PRELIMINARY DRAINAGE LETTER
CONEXUS PHASES 2 AND 3

MAY 2020

Prepared for:

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Project# 19-030

PRELIMINARY DRAINAGE LETTER
CONEXUS PHASE 2 AND 3

MAY 2020

General Location and Description

The Conexus Phase 2and 3 development is located approximately 5,500 feet north of Baptist Road along the west side of Interstate 25 and east of Old Denver Highway in southwest, Monument Colorado. The site consists of approximately 146 acres of currently vacant land. The site is located within Sections 14 and 23, Township 11 South, Range 67 West of the 6th P.M., El Paso County, Colorado (see Figure 1). The Conexus Phase 2 and 3 development is bound on the south by Teachout Creek, on the east by Interstate 25, on the west by Old Denver Road and on the north by Dirty Woman Creek and the I-25 access ramp.

The site generally slopes from east to west toward Old Denver Highway at grades of approximately 2.0 % to 5.0%. Teachout Creek is located at the south end of the development. Dirty Woman Creek is located at the north end of the site. Well established native grasses exist throughout the site. The Santa Fe trails runs along the westerly boundary line of the site.

The exact type of proposed development is unknown at this time, but generally the land uses will consists of commercial, civic, office, light industrial, multi-sue and medium to high density residential development. Three access points from Old Denver Road into the site are currently proposed. A proposed internal road will run north and south through the center of the property. Lots will be created to the east and west of the central roadway.

The current Sketch Plan shows 3 large areas of development - Areas A, B and C. The land uses in these areas will include a combination of the land uses listed above. Areas D and E will remain as open spaces, parks, trails, and drainage ways.

Purpose

The purpose of this drainage letter is to describe the proposed drainage management intent for the overall development. Neither Historic nor Development detailed flow analysis is included in this report due to the uncertainty of the exact land uses and development. Instead general flow patterns, impervious areas, pond locations, and general routing of flows are described to present a conceptual understanding of the drainage. Once more detailed site plans are developed and available, these drainage calculations will be further refined and submitted to the City of Monument.

SUMMARY OF DATA

The sources of information used in the development of this study are listed below:

1.   City of Colorado Springs "Drainage Criteria Manual", May, 2014.

2.   Soil Survey for El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.

3.   "Flood Insurance Studies for Colorado Springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1985.

SOILS

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the soils underlying this parcel consists of Tomah Crowfoot (Soil Type 92) as shown on Figure 2. The Tomah Crowfoot Soil type falls under hydrological group B soils. Runoff coefficients were selected based on the B type soils.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panels #08041C0278 G, dated December 7, 2019, 100 year flood plains exist just to the north and south of the proposed development (See Figure 3). However, the proposed lots and all development will be kept out of these floodplain limits.

DRAINAGE CRITERIA

The El Paso County Drainage Criteria Manual, which further referenced the City of Colorado Springs Drainage Criteria Manual, was utilized in the preparation of this report. Peak runoff quantities were determined using the Rational Method for both the 5 year and 100 year storms. The Urban Drainage and Flood Control District criteria was used in sizing the water quality pond and full spectrum detention.

GENERAL DRAINAGE ANALYSIS

As stated above, the existing terrain of the site generally slopes from east to west from I-25 to Old Denver Highway. A portion of the site (approximately 10 acres) at the north end of the site is tributary to Dirty Woman Creek. The remaining portion of the site generally flow to Old Denver Road and then southerly to Teachout Creek.

Development Area A consists of approximately 23 acres. Runoff generated from Development Area A generally flows to the southwest toward Teachout Creek. The intent is to install a proposed Full Spectrum Detention - Extended Detention Basin (FSD-EDB) at the south end of Development Area A.

The tributary area to this southerly pond could be as large as 30 acres, so for this preliminary design the pond design is based on 30 acres of tributary area. Assuming an impervious area of approximately 80% and a tributary area of 30 acres, the southerly FSD-EDB will be sized to provided 4.05 acre-feet of full spectrum detention volume. The general size of that pond is depicted on Exhibit 1 in the appendix of this report. Historic runoff rates will be released from this pond directly into Teachout Creek.

Development Areas B and C are located in the middle to northerly portions of the proposed development and comprise approximately 74 acres. Runoff generated from Development Areas B and C also generally flows to the southwest toward Old Denver Road with the exception of approximately 10 acres of Development Area C that drains northerly to Dirty Woman Creek. It is anticipated that two (2) FSD-EDB's will be installed to provide water quality and full spectrum detention for Areas B and C.

Approximately 64 acres are tributary to the middle FSD-EDB at the south end of Area. B. Once again, it is assumed approximately 80% of this tributary area will be impervious with 70 acres of tributary area to provide conservative sizing of the pond. These assumptions result in a 9.45 acre-feet pond. Historic runoff rates will be discharged from this pond also, but due to the fact that is no available discharge points along Old Denver Road, a proposed storm sewer pipe will be installed along the east side of Old Denver Road which will convey historic flows to Teachout Creek.

A third FSD-EDB will be installed at the northwest corner of Development Area C to provide full spectrum detention for the 10 acres of development area that is tributary to Dirty Woman Creek. Assuming the same 80% imperviousness of this area, a 1.35 acre-feet detention pond is required to provide full spectrum detention for these 10 acres. Historic runoff rates will be released into Dirty Woman Creek from this pond.

Depending on future layout of lots, street configuration and drainage patterns, these pond sizes and locations may vary.

WATER QUALITY

Three Extended Detention Basin (EDB)/ Full Spectrum Pond will be utilized to provide FSD for Conexus Phase 2 and 3. These 3 EDB/Detention Pond will be constructed to provide water quality capture volume (WQCV), Excessive Urban Runoff Volume (EURV) and Full Spectrum Detention (FSD)..

The Urban Drainage and Flood Control District's UD Detention Spreadsheet was used in determining Water Quality Capture Volume, EURV and Full Spectrum Detention requirements. These calculations are presented in the Appendix of this report.

DRAINAGE FEES

Drainage fees will be paid per City of Monuments requirement based on impervious area. The exact fees to be paid will be determined at the time of final platting of the property.

SUMMARY

Runoff from the Conexus Phase 2 and 3 Development will be collected on site and conveyed to the three proposed FSD\EDB's. Exact sizing and design of these facilities will be fine tuned as more detailed land-use and density information is obtained

APPENDIX

PRELIMINARY DRAINAGE REPORT
CONEXUS BUSINESS PARK
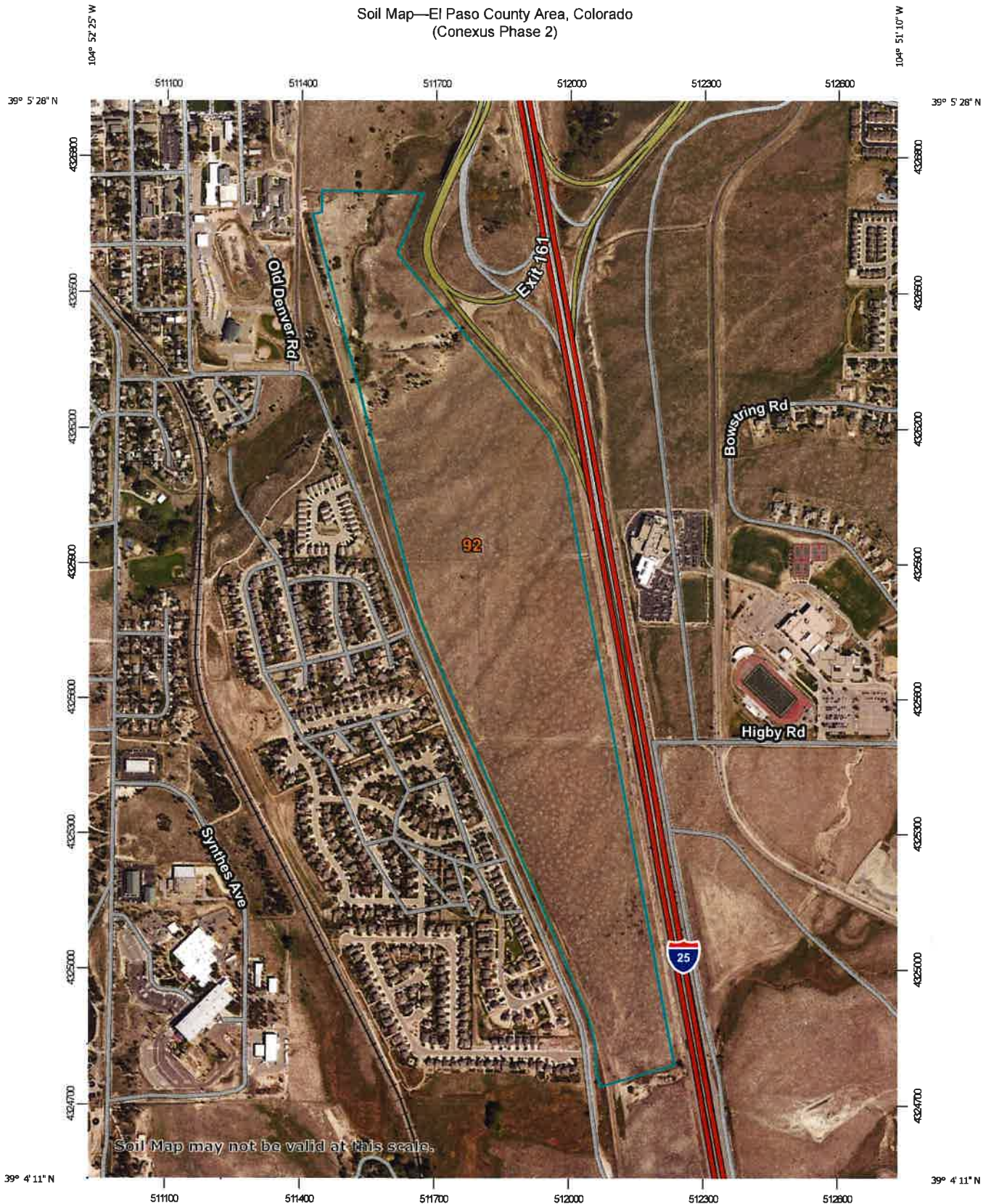
JANUARY 2018

DRAINAGE PLAN STATEMENTS

ENGINEER'S STATEMENT

This report and plan for the preliminary drainage design of Conexus Business Park was prepared by me in accordance with the provisions of Town of Monument Drainage Design and Technical Criteria for the owner thereof. I understand that the Town of Monument does not and will not assume liability for drainage facilities designed by others.

_____

Kent D. Rockwell, P.E.

Registered Professional Engineer State of Colorado No. 25086

Map Scale: 1:11,600 if printed on A portrait (8.5" x 11") sheet.

Meters
0   150   300   600   900

Feet
0   500   1000   2000   3000

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

USDA   Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

5/1/2020
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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 17, Sep 13, 2019

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

5/1/2020
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Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres In AOI	Percent of AOI
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	141.4	100.0%
Totals for Area of Interest		141.4	100.0%

USDA **Natural Resources**
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

5/1/2020
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SITE

ZONE AE

ZONE A

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 278 OF 1300

PANEL 0278G

NATIONAL FLOOD INSURANCE PROGRAM

MAP NUMBER
08041C0278G

MAP SCALE 1" = 500'

Panel Location Map

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Conexus Phase 2-36 acres

Basin ID: Area A

Example Zone Configuration (Retention Pond)
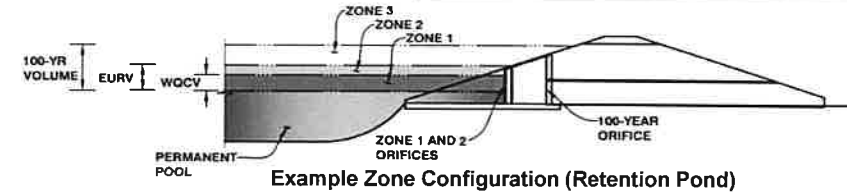
Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	30.00	acres
Watershed Length =	1,800	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.821	acre-feet
Excess Urban Runoff Volume (EURV) =	2.664	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.250	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.959	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.665	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	4.464	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	5.076	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	5.882	acre-feet
500-yr Runoff Volume (P1 = 2.7 in.) =	6.545	acre-feet
Approximate 2-yr Detention Volume =	2.111	acre-feet
Approximate 5-yr Detention Volume =	2.781	acre-feet
Approximate 10-yr Detention Volume =	3.453	acre-feet
Approximate 25-yr Detention Volume =	3.701	acre-feet
Approximate 50-yr Detention Volume =	3.844	acre-feet
Approximate 100-yr Detention Volume =	4.050	acre-feet

Optional User Override
1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
2.70	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.821	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.843	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.386	acre-feet
Total Detention Basin Volume =	4.050	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	

Depth Increment = 1 ft

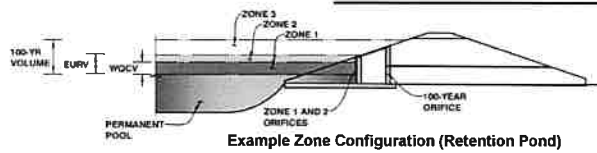| Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	500	0.011		
84	--	0.75	--	--	--	20,414	0.469	7,640	0.175
85	--	1.75	--	--	--	41,088	0.943	38,183	0.877
86	--	2.75	--	--	--	45,268	1.039	81,771	1.877
87	--	3.75	--	--	--	49,554	1.138	129,182	2.966
88	--	4.75	--	--	--	53,940	1.238	180,929	4.154
89	--	5.75	--	--	--	58,423	1.341	237,111	5.443
90	--	6.75	--	--	--	63,013	1.447	297,829	6.837
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Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Conexus Phase 2 and 3-30 acres

Basin ID: Area A

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.68	0.821	Orifice Plate
Zone 2 (EURV)	3.49	1.843	Orifice Plate
Zone 3 (100-year)	4.67	1.386	Weir&Pipe (Restrict)
		4.050	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.188E-02	ft²
Depth at top of Zone using Orifice Plate =	3.49	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	18.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.47	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50	3.00					
Orifice Area (sq. inches)	7.47	7.47	7.47					

	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			**Calculated Parameters for Vertical Orifice**		
					Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected			**Calculated Parameters for Overflow Weir**		
					Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.49	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.49	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet	Over Flow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	4.77	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	17.50	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.75	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected			**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**		
					Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.67	N/A	ft²
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.98	N/A	feet
Restrictor Plate Height Above Pipe Invert =	21.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

				Calculated Parameters for Spillway	
Spillway Invert Stage =	4.67	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.96	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	6.63	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.43	acres
Freeboard above Max Water Surface =	1.00	feet			

Routed Hydrograph Results

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	2.70
Calculated Runoff Volume (acre-ft) =	0.821	2.664	2.250	2.959	3.665	4.464	5.076	5.882	6.545
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.820	2.662	2.248	2.956	3.661	4.461	5.067	5.868	6.538
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.91	1.23	1.56
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.6	6.0	19.8	27.3	36.8	46.8
Peak Inflow Q (cfs) =	13.5	43.3	36.6	48.0	59.2	71.9	81.4	94.0	104.4
Peak Outflow Q (cfs) =	0.4	0.9	0.7	2.1	10.4	21.4	29.7	34.3	38.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.5	1.8	1.1	1.1	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.5	1.1	1.6	1.9	2.0
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	68	63	70	69	68	67	65	64
Time to Drain 99% of Inflow Volume (hours) =	40	72	67	74	74	74	73	73	72
Maximum Ponding Depth (ft) =	1.61	3.36	3.00	3.58	3.85	4.09	4.25	4.49	4.76
Area at Maximum Ponding Depth (acres) =	0.88	1.10	1.06	1.12	1.15	1.17	1.19	1.21	1.24
Maximum Volume Stored (acre-ft) =	0.759	2.518	2.129	2.762	3.080	3.358	3.535	3.835	4.166

Project: Conexus Phase 2 and 3 -70 acres

Basin ID: Area B and C-South

Example Zone Configuration (Retention Pond)
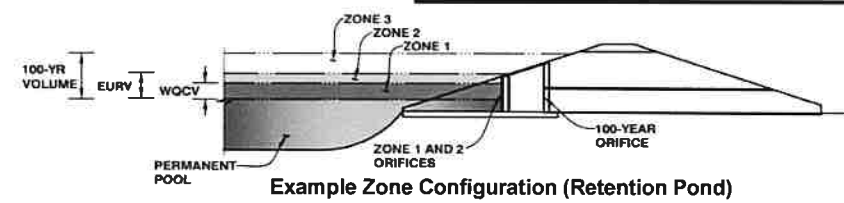
Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	70.00	acres
Watershed Length =	2,500	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

			Optional User Override
Water Quality Capture Volume (WQCV) =	1.915	acre-feet	1-hr Precipitation
Excess Urban Runoff Volume (EURV) =	6.216	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	5.251	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.903	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.551	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	10.416	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	11.844	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	13.724	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 2.7 in.) =	15.271	acre-feet	2.70 inches
Approximate 2-yr Detention Volume =	4.925	acre-feet	
Approximate 5-yr Detention Volume =	6.490	acre-feet	
Approximate 10-yr Detention Volume =	8.057	acre-feet	
Approximate 25-yr Detention Volume =	8.635	acre-feet	
Approximate 50-yr Detention Volume =	8.969	acre-feet	
Approximate 100-yr Detention Volume =	9.451	acre-feet	

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.915	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.301	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.235	acre-feet
Total Detention Basin Volume =	9.451	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	

Depth Increment =	1	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	--	--	--	500	0.011		
22	--	0.50	--	--	--	111,014	2.549	26,775	0.615
23	--	1.50	--	--	--	116,461	2.674	140,447	3.224
24	--	2.50	--	--	--	122,009	2.801	260,846	5.988
25	--	3.50	--	--	--	127,657	2.931	385,679	8.854
26	--	4.50	--	--	--	133,406	3.063	516,211	11.851
27	--	5.50	--	--	--	139,255	3.197	652,541	14.980
28	--	6.50	--	--	--	145,205		794,771	18.245
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Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Conexus Phase 2 and 3-70 acres

Basin ID: Area B and C-South

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.00	1.915	Orifice Plate
Zone 2 (EURV)	2.59	4.301	Orifice Plate
Zone 3 (100-year)	3.71	3.235	Weir&Pipe (Rect.)
		9.451	Total

Example Zone Configuration (Retention Pond)

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.667E-01	ft²
Depth at top of Zone using Orifice Plate =	2.59	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	24.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40					
Orifice Area (sq. inches)	24.00	24.00	24.00					

	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)

				Calculated Parameters for Vertical Orifice			
	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

				Calculated Parameters for Overflow Weir			
	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.59	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.59	N/A	feet
Overflow Weir Front Edge Length =	9.00	N/A	feet	Over Flow Weir Slope Length =	9.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	7.01	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	9.00	N/A	feet	Overflow Grate Open Area w/o Debris =	56.70	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	28.35	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

				Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate			
	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	8.09	N/A	ft²
Rectangular Orifice Width =	37.00	N/A	inches	Outlet Orifice Centroid =	1.31	N/A	feet
Rectangular Orifice Height =	31.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage =	3.90	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.97	feet
Spillway Crest Length =	76.00	feet	Stage at Top of Freeboard =	5.87	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.25	acres
Freeboard above Max Water Surface =	1.00	feet			

Routed Hydrograph Results

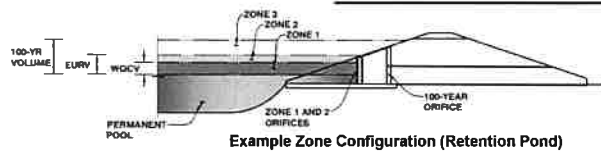|									
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	2.70
Calculated Runoff Volume (acre-ft) =	1.915	6.216	5.251	6.903	8.551	10.416	11.844	13.724	15.271
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.915	6.212	5.241	6.901	8.547	10.406	11.836	13.723	15.261
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.22	0.71	0.98	1.31	1.67
Predevelopment Peak Q (cfs) =	0.0	0.0	0.9	1.6	15.1	49.5	68.4	91.8	116.6
Peak Inflow Q (cfs) =	33.1	105.2	89.1	116.6	143.5	173.7	196.7	226.8	251.1
Peak Outflow Q (cfs) =	0.8	2.4	1.9	4.7	21.2	44.3	62.5	85.6	87.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.0	1.4	0.9	0.9	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	0.7	1.0	1.4	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	65	71	71	69	68	67	66
Time to Drain 99% of Inflow Volume (hours) =	40	73	68	76	76	75	75	74	74
Maximum Ponding Depth (ft) =	0.95	2.47	2.13	2.68	2.97	3.24	3.42	3.63	3.88
Area at Maximum Ponding Depth (acres) =	2.60	2.80	2.75	2.82	2.86	2.90	2.92	2.95	2.98
Maximum Volume Stored (acre-ft) =	1.773	5.876	4.961	6.466	7.290	8.096	8.620	9.236	9.977

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Conexus Phase 2 and 3-30 acres**

Basin ID: **Area C North**

Example Zone Configuration (Retention Pond)
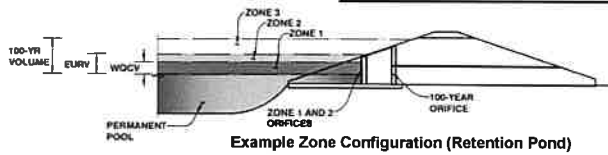
	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.80	0.274	Orifice Plate
Zone 2 (EURV)	1.92	0.614	Orifice Plate
Zone 3 (100-year)	2.67	0.462	Weir&Pipe (Restrict)
		1.350	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.625E-02	ft²
Depth at top of Zone using Orifice Plate =	1.92	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.78	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

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)	3.78	3.78	3.78					

	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)

				Calculated Parameters for Vertical Orifice		
	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

				Calculated Parameters for Overflow Weir		
	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.92	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H₁ =	1.92	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Over Flow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	6.75	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.20	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	5.60	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

				Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate		
	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.66	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.71	N/A	feet
Restrictor Plate Height Above Pipe Invert =	16.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.46	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage =	2.67	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.49	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	4.16	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.74	acres
Freeboard above Max Water Surface =	1.00	feet			

Routed Hydrograph Results

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	2.70
Calculated Runoff Volume (acre-ft) =	0.274	0.888	0.750	0.986	1.222	1.488	1.692	1.961	2.182
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.274	0.888	0.750	0.986	1.222	1.489	1.693	1.961	2.182
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.21	0.68	0.94	1.26	1.60
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	2.1	6.8	9.4	12.6	16.0
Peak Inflow Q (cfs) =	4.7	15.0	12.7	16.6	20.5	24.9	28.3	32.7	36.4
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.8	3.8	7.9	10.9	11.6	13.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.5	1.9	1.2	1.2	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	0.7	0.9	1.0	1.0
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	67	63	68	67	66	65	64	63
Time to Drain 99% of Inflow Volume (hours) =	40	71	66	73	72	72	71	71	71
Maximum Ponding Depth (ft) =	0.76	1.83	1.60	1.97	2.13	2.28	2.37	2.55	2.73
Area at Maximum Ponding Depth (acres) =	0.51	0.58	0.56	0.59	0.60	0.61	0.61	0.63	0.64
Maximum Volume Stored (acre-ft) =	0.252	0.835	0.709	0.917	1.018	1.102	1.163	1.275	1.389

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Conexus Phase 2 and 3-10 acres

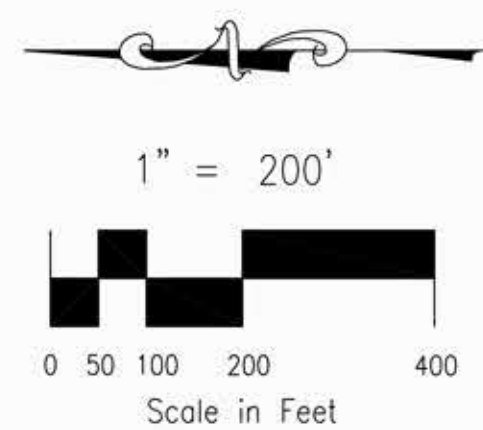**Basin ID: Area C North**

Example Zone Configuration (Retention Pond)
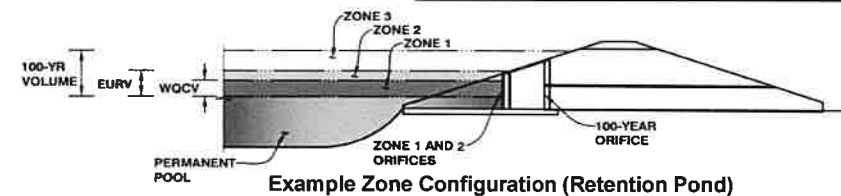
Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	10.00	acres
Watershed Length =	1,000	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Water Quality Capture Volume (WQCV) =	0.274	acre-feet	Optional User Override		
Excess Urban Runoff Volume (EURV) =	0.888	acre-feet	1-hr Precipitation		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.750	acre-feet	1.19	inches	
5-yr Runoff Volume (P1 = 1.5 in.) =	0.986	acre-feet	1.50	inches	
10-yr Runoff Volume (P1 = 1.75 in.) =	1.222	acre-feet	1.75	inches	
25-yr Runoff Volume (P1 = 2 in.) =	1.488	acre-feet	2.00	inches	
50-yr Runoff Volume (P1 = 2.25 in.) =	1.692	acre-feet	2.25	inches	
100-yr Runoff Volume (P1 = 2.52 in.) =	1.961	acre-feet	2.52	inches	
500-yr Runoff Volume (P1 = 2.7 in.) =	2.182	acre-feet	2.70	inches	
Approximate 2-yr Detention Volume =	0.704	acre-feet			
Approximate 5-yr Detention Volume =	0.927	acre-feet			
Approximate 10-yr Detention Volume =	1.151	acre-feet			
Approximate 25-yr Detention Volume =	1.234	acre-feet			
Approximate 50-yr Detention Volume =	1.281	acre-feet			
Approximate 100-yr Detention Volume =	1.350	acre-feet			

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.274	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.614	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.462	acre-feet
Total Detention Basin Volume =	1.350	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	

Depth Increment =	1	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	--	--	--	500	0.011		
54	--	0.50	--	--	--	21,570	0.495	5,303	0.122
55	--	1.50	--	--	--	24,307	0.558	28,212	0.648
56	--	2.50	--	--	--	27,142	0.623	54,180	1.244
57	--	3.50	--	--	--	30,079	0.691	82,790	1.901
58	--	4.50	--	--	--	33,116	0.760	114,388	2.626
59	--	5.50	--	--	--	36,254	0.832	149,073	3.422
60	--	6.50	--	--	--	39,492	0.907	186,946	4.292
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AREA E
6.5 AC

100 YEAR
FLOODPLAIN

POND #1

i-25

i-25

AREA A
23 AC

100-YEAR
FLOODPLAIN PER
FIRM PANEL 278

AREA B
36 AC

OLD DENVER ROAD

POND #2

AREA C
38 AC

AREA D
24 AC

POND #3

OLD DENVER ROAD

AIN

1" = 200'

0 50 100   200   400
Scale in Feet

FILE: 17016cd3.DWG   4/9/20

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CONSULTING, Inc.

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1955 N. UNION BLVD., SUITE 200
COLORADO SPRINGS, CO 80909
(719) 475-2575 • FAX (719) 475-9223

TITLE :   CONEXUS PHASE 2 AND 3
PRELIMINARY DRAINAGE

SCALE : 1"=200'   DRAWN BY :   KDR

DATE :   5/5/20   CHECKED BY :   KDR

19-030
JOB NO.