EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

Reviewed by:
Glenn Reese, P.E.
Stormwater Engineer I
glennreese@elpasoco.com
719-675-2654

SMALL SUBDIVISION FINAL DRAINAGE REPORT
FOR
CLOVERLEAF FILING NO. 1

Prepared For:

PT Cloverleaf, LLC
1864 Woodmoor Drive, Suite 100
Monument, CO 80920
(719) 476-0800

December 1, 2020
Project No. 25158.01

Add text:
PCD Filing No.: SF-21-014

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive, Suite 235
Colorado Springs, CO 80919
719-593-2593

J·R ENGINEERING

SMALL SUBDIVISION FINAL DRAINAGE REPORT FOR
CLOVERLEAF FILING NO. 1

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

_____

Mike Bramlett, Colorado P.E. # 32314
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:

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

Business Name: PT Cloverleaf, LLC.

By: _____

Title: _____

Address: 1864 Woodmoor Drive, Suite 100
Monument, CO 80920

El Paso County:

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

_____ _____

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

Conditions:

Table of Contents

APPENDIX

Update to state what approved plan this report is going to be consistent with. Include filing and PCD file no. and add reference to list of references.

PURPOSE

This document is the Small Subdivision Final Drainage Report for Cloverleaf Filing No. 1, a replat of Woodmoor Greens, Tract F. The purpose of this report is to show that the proposed development is consistent with the original approved drainage plan and to update the previously approved plans to be in conformance with the current El Paso County drainage standards and criteria. Refer to Appendix D for the original drainage plan as represented in the *Woodmoor Greens Drainage Letter*, by Nelson, Haley, Patterson, and Quik, Inc., dated January 7, 1972.

PROPERTY DESCRIPTION

The proposed Cloverleaf Filing No. 1, known as "Cloverleaf" from herein, is three individual lots located in Section 23, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, Colorado. The small subdivision will replat a portion of Tract F of Woodmoor Greens vacation L496-500. The three lots are numbered Lots 142, 143, and 144, and will be suburban lots consistent with the RS-2000 zoning. Lot 142 is approximately 0.51 acres, Lots 143 and 144 are approximately 0.50 acres. Lot 142 borders Leggins Way to the southeast while Lots 143 and 144 border Bowstring Road to the west. A vicinity map of the area is presented in Appendix A.

Each lot is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, each lot slopes to the adjacent road (either Leggins Way or Bowstring Road).

Per an NRCS web soil survey of the area, Cloverleaf is made up of Type B soils. This Type B soil is a Tomah-Crowfoot loamy sand. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well-drained soil. A soil survey map has been presented in Appendix A.

There are no major drainageways or irrigation wells on the site. Each lot is located within Zone X, or areas area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FEMA map containing the site has been presented in Appendix A.

Please update paragraph to include a firm map number and a revision date.

Update to 2021.

EXISTING DRAINAGE CONDITIONS

Cloverleaf lies within the upper reaches of the Teachout Creek watershed basin. Although no DBPS currently exists for Teachout Creek, basin fees have been listed in the Interim Basin Section of the 2020 El Paso County Drainage Basin Fee list. Existing vegetation on the lots consists primarily of native grasses. The terrain is sloped generally to the adjacent roadside ditch and ranges from 2% to

7%. Drainage from the site currently flows southwest through existing culverts to Lewis Palmer High School under Bowstring Road, into Teachout Creek, and eventually reaches Monument Creek.

Each of the three lots was analyzed in the existing condition as its own basin. The basin descriptions are below. Refer to Appendix E for the existing drainage map.

Basin EX-142 is approximately 0.51 acres and consists of prairie grasses. Flow from this basin (Q_5=0.1 cfs, Q_{100} =1.1 cfs) flows southwest to the adjacent properties and Leggins Way at design point (DP) EX142. The flow eventually reaches the existing 28" by 42" CMP culvert under Bowstring Road at Leggins Way and is routed under Bowstring Road to Lewis Palmer High School to the southwest.

Basin EX-143 is approximately 0.50 acres and consists of prairie grasses. Flow from this basin (Q_5=0.1 cfs, Q_{100} =0.9 cfs) flows west to the roadside ditch along the east side of Bowstring Road at DP-EX143. The roadside ditch routes the flow south to an existing 24" CMP culvert and is routed under Bowstring Road to Lewis Palmer High School to the south.

Basin EX-144 is approximately 0.50 acres and consists of prairie grasses. Flow from this basin (Q_5=0.1 cfs, Q_{100} =0.9 cfs) flows west to the roadside ditch along the east side of Bowstring Road at DP-EX144. The roadside ditch routes the flow south to an existing 24" CMP culvert and is routed under Bowstring Road to Lewis Palmer High School to the south.

PROPOSED DRAINAGE CONDITIONS

The proposed land use (single-family residential) is consistent with the anticipated land use in the approved Woodmoor Greens drainage report, dated January 7, 1972. Refer to Appendix D for the drainage report. Lot 142 was included in the Tract "F" open space shown in the Woodmoor Greens plat recorded on February 16, 1972. Refer to Appendix D for the plat. Lots 143 and 144 were initially portions of platted lots, as shown in the February 16, 1972 plat, and then were replatted to be included in the Tract "F" open space, as shown in the vacation and replat of lots 496 through 500, filed August 23, 1972. Refer to Appendix D for the vacation and replat.

The approved Woodmoor Greens drainage report assumed that each developed lot would have a 2,500 square foot house. However, the existing developed lots within Woodmoor Greens include between about 5,000 and 6,000 square feet of impervious area. For this report, the development of each proposed lot was assumed to add an impervious area equal to 25% of the total lot area, which is consistent with the existing developed lots. Per El Paso County drainage criteria, a sand filter on each of the three lots is proposed to provide water quality to offset the impervious area added as part of the development of the lots. Refer to Appendix C for the sizing calculations for the sand filters. When

Please explain how. Is there a berm around the property to prevent offsite flow from entering the site? It looks like the land to the east of lots 143 and 144 flows onto these lots.
If needed, include tributary basins into the rational method calcs in Appendix B

the approved drainage report was approved, El Paso County did not require water quality for the development of Woodmoor Greens, so no sand filters or similar permanent BMPs were proposed.

Each lot was analyzed as its own basin in the proposed condition. The basin descriptions are below. Each lot will be graded so that the entire lot will drain to the proposed sand filter and no offsite flow will be tributary to the lot. Refer to Appendix E for the proposed drainage map. Basin and design point summary tables are provided after the basin descriptions. The approved Woodmoor Greens drainage report calculated runoff for the 25-year storm event. This report uses the 5-year and 100-year events to conform to current El Paso County drainage criteria.

Basin 142 is approximately 0.51 acres and will consist of prairie grasses and a single-family residential house and associated improvements (driveway and walks). Flow from this basin (Q_5=0.5 cfs, Q_{100} =1.6 cfs) will be routed via drainage ditches and overland flow to the sand filter at DP-142 located in the south corner of the lot. The sand filter will provide water quality and will discharge to the adjacent roadside ditch along the northwest side of Leggins Way. Once in the ditch, the flow will follow historic drainage patterns.

Basin 143 is approximately 0.50 acres and will consist of prairie grasses and a single-family residential house and associated improvements (driveway and walks). Flow from this basin (Q_5=0.5 cfs, Q_{100} =1.5 cfs) will be routed via drainage ditches and overland flow to the sand filter at DP-143 located in the southwest corner of the lot. The sand filter will provide water quality and will discharge to the adjacent roadside ditch along the east side of Bowstring Road. Once in the ditch, the flow will follow historic drainage patterns.

Basin 144 is approximately 0.50 acres and consists of prairie grasses and a single-family residential house and associated improvements (driveway and walks). Flow from this basin (Q_5=0.5 cfs, Q_{100} =1.3 cfs) will be routed via drainage ditches and overland flow to the sand filter at DP-143 located in the southwest corner of the lot. The sand filter will provide water quality and will discharge to the adjacent roadside ditch along the east side of Bowstring Road. Once in the ditch, the flow will follow historic drainage patterns.

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
142	0.51	25%	0.29	0.50	11.9	0.5	1.6
143	0.50	25%	0.29	0.50	13.9	0.5	1.5
144	0.50	25%	0.29	0.50	18.4	0.5	1.3

DESIGN POINT SUMMARY TABLE

DP	Q5	Q100
142	0.5	1.6
143	0.5	1.5
144	0.5	1.3

Please update runoff coefficient columns to use values from table 6-6 in CSDCM. If coefficients are weighted, please specify in column titles.

WATER QUALITY

The sand filters were designed to have a volume above the sand bed of the basin equal to the WQCV based on a 12-hour drain time. Refer to Appendix C for the sizing calculations. The sand filter on lot 142 is required to be 0.005 acre-feet, while the sand filters for the other two lots (143 and 144) are required to be 0.004 acre-feet. Each sand filter is proposed to have the same dimensions and provide 0.007 acre-feet of water quality. Refer to the detail shown on the proposed drainage map in Appendix E.

Each sand filter does not include an impermeable liner but includes an underdrain, so some infiltration is allowed (see the description for "Partial Infiltration Section" sand filter in *Urban Storm Drainage Criteria Manual Volume 3*, page SF-4 and SF-8). The WQCV will drain in 12 hours and the release rate will be controlled by a circular orifice within the slotted underdrain, which discharges to the adjacent roadside ditch. Any runoff in excess of the WQCV will be routed through a proposed 18-inch dome grate and drain basin and into the adjacent roadside ditch via the underdrain. Refer to Appendix C for the dome grate capacity calculation. Each sand filter also includes a spillway notch to allow stormwater to flow out of the sand filter and into the adjacent roadside ditch in the event that the dome grate becomes clogged. The sand filters will be owned and maintained by the property owners.

DRAINAGE AND BRIDGE FEES

The site lies within the Teachout Creek Drainage Basin. Anticipated drainage and bridge fees are presented below and will be paid at time of platting (depending on date of plat submittal):

2020 DRAINAGE AND BRIDGE FEES – CLOVERLEAF FILING NO. 1				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Cloverleaf Drainage Fee	Cloverleaf Bridge Fee
0.38	$5,245	$788	$1,994	$300

Please update drainage basin and bridge fee calculations to use 2021 fees for impervious acre.

SUMMARY

The proposed Cloverleaf Filing No. 1 development drainage improvements, including drainage ditches and three sand filters were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

Update paragraph to compare historic vs developed runoff quantities. Is change is runoff negligible or not?

REFERENCES

1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

2. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

3. Flood Insurance Study- El Paso County, Colorado & Incorporated Areas Vol 7 of 8, Federal Emergency Management Agency, December 7, 2018..

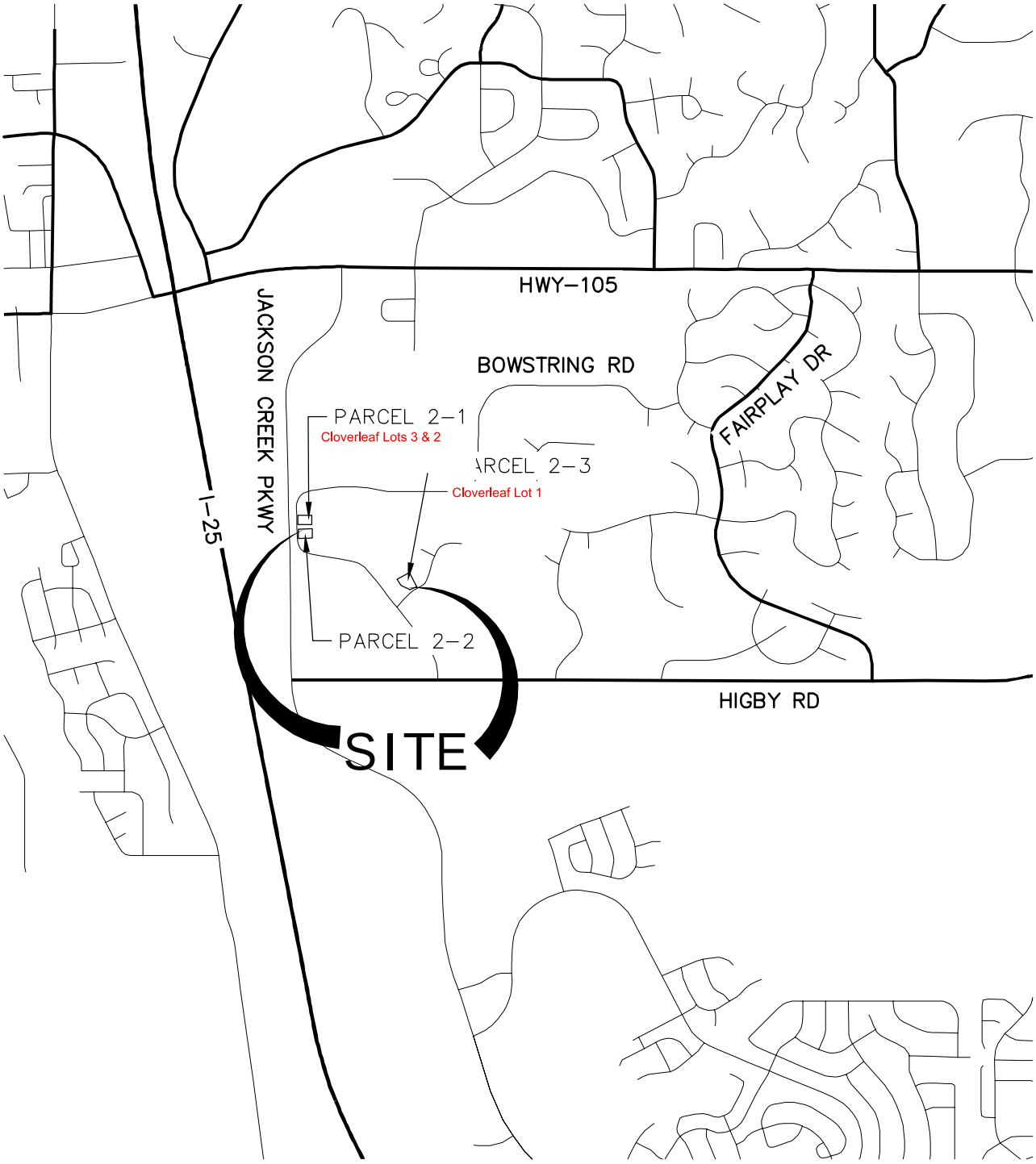
4. Woodmoor Greens Drainage Letter, prepared by Nelson, Haley, Patterson, and Quirk, Inc., 1972.

Update reference list to include latest revisions of EPC ECM, 2014 CSDCM, EPC DCM Vol. 1 and 2, and Cloverleaf preliminary drainage report.

Please update report contents to include a four step process that clearly addresses each step. Reference ECM I.7.2.A for steps and what to include.

Justify why not providing full spectrum detention for these lots. Per USDCM Vol. 3, sand filter basins can be designed to include flood control volume.

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



N

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

VICINITY MAP
CLOVERLEAF FILING 1
JOB NO. 25158.01
11/24/2020
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

National Flood Hazard Layer FIRMette

FEMA

104°51'40"W 39°5'16"N

104°51'2"W 39°4'48"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

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

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

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

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

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

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

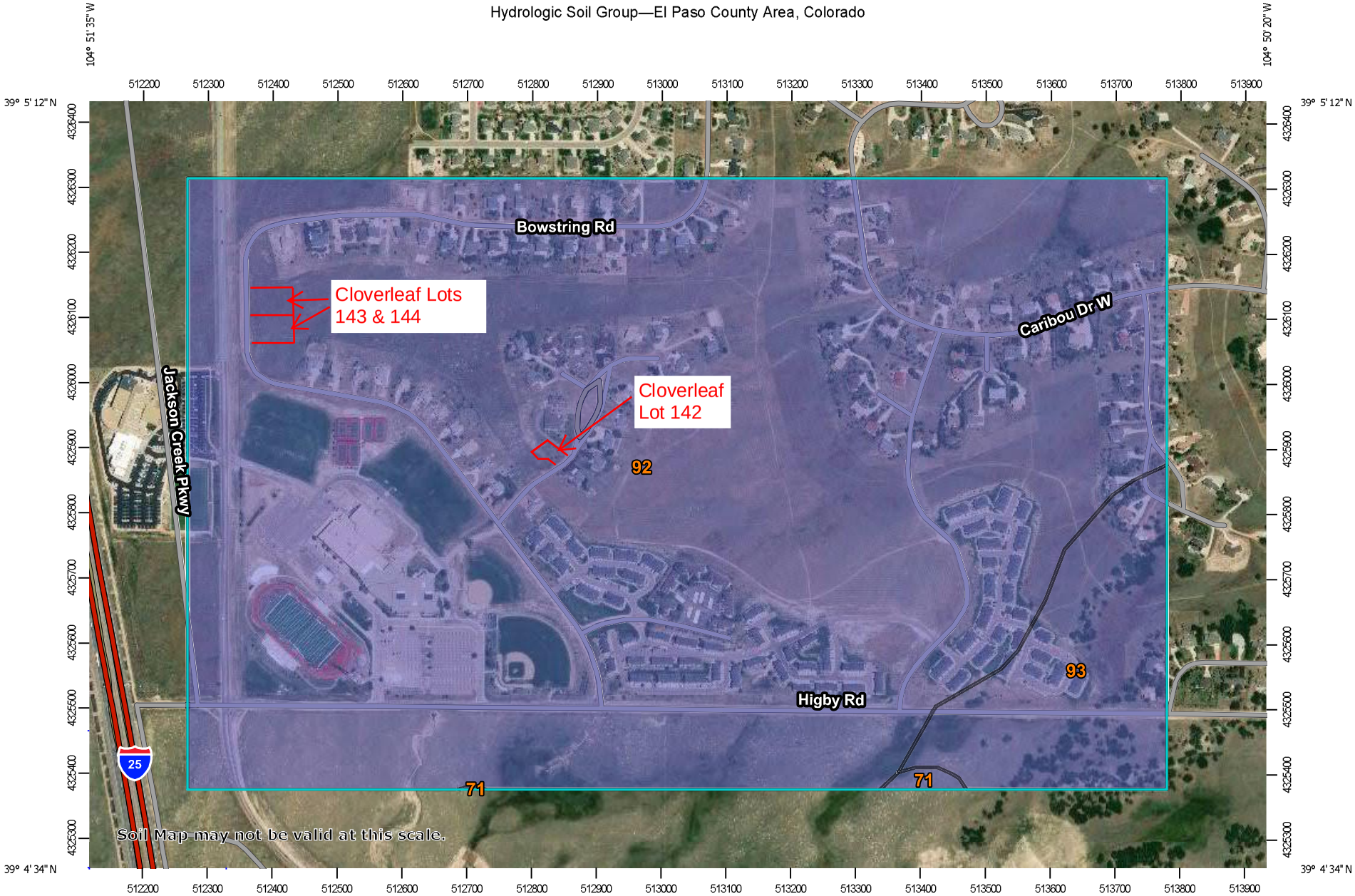
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/24/2020 at 3:51 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:8,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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.

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Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

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.

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	0.8	0.2%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	323.0	91.8%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	28.1	8.0%
Totals for Area of Interest			**352.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°51'40"W 39°5'16"N

104°51'2"W 39°4'48"N

Feet

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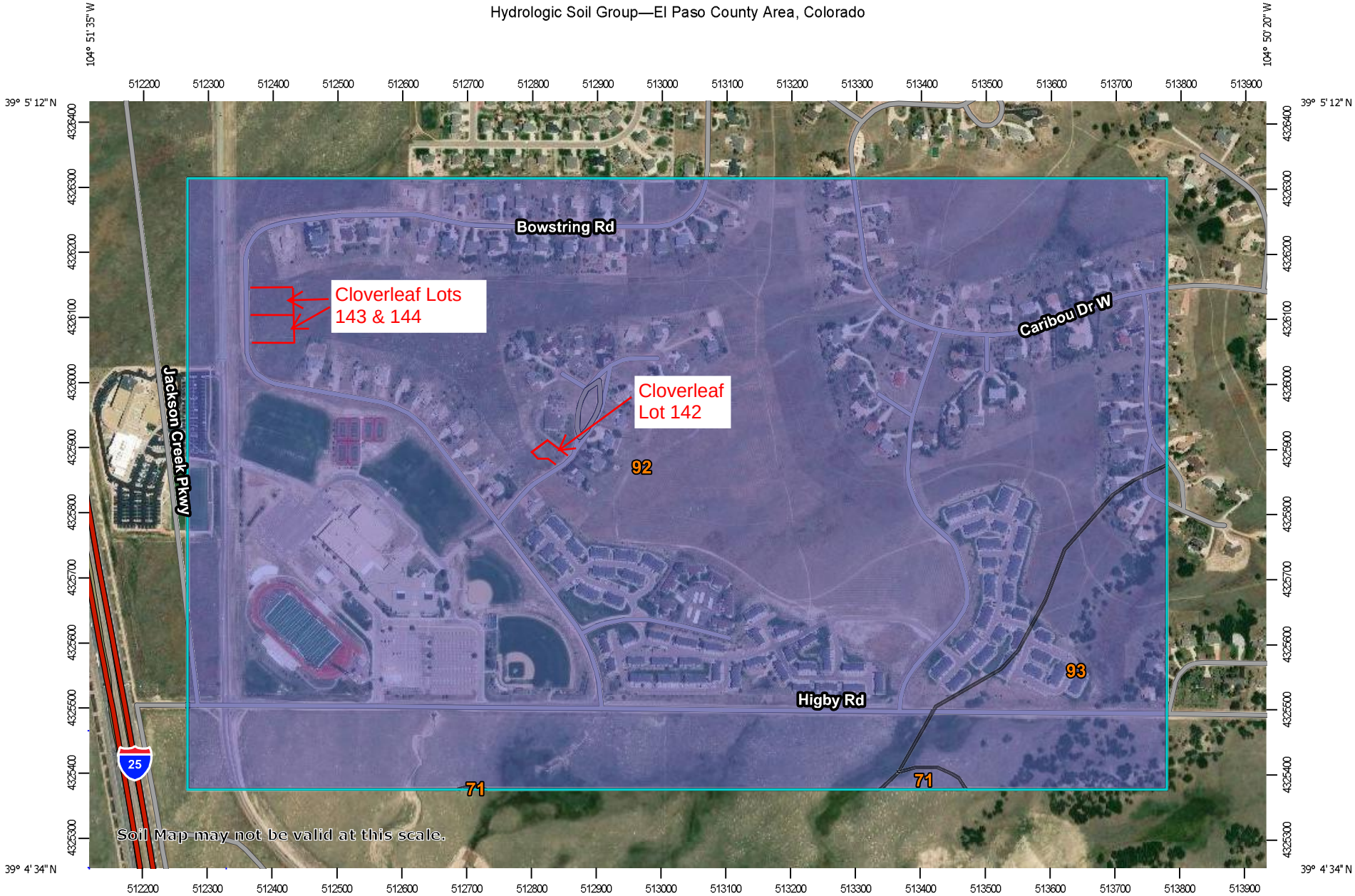

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- Major Roads
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Coordinate System: Web Mercator (EPSG:3857)

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Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix B
Rational Hydrologic Calculations

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS - EXISTING CONDITIONS

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs

Project Name: Cloverleaf Fil. 1 - Existing Conditions
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 11/25/20

Basin ID	Total Area (ac)	Pasture/Meadow (0% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EX-142	0.51	0.08	0.35	0.51	0.0%	0.08	0.35	0.0%
EX-143	0.50	0.08	0.35	0.50	0.0%	0.08	0.35	0.0%
EX-144	0.50	0.08	0.35	0.50	0.0%	0.08	0.35	0.0%
TOTAL	1.51							0.0%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs

Project Name: Cloverleaf Fil. 1 - Existing Conditions
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 11/25/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX-142	0.51	B	0%	0.08	0.35	191	5.1%	14.8	0	1.0%	15.0	1.5	0.0	14.8	191.0	26.0	14.8
EX-143	0.50	B	0%	0.08	0.35	201	3.4%	17.4	0	1.0%	15.0	1.5	0.0	17.4	201.0	26.0	17.4
EX-144	0.50	B	0%	0.08	0.35	217	1.6%	23.0	0	1.0%	15.0	1.5	0.0	23.0	217.0	26.0	23.0

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cloverleaf Fil. 1 - Existing Conditions
Project No.: 2000-5158.
Calculated By: RPD
Checked By:
Date: 11/25/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	EX142	EX-142	0.51	0.08	14.8	0.04	3.54	0.1															Runoff from Basin EX-142 routed to DP-EX142 via overland flow.
	EX143	EX-143	0.50	0.08	17.4	0.04	3.30	0.1															Runoff from Basin EX-143 routed to DP-EX143 via overland flow.
	EX144	EX-144	0.50	0.08	23.0	0.04	2.88	0.1															Runoff from Basin EX-144 routed to DP-EX144 via overland flow.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cloverleaf Fil. 1 - Existing Conditions
Project No.: 2000-5158.
Calculated By: RPD
Checked By:
Date: 11/25/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	EX142	EX-142	0.51	0.35	14.8	0.18	5.94	1.1															Runoff from Basin EX-142 routed to DP-EX142 via overland flow.
	EX143	EX-143	0.50	0.35	17.4	0.17	5.54	0.9															Runoff from Basin EX-143 routed to DP-EX143 via overland flow.
	EX144	EX-144	0.50	0.35	23.0	0.18	4.83	0.9															Runoff from Basin EX-144 routed to DP-EX144 via overland flow.

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS - PROPOSED CONDITIONS

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs

Project Name: Cloverleaf Fil. 1 - Proposed Conditions
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 11/25/20

Basin ID	Total Area (ac)	Pasture/Meadow (0% Impervious)				(100% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
142	0.51	0.08	0.35	0.38	0.0%	0.90	0.96	0.13	25.0%	0.29	0.50	25.0%
143	0.50	0.08	0.35	0.37	0.0%	0.90	0.96	0.12	25.0%	0.29	0.50	25.0%
144	0.50	0.08	0.35	0.38	0.0%	0.90	0.96	0.13	25.0%	0.29	0.50	25.0%
TOTAL	1.51											25.0%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs

Project Name: Cloverleaf Fil. 1 - Proposed Conditions
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 11/25/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
142	0.51	B	25%	0.29	0.50	191	5.1%	11.9	0	1.0%	15.0	1.5	0.0	11.9	191.0	21.8	11.9
143	0.50	B	25%	0.29	0.50	201	3.4%	13.9	0	1.0%	15.0	1.5	0.0	13.9	201.0	21.8	13.9
144	0.50	B	25%	0.29	0.50	217	1.6%	18.4	0	1.0%	15.0	1.5	0.0	18.4	217.0	21.8	18.4

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cloverleaf Fil. 1 - Proposed Conditions
Project No.: 2000-5158.I
Calculated By: RPD
Checked By:
Date: 11/25/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	*I* (in/hr)	Q (cfs)	*tc* (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	142	142	0.51	0.29	11.9	0.14	3.87	0.5															Runoff from Basin 142 routed to sand filter at DP-142 via overland flow and drainage ditches.
	143	143	0.50	0.29	13.9	0.14	3.64	0.5															Runoff from Basin 143 routed to sand filter at DP-143 via overland flow and drainage ditches.
	144	144	0.50	0.29	18.4	0.14	3.22	0.5															Runoff from Basin 144 routed to sand filter at DP-144 via overland flow and drainage ditches.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Filing No. 1
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cloverleaf Fil. 1 - Proposed Conditions
Project No.: 2000-5158.
Calculated By: RPD
Checked By:
Date: 11/25/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	142	142	0.51	0.50	11.9	0.25	6.50	1.6															Runoff from Basin 142 routed to sand filter at DP-142 via overland flow and drainage ditches.
	143	143	0.50	0.50	13.9	0.25	6.11	1.5															Runoff from Basin 143 routed to sand filter at DP-143 via overland flow and drainage ditches.
	144	144	0.50	0.50	18.4	0.25	5.40	1.3															Runoff from Basin 144 routed to sand filter at DP-144 via overland flow and drainage ditches.

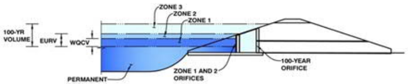
Appendix C
Water Quality Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **Cloverleaf Filing No. 1**

Basin ID: **Lot 142**



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**SF**			
Watershed Area =	0.51	acres		
Watershed Length =	191	ft		
Watershed Slope =	0.051	ft/ft		
Watershed Imperviousness =	25.00%	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 =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.005	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.010	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.023	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.041	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.052	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.067	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.093	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.009	acre-feet		
Approximate 5-yr Detention Volume =	0.013	acre-feet		
Approximate 10-yr Detention Volume =	0.020	acre-feet		
Approximate 25-yr Detention Volume =	0.024	acre-feet		
Approximate 50-yr Detention Volume =	0.025	acre-feet		
Approximate 100-yr Detention Volume =	0.030	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.005	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.005	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Total detention volume is less than 100-year volume.

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)
Media Surface	--	0.00	--	--	--	146	0.003		
	--	1.00	--	--	--	457	0.010	297	0.007
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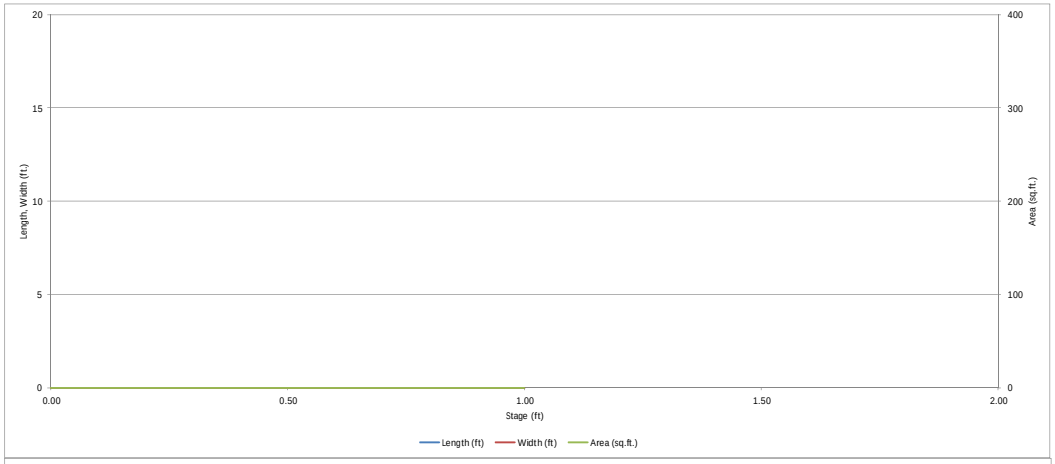
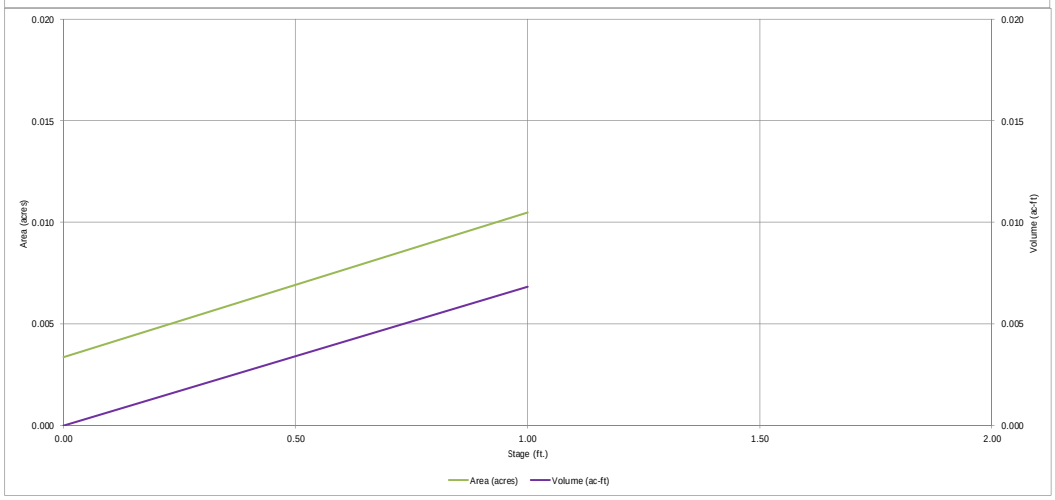
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





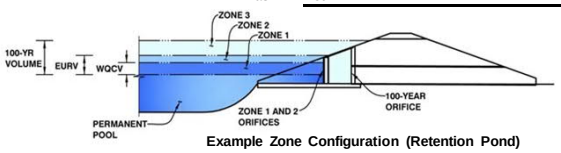
If applicable, input the overflow domed grate and 4" outlet pipe calcs into this sheet so all calcs are in one place.

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Filing No. 1

Basin ID: Lot 142



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.76	0.005	Filtration Media
Zone 2			
Zone 3			
		0.005	Total

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

Underdrain Orifice Invert Depth =	1.80	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.31	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.01	feet

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

Invert of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =		inches
Orifice Plate: Orifice Area per Row =		inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

	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 =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be $\geq$ 4
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

Complete this section and revise detail on plans if necessary.

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres

Routed Hydrograph Results

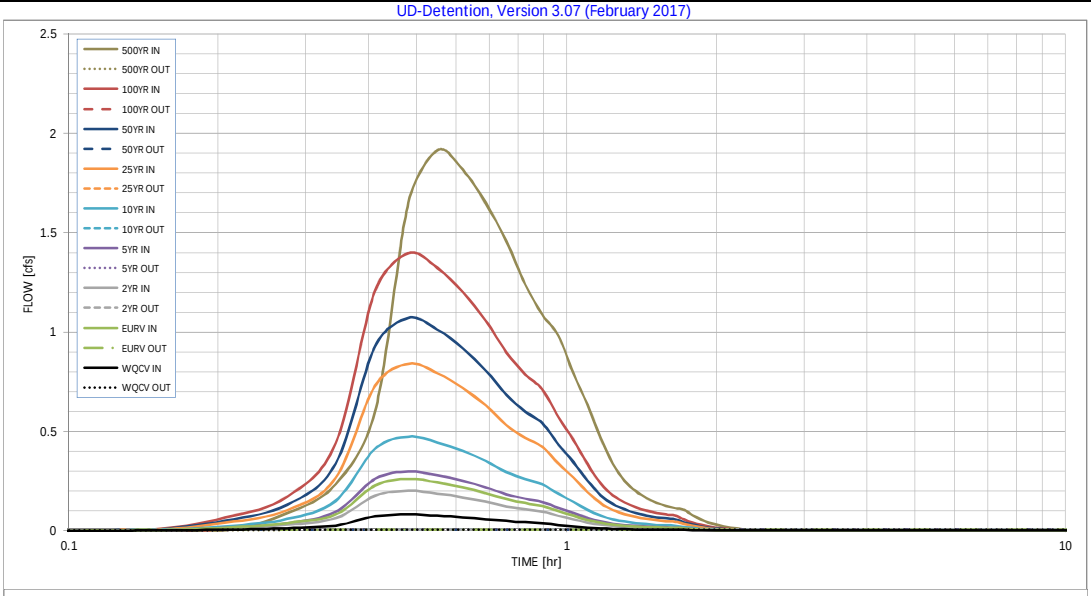
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.005	0.013	0.010	0.014	0.023	0.041	0.052	0.067	0.093
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.004	0.012	0.009	0.014	0.022	0.040	0.051	0.067	0.093
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.25	0.81	1.12	1.49	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.8	1.1
Peak Inflow Q (cfs) =	0.1	0.3	0.2	0.3	0.5	0.8	1.1	1.4	1.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	12	36	28	40	64	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	12	36	28	41	65	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	0.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Area at Maximum Ponding Depth (acres) =	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Maximum Volume Stored (acre-ft) =	0.003	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

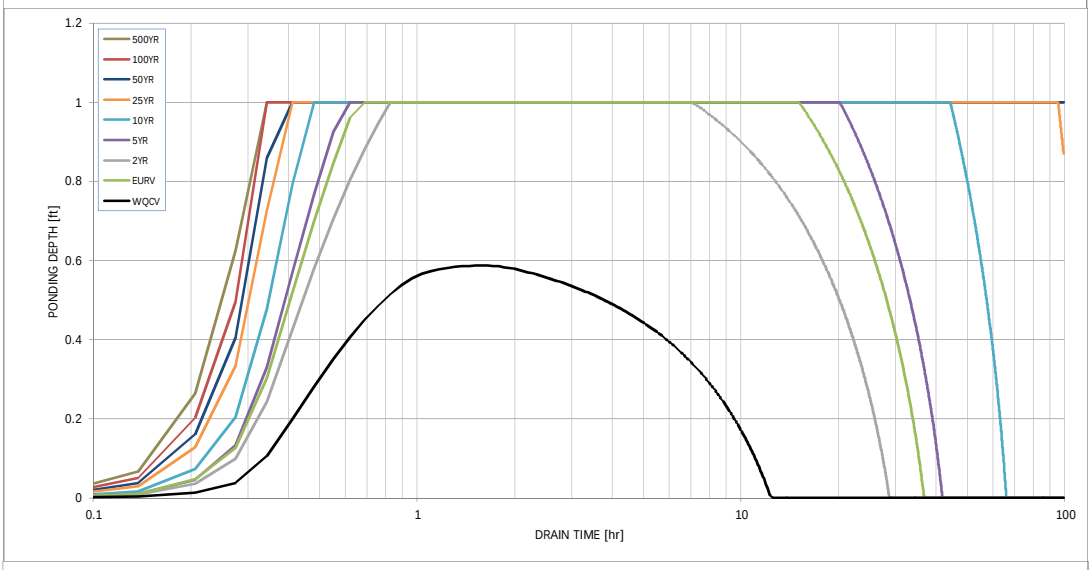
At depth of 1ft, the overflow grate (not filtration media) would be utilized up to 100-yr storm (according to calcs on page 49) and then the spillway for the 500yr. Revise accordingly for each SF.

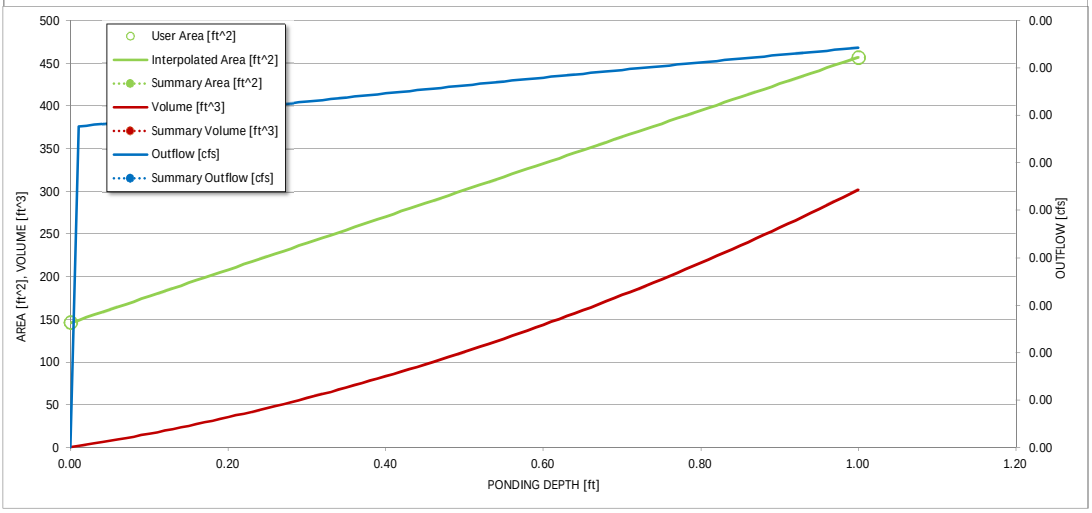
From EURV to 500-yr storm, there is not much detention happening since the overflow grate is being utilized. For these storms, the inflow should almost equal the outflow. Meaning that the Peak Outflow for these storms should be greater than 0.0. Please revise.

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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: _____

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
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]
4.13 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:12:23	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	0.09
1.210	0:16:31	0.01	0.04	0.03	0.04	0.06	0.10	0.13	0.17	0.23
	0:20:39	0.03	0.08	0.06	0.09	0.15	0.26	0.34	0.44	0.60
	0:24:47	0.07	0.23	0.18	0.26	0.41	0.73	0.93	1.21	1.65
	0:28:55	0.08	0.26	0.20	0.30	0.47	0.84	1.07	1.40	1.92
	0:33:02	0.08	0.24	0.19	0.28	0.44	0.79	1.01	1.32	1.82
	0:37:10	0.07	0.22	0.17	0.25	0.40	0.72	0.92	1.20	1.65
	0:41:18	0.06	0.19	0.15	0.22	0.35	0.63	0.81	1.06	1.46
	0:45:26	0.05	0.16	0.12	0.18	0.29	0.53	0.68	0.90	1.24
	0:49:34	0.04	0.14	0.11	0.16	0.26	0.47	0.60	0.79	1.09
	0:53:41	0.04	0.12	0.10	0.14	0.23	0.42	0.54	0.71	0.98
	0:57:49	0.03	0.10	0.07	0.11	0.19	0.34	0.43	0.57	0.79
	1:01:57	0.02	0.07	0.06	0.09	0.15	0.27	0.34	0.46	0.63
	1:06:05	0.02	0.05	0.04	0.06	0.11	0.19	0.25	0.34	0.47
	1:10:13	0.01	0.04	0.03	0.05	0.07	0.14	0.18	0.24	0.34
	1:14:20	0.01	0.03	0.02	0.03	0.06	0.10	0.13	0.18	0.25
	1:18:28	0.01	0.02	0.02	0.03	0.05	0.08	0.11	0.14	0.20
	1:22:36	0.01	0.02	0.02	0.02	0.04	0.07	0.09	0.12	0.16
	1:26:44	0.01	0.02	0.01	0.02	0.03	0.06	0.08	0.10	0.14
	1:30:52	0.00	0.02	0.01	0.02	0.03	0.05	0.07	0.09	0.12
	1:34:59	0.00	0.02	0.01	0.02	0.03	0.05	0.06	0.08	0.11
	1:39:07	0.00	0.02	0.01	0.02	0.02	0.05	0.06	0.08	0.11
	1:43:15	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.08
	1:47:23	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06
	1:51:31	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.04
	1:55:38	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03
	1:59:46	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	2:03:54	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:08:02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	2:12:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:16:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:20:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:24:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:28:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:32:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:36:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:41:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:49:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:53:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:57:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:26:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:59:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:28:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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]

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'.

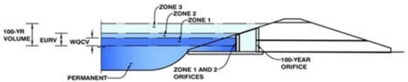
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **Cloverleaf Filing No. 1**

Basin ID: **Lot 143**



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Optional User Override 1-hr Precipitation

Selected BMP Type =	**SF**			
Watershed Area =	0.51	acres		
Watershed Length =	191	ft		
Watershed Slope =	0.042	ft/ft		
Watershed Imperviousness =	25.00%	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 =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.005	acre-feet		
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.010	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.023	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.041	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.052	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.067	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.093	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.009	acre-feet		
Approximate 5-yr Detention Volume =	0.013	acre-feet		
Approximate 10-yr Detention Volume =	0.020	acre-feet		
Approximate 25-yr Detention Volume =	0.024	acre-feet		
Approximate 50-yr Detention Volume =	0.025	acre-feet		
Approximate 100-yr Detention Volume =	0.030	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.005	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.005	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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)
Media Surface	--	0.00	--	--	--	146	0.003		
	--	1.00	--	--	--	457	0.010	297	0.007
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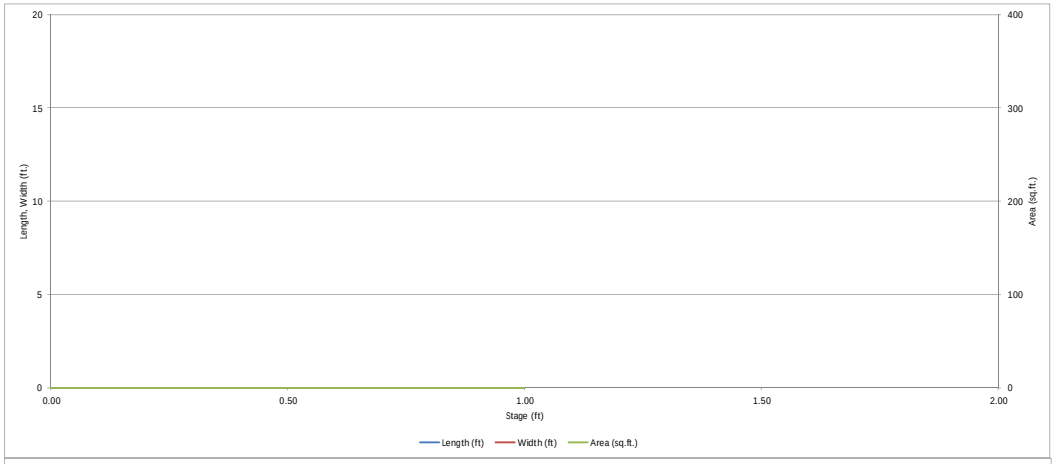
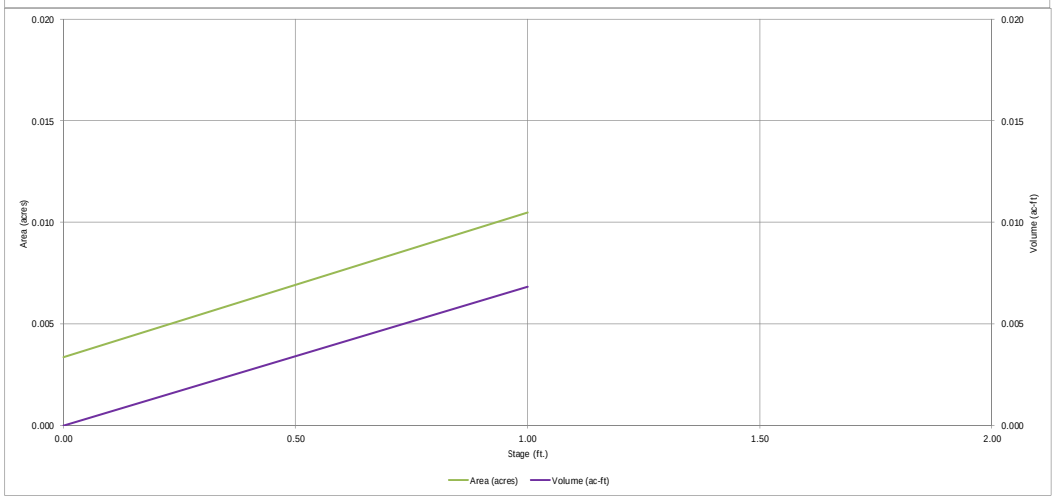
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



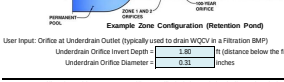


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Filing No. 1

Basin ID: Lot 143



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.76	0.005	Filtration Media
Zone 2			
Zone 3			
		0.005	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	1.80	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.31	inches	Underdrain Orifice Centroid =	0.01	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 =		ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

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

	Not Selected	Not Selected		Calculated Parameters for Overflow Weir	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Over Flow Weir Slope Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area % =			%, grate open area/total area	Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

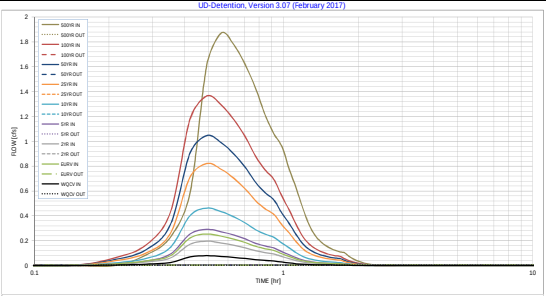
			Calculated Parameters for Spillway		
Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface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

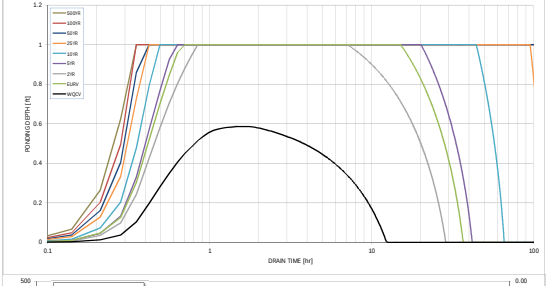
Routed Hydrograph Results

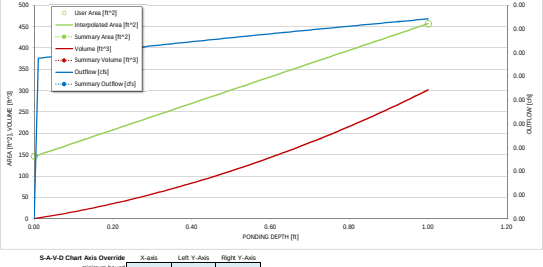
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.005	0.013	0.010	0.014	0.023	0.041	0.052	0.067	0.093
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.004	0.012	0.009	0.014	0.022	0.040	0.051	0.067	0.093
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.25	0.81	1.12	1.49	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.8	1.1
Peak Inflow Q (cfs) =	0.1	0.3	0.2	0.3	0.5	0.8	1.0	1.4	1.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	12	36	28	41	64	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	12	36	29	42	65	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	0.59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Area at Maximum Ponding Depth (acres) =	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Maximum Volume Stored (acre-ft) =	0.003	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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: _____

Storm Inflow Hydrographs: UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
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]
4.23 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:12:41	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	0.09
1.182	0:16:55	0.01	0.04	0.03	0.04	0.06	0.10	0.13	0.17	0.23
	0:21:09	0.02	0.08	0.06	0.09	0.15	0.26	0.33	0.43	0.59
	0:25:23	0.07	0.22	0.17	0.25	0.40	0.71	0.91	1.18	1.61
	0:29:37	0.08	0.25	0.20	0.29	0.46	0.82	1.05	1.37	1.87
	0:33:50	0.07	0.24	0.18	0.27	0.43	0.77	0.99	1.29	1.77
	0:38:04	0.07	0.21	0.16	0.25	0.39	0.70	0.90	1.17	1.61
	0:42:18	0.06	0.18	0.14	0.21	0.34	0.62	0.79	1.03	1.42
	0:46:32	0.05	0.15	0.12	0.18	0.29	0.52	0.67	0.88	1.21
	0:50:46	0.04	0.14	0.10	0.16	0.25	0.46	0.59	0.77	1.06
	0:54:59	0.04	0.12	0.09	0.14	0.23	0.41	0.53	0.69	0.96
	0:59:13	0.03	0.09	0.07	0.11	0.18	0.33	0.42	0.56	0.77
	1:03:27	0.02	0.07	0.06	0.09	0.14	0.26	0.34	0.45	0.62
	1:07:41	0.01	0.05	0.04	0.06	0.10	0.19	0.25	0.33	0.46
	1:11:55	0.01	0.04	0.03	0.04	0.07	0.13	0.17	0.23	0.33
	1:16:08	0.01	0.03	0.02	0.03	0.06	0.10	0.13	0.17	0.24
	1:20:22	0.01	0.02	0.02	0.03	0.04	0.08	0.10	0.14	0.19
	1:24:36	0.01	0.02	0.02	0.02	0.04	0.07	0.09	0.11	0.16
	1:28:50	0.01	0.02	0.01	0.02	0.03	0.06	0.07	0.10	0.14
	1:33:04	0.00	0.02	0.01	0.02	0.03	0.05	0.07	0.09	0.12
	1:37:17	0.00	0.02	0.01	0.02	0.03	0.05	0.06	0.08	0.11
	1:41:31	0.00	0.01	0.01	0.02	0.02	0.04	0.06	0.07	0.10
	1:45:45	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.08
	1:49:59	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06
	1:54:13	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.04
	1:58:26	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03
	2:02:40	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	2:06:54	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:11:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	2:15:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:19:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:23:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:28:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:32:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:36:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:49:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:53:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:57:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:06:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:39:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:56:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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]

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'.

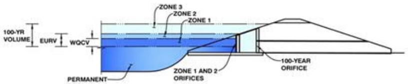
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Filing No. 1

Basin ID: Lot 144



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**SF**			
Watershed Area =	0.50	acres		
Watershed Length =	217	ft		
Watershed Slope =	0.016	ft/ft		
Watershed Imperviousness =	25.00%	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 =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.004	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.010	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.022	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.040	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.051	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.066	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	0.092	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.009	acre-feet		
Approximate 5-yr Detention Volume =	0.013	acre-feet		
Approximate 10-yr Detention Volume =	0.020	acre-feet		
Approximate 25-yr Detention Volume =	0.023	acre-feet		
Approximate 50-yr Detention Volume =	0.025	acre-feet		
Approximate 100-yr Detention Volume =	0.030	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.004	acre-feet	
Select Zone 2 Storage Volume (Optional) =		acre-feet	**Total detention volume is less than 100-year volume.**
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	0.004	acre-feet	
Initial Surcharge Volume (ISV) =	N/A	ft^3	
Initial Surcharge Depth (ISD) =	N/A	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	N/A	ft	
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio ($R_{L/W}$) =	user		

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

Depth Increment = 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)
Media Surface	--	0.00	--	--	--	146	0.003		
	--	1.00	--	--	--	457	0.010	297	0.007
	--		--	--	--				
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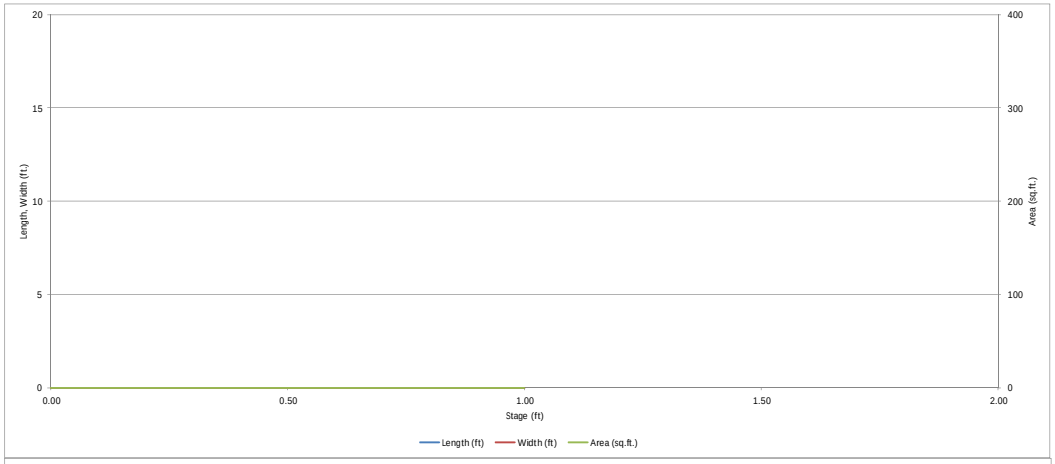
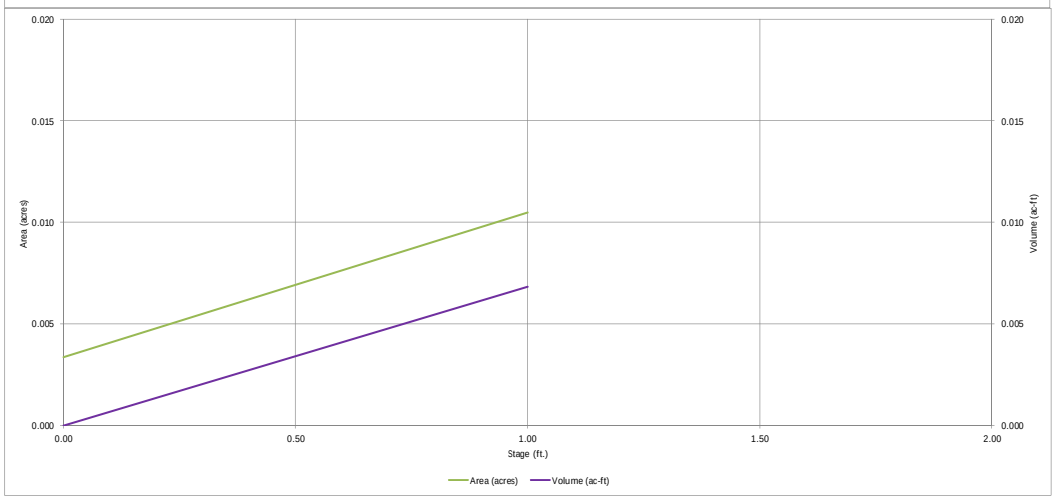
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



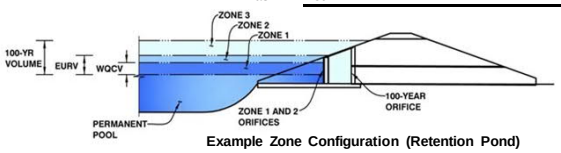


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Cloverleaf Filing No. 1**

Basin ID: **Lot 144**



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.75	0.004	Filtration Media
Zone 2			
Zone 3			
		0.004	Total

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

Underdrain Orifice Invert Depth =	1.80	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.31	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.01	feet

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

Invert of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =		inches
Orifice Plate: Orifice Area per Row =		inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

	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 =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be $\geq$ 4
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

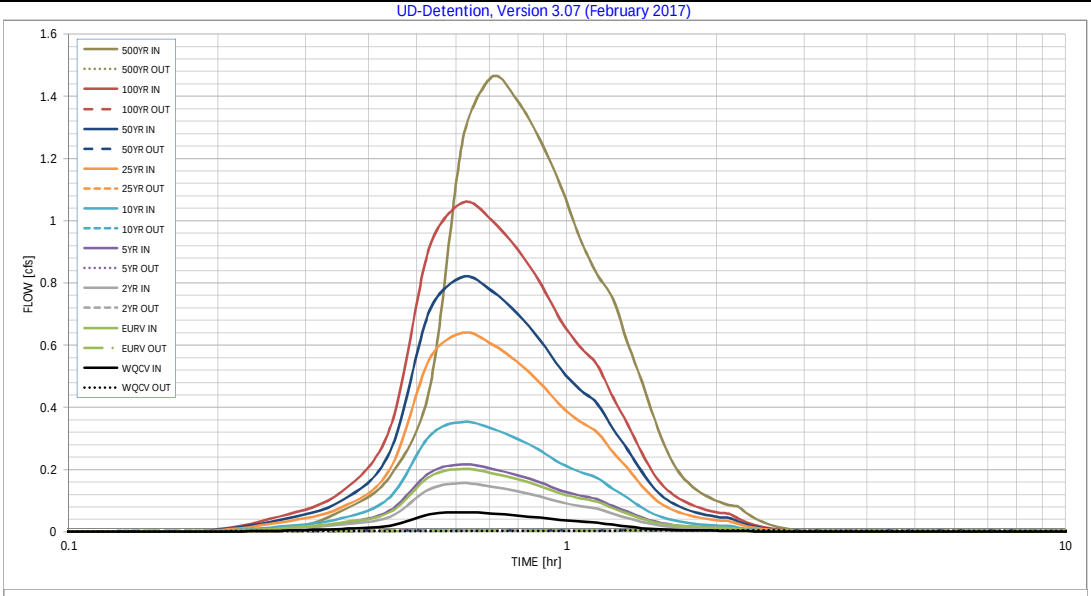
Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres

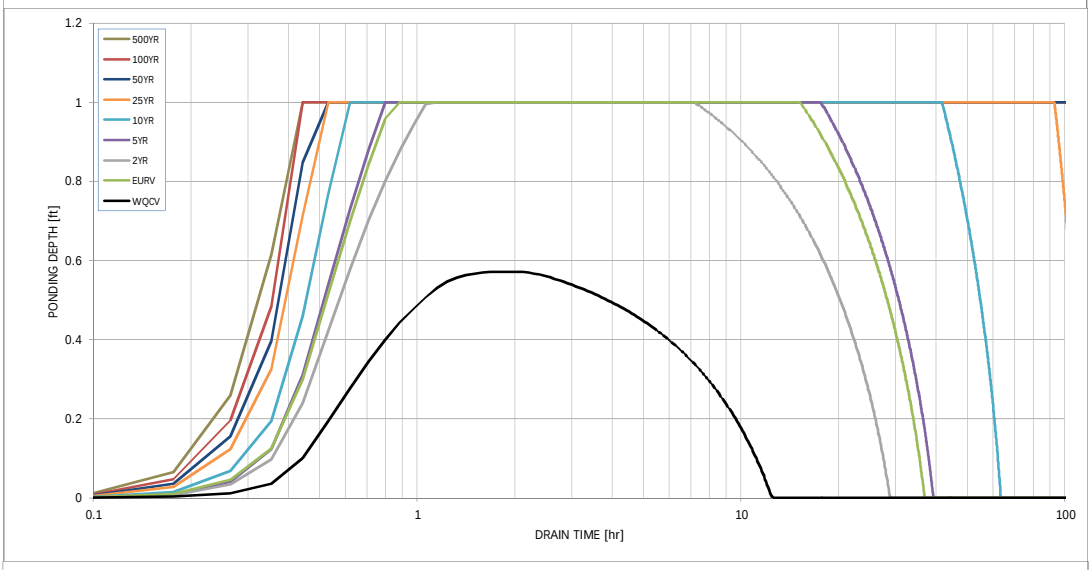
Routed Hydrograph Results

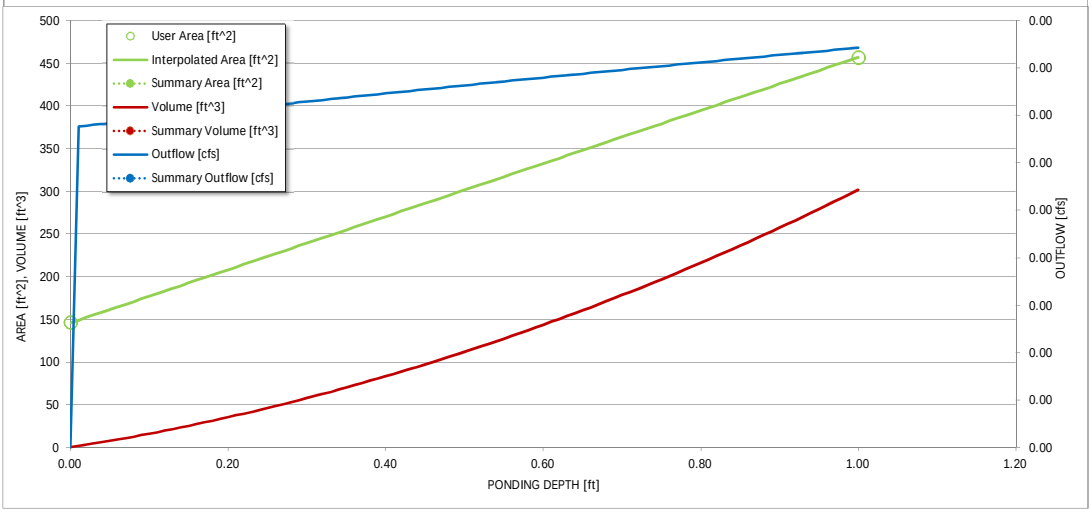
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.004	0.013	0.010	0.014	0.022	0.040	0.051	0.066	0.092
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.004	0.012	0.009	0.013	0.021	0.039	0.050	0.066	0.091
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.19	0.62	0.86	1.16	1.64
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.6	0.8
Peak Inflow Q (cfs) =	0.1	0.2	0.2	0.2	0.4	0.6	0.8	1.1	1.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	12	36	28	38	61	111	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	12	37	29	39	63	113	>120	>120	>120
Maximum Ponding Depth (ft) =	0.57	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Area at Maximum Ponding Depth (acres) =	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Maximum Volume Stored (acre-ft) =	0.003	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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: _____

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
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]
5.31 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:56	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.07
0.942	0:21:14	0.01	0.03	0.02	0.03	0.04	0.08	0.10	0.13	0.18
	0:26:33	0.02	0.06	0.05	0.07	0.11	0.20	0.26	0.33	0.46
	0:31:52	0.06	0.18	0.14	0.19	0.31	0.56	0.71	0.92	1.26
	0:37:10	0.06	0.20	0.16	0.22	0.35	0.64	0.82	1.06	1.46
	0:42:29	0.06	0.19	0.15	0.20	0.33	0.60	0.77	1.00	1.39
	0:47:47	0.05	0.17	0.13	0.18	0.30	0.55	0.70	0.91	1.26
	0:53:06	0.05	0.15	0.11	0.16	0.26	0.48	0.62	0.80	1.11
	0:58:25	0.04	0.12	0.09	0.13	0.22	0.41	0.52	0.68	0.95
	1:03:43	0.03	0.11	0.08	0.12	0.19	0.36	0.46	0.60	0.83
	1:09:02	0.03	0.10	0.07	0.11	0.17	0.32	0.41	0.54	0.75
	1:14:20	0.02	0.08	0.06	0.08	0.14	0.26	0.33	0.43	0.60
	1:19:39	0.02	0.06	0.04	0.06	0.11	0.20	0.26	0.34	0.48
	1:24:58	0.01	0.04	0.03	0.05	0.08	0.15	0.19	0.25	0.36
	1:30:16	0.01	0.03	0.02	0.03	0.06	0.10	0.14	0.18	0.26
	1:35:35	0.01	0.02	0.02	0.02	0.04	0.08	0.10	0.13	0.19
	1:40:53	0.01	0.02	0.01	0.02	0.03	0.06	0.08	0.11	0.15
	1:46:12	0.00	0.02	0.01	0.02	0.03	0.05	0.07	0.09	0.13
	1:51:31	0.00	0.01	0.01	0.01	0.02	0.04	0.06	0.08	0.11
	1:56:49	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.07	0.09
	2:02:08	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	0.09
	2:07:26	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.08
	2:12:45	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06
	2:18:04	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.04
	2:23:22	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03
	2:28:41	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02
	2:33:59	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	2:39:18	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	2:44:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	2:49:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:21:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:29:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:39:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:01:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:11:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:17:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:22:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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.

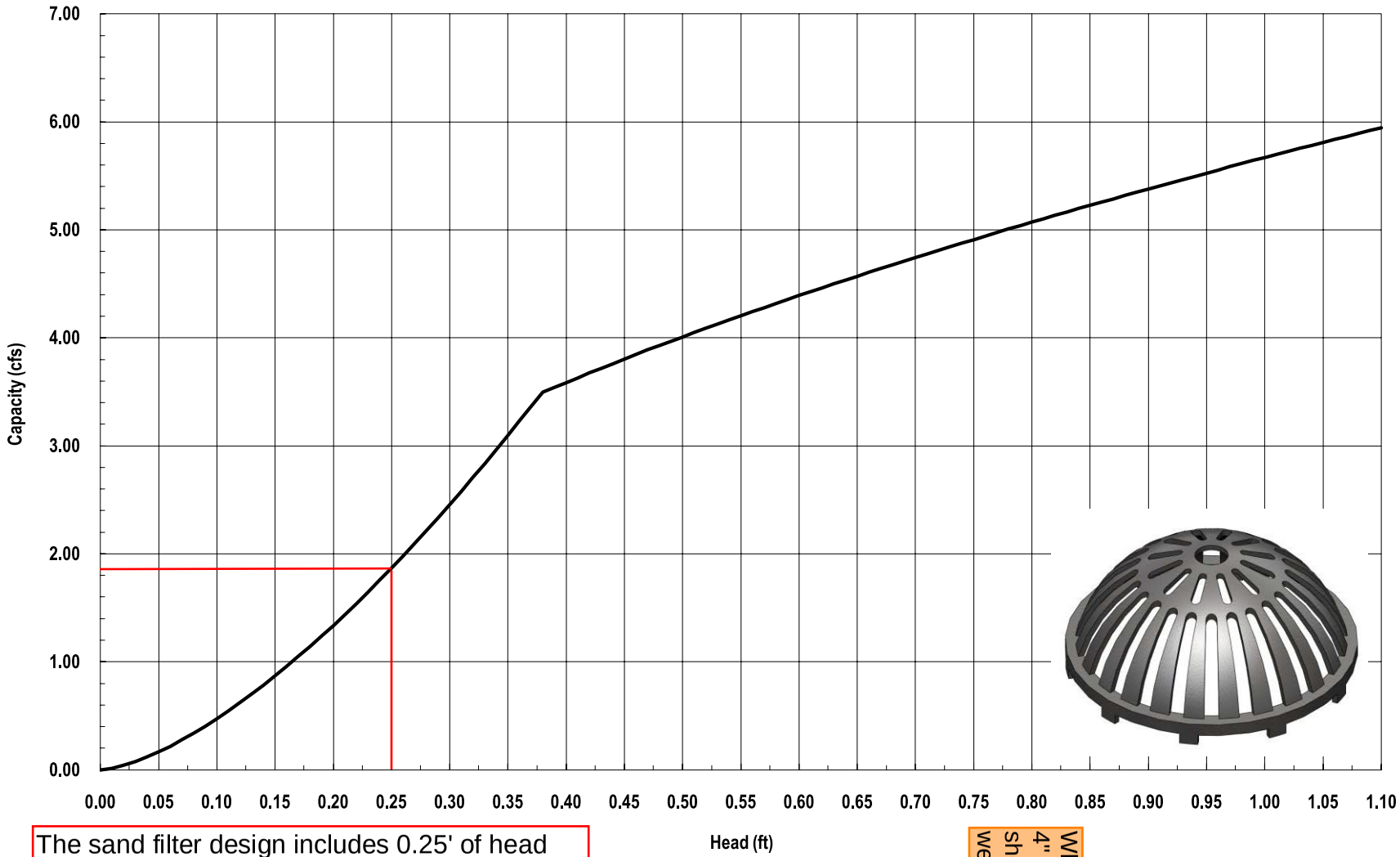
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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).

SAND FILTER OVERFLOW INLET CAPACITY

Nyloplast 18" Dome Grate Inlet Capacity Chart



The sand filter design includes 0.25' of head over the dome grate, which corresponds to about 1.8 cfs of capacity. The 100-year flow into the sand filters ranges from 1.3 to 1.6 cfs, so an 18" dome grate has adequate capacity.

What about capacity of 4" outlet pipe? Please show these calcs as well.

Nyloplast®
3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

Appendix D
Reference Material

ENGINEERING
CONSULTANTS

NELSON, HALEY, PATTERSON AND QUIRK, INC.
THE MINE SHOPPING CENTER, BOX 547, MONUMENT, COLORADO 80132 481-3533

January 7, 1972

Mr. Thomas Russell
El Paso County Engineer
County Office Building
Colorado Springs, Colorado

Dear Mr. Russell:

In compliance with the subdivision regulations of El Paso County, Colorado, we are transmitting the following drainage plan and report for the Woodmoor Greens Subdivision. The Woodmoor Greens is a development of the Woodmoor Corporation, located in the Northeast quarter of Section 23, the North half of Section 24 and the South 1/2 Southwest 1/4 of Section 13, all in T. 11 South. Range 67 West of the 6th Principal Meridian and contains 245.51 acres.

The Woodmoor Greens subdivision lies North of the Higby County Road and adjacent to the West boundary of Woodmoor Summit and Nugget. This proposed subdivision will contain 222 single-family residences and a future golf course.

Existing Conditions:

The Woodmoor Green's area has an existing ground cover composed of medium to dense native grasses. The soil in this area is generally sandy in nature, allowing for a medium infiltration rate. The historical drainage pattern for this area is as follows: Runoff flowing Westerly and Southwesterly from the Woodmoor Summit and Woodmoor Nugget flows through the Woodmoor Greens area, into Teachout Creek and eventually reaches Monument Creek.

Developed Conditions

The future surface runoff of the developed Woodmoor Greens Subdivision will follow the historical drainage pattern of the area. The developed runoff generated from this subdivision was calculated on the basis of the Rational Formula.

Q = CiA, where

Q = The surface runoff in cubic feet per second

C = Runoff factor based upon character of soil and percentage of impervious area

i = Intensity of rainfall

A = Contributing area

The runoff factor C is based upon the following calculations:

222 lots X 2,500 square feet per house ÷ 43,560 = 12.74 acres

12.74 acres of impervious area X 0.90 = 11.50

232.77 acres with grass cover X 0.30 = 69.71

245.51 acres 81.21

C = 81.21 ÷ 245.51 = 0.33

A design storm of 25 years was used in calculations. (Exhibit 2).

During the consttruction of roadways in the Woodmoor Greens Subdivision, corrugated metal pipe culverts will be installed at street intersections and natural drainage ways to accommodate the expected runoff (refer to exhibit 2).

Should there be any questions relative to this report, please contact us at your convenience.

Very truly yours,

NELSON, HALEY, PATTERSON AND QUIRK

Gary R. Windolph

Gary R. Windolph, P. E.

GRW:dw

EXHIBIT 2

AREA NO.	ACREAGE	INTENSITY	Q
1	0.60	3.67	0.7
2	15.2	1.98	9.93
3	110.0	1.73	62.8
4	2.8	3.35	3.1
5	2.8	3.19	2.9
6	16.5 + 9.7	1.55	13.4
7	1.6 + #8	1.73	3.4
8	2.5 + #9	2.31	3.3
9	1.8	3.80	2.3
10	1.0	4.20	1.4
11	3.5	3.12	3.6
12	19.8	2.31	13.7
13	7.9	2.89	7.6
14	5.2 + 9.5 Ac	1.98	29.10
15	1.0	3.55	1.2
16	9.0	2.60	7.7

WOODMOOR GREENS

A PART OF SECTIONS 13 , 23 , AND 24 T-11-S, R-67-W
EL PASO COUNTY, COLORADO

NELSON, HALEY, PATTERSON, and QUIRK INC.
ENGINEERING CONSULTANTS

KNOW ALL MEN BY THESE PRESENTS:
That the Woodmoor Corporation, a Colorado Corporation, Steven N. Arnold, President, John J. Wilkinson, Secretary, James E. Higby Holder of a Deed of Trust, being the parties in interest to the following described tract of land.

TO WIT: That portion of the Northeast and Northwest ¼ of Section 24, the Northeast ¼ of Section 23, and the South ½ of the Southwest ¼ of Section 13, Range 67 West of the 6th Principal Meridian, County of El Paso, State of Colorado, described as follows:

BEGINNING at a point which bears S 89° 39' 40" W, 2523.76 feet from the S.E. corner of the N.E. 1/4 of Sec. 24, T. 11 S. R. 67 W. 6th Principal Meridian, (all bearings in this description are relative to those shown on the plat of "Woodmoor Summit" as recorded in Book Page of the Records of El Paso County), Thence S 89° 39' 40" W, 510.00 feet, Thence N 00° 20' 20" W, 40.00 feet, Thence N 18° 22' 53" E, 159.63 feet, Thence N 00° 20' 20" W, 155.00 feet, Thence N 43° 54' 43" E, 77.60 feet, thence N 46° 05' 17" W, 50.00 feet, Thence N 43° 54' 43" E, 50.00 feet, Thence S 46° 05' 17" E, 50.00 feet, Thence N 43° 54' 43" E, 110.00 feet, Thence N 21° 28' 19" E, 262.60 feet, Thence N 71° 02' 53" W, 290.00 feet, Thence N 42° 52' 49" W, 205.00 feet, Thence N 01° 51' 26" W, 190.00 feet, Thence N 04° 57' 36" E, 135.00 feet, Thence N 04° 36' 23" W, 360.40 feet, Thence N 02° 42' 39" E, 121.86 feet, Thence S 70° 23' 25" W, 375.00 feet, Thence S 01° 44' 16" E, 190.00 feet, Thence S 65° 04' 36" W, 480.00 feet, Thence S 58° 43' 47" W, 177.04 feet, Thence S 84° 38' 59" W, 60.01 feet, Thence N 73° 47' 54" W, 180.00 feet, Thence N 41° 14' 28" W, 175.00 feet, Thence N 19° 02' 15" W, 185.00 feet, Thence N 13° 02' 08" W, 370.00 feet, Thence N 00° 51' 43" W, 265.00 feet, Thence N 09° 23' 11" W, 360.00 feet, Thence N 88° 34' 02" E, 222.14 feet, Thence N 09° 23' 11" W, 30.29 feet, Thence S 88° 34' 02" W, 222.14 feet, Thence N 09° 23' 11" W, 490.00 feet, Thence N 05° 56' 39" W, 210.00 feet, Thence N 11° 56' 55" W, 256.68 feet, Thence S 41° 10' 02" W, 152.42 feet, Thence S 00° 19' 43" E, 904.96 feet, Thence S 45° 59' 17" W, 137.34 feet, Thence S 44° 00' 43" E, 50.00 feet, Thence S 45° 59' 17" W, 50.00 feet, Thence N 44° 00' 43" W, 50.00 feet, Thence S 45° 59' 17" W, 135.84 feet, Thence S 07° 42' 03" E, 250.46 feet, Thence S 17° 32' 19" E, 222.34 feet, Thence S 51° 33' 29" W, 451.97 feet, Thence S 25° 51' 46" W, 511.20 feet, Thence S 80° 49' 05" W, 269.86 feet, Thence S 48° 08' 31" W, 255.30 feet, Thence S 51° 32' 57" W, 60.00 feet, Thence N 38° 27' 03" W, 730.00 feet, to a point on a curve to the left, said curve having a Radius of 310.00 feet and Delta of 42° 36' 04", Thence along the Arc of said curve, 230.49 feet, Thence N 81° 03' 05" W, 573.30 feet to a point on a curve to the right, said curve having a Radius of 190.00 feet and Delta of 79° 22' 30", Thence along the Arc of said curve, 263.22 feet, Thence N 01° 40' 36" W, 483.36 feet to a point on a curve to the right, said curve having a Radius of 190.00 feet and Delta of 82° 35' 54", Thence along the Arc of said curve, 273.91 feet, Thence N 80° 55' 18" E, 370.48 feet to a point on a curve to the right, said curve having a Radius of 430.00 feet and Delta of 08° 26' 10", Thence along the Arc of said curve 63.31 feet, Thence N 89° 21' 28" E, 183.24 feet, Thence N 00° 38' 32" W, 130.00 feet, Thence N 89° 21' 28" E, 1440.04 feet, Thence N 00° 19' 43" W, 1321.09 feet, Thence N 89° 38' 50" E, 2513.53 feet to the N.W. corner of "Woodmoor Nugget" as recorded in Book 7-2 Page 67 of The Records of El Paso County, Thence S 00° 39' 14" E, 1016.58 feet, Thence N 89° 51' 40" E, 638.06 feet, Thence S 14° 25' 04" E, 261.62 feet, Thence N 75° 34' 56" E, 80.00 feet, Thence S 14° 25' 04" E, 75.00 feet to a point on a curve to the right, said curve having a Radius of 1040.00 feet and Delta of 30° 56' 35", Thence along the Arc of said curve 561.66 feet, Thence N 73° 28' 29" W, Radially, 80.00 feet to a point on a curve to the right, said curve having a Radius of 960.00 feet and Delta of 03° 19' 58", Thence along the Arc of said curve 55.84 feet to a point on a reverse curve to the left, said curve having a Radius of 540.00 feet and Delta of 28° 14' 16", Thence along the Arc of said curve 266.13 feet to a point on a compound curve to the left, said curve having a Radius of 1040.00 feet and Delta of 00° 47' 51", Thence along the Arc of said curve 14.47 feet, Thence S 80° 49' 23" W, 272.75 feet, Thence S 19° 58' 10" E, 275.47 feet, Thence S 22° 05' 36" E, 134.73 feet, Thence S 32° 26' 40" E, 145.00 feet, Thence S 41° 53' 46" E, 418.00 feet, Thence S 69° 16' 03" E, 60.00 feet, Thence S 03° 05' 33" W, 345.41 feet, Thence s 75° 23' 35" W, 55.00 feet, Thence S 85° 41' 53" W, 584.00 feet, Thence S 04° 04' 33" W, 520.00 feet to the point of beginning, said description containing 245.51 Acres.

DEDICATION:
The above parties in interest have caused said tract of land to be platted into lots, streets, and easements as shown on the plat, which plat sets forth the boundary and dimensions thereof. Said lots as platted shall be known as "Woodmoor Greens." All streets so platted are hereby dedicated to public use. The aforementioned parties in interest do hereby covenant and agree that they will at their own expense, grade and gravel all platted streets, and provide proper drainage for same, all to the satisfaction of the Board of County Commissioners of El Paso County, Colorado, and upon acceptance by resolution, all streets and drainage ways so dedicated will become matters of maintenance by El Paso County, Colorado.

IN WITNESS WHEREOF: The undersigned have executed their presents this 8th day of January, 1972 A. D.

THE WOODMOOR CORPORATION

Steven N. Arnold, President

John J. Wilkinson, Secretary

HOLDER OF DEED OF TRUST

James E. Higby

STATE OF COLORADO
COUNTY OF EL PASO

The above and foregoing instrument was acknowledged before me this 8th day of January, 1972 A. D. by the Woodmoor Corporation by Steven N. Arnold, Pres. and John J. Wilkinson, Secretary.

Witness my HAND and OFFICIAL SEAL Doris L. Eggo
NOTARY PUBLIC

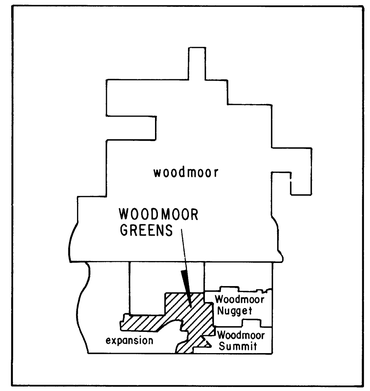
My Commission Expires: October 23, 1973

STATE OF COLORADO
COUNTY OF EL PASO

The above and foregoing instrument was acknowledged before me this 8th day of January, 1972 A. D. by James E. Higby, Holder of Deed of Trust.

Witness my HAND and OFFICIAL SEAL Doris L. Eggo
NOTARY PUBLIC

My Commission Expires: October 23, 1973



VICINITY MAP

PROTECTIVE COVENANTS FOR WOODMOOR GREENS

1. In non-vehicular easements, as abbreviated on the plat, N.V.E., the Woodmoor Corporation reserves the right to construct gravel surfaced pathways for non-vehicular community use, which shall be for the sole and exclusive use of owners within the subdivision. The Woodmoor Corporation will maintain improvements on non-vehicular easements until a Home Owners Association assumes responsibility for maintenance.
2. Private driveways shall not be permitted access to Fairplay Drive or Higby Road.
3. The Woodmoor Corporation will maintain median strips in the road rights of ways until maintenance is assumed by the Home Owners Association.

I, Thomas J. Russell, County Engineer, El Paso County, Colorado, do hereby approve the accompanying plat as to drainage of the streets as shown hereon.

Thomas J. Russell
County Engineer

Approved by the El Paso County Planning Commission this 14th day of February, 1972 A.D.

Steve D. Jones
Chairman

Approved by the El Paso County Planning Department this 9th day of February, 1972 A.D.

D. Crissman
County Planning Engineer

CERTIFICATION:
The undersigned Registered Land Surveyor in the State of Colorado does hereby certify that the accompanying plat was calculated and prepared under his supervision in accordance with Chapter 136 of the Colorado Revised Statutes, as amended July 1, 1968, and that said plat does accurately show the described tract of land and the subdivision thereof to the best of his knowledge and belief.

Donald E. McKee
Registered Land Surveyor
State of Colorado 6616

NOTES:

WATER AND SANITATION TO BE PROVIDED BY THE WOODMOOR WATER AND SANITATION DISTRICT.

Utility and Drainage Easements -- All side and rear lot lines are subject to a 16-foot easement, lying 8 feet on either side of said lot lines and 16 feet along and adjacent to all boundary lines, except those side lot lines adjacent to public streets.

● DESIGNATES BOUNDARY MONUMENTS FOUND-- 1/2" rebar with plastic cap stamped "N.H.P.Q. #2682"

◎ DESIGNATES BOUNDARY MONUMENTS SET-- 1/2" rebar with plastic cap stamped "N.H.P.Q. #2682"

STATE OF COLORADO
COUNTY OF EL PASO

I hereby certify that this instrument was filed for record in my office at 9:25 o'clock A.M., this 16 day of February 1972 A.D. and is duly recorded in Plat Book 21-2 at Page 51 of the Records of El Paso County, Colorado.

RECEPTION NO. 163562

FEE: $70.00

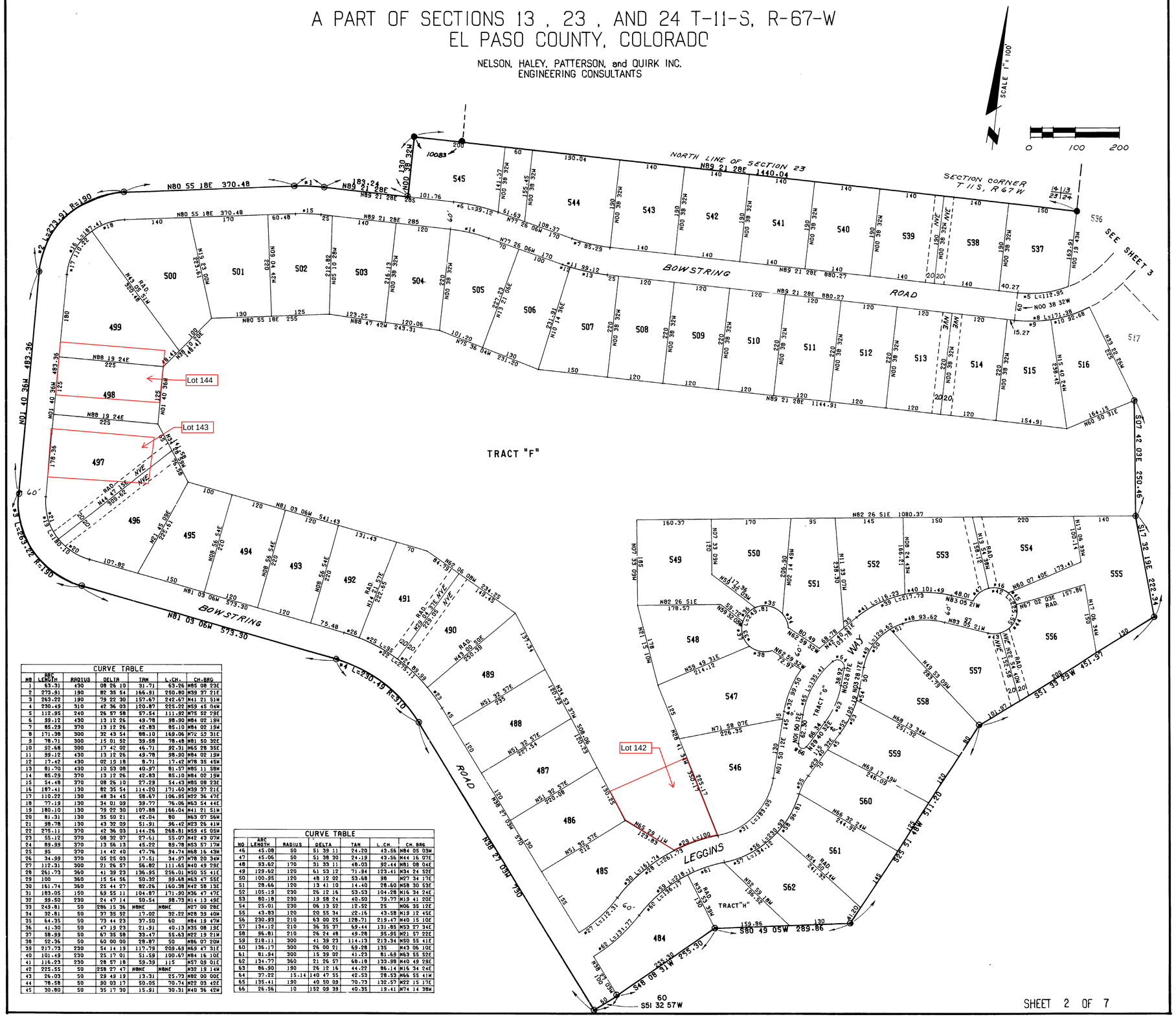
HARRIET BEALS, Recorder

By Lucille Anderson
Deputy

WOODMOOR GREENS

A PART OF SECTIONS 13 , 23 , AND 24 T-11-S, R-67-W
EL PASO COUNTY, COLORADO

NELSON, HALEY, PATTERSON, and QUIRK INC.
ENGINEERING CONSULTANTS

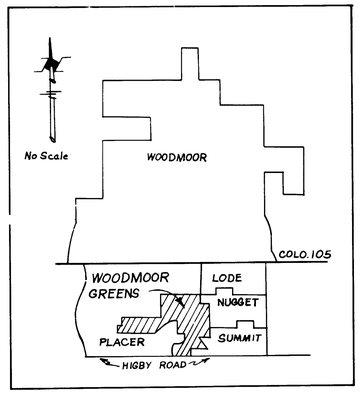


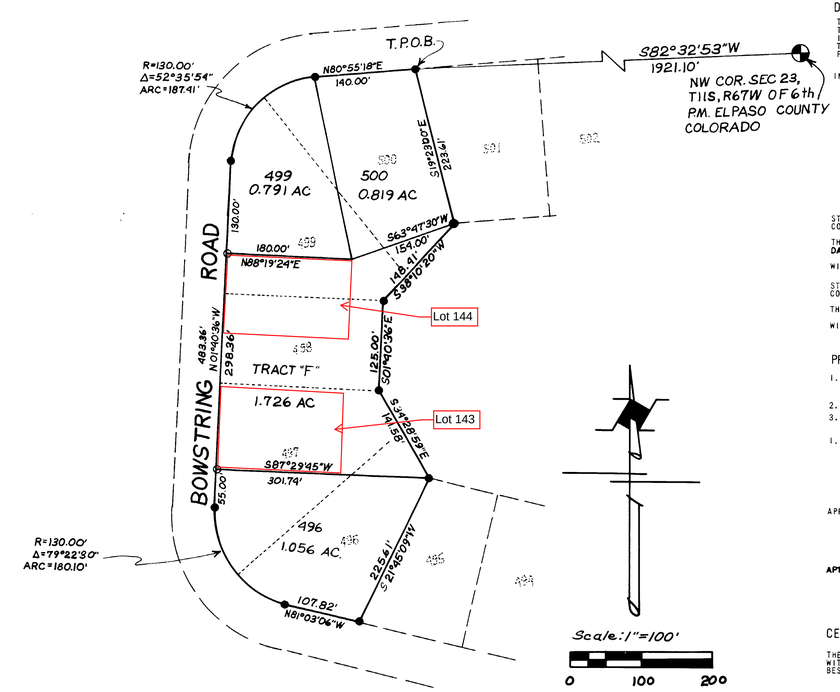
CURVE TABLE						
NO	ARC LENGTH	RADIUS	DELTA	TAN	L.CH.	CH.BRG
1	63.31	430	08 26 10	31.71	63.26	N85 08 23E
2	273.91	190	82 35 54	166.91	250.80	N39 37 21E
3	263.22	190	79 22 30	157.67	242.67	N41 21 51W
4	230.49	310	42 36 03	120.87	225.22	N59 45 04W
5	112.95	240	26 57 58	57.54	111.92	N75 52 29E
6	99.12	430	13 12 26	49.78	98.90	N84 02 19W
7	85.29	370	13 12 26	42.83	85.10	N84 02 19W
8	171.38	300	32 43 54	88.10	169.06	N72 53 31E
9	78.71	300	15 01 52	39.58	78.48	N81 50 30E
10	92.68	300	17 42 02	46.71	92.31	N65 28 35E
11	99.12	430	13 12 26	49.78	98.90	N84 02 19W
12	17.42	430	02 19 18	8.71	17.42	N78 35 45W
13	81.70	430	10 53 08	40.97	81.57	N85 11 58W
14	85.29	370	13 12 26	42.83	85.10	N84 02 19W
15	54.48	370	08 26 10	27.29	54.43	N85 08 23E
16	187.41	130	82 35 54	114.20	171.60	N39 37 21E
17	110.22	130	48 34 45	58.67	106.95	N22 36 47E
18	77.19	130	34 01 09	39.77	76.06	N63 54 44E
19	180.10	130	79 22 30	107.88	166.04	N41 21 51W
20	81.31	130	35 50 21	42.04	80	N63 07 56W
21	98.78	130	43 32 09	51.91	96.42	N23 26 41W
22	275.11	370	42 36 03	144.26	268.81	N59 45 05W
23	55.12	370	08 32 07	27.61	55.07	N42 43 07W
24	89.99	370	13 56 13	45.22	89.78	N53 57 17W
25	95	370	14 42 40	47.76	94.74	N68 16 43W
26	34.99	370	05 25 03	17.51	34.97	N78 20 34W
27	112.31	300	21 26 57	56.82	111.65	N40 49 29E
28	261.73	360	41 39 23	136.95	256.01	N50 55 41E
29	100	360	15 54 56	50.32	99.68	N63 47 55E
30	161.74	360	25 44 27	82.24	160.38	N42 58 13E
31	183.05	150	69 55 11	104.87	171.90	N36 47 47E
32	99.50	230	24 47 14	50.54	98.73	N14 13 49E
33	249.81	50	286 15 36	NONE	NONE	N27 00 28E
34	32.81	50	37 35 52	17.02	32.22	N28 39 40W
35	64.35	50	73 44 23	37.50	60	N84 19 47W
36	41.30	50	47 19 23	21.91	40.13	N35 08 19E
37	58.99	50	67 35 58	33.47	55.63	N22 19 21W
38	52.36	50	60 00 00	28.87	50	N86 07 20W
39	217.73	230	54 14 19	117.79	209.63	N69 47 31E
40	101.49	230	25 17 01	51.59	100.67	N84 16 10E
41	116.23	230	28 57 18	59.39	115	N57 09 01E
42	225.55	50	258 27 47	NONE	NONE	N32 19 14W
43	26.03	50	29 49 19	13.31	25.73	N82 00 00E
44	78.58	50	90 03 17	50.05	70.74	N22 03 42E
45	30.80	50	35 17 30	15.91	30.31	N40 36 42W

CURVE TABLE						
NO	ARC LENGTH	RADIUS	DELTA	TAN	L.CH.	CH.BRG
46	45.08	50	51 39 11	24.20	43.56	N84 05 03W
47	45.06	50	51 38 30	24.20	43.56	N44 16 07E
48	93.62	170	31 33 11	48.03	92.44	N61 08 04E
49	129.62	120	61 53 12	71.94	123.41	N34 24 52E
50	100.95	120	48 12 02	53.68	98	N27 34 17E
51	28.66	120	13 41 10	14.40	28.60	N58 30 53E
52	105.19	230	26 12 16	53.53	104.28	N16 34 24E
53	80.18	230	19 58 24	40.50	79.77	N19 41 20E
54	25.01	230	06 13 52	12.52	25	N06 35 12E
55	43.83	120	20 55 34	22.16	43.58	N13 12 45E
56	230.93	210	63 00 25	128.71	219.47	N40 15 10E
57	134.12	210	36 35 37	69.44	131.85	N53 27 34E
58	96.81	210	26 24 48	49.28	95.95	N21 57 22E
59	218.11	300	41 39 23	114.13	213.34	N50 55 41E
60	136.17	300	26 00 21	69.28	135	N43 06 10E
61	81.94	300	15 39 02	41.23	81.69	N63 55 52E
62	134.77	360	21 26 57	68.18	133.98	N40 49 29E
63	86.90	190	26 12 16	44.22	86.14	N16 34 24E
64	37.22	15.14	140 47 55	42.53	28.53	N66 55 41W
65	135.41	190	40 50 08	70.73	132.57	N22 15 17E
66	26.56	10	152 09 39	40.35	19.41	N74 14 38W

A VACATION AND REPLAT OF LOTS 496-500
WOODMOOR GREENS
A PART OF SECTION 23, T11S, R67W OF 6th P.M.
EL PASO COUNTY, COLORADO

NELSON, HALEY, PATTERSON and QUIRK INC.
ENGINEERING CONSULTANTS





KNOW ALL MEN BY THESE PRESENTS:

THAT THE WOODMOOR CORPORATION, A COLORADO CORPORATION, JOHN A. THOMPSON EXEC. VP, DALE D. WHEELER, AST. SECRETARY. JAMES E. HIGBY, HOLDER OF A DEED OF TRUST, BEING THE PARTIES IN INTEREST TO THE FOLLOWING DESCRIBED TRACT OF LAND.

TO WIT: A VACATION AND REPLAT OF LOTS 496 THRU 500 OF WOODMOOR GREENS AS FILED AND RECORDED IN BOOK U-2 PAGE 51 OF THE RECORDS OF EL PASO COUNTY, COLORADO, SAID LOTS ALSO BEING LOCATED IN THE NORTHWEST QUARTER OF NORTHEAST QUARTER (NW1/4NE1/4) OF SECTION 23, TOWNSHIP 11 SOUTH, RANGE 67 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY COLORADO, DESCRIBED IN PARTICULAR AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER (NW COR) SAID SECTION 23 AND CONSIDERING THE NORTH LINE OF THE NORTHEAST QUARTER (NE1/4) OF SAID SECTION 23 TO BEAR NORTH 89 21' 28" EAST, ALL BEARINGS CONTAINED THEREIN BEING RELATIVE THERETO:

THENCE SOUTH 82 32' 53" WEST, 1921.10 FEET TO THE TRUE POINT OF BEGINNING, SAID POINT ALSO BEING THE NORTHEAST CORNER (NE COR) OF SAID LOT 500:
THENCE SOUTH 19 23' 00" EAST, 223.61 FEET:
THENCE SOUTH 38 10' 20" WEST, 148.41 FEET:
THENCE SOUTH 01 40' 36" EAST, 125.00 FEET:
THENCE SOUTH 34 28' 59" EAST, 141.58 FEET:
THENCE SOUTH 21 45' 09" WEST, 225.61 FEET:
THENCE NORTH 81 03' 06" WEST, 107.82 FEET TO A POINT OF CURVATURE:
THENCE ALONG THE ARC OF A CURVE TO THE RIGHT 180.10 FEET, SAID CURVE HAVING A RADIUS OF 130.00 FEET AND A LONG CHORD WHICH BEARS NORTH 41 21' 51" WEST, 166.04 FEET TO A POINT OF TANGENCY:
THENCE NORTH 01 40' 36" WEST, 483.36 FEET TO A POINT OF CURVATURE:
THENCE ALONG THE ARC OF A CURVE TO THE RIGHT 187.41 FEET, SAID CURVE HAVING A RADIUS OF 130.00 FEET AND A LONG CHORD WHICH BEARS NORTH 39 37' 21" EAST, 171.60 FEET TO A A POINT OF TANGENCY:
THENCE NORTH 80 55' 18" EAST, 140.00 FEET TO THE TRUE POINT OF BEGINNING
SAID PARCEL CONTAINS 4.382 ACRES.

DEDICATION:

THE ABOVE PARTIES IN INTEREST HAVE CAUSED SAID TRACT OF LAND TO BE PLATTED INTO LOTS, STREETS, AND EASEMENTS AS SHOWN ON THE PLAT, WHICH PLAT SETS FORTH THE BOUNDARY AND DIMENSIONS THEREOF. SAID LOTS AS PLATTED SHALL BE KNOWN AS "A REPLAT OF LOTS 496-500 WOODMOOR GREENS". ALL STREETS SO PLATTED ARE HEREBY DEDICATED TO PUBLIC USE. THE AFOREMENTIONED PARTIES IN INTEREST DO HEREBY COVENANT AND AGREE THAT THEY WILL AT THEIR OWN EXPENSE, GRADE AND GRAVEL ALL PLATTED STREETS, AND PROVIDE PROPER DRAINAGE FOR SAME, ALL TO THE SATISFACTION OF THE BOARD OF COUNTY COMMISSIONERS OF EL PASO COUNTY, COLORADO, AND UPON ACCEPTANCE BY RESOLUTION, ALL STREETS AND DRAINAGE WAYS SO DEDICATED WILL BECOME MATTERS OF MAINTENANCE BY EL PASO COUNTY, COLORADO.

IN WITNESS WHEREOF: THE UNDERSIGNED HAVE EXECUTED THEIR PRESENTS THIS 15 DAY OF July, 1972 A.D.

THE WOODMOOR CORPORATION

JOHN A. THOMPSON EXEC. V.P. — DALE D. WHEELER, AST. SECRETARY

HOLDER OF DEED OF TRUST
JAMES E. HIGBY

STATE OF COLORADO
COUNTY OF EL PASO

THE ABOVE AND FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 15th DAY OF July, 1972 A.D. BY THE WOODMOOR CORPORATION BY JOHN A. THOMPSON, EXEC. V.P. DALE D. WHEELER, AST. SECRETARY.

WITNESS MY HAND AND OFFICIAL SEAL Betty A. Brock NOTARY PUBLIC — MY COMMISSION EXPIRES: October 26, 1975

STATE OF COLORADO
COUNTY OF EL PASO

THE ABOVE AND FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS 19th DAY OF July, 1972 A.D. BY JAMES E. HIGBY, HOLDER OF DEED OF TRUST.

WITNESS MY HAND AND OFFICIAL SEAL Betty A. Brock NOTARY PUBLIC — MY COMMISSION EXPIRES: October 31, 1975

PROTECTIVE COVENANTS FOR WOODMOOR GREENS

1. IN NON-VEHICULAR EASEMENTS, AS ABBREVIATED ON THE PLAT, N.V.E., THE WOODMOOR CORPORATION RESERVES THE RIGHT TO CONSTRUCT GRAVEL SURFACED PATHWAYS FOR NON-VEHICULAR COMMUNITY USE, WHICH SHALL BE FOR THE SOLE AND EXCLUSIVE USE OF OWNERS WITHIN THE SUBDIVISION. THE WOODMOOR CORPORATION WILL MAINTAIN IMPROVEMENTS ON ON-VEHICULAR EASEMENTS UNTIL A HOME OWNERS ASSOCIATION ASSUMES RESPONSIBILITY FOR MAINTENANCE.
2. PRIVATE DRIVEWAYS SHALL NOT BE PERMITTED ACCESS TO FAIRPLAY DRIVE OR HIGBY ROAD.
3. THE WOODMOOR CORPORATION WILL MAINTAIN MEDIAN STRIPS IN THE ROAD RIGHTS OF WAYS UNTIL MAINTENANCE IS ASSUMED BY THE HOME OWNERS ASSOCIATION.

I, THOMAS J. RUSSELL, COUNTY ENGINEER, EL PASO COUNTY, COLORADO, DO HEREBY APPROVE THE ACCOMPANYING PLAT AS TO DRAINAGE OF THE STREETS AS SHOWN HEREON.

COUNTY ENGINEER

APPROVED BY THE EL PASO COUNTY PLANNING COMMISSION THIS 9th DAY OF August, 1972. A.D.

CHAIRMAN

APPROVED BY THE EL PASO COUNTY PLANNING DEPARTMENT THIS 22 DAY OF August, 1972, A.D.

CERTIFICATION:

THE UNDERSIGNED REGISTERED LAND SURVEYOR IN THE STATE OF COLORADO DOES HEREBY CERTIFY THAT THE ACCOMPANYING PLAT WAS CALCULATED AND PREPARED UNDER HIS SUPERVISION IN ACCORDANCE WITH CHAPER 136 OF THE COLORADO REVISED STATUTES, AS AMENDED JULY 1, 1968, AND THAT SAID PLAT DOES ACCURATELY SHOW THE DESCRIBED TRACT OF LAND AND THE SUBDIVISION THEREOF TO THE BEST OF HIS KNOWLEDGE AND BELIEF.

Gerald B. McRae
REGISTERED LAND SURVEYOR
STATE OF COLORADO, 6616

NOTES:

WATER AND SANITATION TO BE PROVIDED BY THE WOODMOOR WATER AND SANITATION DISTRICT.

UTILITY AND DRAINAGE EASEMENTS -- ALL SIDE AND REAR LOT LINES ARE SUBJECT TO A 16-FOOT EASEMENT, LYING 8 FEET ON EITHER SIDE OF LOT LINES AND 16 FEET ALONG AND ADJACENT TO ALL BOUNDARY LINES, EXCEPT THOSE SIDE LOT LINES ADJACENT TO PUBLIC STREETS.

● DESIGNATES BOUNDARY MONUMENTS FOUND--
1/2" REBAR WITH PLASTIC CAP STAMPED "N.H.P.Q. -2682"

◎ DESIGNATES BOUNDARY MONUMENTS SET--
1/2" REBAR WITH PLASTIC CAP STAMPED "N.H.P.Q. -2682"

STATE OF COLORADO
COUNTY OF EL PASO

I HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED FOR RECORD IN MY OFFICE AT 3:36 O'CLOCK P M., THIS 23rd DAY OF August, 1972, A.D. AND IS DULY RECORDED IN PLAT BOOK U-2 AT PAGE 26 OF THE RECORDS OF EL PASO COUNTY, COLORADO.

RECEPTION NO: 912153

FEE: $10.00

HARRIET BEALS, RECORDER
BY: Dorothy Rosamond
DEPUTY

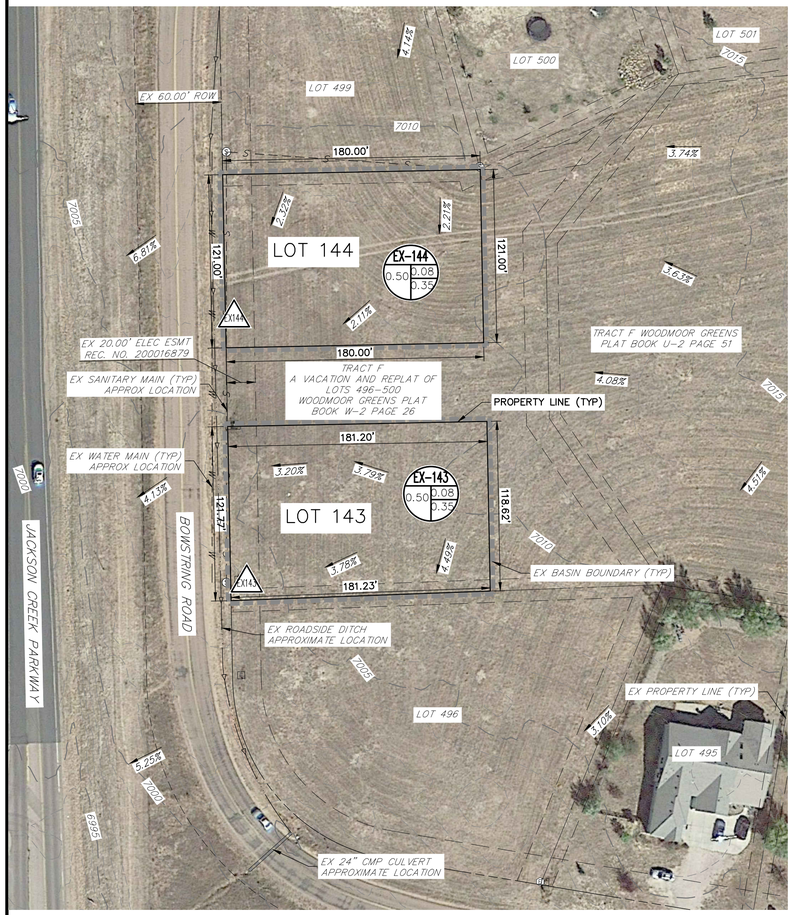
APPROVED BY THE EL PASO COUNTY BOARD OF COMMISSIONERS THIS 14th DAY OF August, 1972 A.D.

CHAIRMAN

Appendix E
Drainage Maps

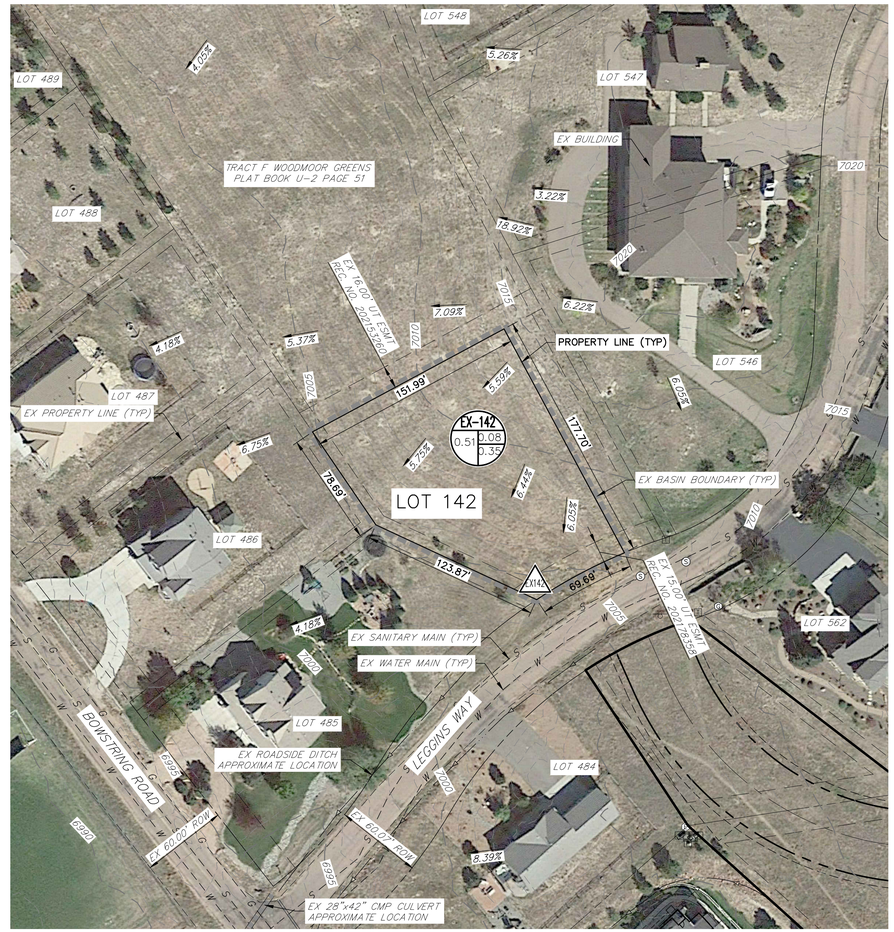
CLOVERLEAF FILING NO. 1

EXISTING DRAINAGE MAP



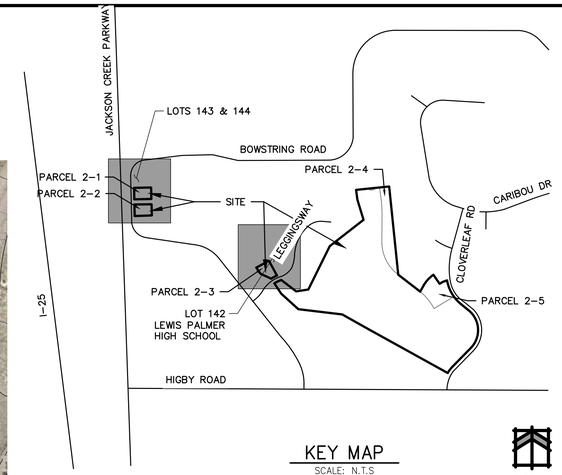
LOTS 143 & 144

0.50 AC EACH



LOT 142

0.51 AC



KEY MAP

SCALE: N.T.S

NORTH
Not to Scale

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-142	0.5	0%	0.08	0.35	14.8	0.1	1.1
EX-143	0.5	0%	0.08	0.35	17.4	0.1	0.9
EX-144	0.5	0%	0.08	0.35	23.0	0.1	0.9

DESIGN POINT SUMMARY TABLE		
DP	Q5	Q100
EX142	0.1	1.1
EX143	0.1	0.9
EX144	0.1	0.9

LAYER LINETYPE LEGEND

EXISTING

BOUNDARY LINE
PROPERTY LINE
EASEMENT LINE
RIGHT OF WAY
CENTERLINE
STORM SEWER
SWALE/WATERWAY FLOWLINE
INDEX CONTOUR (6100)
INTERMEDIATE CONTOUR
DEPRESSION CONT. (INDEX) (6100)
DEPRESSION CONT. (INTER)
CURB & GUTTER
SUB-BASIN DRAINAGE AREA

BASIN TAG: BASIN ID (A), AREA [AC] (4.1), C_5 (0.47), C_{100} (0.62)

DESIGN POINT DESIGNATION (1)

FLOW DIRECTION (PROPOSED)
FLOW DIRECTION (EXISTING)

ISOLATED LOTS PRELIMINARY GRADING & UTILITY NOTES

1. PROPOSED LOT GRADING IS NOT SHOWN ON THESE PLANS AND WILL ROUTE STORMWATER RUNOFF FROM EACH LOT TO THE PROPOSED SAND FILTER ON EACH LOT.
2. PROPOSED WATER AND SANITARY SERVICES ARE NOT SHOWN ON THESE PLANS AND WILL CONNECT TO THE EXISTING PUBLIC MAINS WITHIN THE ADJACENT ROADWAY.

N

50 25 0 50

ORIGINAL SCALE: 1" = 50'

Know what's below. Call before you dig.

PREPARED FOR
PT CLOVERLEAF, LLC
1864 WOODMOOR DRIVE, SUITE 100
COLORADO SPRINGS, CO 80920
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Fort Collins 970-491-9888 • www.jrengineering.com

No.	REVISION	BY	DATE

H-SCALE	1"=50'
V-SCALE	N/A
DATE	12/01/20
DESIGNED BY	RPD
DRAWN BY	RPD
CHECKED BY	

CLOVERLEAF FILING NO. 1

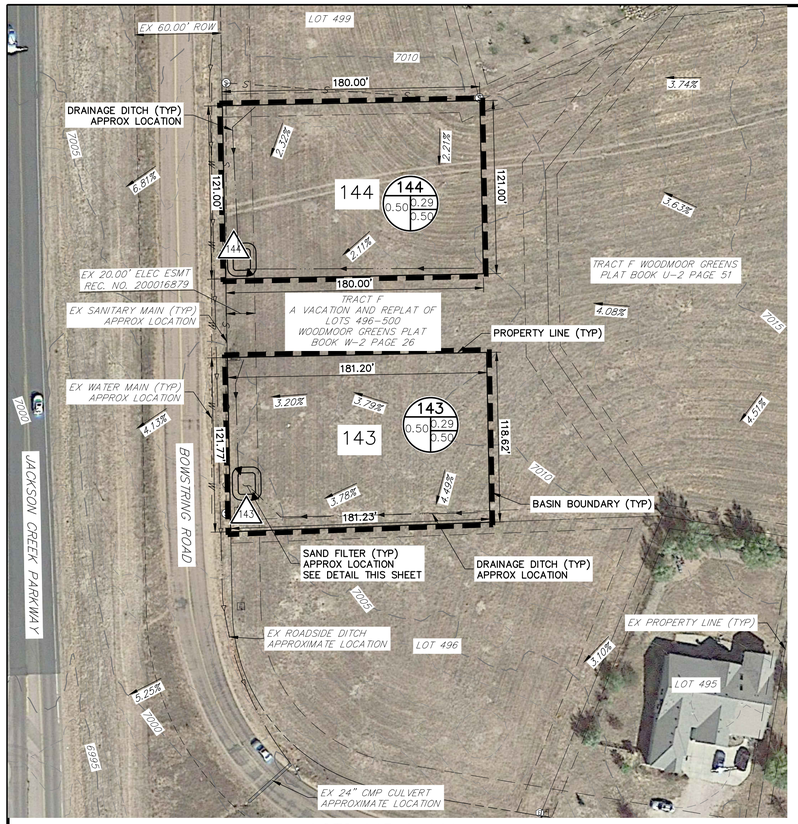
EXISTING DRAINAGE MAP

SHEET 1 OF 1

JOB NO. 25158.01

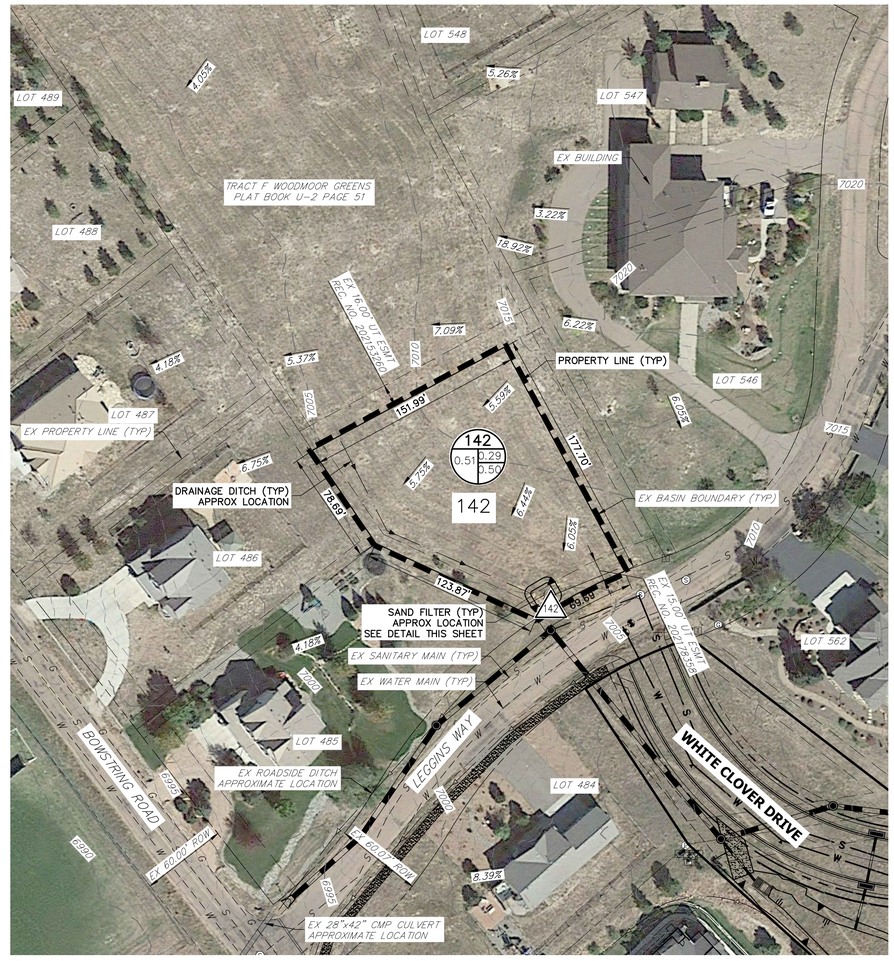
CLOVERLEAF FILING NO. 1

PROPOSED DRAINAGE MAP



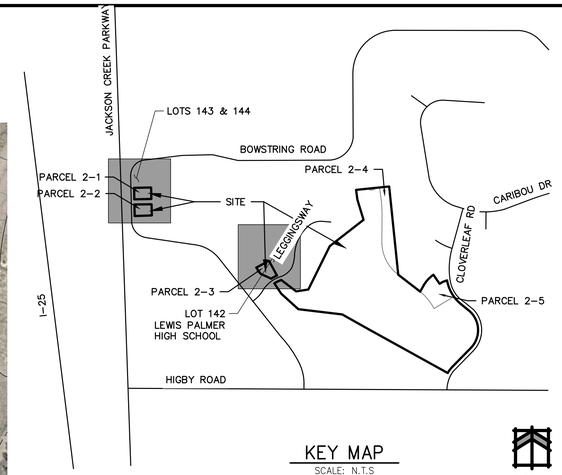
LOTS 143 & 144

0.50 AC EACH



LOT 142

0.51 AC



KEY MAP

SCALE: N.T.S

NORTH
Not to Scale

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
142	0.51	25%	0.29	0.50	11.9	0.5	1.6
143	0.50	25%	0.29	0.50	13.9	0.5	1.5
144	0.50	25%	0.29	0.50	18.4	0.5	1.3

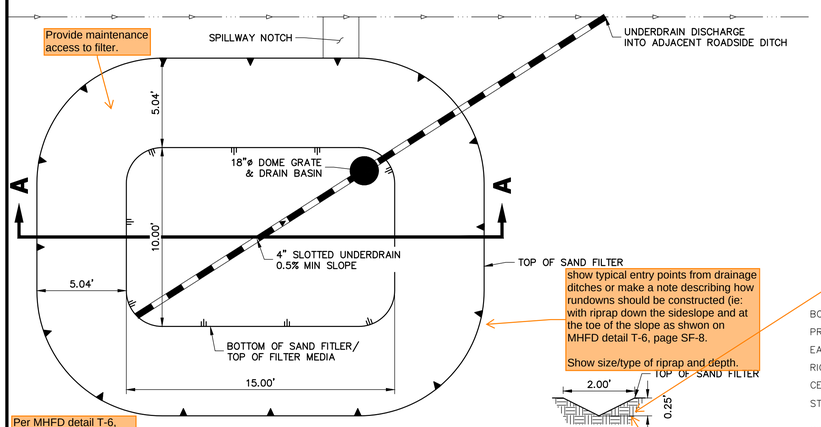
DESIGN POINT SUMMARY TABLE		
DP	Q5	Q100
142	0.5	1.6
143	0.5	1.5
144	0.5	1.3

We suggest that you consider using runoff reduction methods instead of sand filters for these 3 lots. Sand filters are commonly constructed incorrectly by builders and also homeowners are likely to not understand how to properly maintain them. Hence, there is a high likelihood of the sand filters not functioning as intended in this case. Ideally doing runoff reduction will be cheaper and easier to install and maintain than a sand filter.

For an example of acceptable calcs, see the "Runoff Reduction" tab on the UD-BMP_v3.07 spreadsheet that can be downloaded here: https://mhfd.org/resources/software/

And an example drainage map that properly shows a breakdown on runoff reduction calcs is shown to the right:

Also note that:
Any green infrastructure that would be used to meet the runoff reduction requirements is required to be in a drainage easement. And a maintenance agreement would also be required

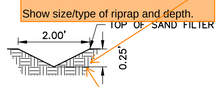


show typical entry points from drainage ditches or make a note describing how rundowns should be constructed (ie: with riprap down the sideslope and at the toe of the slope as shwon on MHFD detail T-6, page SF-8.

Show size/type of riprap and depth.

SAND FILTER – PLAN VIEW

SCALE: N.T.S.



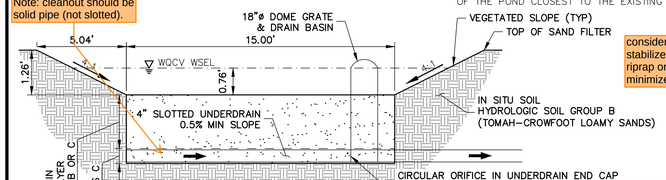
SAND FILTER – SPILLWAY NOTCH

SCALE: N.T.S.

NOTE: SPILLWAY NOTCH IS TO BE LOCATED ON THE SIDE OF THE POND CLOSEST TO THE EXISTING ROADSIDE DITCH.

Per MHFD detail T-6, page SF-8, show a cleanout with 45deg elbows and cap.

Note: cleanout should be solid pipe (not slotted).



consider making this a stabilized surface with riprap or soil riprap to minimize erosion.

According to MHFD UD-BMP spreadsheet, the minimum orifice diameter is 3/8". Revise accordingly.

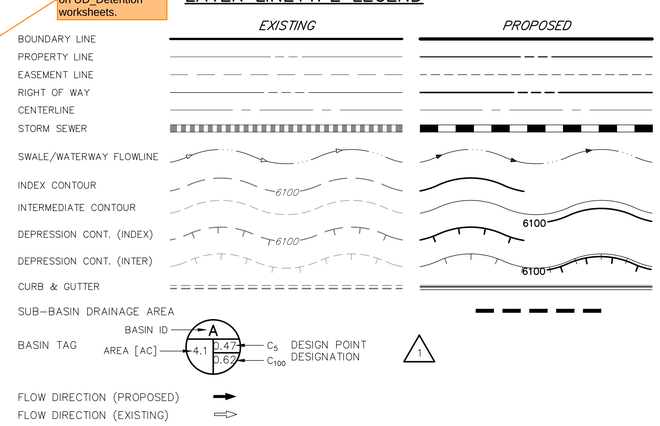
SAND FILTER – SECTION A–A

SCALE: N.T.S.

NOTE: SAND FILTERS SHALL FOLLOW THE "PARTIAL INFILTRATION SECTION" AS DESCRIBED IN THE URBAN STORM DRAINAGE CRITERIA MANUAL VOLUME 3, SPECIFICALLY PAGES SF-4 AND SF-8.

Show capacity calcs on UD_Detention worksheets.

LAYER LINETYPE LEGEND



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Reminder: Per the stormwater teams comment if runoff reduction is a viable alternative then plat note 11 for engineered site plan is no longer applicable and shall be removed.

50 25 0 50

ORIGINAL SCALE: 1" = 50'

Know what's below. Call before you dig.

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR
PT CLOVERLEAF, LLC
1864 WOODMOOR DRIVE, SUITE 100
COLORADO SPRINGS, CO 80920
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No.	REVISION	BY	DATE

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DATE	12/01/20
DESIGNED BY	RPD
DRAWN BY	RPD
CHECKED BY	

CLOVERLEAF FILING NO. 1

PROPOSED DRAINAGE MAP

SHEET 1 OF 1

JOB NO. 25158.01