	0.54	7.80	4.2				4.2									
	2	Ex-B	2.46	0.35	13.3	0.86	6.21	5.3	13.3	8.62	6.21	53.6									
		Ex-OS2	0.02	0.50	5.0	0.01	8.68	0.1				0.1									
	3 3a	Ex-C	1.64	0.35	12.8	0.57	6.31	3.6	12.8 13.3	0.58 9.20	6.31 6.21	3.7 57.2	at inlet grate at inlet box								

Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Design Storm: **5-year**

Note:
$I_5 = -1.50 \times \ln(t_c) + 7.583$

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			REMARKS
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t_c	C*A	I	Q	t_c	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min.		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
		OS1	0.41	0.30	7.1	0.12	4.64	0.6				0.6	1.0	0.6				67.5	2.0	0.6	
	1a	A1	0.63	0.70	5.7	0.44	4.97	2.2	7.7	0.56	4.52	2.5									
		OS2	0.33	0.30	7.1	0.10	4.64	0.5				0.5	0.6	0.5				75	2.0	0.6	
	1b	A2	0.34	0.67	6.7	0.23	4.73	1.1	7.7	0.33	4.52	1.5									
	1								7.7	0.89	4.52	4.0			4.0	0.4	24	55	3.8	0.2	
	2	B	0.13	0.82	5.0	0.10	5.17	0.5	7.9	0.99	4.48	4.4			4.4	0.4	24	145	3.9	0.6	
		OS3	0.16	0.30	7.9	0.05	4.48	0.2				0.2	0.8	0.2				120	1.8	1.1	
	3	C	0.32	0.84	5.3	0.27	5.08	1.4	9.0	0.32	4.29	1.4			1.4	0.5	12	90	3.3	0.5	
	4	D	0.83	0.81	5.0	0.67	5.17	3.5				3.5									
	5								9.5	1.98	4.21	8.3			8.3	0.3	30	190	4.2	0.8	
		OS4	0.2	0.30	8.7	0.06	4.34	0.3				0.3									
	6	E	0.85	0.69	11.3	0.58	3.95	2.3	8.7	0.64	4.34	2.8									
	6a	F	0.27	0.73	5.0	0.20	5.17	1.0	11.3	0.84	3.95	3.3			3.3	12.0	4	25	7.6	0.1	
	7								11.4	2.82	3.93	11.1			11.1	0.4	30	15	5.1	0.0	
	8	G	0.17	0.19	10.7	0.03	4.03	0.1	11.4	2.85	3.93	11.2									
Basin D9A per the Final Drainage Report for Struthers Ranch Filing No. 2	D9A	D9A	14.45	0.30	9.0	4.33	4.29	18.6				18.6									
	9	H	0.13	0.08	6.2	0.01	4.85	0.05	9.0	4.34	4.29	18.6									
	10	I	0.16	0.08	6.2	0.01	4.85	0.05	9.0	4.35	4.29	18.6									
	11	J	0.3	0.08	5.8	0.02	4.95	0.1	11.4	7.22	3.93	28.4									

Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS
Company: CIVAS Engineering, LLC
Date: 5/10/2021
Project Name: Struthers Ranch Retail
Project Number: 20-288

Design Storm: **100-year**

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

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			REMARKS
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t_c	C*A	I	Q	t_c	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min.		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
		OS1	0.41	0.50	7.1	0.20	7.80	1.6				1.6	1.0	1.6				67.5	2.0	0.6	
	1a	A1	0.63	0.80	5.7	0.50	8.35	4.2	7.7	0.70	7.59	5.3									
		OS2	0.33	0.50	7.1	0.17	7.80	1.3				1.3	0.6	1.3				75	2.0	0.6	
	1b	A2	0.34	0.78	6.7	0.27	7.94	2.1	7.7	0.44	7.59	3.3									
	1								7.7	1.14	7.59	8.7			8.7	0.4	24	55	4.8	0.2	
	2	B	0.13	0.89	5.0	0.11	8.68	1.0	7.9	1.25	7.53	9.4			9.4	0.4	24	145	4.9	0.5	
		OS3	0.16	0.50	7.9	0.08	7.53	0.6				0.6	0.8	0.6				120	1.8	1.1	
	3	C	0.32	0.92	5.3	0.29	8.53	2.5	9.0	0.37	7.20	2.7			2.7	0.5	12	90	3.5	0.4	
	4	D	0.83	0.90	5.0	0.74	8.68	6.4				6.4									
	5								9.4	2.36	7.09	16.7			16.7	0.3	30	190	5.1	0.6	
		OS4	0.2	0.50	8.7	0.10	7.28	0.7				0.7									
	6	E	0.85	0.80	11.3	0.68	6.62	4.5	8.7	0.78	7.28	5.7									
	6a	F	0.27	0.81	5.0	0.22	8.68	1.9	11.3	1.00	6.62	6.6			6.6	12.0	4	25	7.6	0.1	
	7								11.4	3.36	6.60	22.2			22.2	0.4	30	15	6.1	0.0	
	8	G	0.17	0.42	10.7	0.07	6.76	0.5	11.4	3.43	6.60	22.6									
Basin D9A per the Final Drainage Report for Struthers Ranch Filing	D9A	D9A	14.45	0.50	9.0	7.23	7.20	52.0				52.0									
	9	H	0.13	0.35	6.2	0.04	8.14	0.3	9.0	7.27	7.20	52.3									
	10	I	0.16	0.35	6.2	0.06	8.14	0.5	9.0	7.33	7.20	52.8									
	11	J	0.3	0.35	5.8	0.10	8.31	0.8	11.4	10.86	6.60	71.7									

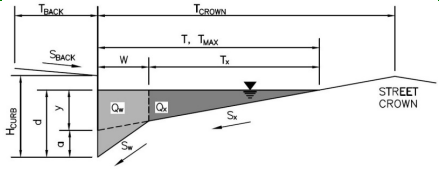
Version 4.05 Released March 2017

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)

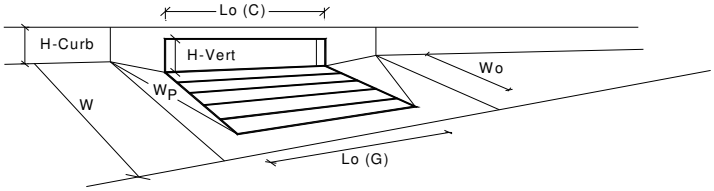
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**10.5**	**10.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.0	8.7	cfs

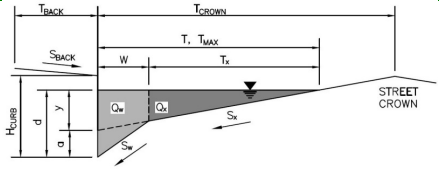
Version 4.05 Released March 2017

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)

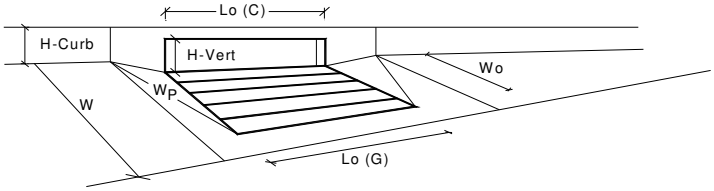
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	3.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	3.00	3.00	feet
Width of a Unit Grate		W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	0.60	0.60	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	0.523	0.523	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	0.94	0.94	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**2.6**	**2.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	0.5	1.0	cfs

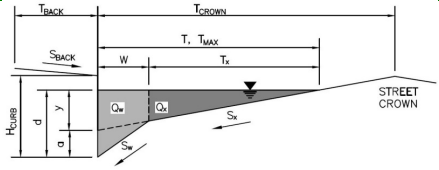
Version 4.05 Released March 2017

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)

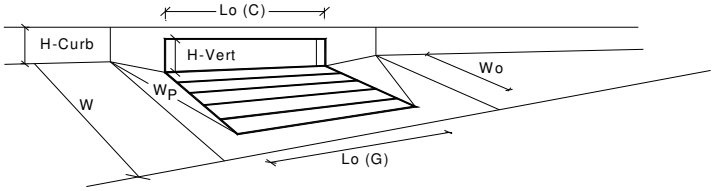
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.4	2.5	cfs

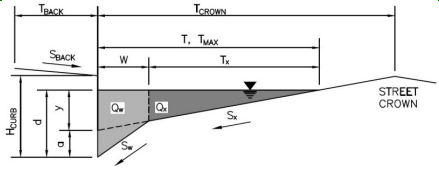
Version 4.05 Released March 2017

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)

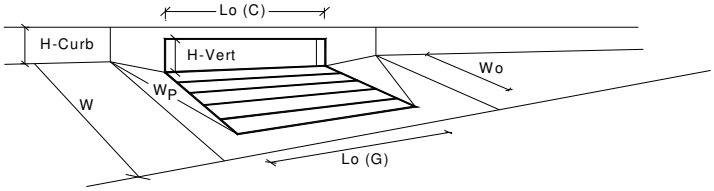
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	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	

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

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**10.5**	**10.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.5	6.4	cfs

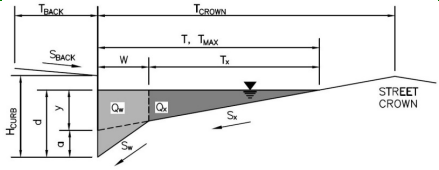
Version 4.05 Released March 2017

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)

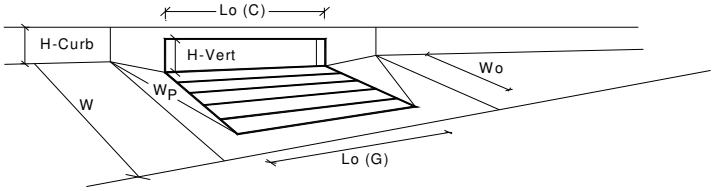
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.3	4.5	cfs

HYDRAULIC GRADE

CALCULATIONS - 5 year storm

CALCULATED BY: SMS
DATE: 5/10/2021
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	**Q_{full}** cfs	**Flow Depth** in.	**V** fps	**A** sf	**R**	**D_m** ft.	**Froude**	**H_v** ft.	**E.G.** E.G.	**c***	**S_f** S_f	**Ave. S_f** S_f	**L** L	**H_f** H_f	**H_b** K_b	**H_b** H_b	**Hj** K_j	**Hj** H_j	**Hm** K_m	**Hm** H_m	**Ht** K_t	**Ht** H_t	**Total Loss** Loss
Storm Line 1																													
30" FES	6755.95	30	6757.10	0.0040	0.013	11.10	25.94	13.80	5.04	2.20	0.59	0.89	0.94	0.39	6757.49	0.00492	0.0039	Open Channel Flow											0.00
5' Dia. Storm MH out - DP 7	6756.01	30	6757.16	0.0040	0.013	11.10	25.94	13.80	5.04	2.20	0.59	0.89	0.94	0.39	6757.55	0.00492	0.0039	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 7	6756.06	30	6757.16	0.0030	0.013	8.80	22.47	12.90	4.36	2.02	0.57	0.82	0.85	0.30	6757.46	0.00492	0.0031	Open Channel Flow											0.00
5' Dia. Storm MH out - DP 5	6756.62	30	6757.67	0.0030	0.013	8.30	22.47	12.60	4.24	1.96	0.56	0.79	0.84	0.28	6757.95	0.00492	0.0030	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 5	6756.77	24	6757.67	0.0040	0.013	4.40	14.31	9.12	4.16	1.06	0.40	0.55	0.99	0.27	6757.94	0.00492	0.0044	Open Channel Flow											0.00
ingle Type 16 Area Inlet out - DP	6757.35	24	6758.11	0.0040	0.013	4.40	14.31	9.12	4.16	1.06	0.40	0.55	0.99	0.27	6758.38	0.00492	0.0044	Open Channel Flow											0.00
ingle Type 16 Area Inlet in - DP	6757.40	24	6758.12	0.0040	0.013	4.00	14.31	8.64	4.08	0.98	0.39	0.51	1.00	0.26	6758.38	0.00492	0.0045	Open Channel Flow											0.00
10' Type R Inlet out - DP 1	6757.62	24	6758.34	0.0040	0.013	4.00	14.31	8.64	4.08	0.98	0.39	0.51	1.00	0.26	6758.60	0.00492	0.0045	Open Channel Flow											0.00
Storm Line 2																													
5' Dia. Storm MH out - DP 7	6756.01	30	6757.16	0.0040	0.013	11.10	25.94	13.80	5.04	2.20	0.59	0.89	0.94	0.39	6757.55	0.00492	0.0039	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 7	6757.50	12	6757.98	0.0400	0.013	3.30	7.13	5.76	8.85	0.37	0.24	0.37	2.55	1.22	6759.20	0.00492	0.0394	Open Channel Flow											0.00
5' Type R Inlet out	6758.50	12	6758.98	0.0400	0.013	3.30	7.13	5.76	8.85	0.37	0.24	0.37	2.55	1.22	6760.20	0.00492	0.0394	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	6757.67	0.0030	0.013	8.30	22.47	12.60	4.24	1.96	0.56	0.79	0.84	0.28	6757.95	0.00492	0.0030	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	6757.67	0.0030	0.013	8.30	22.47	12.60	4.24	1.96	0.56	0.79	0.84	0.28	6757.95	0.00492	0.0030	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																													
36" 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
36" 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: 5/10/2021
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***	**Sf** Sf	**Ave. Sf** Sf	**L** L	**Hf** Hf	**Hb** Kb	Hb	**Hj** Kj	Hj	**Hm** Km	Hm	**Ht** Kt	Ht	**Total Loss** Loss
Storm Line 1																													
30" FES	6755.95	30	6757.73	0.0040	0.013	22.20	25.94	21.30	6.05	3.67	0.74	1.60	0.84	0.57	6758.29	0.00492	0.0042	Open Channel Flow											0.00
5' Dia. Storm MH out - DP 7	6756.01	30	6757.79	0.0040	0.013	22.20	25.94	21.30	6.05	3.67	0.74	1.60	0.84	0.57	6758.35	0.00492	0.0042	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 7	6756.06	30	6757.79	0.0030	0.013	16.70	22.47	19.20	5.03	3.32	0.72	1.38	0.75	0.39	6758.18	0.00492	0.0030	Open Channel Flow											0.00
5' Dia. Storm MH out - DP 5	6756.62	30	6758.22	0.0030	0.013	16.70	22.47	19.20	5.03	3.32	0.72	1.38	0.75	0.39	6758.61	0.00492	0.0030	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 5	6756.77	24	6758.22	0.0040	0.013	9.40	14.31	14.16	4.88	1.93	0.55	0.98	0.87	0.37	6758.59	0.00492	0.0040	Open Channel Flow											0.00
Single Type 16 Area Inlet out - DP 2	6757.35	24	6758.53	0.0040	0.013	9.40	14.31	14.16	4.88	1.93	0.55	0.98	0.87	0.37	6758.90	0.00492	0.0040	Open Channel Flow											0.00
Single Type 16 Area Inlet in - DP 2	6757.40	24	6758.53	0.0040	0.013	8.70	14.31	13.44	4.80	1.81	0.54	0.91	0.89	0.36	6758.89	0.00492	0.0040	Open Channel Flow											0.00
10' Type R Inlet out - DP 1	6757.62	24	6758.74	0.0040	0.013	8.70	14.31	13.44	4.80	1.81	0.54	0.91	0.89	0.36	6759.10	0.00492	0.0040	Open Channel Flow											0.00
Storm Line 2																													
5' Dia. Storm MH out - DP 7	6756.01	30	6757.79	0.0040	0.013	22.20	25.94	21.30	6.05	3.67	0.74	1.60	0.84	0.57	6758.35	0.00492	0.0042	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 7	6757.50	12	6758.25	0.0400	0.013	6.60	7.13	9.00	10.44	0.63	0.30	0.73	2.15	1.69	6759.94	0.00492	0.0410	Open Channel Flow											0.00
5' Type R Inlet out	6758.50	12	6759.25	0.0400	0.013	6.60	7.13	9.00	10.44	0.63	0.30	0.73	2.15	1.69	6760.94	0.00492	0.0410	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	6758.22	0.0030	0.013	16.70	22.47	19.20	5.03	3.32	0.72	1.38	0.75	0.39	6758.61	0.00492	0.0030	Open Channel Flow											0.00
5' Dia. Storm MH in - DP 5	6756.77	18	6757.94	0.0040	0.013	6.40	6.64	14.04	4.33	1.48	0.46	1.19	0.70	0.29	6758.23	0.00492	0.0041	Open Channel Flow											0.00
5' Type R Inlet out	6756.90	18	6758.07	0.0040	0.013	6.40	6.64	14.04	4.33	1.48	0.46	1.19	0.70	0.29	6758.36	0.00492	0.0041	Open Channel Flow											0.00
Storm Line 4																													
5' Dia. Storm MH out - DP 5	6756.62	30	6758.22	0.0030	0.013	16.70	22.47	19.20	5.03	3.32	0.72	1.38	0.75	0.39	6758.61	0.00492	0.0030	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																													
36" 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
36" 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

Project Name: Struthers Ranch Retail
Project No. 20-288
By: SMS
Checked By: SMS
Date: 5/10/2021

Forebay

WQCV volume =	0.107	ac-ft
Forebay volume = 2% of WQCV volume =	0.0021	ac-ft
	93	cu-ft

Elev.	*h* 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 =	6756.79	
height =	0.94	ft
=	11.3	in
USE	**12**	**in curb**

ORIFICE /WEIR SIZING

Project Name:	Struthers Ranch Retail
Project No.	20-288
By:	SMS
Checked By:	SMS
Date:	5/10/2021

Water Quality EDB

Orifice Discharge rate Q= C*A*(2gh)^0.5

Where:

C= 0.65 orifice coefficient for square-edged openings
A = orifice opening
h = head on orifce measured from centerline
g = 32.2 ft^2/sec gravitational constant

Forebay orifice

Discharge =	2% of 100-year EDB inflow	
=	2% of 16.1 cfs	
=	0.32	cfs
W. Surf =	6756.79	
Invert =	6755.85	
Height =	0.94	ft
Area =	0.06	sf
Width =	0.07	ft
=	**0.81**	**in**
USE	**0.8**	**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.

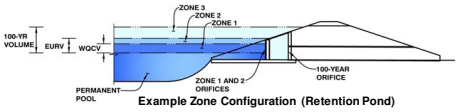
Low Flow Channel Flow:	**0.39 cfs**	
2% of 100-yr EDB Inflow:	**0.32**	**OK**
(2% of 16.1 cfs)		

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

Project: **Struthers Ranch Subdivision Filing No. 5**

Basin ID: **G**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = **EDB**
Watershed Area = 4.63 acres
Watershed Length = 650 ft
Watershed Length to Centroid = 325 ft
Watershed Slope = 0.040 ft/ft
Watershed Imperviousness = 70.30% percent
Percentage Hydrologic Soil Group A = 0.0% percent
Percentage Hydrologic Soil Group B = 100.0% percent
Percentage Hydrologic Soil Groups C/D = 0.0% percent
Target WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = User Input

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.107	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.358	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.308	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.415	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.506	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.612	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.706	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.819	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.059	acre-feet		inches
Approximate 2-yr Detention Volume =	0.280	acre-feet		
Approximate 5-yr Detention Volume =	0.372	acre-feet		
Approximate 10-yr Detention Volume =	0.470	acre-feet		
Approximate 25-yr Detention Volume =	0.505	acre-feet		
Approximate 50-yr Detention Volume =	0.525	acre-feet		
Approximate 100-yr Detention Volume =	0.562	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 0.107 acre-feet
Select Zone 2 Storage Volume (Optional) = acre-feet
Select Zone 3 Storage Volume (Optional) = acre-feet
Total Detention Basin Volume = 0.107 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

Total detention volume is less than 100-year volume.

Initial Surcharge Area (A_{ISV}) = user ft^2
Surcharge Volume Length (L_{ISV}) = user ft
Surcharge Volume Width (W_{ISV}) = user ft
Depth of Basin Floor (H_{FLOOR}) = user ft
Length of Basin Floor (L_{FLOOR}) = user ft
Width of Basin Floor (W_{FLOOR}) = user ft
Area of Basin Floor (A_{FLOOR}) = user ft^2
Volume of Basin Floor (V_{FLOOR}) = user ft^3
Depth of Main Basin (H_{MAIN}) = user ft
Length of Main Basin (L_{MAIN}) = user ft
Width of Main Basin (W_{MAIN}) = user ft
Area of Main Basin (A_{MAIN}) = user ft^2
Volume of Main Basin (V_{MAIN}) = user ft^3
Calculated Total Basin Volume (V_{total}) = **user** acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
	--	0.50	--	--	--	1,085	0.025	274	0.006
	--	1.50	--	--	--	1,920	0.044	1,776	0.041
	--	2.50	--	--	--	2,975	0.068	4,224	0.097
	--	3.50	--	--	--	4,270	0.098	7,846	0.180
	--	4.50	--	--	--	5,230	0.120	12,596	0.289
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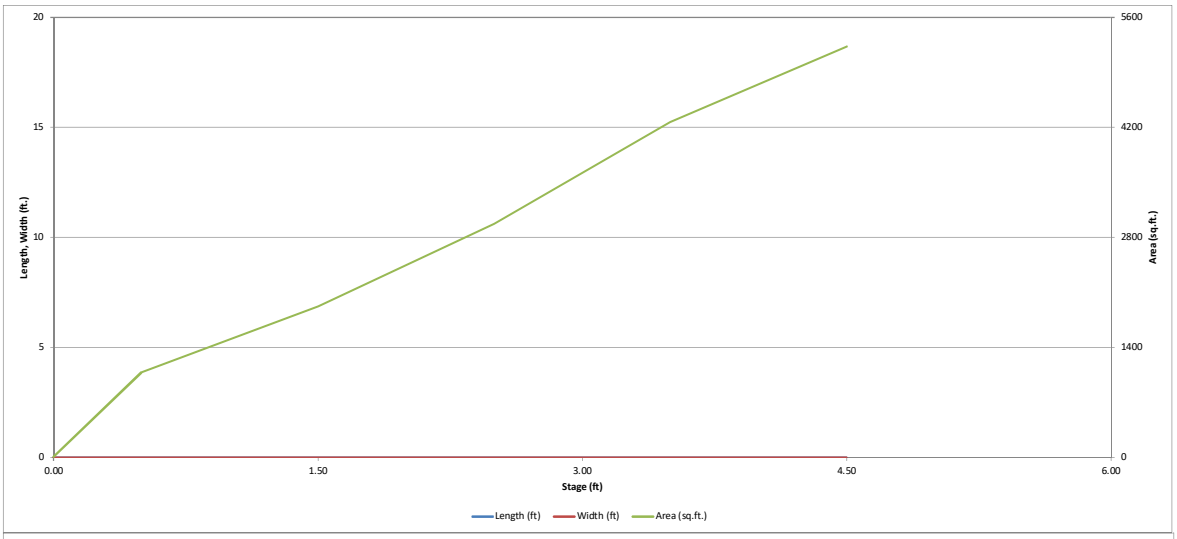
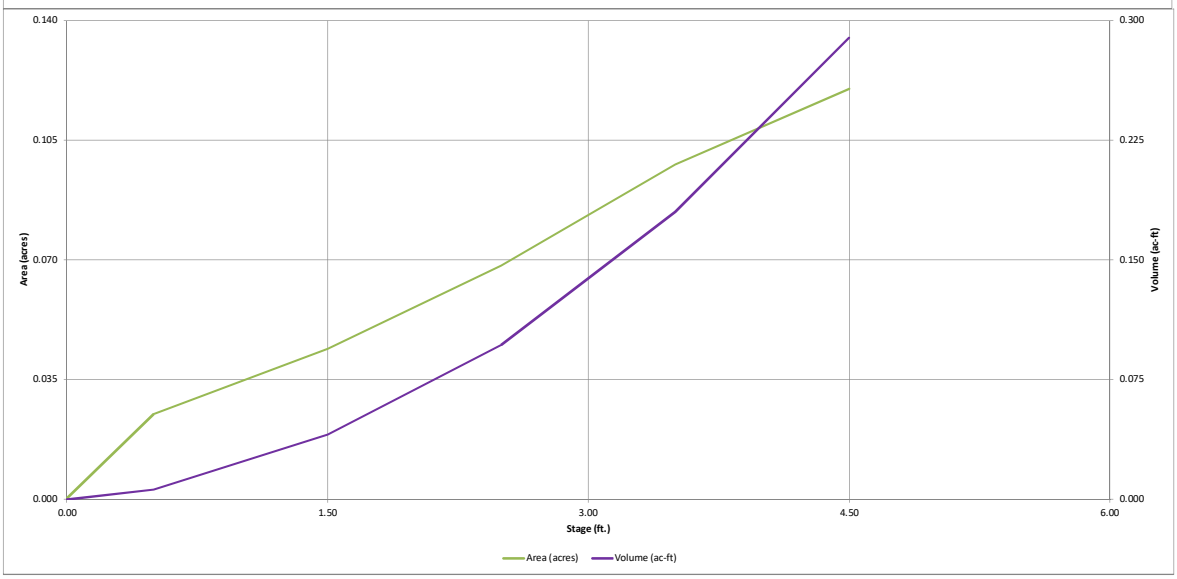

20
15
10
5
0
Length, Width (ft.)
5600
4200
2800
1400
0
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

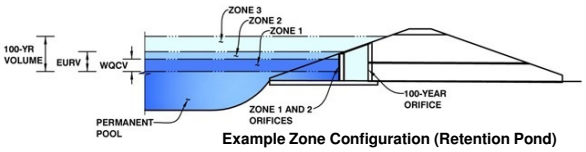

0.140
0.105
0.070
0.035
0.000
Area (acres)
0.300
0.225
0.150
0.075
0.000
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: **Struthers Ranch Subdivision Filing No. 5**

Basin ID: **G**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.64	0.107	Orifice Plate
Zone 2			Weir&Pipe (Circular)
Zone 3			Not Utilized
Total (all zones)		0.107	

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

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	3.819E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.64	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.55	sq. inches (diameter = 13/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.90	1.80					
Orifice Area (sq. inches)	0.55	0.55	0.55					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	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

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.60	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.46	N/A	
Overflow Grate Open Area w/o Debris =	14.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	14.00	N/A	ft^2

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

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	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 Design Flow Depth=	0.38	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	4.63	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.12	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.29	acre-ft

Calculated Parameters for Spillway

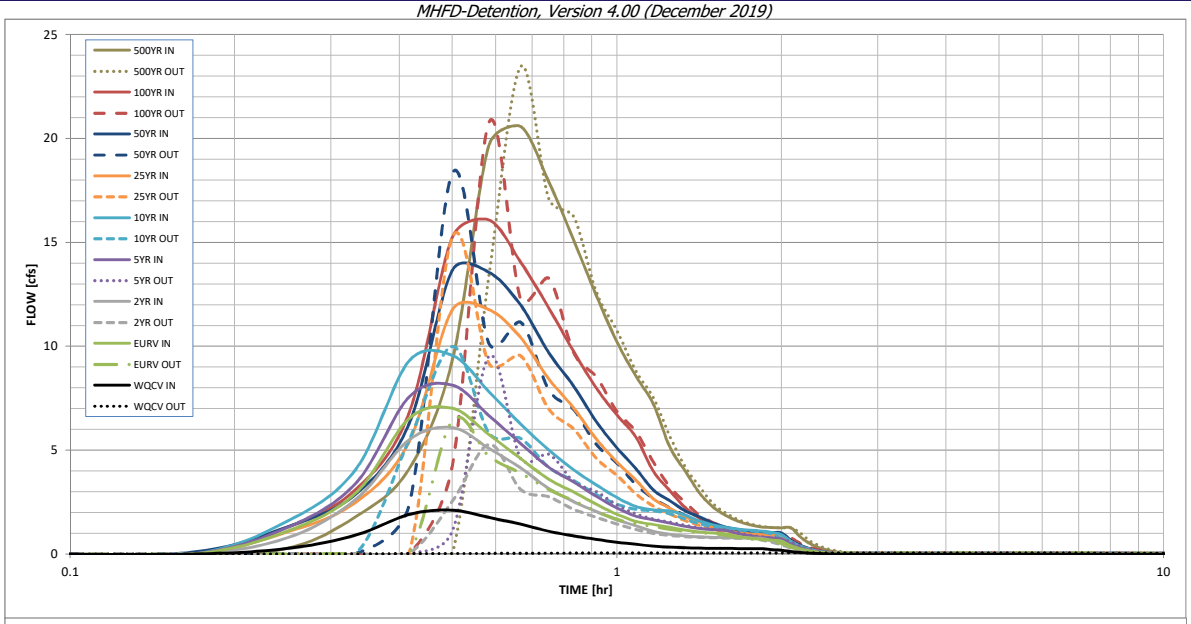
Routed Hydrograph Results

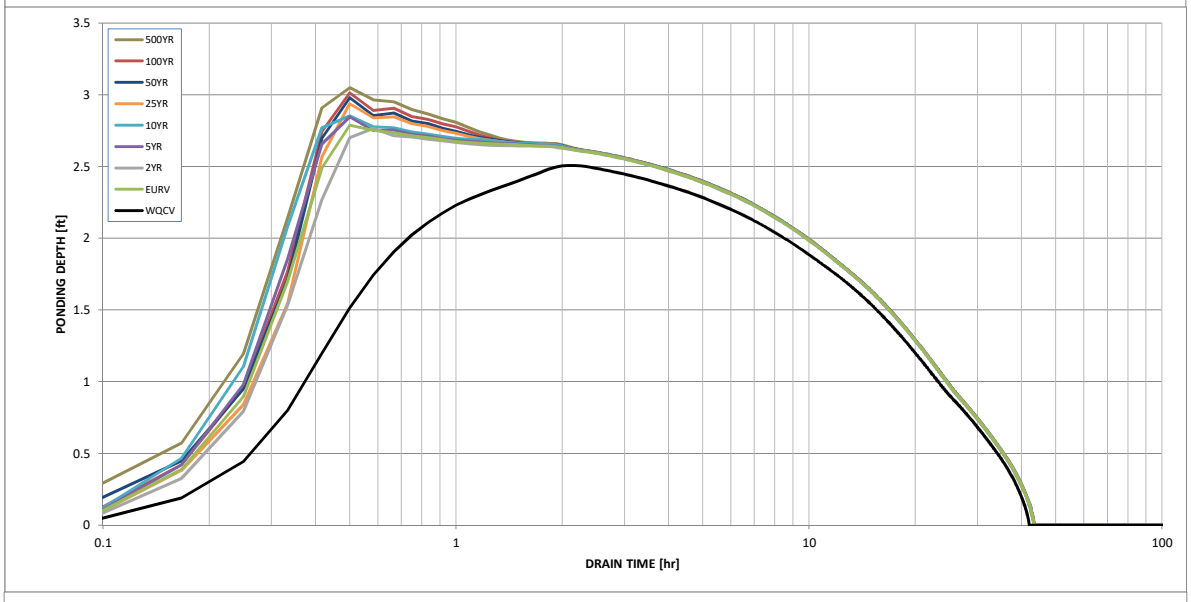
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

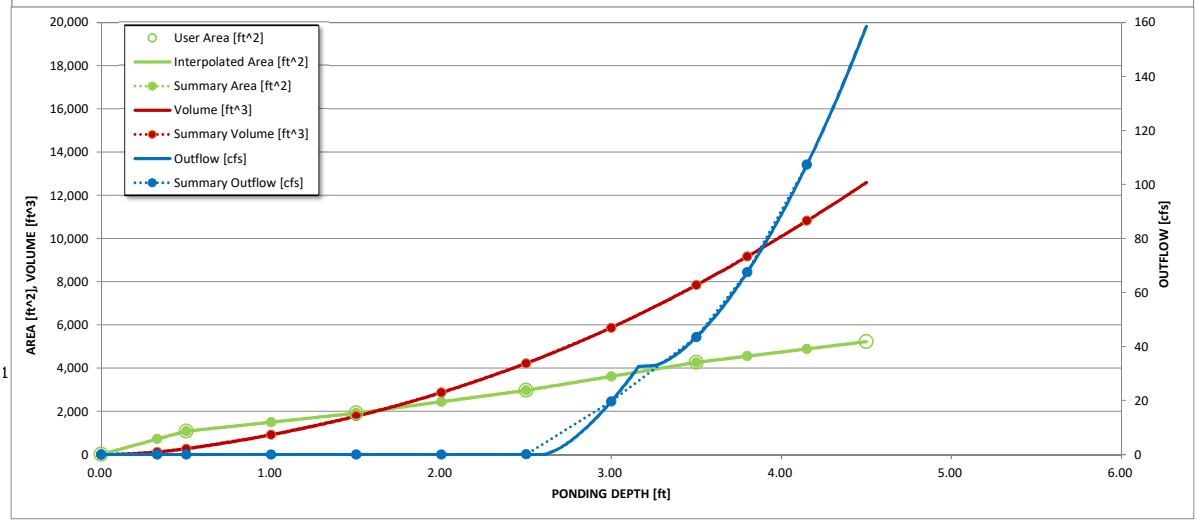
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.107	0.358	0.308	0.415	0.506	0.612	0.706	0.819	1.059
Inflow Hydrograph Volume (acre-ft) =	0.107	0.358	0.308	0.415	0.506	0.612	0.706	0.819	1.059
CUHP Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	1.6	2.4	4.3	5.4	6.8	9.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.13	0.35	0.53	0.93	1.17	1.46	2.04
Peak Inflow Q (cfs) =	2.1	7.0	6.1	8.1	9.6	11.8	13.6	16.1	20.6
Peak Outflow Q (cfs) =	0.1	6.4	5.3	9.5	10.0	15.3	18.3	20.8	23.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	5.8	4.1	3.5	3.4	3.1	2.5
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
Max Velocity through Grate 1 (fps) =	N/A	0.46	0.39	0.7	0.7	1.1	1.3	1.5	1.7
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) =	37	32	33	30	28	26	25	23	20
Time to Drain 99% of Inflow Volume (hours) =	**40**	38	39	38	37	36	35	34	32
Maximum Ponding Depth (ft) =	2.51	2.79	2.77	2.85	2.85	2.94	2.98	3.01	3.05
Area at Maximum Ponding Depth (acres) =	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Maximum Volume Stored (acre-ft) =	0.097	0.117	0.116	0.122	0.123	0.129	0.133	0.136	0.138

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			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.01	0.29
	0:15:00	0.28	1.11	0.79	1.29	1.60	1.07	1.31	1.30	1.81
	0:20:00	0.92	2.95	2.65	3.42	4.09	2.50	2.89	3.12	4.09
	0:25:00	1.91	6.51	5.49	7.55	9.29	5.39	6.26	6.78	9.30
	0:30:00	2.11	7.02	6.09	8.13	9.56	11.75	13.64	15.23	19.65
	0:35:00	1.77	5.75	5.09	6.67	7.82	11.76	13.56	16.08	20.57
	0:40:00	1.44	4.60	4.15	5.33	6.27	10.43	11.99	14.06	17.95
	0:45:00	1.10	3.61	3.17	4.19	5.02	8.45	9.71	11.87	15.13
	0:50:00	0.88	2.99	2.53	3.47	4.07	7.05	8.09	9.77	12.46
	0:55:00	0.71	2.40	2.05	2.79	3.33	5.55	6.39	8.00	10.23
	1:00:00	0.57	1.92	1.65	2.23	2.73	4.44	5.12	6.70	8.57
	1:05:00	0.47	1.57	1.37	1.83	2.29	3.57	4.12	5.64	7.22
	1:10:00	0.38	1.42	1.09	1.65	2.13	2.66	3.08	3.99	5.16
	1:15:00	0.33	1.29	0.96	1.49	2.08	2.21	2.57	3.06	4.01
	1:20:00	0.31	1.15	0.88	1.34	1.87	1.80	2.09	2.25	2.94
	1:25:00	0.29	1.07	0.83	1.24	1.59	1.55	1.79	1.73	2.27
	1:30:00	0.28	1.01	0.81	1.17	1.41	1.30	1.49	1.43	1.86
	1:35:00	0.27	0.98	0.79	1.13	1.29	1.14	1.30	1.22	1.59
	1:40:00	0.27	0.85	0.77	0.99	1.21	1.04	1.18	1.09	1.41
	1:45:00	0.27	0.77	0.77	0.89	1.15	0.97	1.10	1.01	1.31
	1:50:00	0.27	0.71	0.77	0.82	1.11	0.94	1.06	0.99	1.28
	1:55:00	0.22	0.68	0.64	0.78	1.05	0.92	1.03	0.98	1.26
	2:00:00	0.19	0.63	0.55	0.73	0.94	0.91	1.02	0.98	1.26
	2:05:00	0.12	0.41	0.35	0.47	0.61	0.59	0.67	0.64	0.83
	2:10:00	0.08	0.26	0.23	0.30	0.39	0.38	0.43	0.41	0.53
	2:15:00	0.05	0.16	0.14	0.18	0.24	0.24	0.27	0.26	0.33
	2:20:00	0.03	0.09	0.08	0.11	0.14	0.14	0.16	0.16	0.20
	2:25:00	0.01	0.06	0.04	0.06	0.08	0.08	0.10	0.09	0.12
	2:30:00	0.01	0.03	0.02	0.03	0.04	0.04	0.05	0.04	0.06
	2:35:00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Summary Stage-Area-Volume-Discharge Relationships

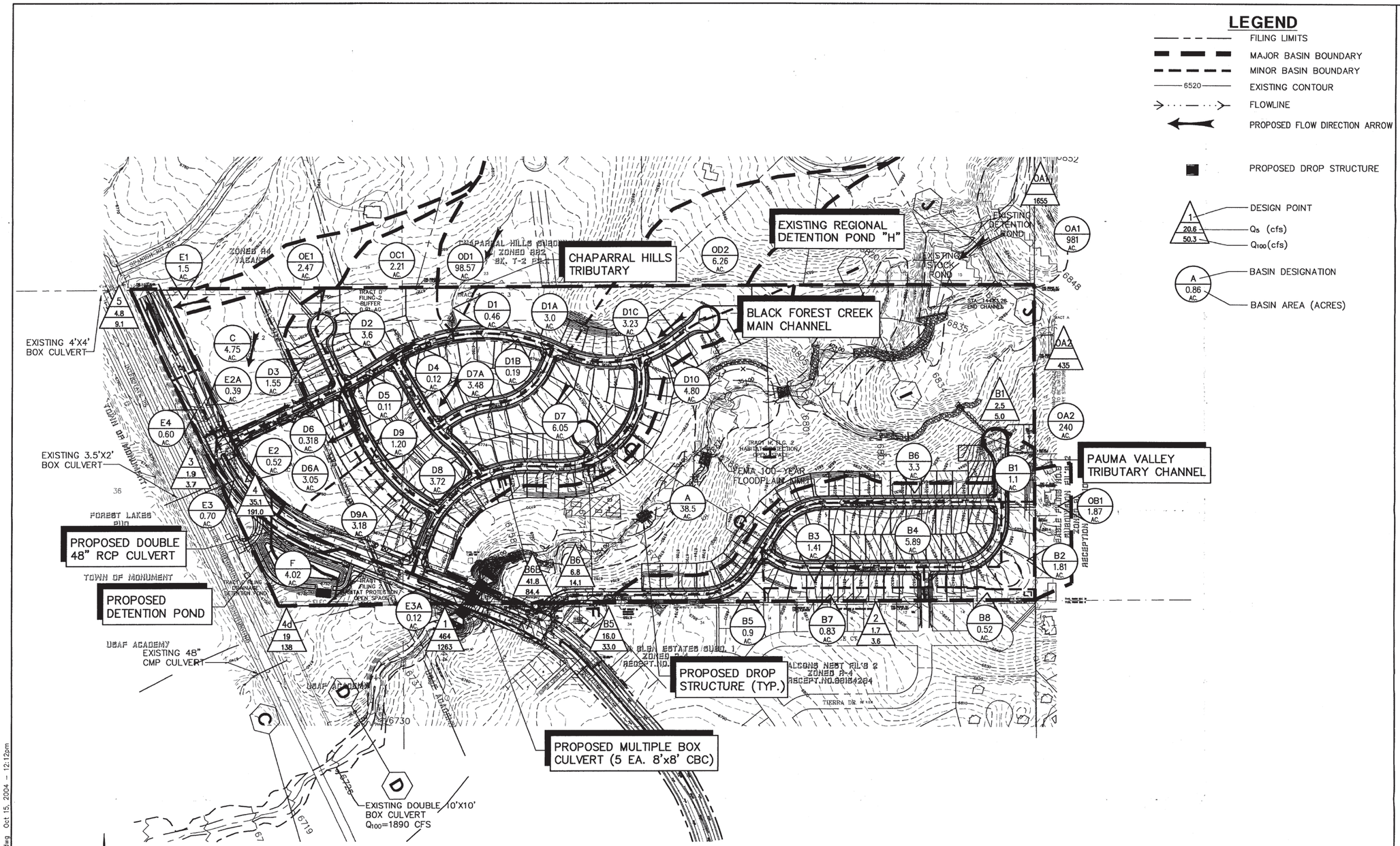
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Micropool	0.00	10	0.000	0	0.000	0.00
ISV	0.33	720	0.017	120	0.003	0.01
	0.50	1,085	0.025	274	0.006	0.01
	1.00	1,503	0.034	921	0.021	0.02
	1.50	1,920	0.044	1,776	0.041	0.04
	2.00	2,448	0.056	2,868	0.066	0.05
	2.50	2,975	0.068	4,224	0.097	0.07
	3.00	3,622	0.083	5,873	0.135	19.72
	3.50	4,270	0.098	7,846	0.180	43.50
	3.80	4,558	0.105	9,170	0.211	67.57
	4.15	4,894	0.112	10,825	0.248	107.37

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

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



NOTES:

1. DEVELOPMENT SHALL FOLLOW ALL REQUIREMENTS OF THE APPROVED HABITAT CONSERVATION PLAN (HCP) AND ASSOCIATED ENVIRONMENTAL PERMITS.

2. PERIMETER DRAINS SHALL BE REQUIRED FOR ALL HOMES WITH BASEMENTS.

STRUTHERS RANCH SUBDIVISION

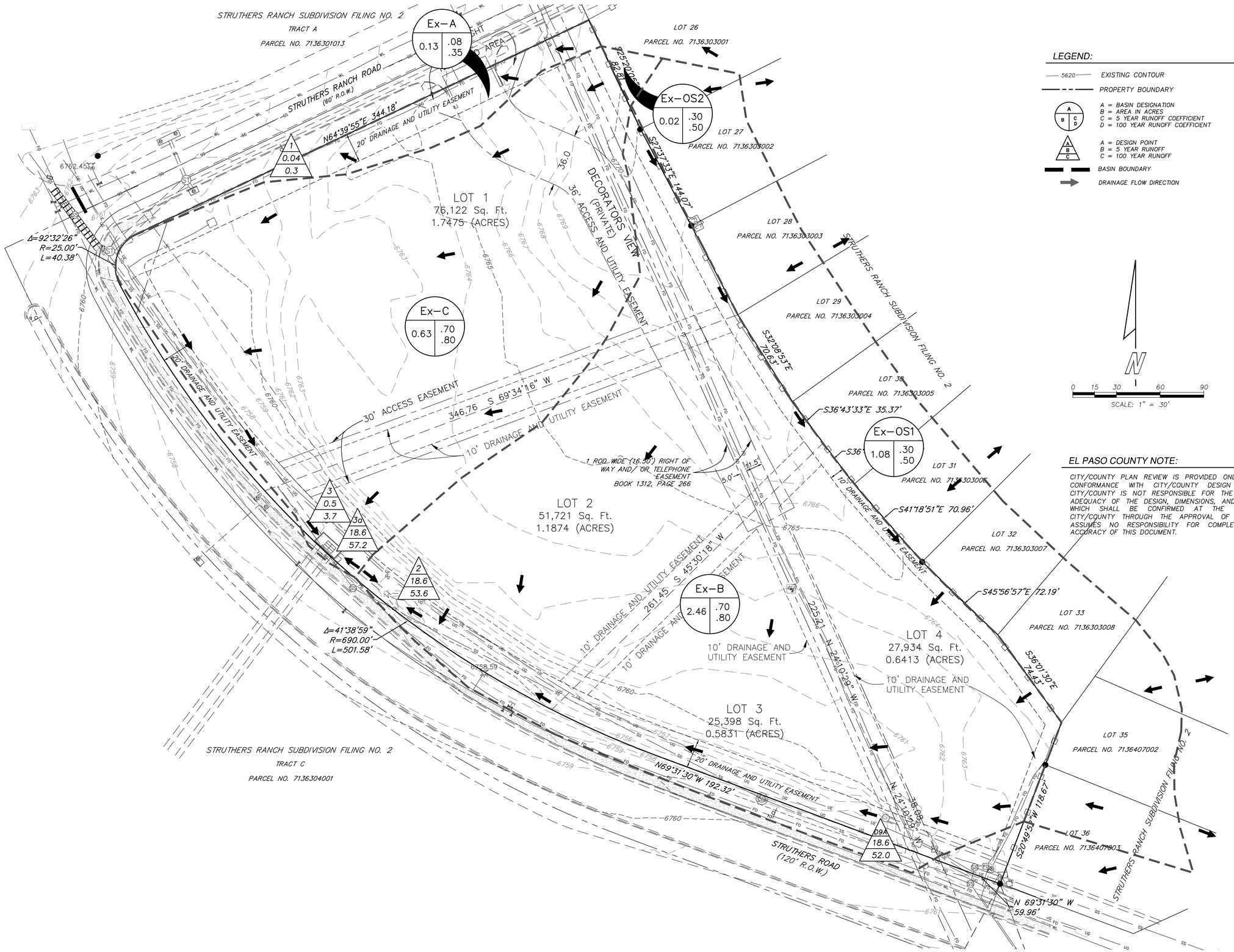
DEVELOPED DRAINAGE PLAN

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO
80903
PH: 719-477-9429
FAX: 719-471-0766

No.	REVISION	BY	DATE
1	EPC COMMENTS	JPS	4/8/04
2	EPC COMMENTS	JPS	5/7/04
3	EPC COMMENTS	JPS	5/25/04
4	EPC COMMENTS	JPS	9/2/04
5	RE-SUBMITTAL TO EPC	JPS	9/30/04

HORZ. SCALE: 1"=200'	DRAWN: MJP
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: PINNACLE	CHECKED: JPS
CREATED: 9/11/00	LAST MODIFIED: 10/15/04
PROJECT NO: 080006	MODIFIED BY: MJP
SHEET: D1	

J:\jpsprojects\080006.struthers\dwg\civil\D1.dwg Oct 15, 2004 - 12:12pm



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.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
811
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

REVISION	DATE	BY

DATE: 5/10/2021
DESIGNED BY: SMS
DRAWN BY: SS
CHECKED BY

STRUTHERS RANCH SUBDIVISION FILING NO. 5

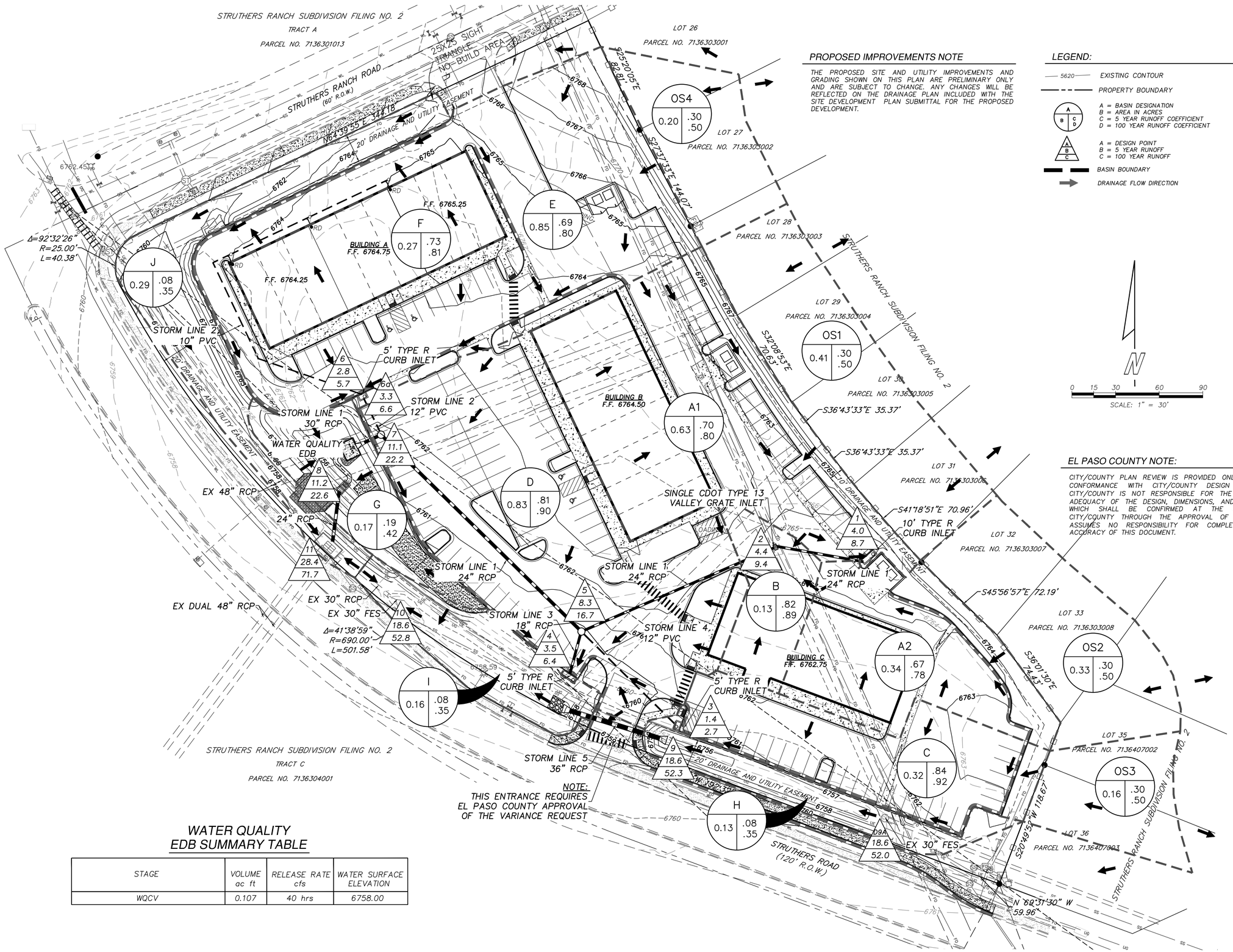
EXISTING CONDITIONS DRAINAGE PLAN

CIVAS engineering
civil engineering solutions
10056 Brisbane Lane
Littleton, Colorado 80130
720-240-5882
civas-eng.com

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

JOB NO. 20-288

SHEET 1 OF 1



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	0.107	40 hrs	6758.00

CALL UTILITY NOTIFICATION CENTER OF COLORADO
811
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

REVISION	DATE	BY
EPC REVIEW COMMENTS	5/10/21	SS

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

STRUTHERS RANCH SUBDIVISION FILING NO. 5

FINAL DRAINAGE PLAN

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

JOB NO. 20–288

SHEET 1 OF 1