PRELIMINARY/FINAL DRAINAGE REPORT

FOR

JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT

Prepared For:
Prairie Stone, LLC
9476 Dakota Dunes Lane
Peyton, CO 80831-4138

Prepared By:
Associated Design Professionals, Inc.
3520 Austin Bluffs Parkway
Colorado Springs, CO 80918
719.266-5212

ADP Project No.160301
July 25, 2018

PCD Project #PPR-16-040

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ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports, and said report is in conformity with the 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.

_____
Michael A. Bartusek, P.E. #23329

DEVELOPER'S STATEMENT:
I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

By: _____
Andrea Minnich

Title: President

Address: Prairie Stone, LLC
9476 Dakota Dunes Lane
Peyton, CO 80831-4138

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

_____ _____
Jennifer Irvine, County Engineer/ECM Administrator Date

Conditions:

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PRELIMINARY/FINAL DRAINAGE REPORT
JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT

GENERAL

The Judge Orr Road RV Park & Storage project consists of 35.0 acres located along Judge Orr Road just east of US 24 and approximately two miles northeast of Falcon, Colorado. The project is located within the previously approved Meadowlake Commons Master Plan area. The site is further described as being located in central El Paso County within the Southwest Quarter of Section 33, Township 12 South, Range 64 West of the 6th Principal Meridian, El Paso County, Colorado.

The proposed development lies within the Haegler Ranch Drainage Basin Planning Study area, prepared by URS Corporation in 2007. It is also included in the Meadowlake Commons MDDP, prepared by Springs Engineering in 2008. For this report, the existing flows for this project utilize the findings of the Meadowlake Commons MDDP.

SOILS

The Soil Conservation Service (NRCS) soil survey for El Paso County has identified the soil type in this study area as follows:

Map Symbol No.	Soil Name	Hydrologic Soil Group
19	Columbine Gravelly Sandy Loam	A

FLOODPLAIN STATEMENT

A small portion of the site is located within a Zone A floodplain as determined by FEMA on the Flood Insurance Rate Map (FIRM) Panel 08041CO575F, dated March 17, 1997.

METHOD OF COMPUTATION

The methodology used for this report is in accordance with the *City/County Drainage Criteria Manual*. The Rational Method for computation of runoff was used for local basin design.

$$Q = cia$$

Where	Q	=	Maximum rate of runoff in cubic feet per second
	c	=	Runoff coefficient representing drainage area characteristics
	i	=	Average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
	a	=	Drainage basin size in acres

The overall drainage for the area including off-site flows was calculated using the US Army Corp of Engineers Hydrologic Engineering Center – Hydrologic Modeling System, Version 3.1.0 (HEC-HMS). The Soil Conservation Service (SCS) (since renamed National Resources Conservation Service - NRCS) curve number method was selected for calculating the runoff volumes from the drainage basins per the DCM. Runoff rates for the five-year minor storm and 100-year major design storm were calculated.

Times of concentration were estimated using the SCS procedures described in the DCM based upon the hydrologic soil type, the natural conditions found in the basins and the runoff curve numbers (CN) chart from Table 5-4 of the DCM.

The 100-year, 24-hour storm precipitation selected from the NOAA isopluvial map in Figure 5-4e from the DCM was 4.6 inches. The ten-year, 24-hour storm precipitation selected from the rainfall depth-duration relationship chart in Figure 5-6 from the DCM was 3.1 inches. The five-year, 24-hour storm precipitation was derived from Figure 5-6 of the *City/County Drainage Criteria Manual.* The calculated rainfall amount was 2.6 inches. These numbers, along with SCS information, were used as input.

WATER QUALITY/DETENTION CONCEPTS

In accordance with current NPDES requirements, stormwater quality BMPs will be incorporated into the development of this project. Water quality facilities will be included in all proposed full spectrum detention facilities.

EXISTING DRAINAGE CONDITIONS

The existing site is only minimally developed with some gravel roads and two existing structures. The site is covered with Rangeland grasses and generally drains to the southeast at an average slope of three percent. An existing channel and a Zone A floodplain exist within the far northeastern corner of the project area. An existing, broad swale bisects the site and travels through an abandoned stock pond prior to exiting the site. All flows from Judge Orr Road are intercepted by a roadside ditch which continues past the site to the east.

There are currently two culvert crossings running under US 24. One crossing is a 24-inch CMP culvert located approximately 1,000 feet northeast of the US 24/Judge Orr Road intersection. This pipe is estimated to accommodate flows of 12.9 cfs for the five-year storm and 54.1 cfs for the 100-year storm. The second crossing consists of twin 54-inch CMP culverts. These pipes are located approximately 2,900 ft northeast of the intersection. The twin culverts carry offsite flows of 44.2 cfs for the five-year storm and 192.7 cfs for the 100-year storm and enter the project in the northeast corner, enter the existing channel located in the far northeast corner of the site and cross the property north of the project site.

The existing area located northwest of the parcel is designated as Sub-Basin OS1. This sub-basin drains existing pasture land and produces flows of 1.7 cfs for the 5-year storm and 12.9cfs for the 100-year storm. These flows are intercepted by an existing ditch which carries the flows south along the property line to a low point from Sub-Basin OS2.

Sub-Basin OS2 drains the area just west of the parcel. This area is currently vacant and produces flows of 3.6 cfs and 27.1 cfs respectively. These flows combine with the flows from Sub-Basin OS1 at DP1 for total flows of 4.8 cfs for the 5-year storm and 36.7 cfs for the 100-year storm. These flows travel east through a broad swale located in Sub-Basin A2 and into an existing stock pond.

Sub-Basin A1 drains the northeastern portion of the site. It is currently vacant and covered with rangeland grasses. This sub-basin produces flows of 2.2 cfs for the 5-year storm and 16.5 cfs for the 100-year storm. These flows leave the site in a southeasterly direction approximately 600 ft north of the main channel. These flows eventually join the main channel about 500 ft east of the site.

Sub-Basin A2 drains the major portion of the site and contains the stock pond and farm residence. The site also contains an existing stock pond which has been breached and is covered with rangeland grasses. This sub-basin produces flows of 3.1 cfs and 24.0 cfs respectively. These flows combine with the flows from DP1 at DP2 to produce total flows of 6.6 cfs for the 5-

year storm and 50.1 cfs for the 100-year storm. These flows leave the site in the southeast area of the site.

Sub-Basin OS3 drains an area west of SH24 and drains to the east into Sub-Basin OS4 through a 24" CMP. This area is currently zoned A-35 and is primarily open range. This sub-basin produces flows of 17.8 cfs and 62.0 cfs respectively.

Sub-Basin OS4 drains an area west of the parcel. The area is vacant and covered with rangeland grasses. It slopes to the southeast and flows east along Judge Orr Road. It produces flows of 4.0 cfs and 30.4 cfs respectively. These flows combine with the flows from OS3 at DP3 to produce flows of 20.1 cfs for the 5-year storm and 86.7 cfs for the 100-year storm.

Sub-Basin A3 drains the southern area of the site and is mostly vacant with a barn and some gravel drives located in the western portion of the site. It produces flows of 1.1 cfs and 5.3 cfs respectively and drains into the roadside ditch. OS5 drains the area between the property line and the center line of Judge Orr Road. This area produces flows of 1.3 and 3.3 respectively, and combines with the flows from A3 at DP4 within the Judge Orr roadside ditch to produce total flows of 2.0 cfs for the 5-year storm and 7.6 cfs for the 100-year storm. These flows combine with the flows from DP3 at DP5 to produce total flows of 18.9 cfs for the 5-year storm and 80.7 cfs for the 100-year storm within the roadside ditch. These flows leave the site in a northeasterly direction and join with the main channel about 300 ft east of the property. These flows eventually combine with the flows from DP2 and Sub-Basin A1 at DP6 to produce total flows in the main channel of 27.1 cfs for the 5-year storm and 143.3 cfs for the 100-year storm.

Sub-Basin B drains a small portion of the site in the northern corner. It produces flows of 0.2 cfs for the 5-year storm and 1.6 cfs for the 100-year storm.

The estimated runoff amounts produced for the project under existing conditions are shown in Table 1 below.

Update the narrative based on the meeting on 8/8/18

TABLE 1 – EXISTING CONDITIONS

Sub-Basin	Q_5 CFS	Q_{100} CFS
OS1	1.7	12.9
OS2	3.6	27.1
OS3	17.8	62.0
OS4	4.0	30.4
OS5	1.3	3.3
A1	2.2	16.5
A2	3.1	24.0
A3	1.1	5.3
B	0.2	1.6
DP1 (OS1 + OS2)	4.8	36.7
DP2 (DP1 + A2)	6.6	50.1
DP3 (OS3 + OS4)	20.1	86.7
DP4 (OS5 + A3)	2.0	7.6
DP5 (DP3 + DP4)	18.9	80.7
DP6 (DP2 + DP4 + A1)	27.1	143.3

1. The flow rate does not match the drainage map. Verify the values for all the other basins.

Provide additional detail on the narrative regarding Basin B. The proposed condition has increased the area and flow draining into the existing channel and untreated developed flow is now draining onto the existing channel.

8/8/18 - This is to avoid confusion in the future since it is for conveying offsite flow across the property. When this property is platted, then this stormline must be located in a drainage easement.

Unresolved
08/08/2018

State in the narrative who own/maintain this stormline.

DEVELOPED DRAINAGE CONDITIONS

The development of the site will include an RV storage area in the northern portion of the site with RV pads located in the southern portion of the site. The northern area will be covered by 4 inches of loose gravel. The southern area will have 120 gravel RV pad sites with asphalt roads connecting the sites and vegetated areas between the pads.

Flows from the off-site area will remain the same as delineated in the existing conditions portion of the report.

Existing historic flows from the property to the west will be transported through the site by way of a 36" HDPE storm sewer. The proposed 36" HDPE storm sewer will be located near the west property line to facilitate the connection from a future detention facility once the property to the west has been developed. This design has been coordinated with the current property owner, as has the proposed swale within the west property. OS1 will flow down the existing swale on the west property and into a 4' wide swale which connects into the 36" HDPE storm sewer that flows into the detention basin. In the future a new detention pond will replace the swale and will tie directly into the 36" HDPE private storm sewer. A conceptual 4.6 acre foot pond (Pond 1) was calculated for the future neighborhood commercial site with an estimated outflow of 0.1 cfs for the 5-year storm and 57.3 cfs for the 100-year storm.

Sub-Basin A1 will drain the northern part of the site. This area will be used for RV storage and will be covered by 4 inches of loose gravel. This area will produce flows of 17.2 cfs and 36.5 cfs for the five- and 100-year storm. A 12" berm will keep the flows within the sub-basin. The flows will travel along the berm to the south and ditch where it will produce flow into a ditch which will take the flows into Pond 2.

Update the narrative and discuss in detail the plans to construct the north-south road to County standard to include the intended phasing plan.

Since the intent is to construct to county standard section for future dedication, clearly describe the intent of the runoff conveyance with regards to the future road. Also, provide the drainage analysis for the roadway (street capacity, etc.).

Finally, submit street construction plans for the road and roundabout being constructed.

Sub-Basin A2 drains the area between the property line and the centerline of Judge Orr Road. This area will be developed for RV pad sites and will produce flows of 0.9 cfs and 2.2 cfs respectively. These flows will be intercepted by two (2) type C inlets and routed via the proposed 36" HDPE private storm sewer. These flows will combine with the flows from DP1 at DP2 to produce total flows of 5.1 cfs for the 5-year storm and 69.1 cfs for the 100-year storm which will flow directly into Pond 2.

Sub-Basin A3 drains the southern part of the developed parcel. This area will be developed as an RV park with gravel parking areas for RV's in two phases. However this report is developed for final buildout. This area will have asphalt roads with natural grass areas between the parking pads. Flows will travel to the southeast and be intercepted by a main road and transported into the detention basin. It will produce flows of 13.7 cfs and 37.2 cfs respectively. These flows will combine with the flows from Sub-Basin A1 at DP3 to produce total flows into the detention basin of 25.4 cfs and 61.9 cfs respectively. The total flows into the basin at DP4 will be 20.1 cfs for the 5-year storm and 103.3 cfs for the 100-year storm. The proposed 2.71 AF detention basin will release these flows through an outlet structure with a 30 inch HDPE pipe at a rate of 0.5 cfs for the 5-year storm and 23.7 cfs for the 100-year storm.

Sub-Basin A4 drains the southernmost area of the site. This area contains a proposed cinder trail and 75 ft future Judge Orr Road right-of-way. This area will produce flows of 0.4 cfs and 2.9 cfs respectively. OS5 drains the area between the property line and the centerline of Judge Orr Road. This area produces flows of 1.0 cfs and 2.6 cfs respectively and combines with the flows from A3 at DP6 to produce total flows of 1.0 cfs for the 5-year storm and 4.6 cfs for the 100-year storm. These flows will combine with the off-site flows from DP6 at DP7 to produce total flows in this area of 16.3 cfs for the 5-year storm and 60.1 cfs for the 100-year storm. These flows will

Unresolved
08/08/2018

8/8/18 - Based on the re-submittal, the intent is to construct the site in two phases. Table 2 notes flows based on Phase 1 developed condition. Does this mean the pond design will need to be retrofitted with phase 2? Include a narrative in the Detention section to categorically state whether or not Pond 2 is designed and constructed for the built out condition or a retrofit will be required with phase 2 to be provided with an updated drainage report.

combine with the detained flows at DP8 to produce total flows of 16.6 cfs for the 5-year storm and 91.1 cfs for the 100-year storm.

Remove "Phase 1"

Sub-Basin B in the northeastern portion of the site will contain a landscaped area and produce flows of 0.3 cfs for the 5-year storm and 2.3 cfs for the 100-year storm.

Table 2 shows the estimated runoff which will be produced for the project under developed conditions.

TABLE 2 – PHASE I DEVELOPED CONDITIONS		
Sub-Basin	**Q_5CFS**	**Q_{100} CFS**
OS1	1.7	12.9
OS2	7.2	54.9
OS3	17.8	62.0
OS4	0.8	5.9
OS5	1.0	2.6
A1	17.2	36.5
A2	6.5	17.6
A3	13.7	37.2
A4	0.4	2.9
B	0.3	2.3
DP1 (OS1+OS2)	8.5	65.0
DPD1 (Detained DP1)	0.1	57.3
DP2 (DPD1 + A2)	5.1	69.1
DP3 (A1 + A3)	25.4	61.9
DP4 (DP2 + DP3)	20.2	103.3
DPD2 (Detained DP2)	0.5	40.6
DP5 (OS3+OS4)	16.3	59.6
DP6 (A3+OS5)	1.0	4.6
DP7 (DP4+DP5)	16.3	60.1
DP8 (DPD2+DP6)	16.6	91.1

WATER QUALITY

The water quality basin for this project is incorporated with the detention basin for this project and is designed with current NPDES requirements as provided by the El Paso County Drainage Criteria Manual as amended for an EDB. The required water quality capture volume is 0.501 AC-FT. The basin will be constructed with a 2.5-foot permanent micro-pool and a forebay. Design forms for this basin can be found in Appendix B. The design summary is below.

TABLE 3 –WATER QUALITY DESIGN SUMMARY				
Location	**Depth**	**Size (CF)**	**Depth (FT)**	**Size (IN)**
Pond 2	3.38	21,824	0,1.88,3.76	1.75,1.75,1.75

DETENTION

Developed flows from this project will be reduced to historic levels by using a privately owned and maintained detention facility. The *UDFCD Design for Full Spectrum Detention Basins* is used for the basin. Since a neighborhood commercial development is proposed for the property to the west, a conceptual detention basin was designed for the area and routed through the on-site

detention basin for the RV development with the ponds designed in series. The outflow hydrograph from the commercial site (Pond 1) which was designed to produce flows that matched the current historic rates was manually added to the inflow hydrograph for the RV development (Pond 2) and routed through a third spreadsheet (Pond 1 + 2) to produce new detention basin design.

TABLE 4
DETENTION BASIN DETAILS

Location	Size (AF)	Pipe Outlet	Outlet Structure	Riprap Weir Width
2	2.711	30"	Typical Outlet Structure OS-2	40'

Flows from the detention basin drain into a broad grasses swale. The swale is located within an existing pasture area with an existing slope of approximately 1.7%. It has an average bottom width of 8 ft. with 8:1 side slopes. The detention basin outflow of 33.7 cfs will only produce a flow depth of 0.8 ft. and a velocity of 3.2 fps. Once the Judge Orr ditch flows combine with the detained flows, the 91.5 cfs, approximately 300 ft. east of the project, will produce a flow depth of 1.2 ft and a velocity of 4.10 fps. There are no downstream manmade drainage systems in the area to tie into.

Should a 20 ft. breach occur in the detention embankment, the outflow would be approximately 500 cfs and would produce an initial wave of approximately 2.7 ft. and a velocity of 6.8 fps. This wave would dissipate within the 850 ft. prior to flows crossing Judge Orr Road. No structures exist prior to this crossing.

PRIVATE DRAINAGE FACILITIES

Item	Unit	Quantity	Unit Cost	Total Cost
30" RCP FES	EA	1	$750	$ 750.00
36" HDPE FES	EA	2	$800	$ 1,600.00
38" x 24" RCEP FES	EA	4	$700	$ 2,800.00
30" RCP	LF	20	$101	$ 2,020.00
36" HDPE	LF	1,250	$124	$155,000.00
38" x 24" RCEP	LF	120	$94	$ 11,280.00
Detention Outlet Structure	EA	1	$5,000	$ 5,000.00
Emergency Spillway	EA	1	$1,500	$ 1,500.00
Storm Manhole				

Unresolved
08/08/2018

State what the percent impervious is based on the proposed site development plan. This number is likely to be used in calculating the fee instead of the typical values listed in ECM Appendix L Table 3-1 which is 95% for commercial.

DRAINAGE BASIN FEES

The entire project lies within the Haegler Ranch Drainage Basin. However, the parcel is not being platted at this time, so no fees are due. In the future when this site is platted the drainage and bridge fees will be determined based on the percent of imperviousness of the platted subdivision.

CONCLUSION

The proposed development and subsequent lot developments follow the "Four Step Process" as mandated by the EPA as follows:

Step 1: Runoff Reduction Practices

Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.

Step 2: Stabilize drainage ways

All drainageways, ditches and channels have been stabilized by the following methods:

- Tributaries have been left in their relatively natural state where possible.
- New drainageways and swales have been stabilized with either riprap or erosion control fabric depending on the erosion potential.
- No new roadside ditches are proposed for the development.

Step 3: Estimate of disturbed area

The proposed development will disturb approximately 35 acres.

Step 4: Sites tributary to sensitive waters

The development of this project will not affect sensitive waters. The site is tributary to a grassland swale with no constant flow.

The development of this site will not impact the downstream properties due to the construction of the water quality/detention basin which reduces tributary flows below historic levels.

Type the headers for each step. (See ECM Appendix I page I-21). The explanation for how step 3 & 4 were considered does not match the Counties criteria.

Unresolved
08/08/2018

8/8/18
Step 3: Provide Water Quality Capture Volume (WQCV)
Step 4: Consider Need for Industrial and Commercial BMPs

REFERENCES

1. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume 1*** (DCM).

2. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume II*** (DCM).

3. Soil Survey of El Paso County Area, Colorado by USDA, NRCS.

4. ***El Paso County (January 2006) Engineering Criteria Manual.***

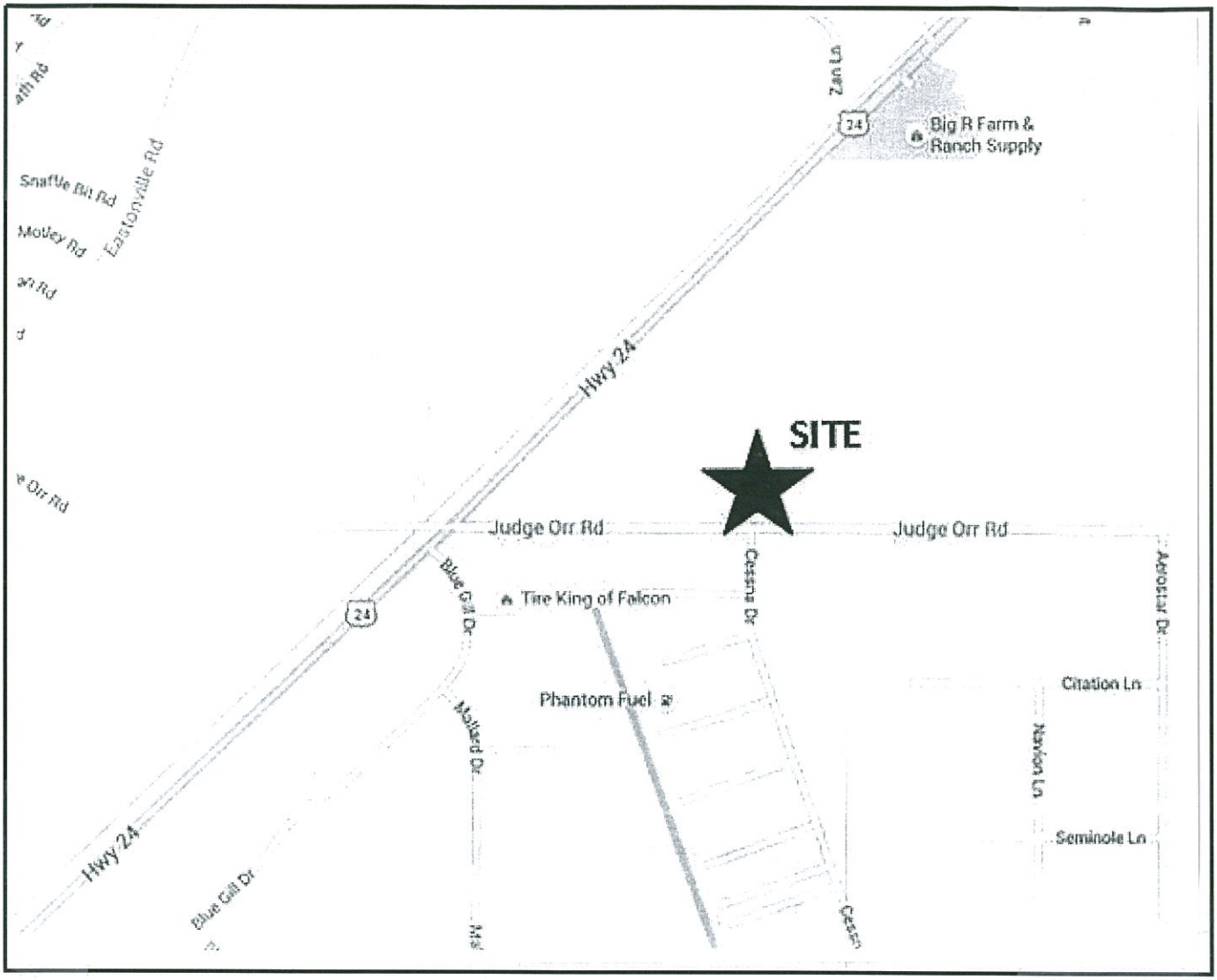
5. Urban Drainage and Flood Control District (June 2011). ***Urban Storm Drainage Criteria Manual, Volume 1-3.***

6. Meadowlake Commons MDDP by Springs Engineering, dated July, 2008.

7. Heagler DBPS by URS Corporation dated July, 2007.

APPENDIX A

MAPS



VICINITY MAP

N.T.S.

ADP CIVIL
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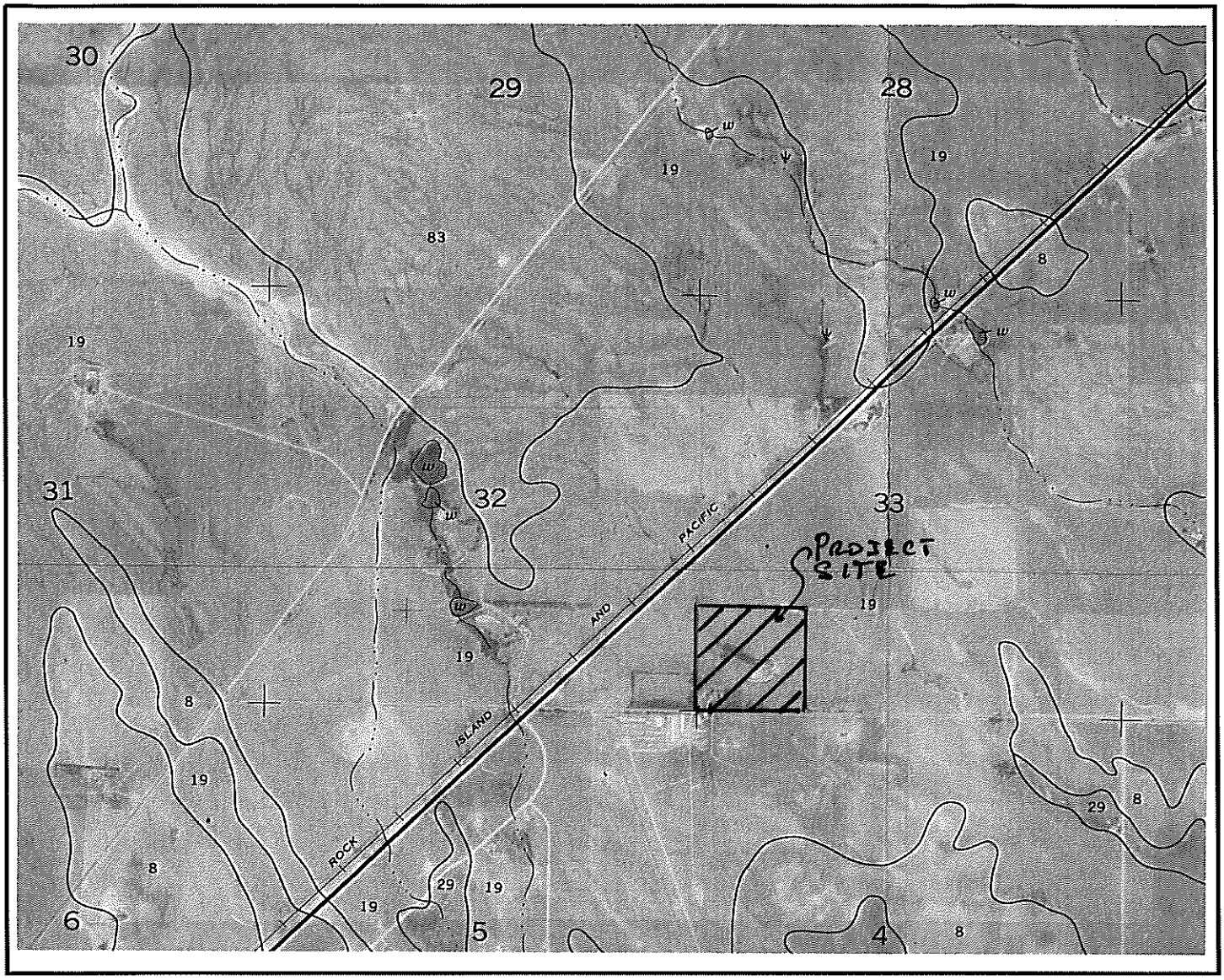
3520 Austin Bluffs Pkwy, Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341



SOILS MAP

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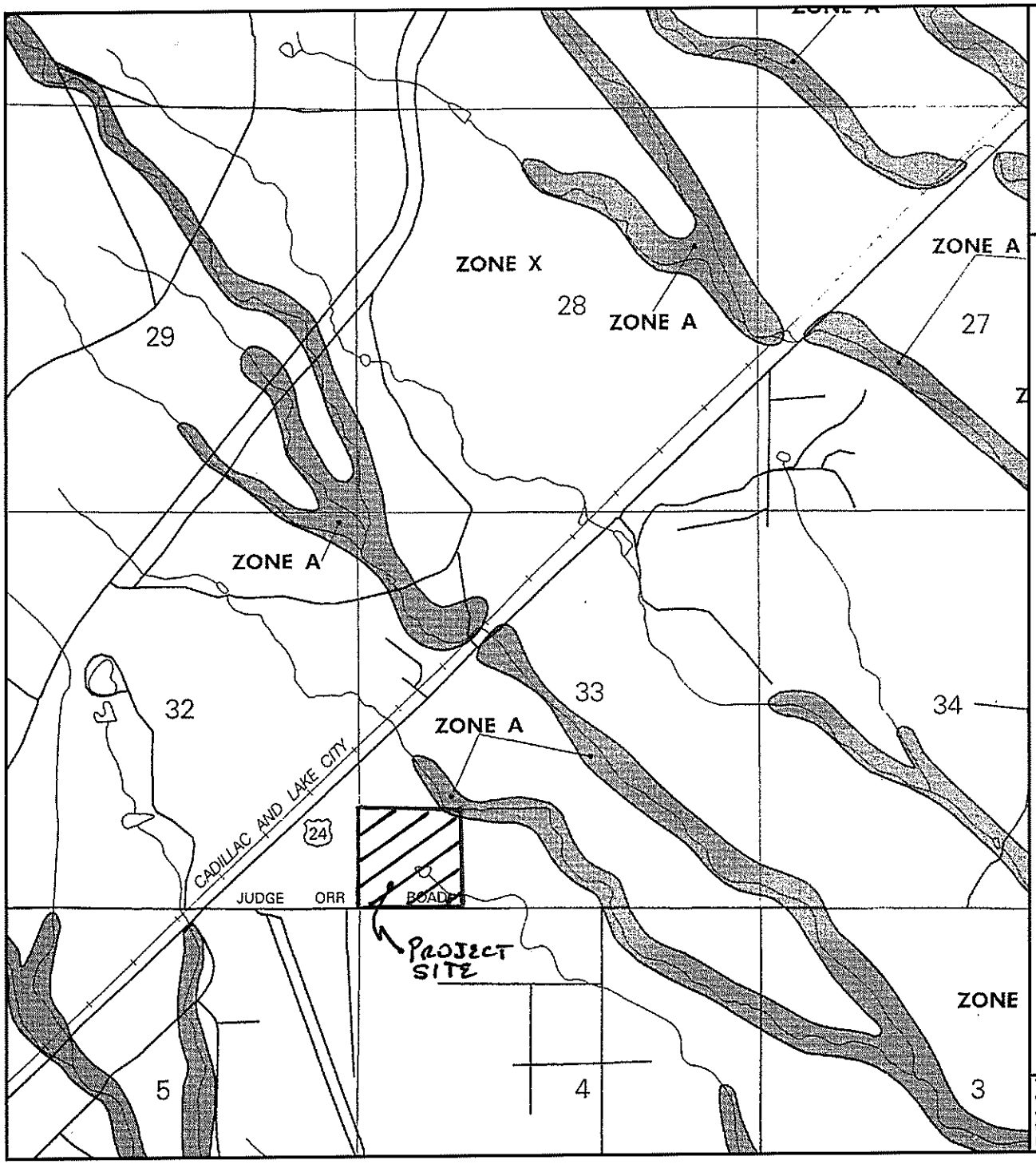
ADP CIVIL
ENGINEERING FOR THE FUTURE

3520 Austin Bluffs Pkwy, Suite 200
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 575 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0575	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0575	F

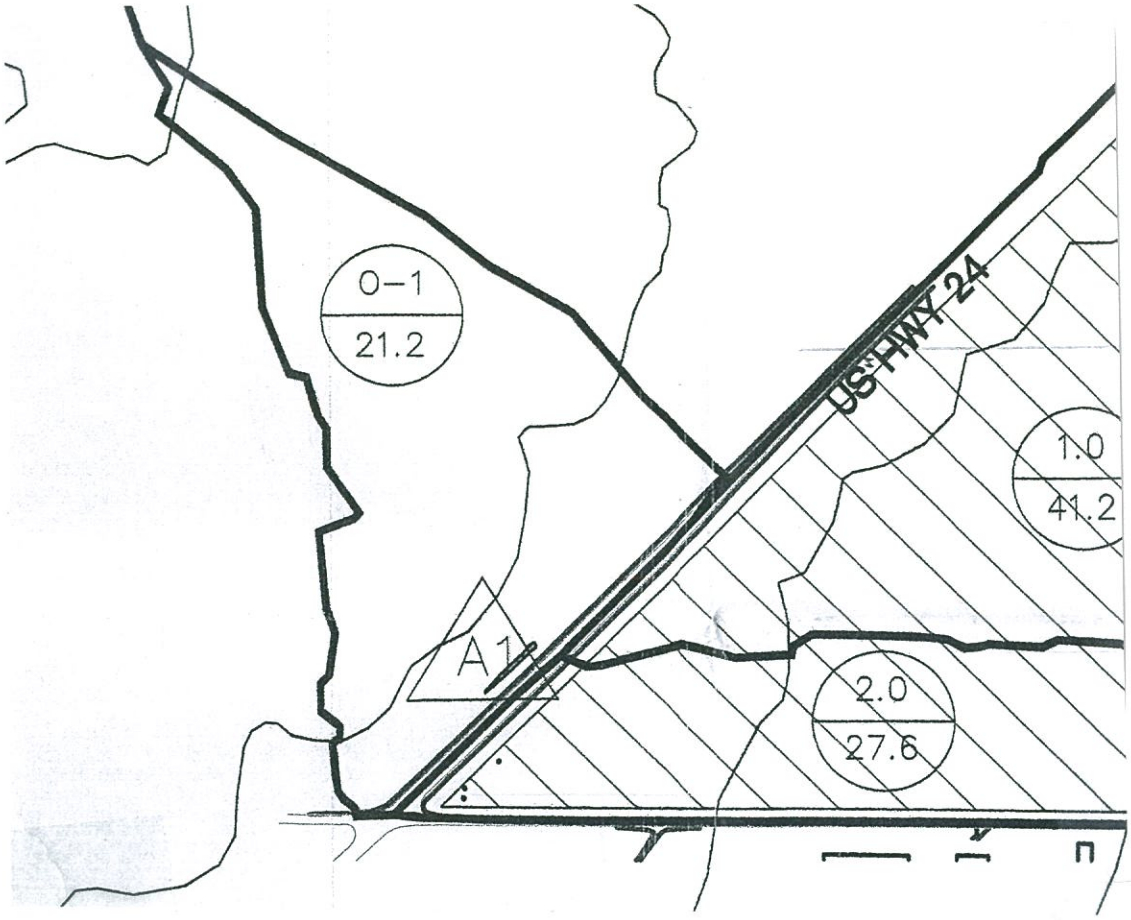
MAP NUMBER
08041C0575 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX B

DESIGN CALCULATIONS



NOTE: SUBBASIN O-1* RENAMED AS SUBBASIN OS3 IN THIS REPORT

*** FROM MEADOWLAKE COMMONS MDDP BY SPRINGS ENGINEERING, DATED JULY 2008**

N

OFFSITE DRAINAGE MAP

SCALE: 1" = 500'

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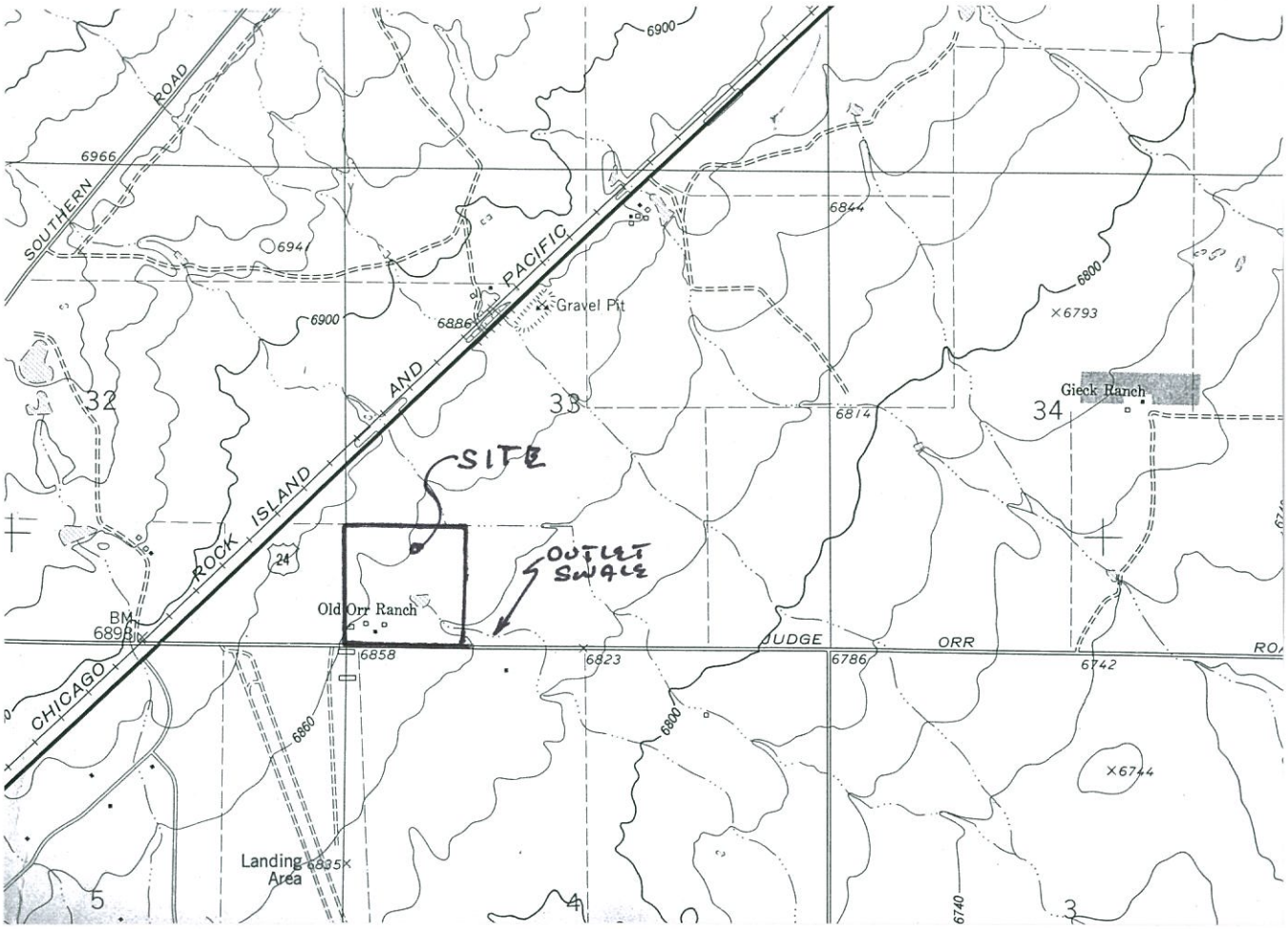
ENGINEERING FOR THE FUTURE

3520 Austin Bluffs Pkwy, Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341



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OFFSITE DRAINAGE MAP

SCALE; 1'=2000'

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3520 Austin Bluffs Pkwy, Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341

Unresolved
08/08/2018

JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT

C FACTOR CALCULATION SHEET

Include Basins B, OS4, OS5, OS6

RUNOFF COEFICIENT

TYPE A/B SOILS

LAND USE	5 YR	100 YR	IMPERV. %
UNDEV	0.08	0.35	0
LOOSE GRAVEL	0.59	0.7	80
GRAVEL ROADS	0.59	0.7	80
GRAVEL RV PARKING PAD	0.59	0.7	80
PAVED ROADS/BUILDINGS	0.9	0.96	100

Historic Conditions

AREA DESIG.	TOTAL AREA (acre)	SURFACE CONDITION AREAS: GRASSED SURFACE	LOOSE GRAVEL	GRAVEL ROADS	BUILDINGS	CALCULATED C: 5 YR	100 YR
A1	11.75	11.75	0.00	0.00	0.00	**0.08**	**0.35**
A2	20.75	20.60	0.00	0.10	0.05	**0.08**	**0.35**
A3	4.36	3.91	0.00	0.35	0.10	**0.14**	**0.39**
	36.86	36.26	0.00	0.45	0.15	0.09	0.36
% Impervious		0%	80%	80%	100%		
Imp x A		0	0	0.36	0.15		
Total I x A	0.51						
Total Imp	0.51/36.86 = 1.4%						

Developed Conditions

AREA DESIG.	TOTAL AREA (acre)	SURFACE CONDITION AREAS: GRASSED SURFACE	LOOSE GRAVEL	GRAVEL RV PARKING	PAVED ROADS	CALCULATED C: 5 YR	100 YR
A1	8.30	0.45	7.85	0.00	0.00	**0.56**	**0.68**
A2	6.85	4.24	0.00	0.73	1.88	**0.36**	**0.55**
A3	15.20	9.38	0.00	1.62	4.20	**0.36**	**0.56**
Total @Pond	30.35	14.07	7.85	2.35	6.08		
A4	1.80	1.72	0.00	0.00	0.08	**0.08**	**0.38**

% Impervious		0%	80%	80%	100%		
Imp x A		0	6.28	1.88	6.08		
Total I x A	14.24						
Total Imp	14.24/30.35 = 46.9%						
Pond 1							
% Impervious							
	TOTAL	**GRASSED**	**NEIGHBORHOOD**				
	AREA	**SURFACE**	**COMMERCIAL**				
OS1	7.81	7.81					
OS2	42.70	1.65	41.05				
	50.51	9.46	41.05				
% Impervious		0%	70%				
Imp x A		0	28.74				
Total I x A	28.74						
Total Imp	28.74/50.51 = 56.9%						

JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT

PROJ. #160301

DRAINAGE CALCULATION SHEET

file:judge orr rvl dr

07/23/18

							Initial Tci			Travel Time								length	vel.		
AREA	AREA	C5	C100	C5 X A	C100 X A		Slope	ti		Slope	V	Tt	TC	I5	I100	Q5	Q100	L	V	^t	AREA
DESIG.	(acre)	(5 yr)	(100 yr)			L (ft)	(%)	(min)	L (ft)	(%)	(fps)	(min)	(min)	(in/hr	(in/hr	(cfs)	(cfs)	(feet)	(fps)	(min)	DESIG.
EXISTING CONDITIONS																					
A1	11.75	0.08	0.35	0.94	4.11	200	2.00	21.46	1150	1.90	2.10	9.13	30.59	2.29	4.00	2.15	16.47				A1
OS1	7.81	0.08	0.35	0.62	2.73	150	2.00	18.58	600	1.18	2.35	4.26	22.84	2.71	4.74	1.69	12.94	450	4.50	1.67	OS1
OS2	22.10	0.08	0.35	1.77	7.74	150	2.00	18.58	1400	1.20	1.20	19.44	38.03	2.01	3.51	3.55	27.11				OS2
DP1	29.91			2.39	10.47								38.03	2.01	3.51	4.80	36.69	1250	2.10	9.92	DP1
A2	17.47	0.08	0.35	1.40	6.11	250	3.20	20.55	1400	1.90	2.10	11.11	31.66	2.25	3.92	3.14	23.98				A2
DP2	47.38			3.79	16.58								47.95	1.73	3.02	6.56	50.12				DP2
OS3	27.21	0.30	0.60	8.16	16.33	250	2.00	18.82	1570	2.90	1.80	14.54	33.35	2.18	3.80	17.76	62.04	1800	4.00	7.50	OS3
OS4	25.14	0.08	0.35	2.01	8.80	250	2.00	23.99	1800	1.00	2.00	15.00	38.99	1.98	3.45	3.97	30.36				OS4
DP3	52.35			10.17	25.13								38.99	1.98	3.45	20.10	86.70	1050	2.25	7.78	DP3
A3	2.80	0.14	0.39	0.39	1.09	100	2.00	14.28	1050	1.23	2.25	7.78	22.06	2.76	4.83	1.08	5.27				A3
OS5	0.82	0.41	0.59	0.33	0.49	10	2.00	3.26	1050	1.23	2.25	7.78	11.03	3.88	6.78	1.30	3.30				OS5
DP4	3.62			0.73	1.58								22.06	2.76	4.83	2.01	7.62				DP4
DP5	55.97			10.90	26.70								47.95	1.73	3.02	18.86	80.71				DP5
DP6	115.10			15.63	47.40								47.95	1.73	3.02	27.05	143.26				DP6
B	0.87	0.08	0.35	0.07	0.30	80	2.00	13.57	650	1.30	2.30	4.71	18.28	3.05	5.34	0.21	1.62				B
DEVELOPED CONDITIONS																					
OS1	7.81	0.08	0.35	0.62	2.73	150	2.00	18.58	600	1.18	2.35	4.26	22.84	2.71	4.74	1.69	12.94	450	4.50	1.67	OS1
OS2	42.70	0.08	0.35	3.42	14.95	150	2.00	18.58	1200	1.20	1.20	16.67	35.25	2.10	3.67	7.19	54.91	1300	4.50	4.81	OS2
DP1	50.51			4.04	17.68								35.25	2.10	3.67	8.50	64.95	1020	5.00	3.40	DP1
DPD1	50.51			0.03	15.61	*Adjusted C Factor for Detention Basin							35.25	2.10	3.67	0.06	57.30	1158	10.00	1.93	DPD1
A2	6.85	0.36	0.56	2.47	3.84	100	2.00	11.01	950	1.50	1.20	13.19	24.20	2.62	4.58	6.47	17.59				A2
DP2	57.36			2.50	19.45								37.18	2.04	3.55	5.08	69.13				DP2
A1	8.30	0.56	0.68	4.65	5.64	100	2.00	8.03	1150	0.50	4.50	4.26	12.29	3.70	6.47	17.21	36.51				A1
A3	15.20	0.36	0.56	5.47	8.51	100	2.00	11.01	1100	1.50	1.20	15.28	26.29	2.50	4.37	13.71	37.24				A3
DP3	23.50			10.12	14.16								26.29	2.50	4.37	25.35	61.93	1020	5.00	3.40	DP3
DP4	80.86			10.15	29.77								38.65	1.99	3.47	20.16	103.28	150	5.00	0.50	DP4
DPD2	80.86			0.20	9.71	*Adjusted C Factor for Detention Basin							38.65	1.99	3.47	0.50	33.70				DPD2
OS3	27.21	0.30	0.60	8.16	16.33	250	2.00	18.82	1570	2.90	1.80	14.54	33.35	2.18	3.80	17.76	62.04	1800	4.00	7.50	OS3
OS4	4.18	0.08	0.35	0.33	1.46	100	2.00	15.17	1800	1.00	2.00	15.00	30.17	2.31	4.04	0.77	5.90				OS4
DP5	31.39			8.50	17.79								40.85	1.92	3.35	16.30	59.60	1020	5.00	3.40	DP5
A4	1.80	0.08	0.38	0.14	0.68	180	2.00	20.36	1050	1.23	2.25	7.78	28.14	2.41	4.21	0.35	2.88				A4
OS5	0.70	0.41	0.59	0.29	0.42	10	2.00	3.26	1300	1.23	2.25	9.63	12.89	3.62	6.33	1.04	2.63				OS5
DP6	2.50			0.43	1.10								28.14	2.41	4.21	1.03	4.63				DP6
DP7	33.89			8.93	18.89								44.25	1.82	3.18	16.27	60.14				DP7
DP8	114.75			9.13	28.60								44.25	1.82	3.18	16.64	91.05				DP8
B	1.22	0.08	0.35	0.10	0.43	80	2.00	13.57	650	1.30	2.30	4.71	18.28	3.05	5.34	0.30	2.28				B

* C Factor Adjusted to Model Flows from Detention Model into Rational Method Design

DITCH CAPACITY CALCULATION SHEET

Swale Location	Q5 cfs	Q100 cfs	S %	B ft	n	Z	D ft	d100 ft	V fps	Froude #	Riprap Size ft	Riprap Size in
Swale A	4.8	36.7	1.00	4.00	0.035	3:1	3.00	1.30	3.70	0.71		
Swale B	3.0	10.0	1.00	0.00	0.035	3:1	1.50	1.10	2.75	0.65		
Swale C	17.2	36.5	1.40	0.00	0.035	3:1	1.00	1.10	2.75	0.65		
Swale D	17.2	36.5	1.50	0.00	0.035	3:1	2.00	1.70	4.40	0.86		
Swale E	9.1	24.8	1.40	0.00	0.015	56:1	0.25	0.24*	2.80	1.45		
								*d5				
Judge Orr Rd Ditch	16.3	59.6	1.80	2.00	0.035	3:1	2.00	1.60	5.40	0.97		
Spillway	27.5	117.6	5.00	40.00	0.040	3:1	2.00	0.50	5.30	1.31	0.28	Use 12"
Exist Swale At Prop Line	0.5	33.7	1.70	8.00	0.040	8:1	6.00	0.80	3.20	0.77		
*Swale 300' East of PL	16.6	91.5	1.70	8.00	0.040	8:1	6.00	1.20	4.10	0.82		
*Det Breach Flow	---	500.0	1.70	8.00	0.040	8:1	6.00	2.70	6.40	0.91		

Per DCM 6.5.2, grass lined channel shall not be used where the Froude number is greater than 0.9.

*Flows from the development travel within a natural swale covered with rangeland grasses. No downstream manmade facilities exist.

STORM SEWER HYDRAULIC GRADELINE CALCULATION SHEET

Location	Pipe Size	Slope %	Q5	Q100	Pipe Cap	Critical d	Invert	
DPD1	36"	1.3	8.6	57.3	88.6	2.6	6855.5	Future Pond Flows
DP2	36"	1.3	5.1	69.1	88.6	2.6	6855.5	
DPD1 @ GB	36"	4.0	8.6	57.3	155.5	2.6	6836.0	
DP4	38"x24"	1.0	16.3	59.6	44	1.36	6856.0	
DP6	38"x24"	1.0	16.3	60.1	44	1.36	6841.6	

SPILLWAY CALCULATIONS

b = 40'
d = 1.0'
C = 3.0

Q = d^1.5xbxC
Q100 = 117.6 cfs
QMAX=120.0 cfs

FOREBAY CALCULATIONS

2% OF WQV
0.02 X 0.501 = 0.010 AF = 436 CF

FOREBAY NOTCH CALCULATIONS

0.02 OF 100YR FLOW
0.02 X 117.6 = 2.35 CFS
W =Q/(D^1.5XC)
W=2.35/(1X3.0)=0.78 FT

OUTLET PIPE RIPRAP SIZE CALCULATIONS

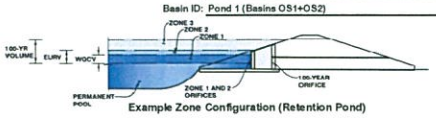
Q100 = 77.5 cfs
30" RCP @ 3.0%
Yt=Downstream tailwater
Yt=1.4'
Yt/D=1.4/2.5=0.56
Q/D^1.5=77.5/(2.5^1.5)=19.6
Use Type M Riprap per Table 5-7, 5'x10'

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd PUD

Basin ID: Pond 1 (Basins OS1+OS2)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	50.51	acres
Watershed Length =	1,950	ft
Watershed Slope =	0.013	ft/ft
Watershed Imperviousness =	56.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	0.952	acre-feet
Excess Urban Runoff Volume (EURV) =	2.747	acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	1.805	acre-feet
5-yr Runoff Volume (P1 = 1.09 in.) =	2.734	acre-feet
10-yr Runoff Volume (P1 = 1.33 in.) =	3.597	acre-feet
25-yr Runoff Volume (P1 = 1.69 in.) =	5.281	acre-feet
50-yr Runoff Volume (P1 = 1.99 in.) =	6.565	acre-feet
100-yr Runoff Volume (P1 = 2.31 in.) =	8.139	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	11.838	acre-feet
Approximate 2-yr Detention Volume =	1.693	acre-feet
Approximate 5-yr Detention Volume =	2.576	acre-feet
Approximate 10-yr Detention Volume =	3.073	acre-feet
Approximate 25-yr Detention Volume =	3.669	acre-feet
Approximate 50-yr Detention Volume =	3.966	acre-feet
Approximate 100-yr Detention Volume =	4.585	acre-feet

Optional User Override 1-hr Precipitation

	inches
	inches
	inches
	inches
	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.952	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.795	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.838	acre-feet
Total Detention Basin Volume =	4.585	acre-feet
Initial Surcharge Volume (ISV) =	10	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	

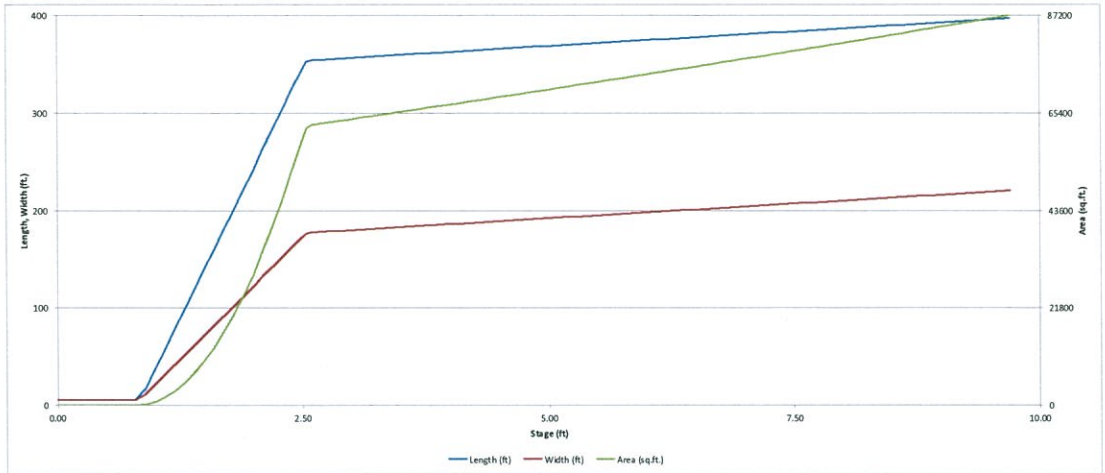
Initial Surcharge Area (A_{SV}) =	30	ft^2
Surcharge Volume Length (L_{SV}) =	5.5	ft
Surcharge Volume Width (W_{SV}) =	5.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.71	ft
Length of Basin Floor (L_{FLOOR}) =	353.5	ft
Width of Basin Floor (W_{FLOOR}) =	176.9	ft
Area of Basin Floor (A_{FLOOR}) =	62,556	ft^2
Volume of Basin Floor (V_{FLOOR}) =	36,553	ft^3
Depth of Main Basin (H_{MAIN}) =	2.45	ft
Length of Main Basin (L_{MAIN}) =	368.3	ft
Width of Main Basin (W_{MAIN}) =	191.7	ft
Area of Main Basin (A_{MAIN}) =	70,578	ft^2
Volume of Main Basin (V_{MAIN}) =	163,150	ft^3
Calculated Total Basin Volume (V_{total}) =	4.585	acre-feet

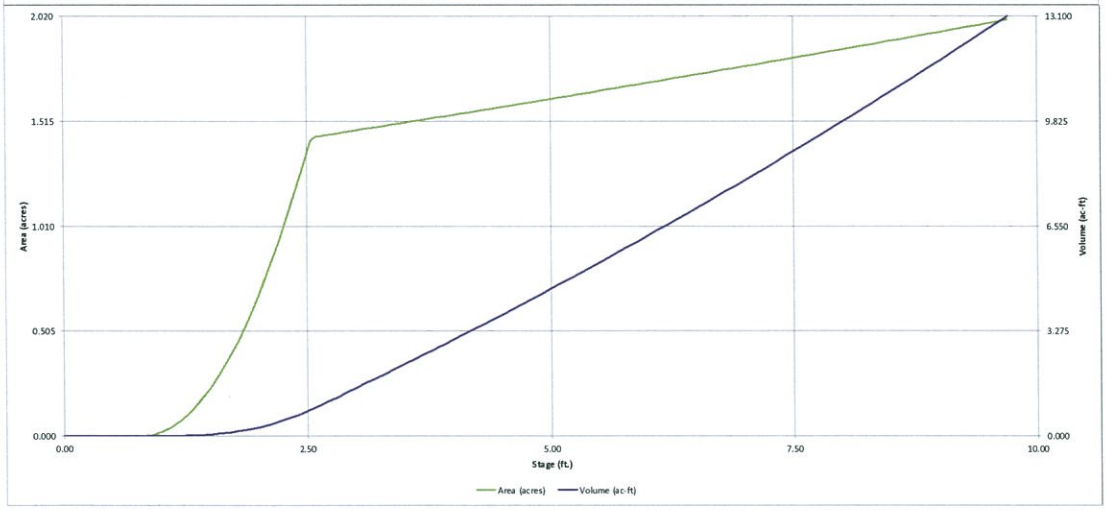
Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		5.5	5.5	30		0.001		
ISV	0.33		5.5	5.5	30		0.001	10	0.000
	0.40		5.5	5.5	30		0.001	12	0.000
	0.50		5.5	5.5	30		0.001	15	0.000
	0.60		5.5	5.5	30		0.001	18	0.000
	0.70		5.5	5.5	30		0.001	21	0.000
	0.80		5.5	5.5	30		0.001	24	0.001
	0.90		17.1	11.2	191		0.004	31	0.001
	1.00		37.4	21.2	791		0.018	76	0.002
	1.10		57.7	31.2	1,798		0.041	202	0.005
	1.20		78.0	41.2	3,210		0.074	449	0.010
	1.30		98.3	51.2	5,028		0.115	858	0.020
	1.40		118.6	61.2	7,253		0.167	1,469	0.034
	1.50		138.9	71.2	9,883		0.227	2,322	0.053
	1.60		159.2	81.2	12,920		0.297	3,450	0.079
	1.70		179.5	91.2	16,362		0.376	4,920	0.113
	1.80		199.8	101.2	20,211		0.464	6,745	0.155
	1.90		220.1	111.2	24,465		0.562	8,975	0.206
	2.00		240.4	121.2	29,126		0.669	11,651	0.267
	2.10		262.7	132.2	34,721		0.797	15,159	0.348
	2.20		283.0	142.2	40,234		0.924	18,903	0.434
	2.30		303.3	152.2	46,153		1.060	23,219	0.533
	2.40		323.6	162.2	52,478		1.205	28,147	0.646
	2.50		343.9	172.2	59,209		1.359	33,728	0.774
Floor	2.55		352.0	176.2	62,016		1.424	36,152	0.830
	2.60		353.9	177.3	62,723		1.440	39,907	0.916
Zone 1 (WQCV)	2.63		354.0	177.4	62,819		1.442	41,791	0.959
	2.70		354.5	177.9	63,042		1.447	46,196	1.061
	2.80		355.1	178.5	63,362		1.455	52,516	1.206
	2.90		355.7	179.1	63,682		1.462	58,868	1.351
	3.00		356.3	179.7	64,003		1.469	65,252	1.498
	3.10		356.9	180.3	64,325		1.477	71,669	1.645
	3.20		357.5	180.9	64,648		1.484	78,117	1.793
	3.30		358.1	181.5	64,971		1.492	84,598	1.942
	3.40		358.7	182.1	65,295		1.499	91,112	2.092
	3.50		359.3	182.7	65,620		1.506	97,657	2.242
	3.60		359.9	183.3	65,946		1.514	104,236	2.393
	3.70		360.5	183.9	66,272		1.521	110,847	2.545
	3.80		361.1	184.5	66,599		1.529	117,490	2.697
Zone 2 (EURV)	3.84		361.3	184.7	66,730		1.532	120,157	2.758
	3.90		361.7	185.1	66,926		1.536	124,166	2.850
	4.00		362.3	185.7	67,255		1.544	130,875	3.004
	4.10		362.9	186.3	67,584		1.552	137,617	3.159
	4.20		363.5	186.9	67,914		1.559	144,392	3.315
	4.30		364.1	187.5	68,244		1.567	151,200	3.471
	4.40		364.7	188.1	68,576		1.574	158,041	3.628
	4.50		365.3	188.7	68,908		1.582	164,915	3.786
	4.60		365.9	189.3	69,240		1.590	171,823	3.945
	4.70		366.5	189.9	69,574		1.597	178,763	4.104
	4.80		367.1	190.5	69,908		1.605	185,737	4.264
	4.90		367.7	191.1	70,243		1.613	192,745	4.425
Zone 3 (100-year)	5.00		368.3	191.7	70,578		1.620	199,786	4.586
	5.10		368.9	192.3	70,915		1.628	206,861	4.749
	5.20		369.5	192.9	71,252		1.636	213,969	4.912
	5.30		370.1	193.5	71,589		1.643	221,111	5.076
	5.40		370.7	194.1	71,928		1.651	228,287	5.241
	5.50		371.3	194.7	72,267		1.659	235,497	5.406
	5.60		371.9	195.3	72,607		1.667	242,740	5.573
	5.70		372.5	195.9	72,948		1.675	250,018	5.740
	5.80		373.1	196.5	73,289		1.682	257,330	5.907
	5.90		373.7	197.1	73,631		1.690	264,676	6.076
	6.00		374.3	197.7	73,974		1.698	272,056	6.246
	6.10		374.9	198.3	74,317		1.706	279,471	6.416
	6.20		375.5	198.9	74,661		1.714	286,919	6.587
	6.30		376.1	199.5	75,006		1.722	294,403	6.759
	6.40		376.7	200.1	75,352		1.730	301,921	6.931
	6.50		377.3	200.7	75,698		1.738	309,473	7.105
	6.60		377.9	201.3	76,046		1.746	317,060	7.279
	6.70		378.5	201.9	76,393		1.754	324,682	7.454
	6.80		379.1	202.5	76,742		1.762	332,339	7.629
	6.90		379.7	203.1	77,091		1.770	340,031	7.806
	7.00		380.3	203.7	77,441		1.778	347,757	7.983
	7.10		380.9	204.3	77,792		1.786	355,519	8.162
	7.20		381.5	204.9	78,143		1.794	363,316	8.341
	7.30		382.1	205.5	78,496		1.802	371,148	8.520
	7.40		382.7	206.1	78,848		1.810	379,015	8.701
	7.50		383.3	206.7	79,202		1.818	386,918	8.882
	7.60		383.9	207.3	79,556		1.826	394,855	9.065
	7.70		384.5	207.9	79,911		1.835	402,829	9.248
	7.80		385.1	208.5	80,267		1.843	410,838	9.432
	7.90		385.7	209.1	80,624		1.851	418,882	9.616
	8.00		386.3	209.7	80,981		1.859	426,962	9.802
	8.10		386.9	210.3	81,339		1.867	435,078	9.988
	8.20		387.5	210.9	81,697		1.876	443,230	10.175
	8.30		388.1	211.5	82,057		1.884	451,418	10.363
	8.40		388.7	212.1	82,417		1.892	459,642	10.552
	8.50		389.3	212.7	82,777		1.900	467,901	10.742
	8.60		389.9	213.3	83,139		1.909	476,197	10.932
	8.70		390.5	213.9	83,501		1.917	484,529	11.123
	8.80		391.1	214.5	83,864		1.925	492,897	11.315
	8.90		391.7	215.1	84,228		1.934	501,302	11.508
	9.00		392.3	215.7	84,592		1.942	509,743	11.702
	9.10		392.9	216.3	84,957		1.950	518,220	11.897
	9.20		393.5	216.9	85,323		1.959	526,734	12.092
	9.30		394.1	217.5	85,690		1.967	535,285	12.288
	9.40		394.7	218.1	86,057		1.976	543,872	12.486
	9.50		395.3	218.7	86,425		1.984	552,496	12.684
	9.60		395.9	219.3	86,794		1.993	561,157	12.882
	9.70		396.5	219.9	87,163		2.001	569,855	13.082

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



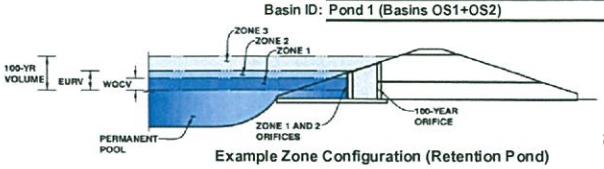


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd PUD

Basin ID: Pond 1 (Basins OS1+OS2)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.63	0.952	Orifice Plate
Zone 2 (EURV)	3.84	1.795	Orifice Plate
Zone 3 (100-year)	5.00	1.838	Weir&Pipe (Restrict)
		4.585	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.90	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	15.60	inches
Orifice Plate: Orifice Area per Row =	3.76	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.611E-02	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.30	2.60					
Orifice Area (sq. inches)	3.76	3.76	3.76					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.90	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	7.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	7.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.90	N/A	feet
Over Flow Weir Slope Length =	7.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.81	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	34.30	N/A	ft^2
Overflow Grate Open Area w/ Debris =	17.15	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	28.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.90	N/A	ft^2
Outlet Orifice Centroid =	1.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.16	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	47.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

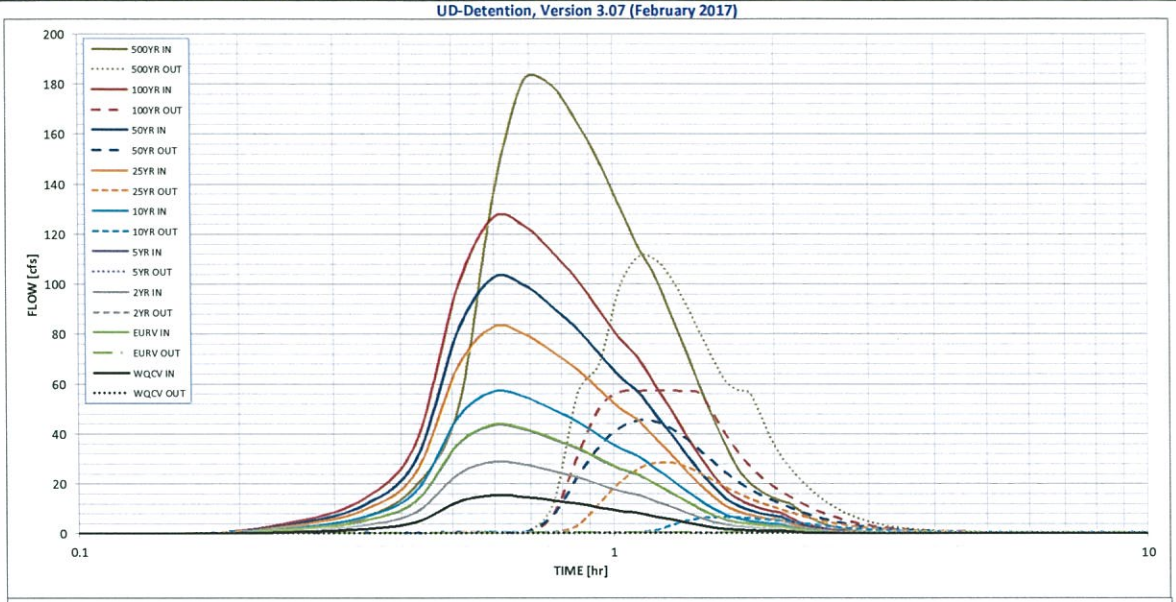
Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	7.00	feet
Basin Area at Top of Freeboard =	1.78	acres

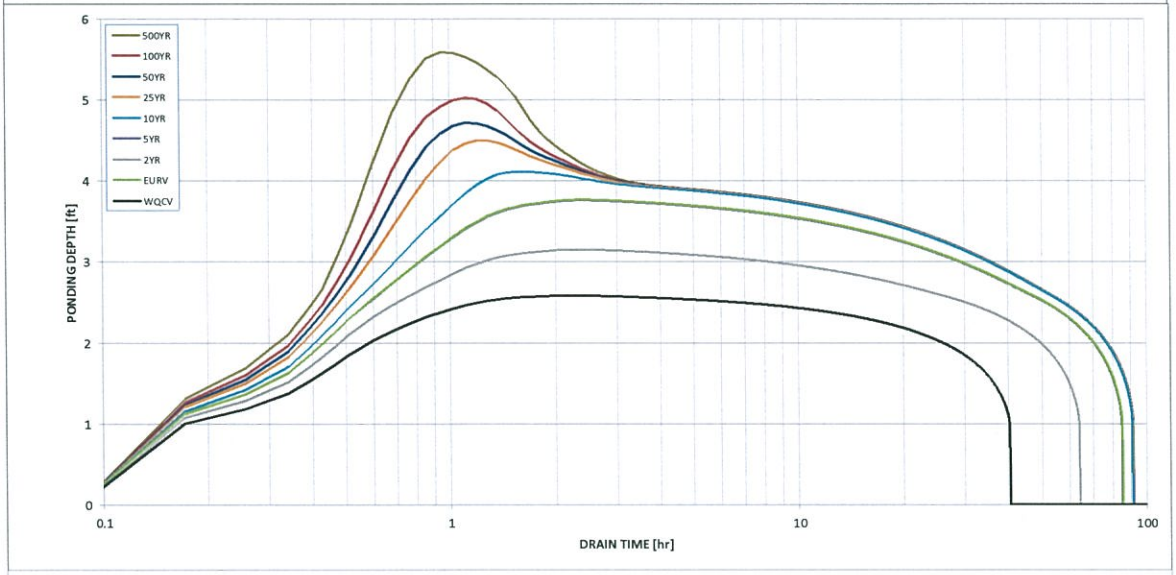
Routed Hydrograph Results

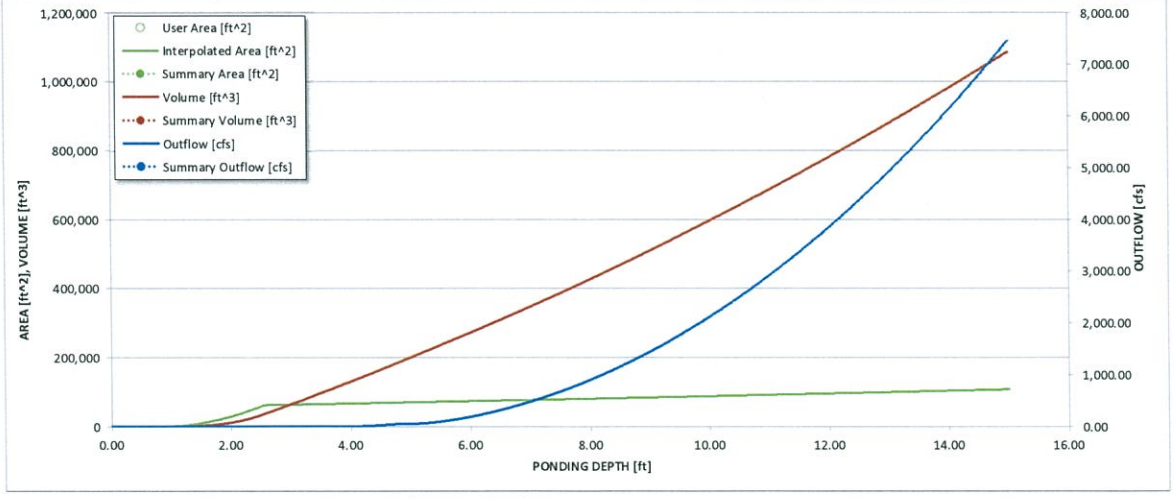
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.83	1.09	1.33	1.69	1.99	2.31	3.14
Calculated Runoff Volume (acre-ft) =	0.952	2.747	1.805	2.734	3.597	5.281	6.565	8.139	11.838
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.952	2.748	1.805	2.735	3.597	5.273	6.564	8.141	11.839
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.09	0.25	0.65	0.89	1.21	1.91
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	4.4	12.6	32.7	45.1	61.0	96.5
Peak Inflow Q (cfs) =	15.3	43.6	28.8	43.4	56.8	82.7	102.4	126.2	181.5
Peak Outflow Q (cfs) =	0.3	0.6	0.5	0.6	6.5	28.3	45.2	57.3	110.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.5	0.9	1.0	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.8	1.3	1.6	1.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	80	60	79	84	82	80	78	74
Time to Drain 99% of Inflow Volume (hours) =	40	83	63	83	88	87	87	86	84
Maximum Ponding Depth (ft) =	2.58	3.77	3.15	3.76	4.11	4.49	4.72	5.02	5.59
Area at Maximum Ponding Depth (acres) =	1.44	1.53	1.48	1.53	1.55	1.58	1.60	1.62	1.67
Maximum Volume Stored (acre-ft) =	0.887	2.636	1.719	2.621	3.175	3.770	4.120	4.619	5.539

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: ..\..\2016\160301-Judge Orr Road RV Park\Reports\Outflow Hydrographs.xlsx

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.

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
5.14 min	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]
	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:10:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:25	0.67	1.85	1.24	1.84	2.38	3.35	4.04	4.82	6.44
0.973	0:20:34	1.82	5.09	3.39	5.07	6.59	9.42	11.50	13.94	19.31
	0:25:42	4.67	13.07	8.70	13.01	16.92	24.19	29.53	35.80	49.62
	0:30:50	12.83	35.87	23.89	35.70	46.42	66.27	80.85	97.92	135.47
	0:35:59	15.32	43.60	28.81	43.39	56.84	82.68	102.39	126.25	181.45
	0:41:07	14.63	41.80	27.58	41.60	54.59	79.88	99.40	123.29	179.49
	0:46:16	13.32	38.04	25.10	37.86	49.68	72.89	90.88	112.97	165.19
	0:51:24	11.92	34.21	22.53	34.05	44.74	65.69	81.94	101.90	149.13
	0:56:32	10.32	29.83	19.57	29.68	39.09	57.56	71.92	89.59	131.50
	1:01:41	8.98	25.97	17.00	25.85	34.10	50.31	62.91	78.42	115.20
	1:06:49	8.14	23.51	15.42	23.40	30.82	45.33	56.58	70.39	103.03
	1:11:58	6.74	19.64	12.84	19.54	25.79	38.10	47.70	59.54	87.72
	1:17:06	5.52	16.23	10.58	16.15	21.35	31.61	39.61	49.50	73.04
	1:22:14	4.28	12.78	8.29	12.72	16.88	25.14	31.61	39.63	58.83
	1:27:23	3.21	9.80	6.30	9.76	13.01	19.48	24.57	30.88	46.02
	1:32:31	2.32	7.26	4.63	7.23	9.69	14.61	18.50	23.32	34.94
	1:37:40	1.79	5.48	3.52	5.46	7.29	10.91	13.77	17.30	25.75
	1:42:48	1.47	4.44	2.87	4.42	5.87	8.74	10.99	13.76	20.36
	1:47:56	1.25	3.74	2.42	3.72	4.94	7.35	9.23	11.54	17.04
	1:53:05	1.09	3.26	2.12	3.25	4.31	6.39	8.00	10.00	14.71
	1:58:13	0.98	2.92	1.90	2.91	3.85	5.70	7.14	8.91	13.09
	2:03:22	0.91	2.68	1.74	2.67	3.53	5.22	6.53	8.14	11.93
	2:08:30	0.66	1.99	1.29	1.98	2.62	3.92	4.93	6.20	9.25
	2:13:38	0.49	1.44	0.94	1.43	1.90	2.83	3.56	4.47	6.66
	2:18:47	0.36	1.06	0.69	1.06	1.40	2.10	2.64	3.32	4.94
	2:23:55	0.26	0.79	0.51	0.79	1.05	1.56	1.96	2.46	3.67
	2:29:04	0.19	0.58	0.37	0.57	0.76	1.14	1.44	1.82	2.72
	2:34:12	0.13	0.41	0.26	0.41	0.55	0.82	1.04	1.31	1.97
	2:39:20	0.10	0.30	0.19	0.30	0.40	0.60	0.75	0.95	1.42
	2:44:29	0.06	0.21	0.13	0.21	0.28	0.42	0.53	0.67	1.02
	2:49:37	0.04	0.13	0.08	0.13	0.18	0.27	0.35	0.44	0.68
	2:54:46	0.02	0.07	0.04	0.07	0.10	0.16	0.20	0.26	0.41
	2:59:54	0.01	0.03	0.02	0.03	0.05	0.07	0.10	0.13	0.20
	3:05:02	0.00	0.01	0.00	0.01	0.01	0.02	0.03	0.04	0.07
	3:10:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:41:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:28:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:39:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:44:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:49:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:04:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:10:05	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'.

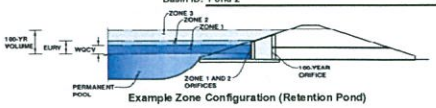
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Road RV Park and Storage

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	30.35	acres
Watershed Length =	1,600	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	46.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	0.501	acre-feet
Excess Urban Runoff Volume (EURV) =	1.514	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.213	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.665	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.283	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.250	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.915	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.786	acre-feet
500-yr Runoff Volume (P1 = 3.01 in.) =	6.293	acre-feet
Approximate 2-yr Detention Volume =	1.135	acre-feet
Approximate 5-yr Detention Volume =	1.564	acre-feet
Approximate 10-yr Detention Volume =	2.093	acre-feet
Approximate 25-yr Detention Volume =	2.303	acre-feet
Approximate 50-yr Detention Volume =	2.411	acre-feet
Approximate 100-yr Detention Volume =	2.711	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.01	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.501	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.013	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.197	acre-feet
Total Detention Basin Volume =	2.711	acre-feet
Initial Surcharge Volume (ISV) =	10	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	8.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	5	

Initial Surcharge Area (A_{ISV}) =	30	ft^2
Surcharge Volume Length (L_{ISV}) =	5.5	ft
Surcharge Volume Width (W_{ISV}) =	5.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.19	ft
Length of Basin Floor (L_{FLOOR}) =	247.1	ft
Width of Basin Floor (W_{FLOOR}) =	53.1	ft
Area of Basin Floor (A_{FLOOR}) =	13,127	ft^2
Volume of Basin Floor (V_{FLOOR}) =	5,471	ft^3
Depth of Main Basin (H_{MAIN}) =	5.98	ft
Length of Main Basin (L_{MAIN}) =	283.0	ft
Width of Main Basin (W_{MAIN}) =	89.0	ft
Area of Main Basin (A_{MAIN}) =	25,187	ft^2
Volume of Main Basin (V_{MAIN}) =	112,612	ft^3
Calculated Total Basin Volume (V_{total}) =	2.711	acre-feet

Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)
Top of Micropool	0.00		5.5	5.5	30		0.001	
ISV	0.33		5.5	5.5	30		0.001	10
	0.40		5.5	5.5	30		0.001	12
	0.50		5.5	5.5	30		0.001	15
	0.60		5.5	5.5	30		0.001	18
	0.70		5.5	5.5	30		0.001	21
	0.80		5.5	5.5	30		0.001	24
	0.90		17.7	7.9	140		0.003	30
	1.00		38.0	11.9	452		0.010	58
	1.10		58.3	15.9	927		0.021	126
	1.20		78.6	19.9	1,564		0.036	249
	1.30		98.9	23.9	2,364		0.054	444
	1.40		119.2	27.9	3,326		0.076	727
	1.50		139.5	31.9	4,450		0.102	1,115
	1.60		159.8	35.9	5,737		0.132	1,623
	1.70		180.1	39.9	7,186		0.165	2,267
	1.80		200.4	43.9	8,798		0.202	3,065
	1.90		220.7	47.9	10,572		0.243	4,032
	2.00		241.0	51.9	12,508		0.287	5,185
Floor	2.02		247.1	53.1	13,121		0.301	5,570
	2.10		247.6	53.6	13,271		0.305	6,625
	2.20		248.2	54.2	13,452		0.309	7,962
	2.30		248.8	54.8	13,634		0.313	9,316
	2.40		249.4	55.4	13,816		0.317	10,688
	2.50		250.0	56.0	14,000		0.321	12,079
	2.60		250.6	56.6	14,183		0.326	13,488
	2.70		251.2	57.2	14,368		0.330	14,916
	2.80		251.8	57.8	14,554		0.334	16,362
	2.90		252.4	58.4	14,740		0.338	17,827
	3.00		253.0	59.0	14,927		0.343	19,310
	3.10		253.6	59.6	15,114		0.347	20,812
Zone 1 (WQCV)	3.17		254.0	60.0	15,246		0.350	21,874
	3.20		254.2	60.2	15,302		0.351	22,333
	3.30		254.8	60.8	15,491		0.356	23,872
	3.40		255.4	61.4	15,681		0.360	25,431
	3.50		256.0	62.0	15,872		0.364	27,009
	3.60		256.6	62.6	16,063		0.369	28,605
	3.70		257.2	63.2	16,255		0.373	30,221
	3.80		257.8	63.8	16,447		0.378	31,856
	3.90		258.4	64.4	16,641		0.382	33,511
	4.00		259.0	65.0	16,835		0.386	35,184
	4.10		259.6	65.6	17,029		0.391	36,878
	4.20		260.2	66.2	17,225		0.395	38,590
	4.30		260.8	66.8	17,421		0.400	40,323
	4.40		261.4	67.4	17,618		0.404	42,075
	4.50		262.0	68.0	17,816		0.409	43,846
	4.60		262.6	68.6	18,014		0.414	45,638
	4.70		263.2	69.2	18,213		0.418	47,449
	4.80		263.8	69.8	18,413		0.423	49,280
	4.90		264.4	70.4	18,613		0.427	51,132
	5.00		265.0	71.0	18,815		0.432	53,003
	5.10		265.6	71.6	19,017		0.437	54,895
	5.20		266.2	72.2	19,219		0.441	56,806
	5.30		266.8	72.8	19,423		0.446	58,739
	5.40		267.4	73.4	19,627		0.451	60,691
	5.50		268.0	74.0	19,832		0.455	62,664
	5.60		268.6	74.6	20,037		0.460	64,657
Zone 2 (EURV)	5.67		269.0	75.0	20,182		0.463	66,065
	5.70		269.2	75.2	20,244		0.465	66,671
	5.80		269.8	75.8	20,451		0.469	68,706
	5.90		270.4	76.4	20,658		0.474	70,762
	6.00		271.0	77.0	20,867		0.479	72,838
	6.10		271.6	77.6	21,076		0.484	74,935
	6.20		272.2	78.2	21,286		0.489	77,053
	6.30		272.8	78.8	21,496		0.493	79,192
	6.40		273.4	79.4	21,708		0.498	81,352
	6.50		274.0	80.0	21,920		0.503	83,534
	6.60		274.6	80.6	22,133		0.508	85,736
	6.70		275.2	81.2	22,348		0.513	87,960
	6.80		275.8	81.8	22,560		0.518	90,205
	6.90		276.4	82.4	22,775		0.523	92,472
	7.00		277.0	83.0	22,991		0.528	94,761
	7.10		277.6	83.6	23,207		0.533	97,070
	7.20		278.2	84.2	23,424		0.538	99,402
	7.30		278.8	84.8	23,642		0.543	101,755
	7.40		279.4	85.4	23,861		0.548	104,130
	7.50		280.0	86.0	24,080		0.553	106,527
	7.60		280.6	86.6	24,300		0.558	108,946
	7.70		281.2	87.2	24,520		0.563	111,387
	7.80		281.8	87.8	24,742		0.568	113,850
	7.90		282.4	88.4	24,964		0.573	116,336
Zone 3 (100-year)	7.98		282.9	88.9	25,142		0.577	118,340
	8.00		283.0	89.0	25,187		0.578	118,843
	8.10		283.6	89.6	25,410		0.583	121,373
	8.20		284.2	90.2	25,635		0.588	123,925
	8.30		284.8	90.8	25,860		0.594	126,500
	8.40		285.4	91.4	26,085		0.599	129,097
	8.50		286.0	92.0	26,312		0.604	131,717
	8.60		286.6	92.6	26,539		0.609	134,360
	8.70		287.2	93.2	26,767		0.614	137,025
	8.80		287.8	93.8	26,996		0.620	139,713
	8.90		288.4	94.4	27,225		0.625	142,424
	9.00		289.0	95.0	27,455		0.630	145,158
	9.10		289.6	95.6	27,686		0.636	147,915
	9.20		290.2	96.2	27,917		0.641	150,695
	9.30		290.8	96.8	28,149		0.646	153,499
	9.40		291.4	97.4	28,382		0.652	156,325
	9.50		292.0	98.0	28,616		0.657	159,175
	9.60		292.6	98.6	28,850		0.662	162,048

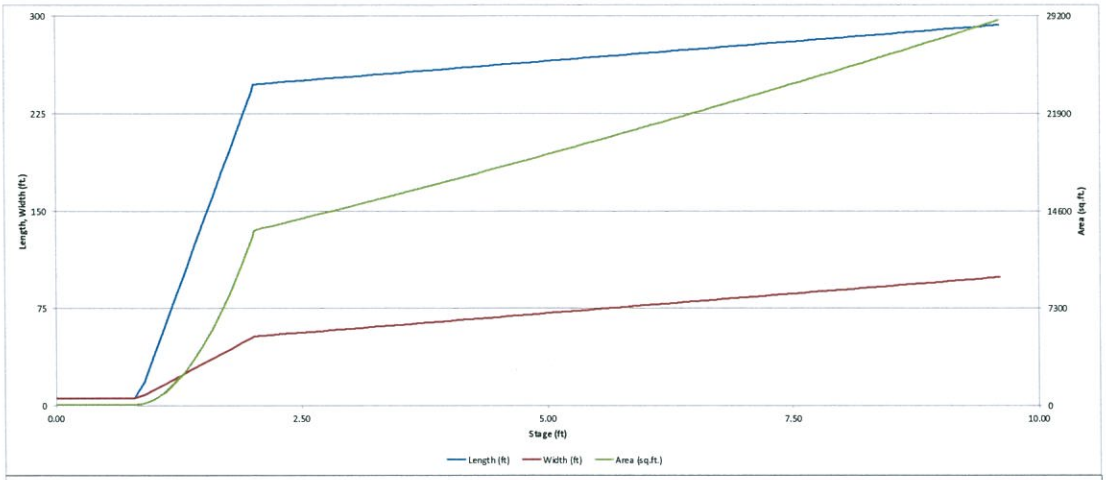
Revise the Pond 2 stage-storage based on the constructed pond shape shown on the GEC plan and not the computer generated values. Input the values in the "optional override stage/area".

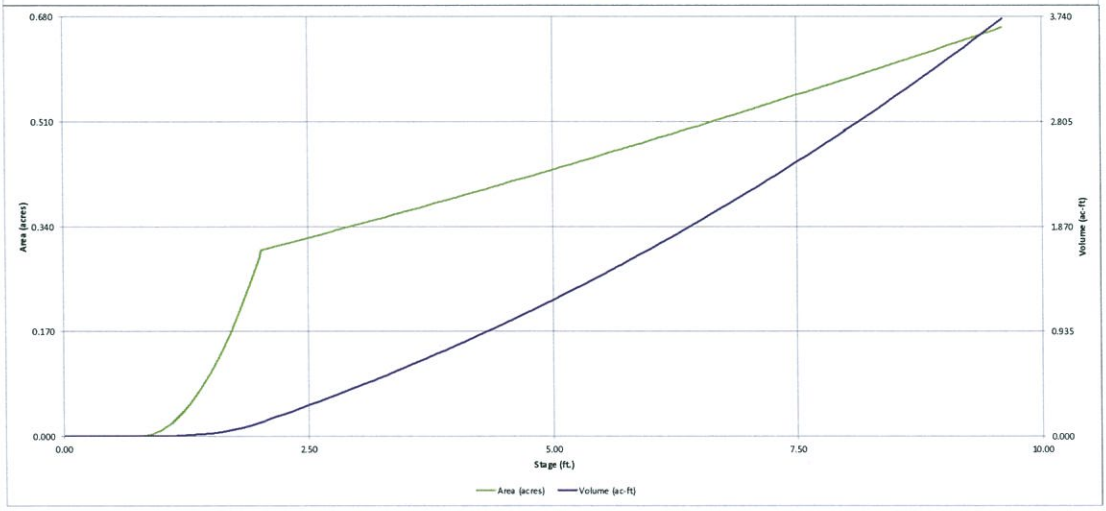
The auto-generate for Pond 1 is okay since it was mainly to for modeling the pond in a series based on an assumed condition for Pond 1.

However, add a statement that with development of pond 1, that drainage report will have to provide the same pond in a series analysis to verify release rates still meet Senate Bill 15-212.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



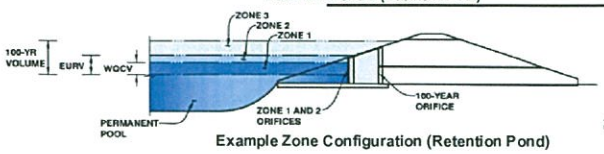


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Road RV Park and Storage

Basin ID: Pond 2 (Basins A1+A2)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.17	0.501	Orifice Plate
Zone 2 (EURV)	5.67	1.013	Orifice Plate
Zone 3 (100-year)	7.98	1.197	Weir&Pipe (Restrict)
		2.711	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.96	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	23.80	inches
Orifice Plate: Orifice Area per Row =	2.37	sq. inches (diameter = 1-3/4 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.646E-02	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.99	3.97					
Orifice Area (sq. inches)	2.37	2.37	2.37					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.00	N/A	feet
Over Flow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.98	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	25.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.60	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	27.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	20.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.16	N/A	ft^2
Outlet Orifice Centroid =	0.92	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.07	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.40	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	32.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

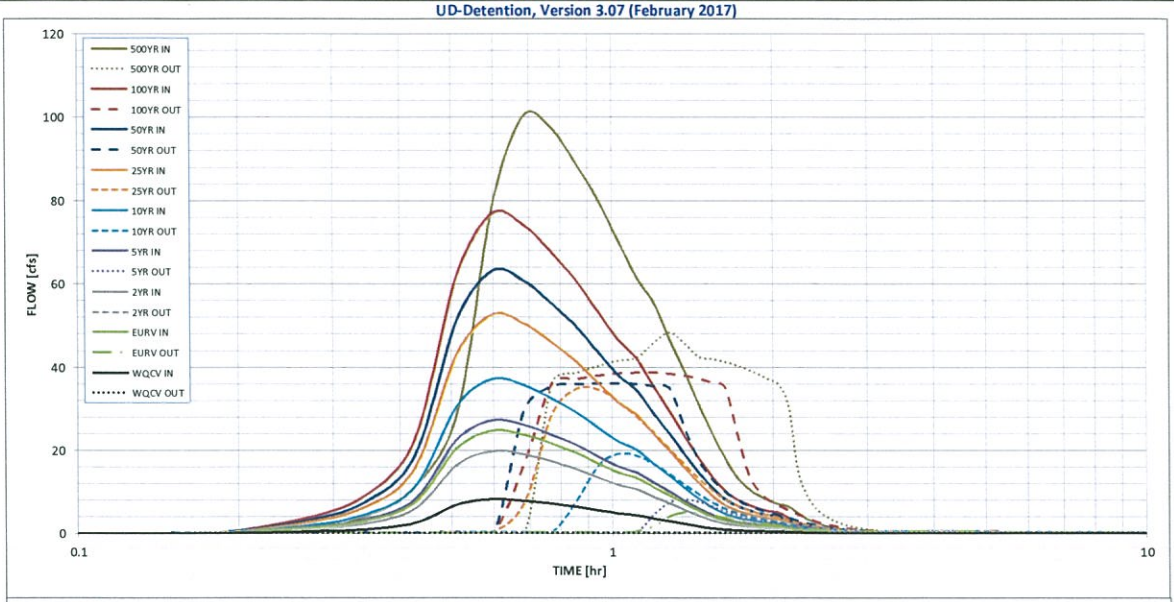
Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	11.30	feet
Basin Area at Top of Freeboard =	0.76	acres

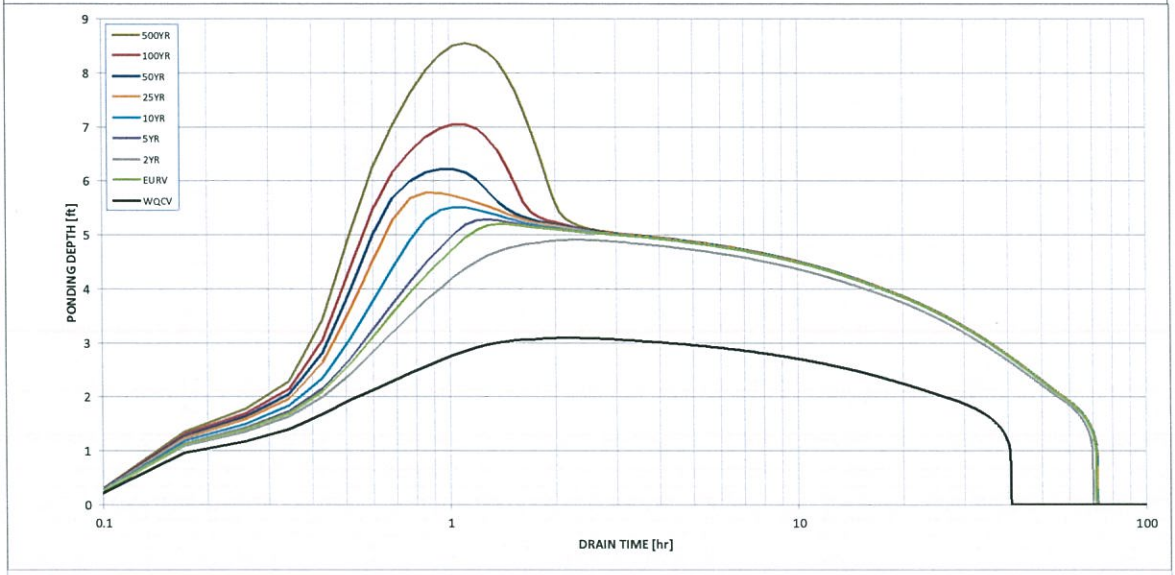
Routed Hydrograph Results

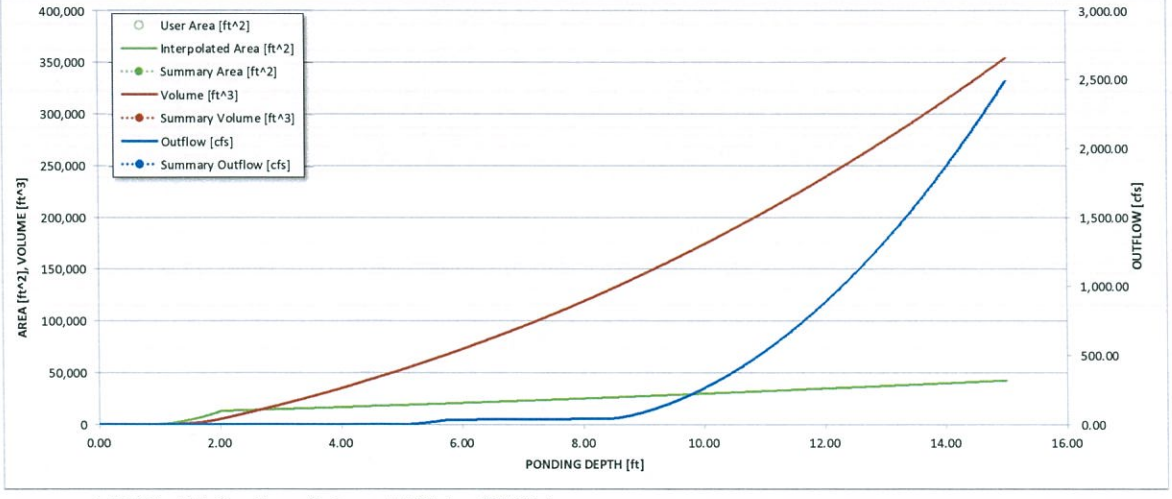
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.01
Calculated Runoff Volume (acre-ft) =	0.501	1.514	1.213	1.665	2.283	3.250	3.915	4.786	6.293
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.510	1.546	1.238	1.700	2.331	3.318	3.997	4.886	6.426
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.91	1.23	1.74
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.6	6.1	20.0	27.7	37.3	52.8
Peak Inflow Q (cfs) =	8.3	24.7	19.8	27.2	37.1	52.5	63.1	76.8	100.3
Peak Outflow Q (cfs) =	0.2	5.0	0.4	8.2	19.1	34.6	36.1	38.6	48.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	13.0	3.2	1.7	1.3	1.0	0.9
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.18	N/A	0.3	0.7	1.4	1.4	1.5	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	66	65	65	63	60	58	55	52
Time to Drain 99% of Inflow Volume (hours) =	40	70	68	70	69	68	67	66	64
Maximum Ponding Depth (ft) =	3.09	5.20	4.91	5.28	5.51	5.77	6.22	7.04	8.55
Area at Maximum Ponding Depth (acres) =	0.35	0.44	0.43	0.44	0.46	0.47	0.49	0.53	0.61
Maximum Volume Stored (acre-ft) =	0.474	1.300	1.174	1.340	1.439	1.563	1.774	2.197	3.048

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.

User-Defined	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]
5.14 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:10:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:25	0.37	1.07	0.87	1.17	1.59	2.22	2.63	3.15	3.98
0.993	0:20:34	0.99	2.92	2.35	3.20	4.35	6.11	7.29	8.80	11.30
	0:25:42	2.54	7.49	6.03	8.22	11.16	15.69	18.72	22.58	29.02
	0:30:50	6.99	20.56	16.57	22.56	30.62	43.03	51.34	61.90	79.47
	0:35:59	8.27	24.72	19.85	27.16	37.09	52.52	63.07	76.79	100.34
	0:41:07	7.89	23.65	18.97	25.99	35.53	50.40	60.64	74.05	97.31
	0:46:16	7.18	21.53	17.27	23.66	32.34	45.87	55.20	67.52	88.93
	0:51:24	6.40	19.31	15.48	21.23	29.06	41.28	49.72	60.84	80.18
	0:56:32	5.52	16.75	13.41	18.43	25.29	36.04	43.48	53.27	70.35
	1:01:41	4.81	14.56	11.66	16.01	22.00	31.42	37.95	46.54	61.53
	1:06:49	4.36	13.20	10.58	14.52	19.93	28.41	34.27	41.96	55.36
	1:11:58	3.59	10.98	8.78	12.09	16.63	23.76	28.71	35.23	46.64
	1:17:06	2.92	9.04	7.21	9.96	13.73	19.66	23.78	29.21	38.73
	1:22:14	2.24	7.06	5.61	7.79	10.78	15.52	18.82	23.20	30.88
	1:27:23	1.66	5.35	4.23	5.91	8.24	11.94	14.53	17.95	23.99
	1:32:31	1.21	3.91	3.08	4.33	6.08	8.88	10.84	13.44	18.05
	1:37:40	0.94	2.98	2.36	3.30	4.60	6.68	8.13	10.06	13.44
	1:42:48	0.77	2.44	1.93	2.69	3.74	5.39	6.55	8.07	10.74
	1:47:56	0.66	2.06	1.63	2.27	3.15	4.55	5.51	6.79	9.02
	1:53:05	0.58	1.80	1.43	1.99	2.75	3.96	4.80	5.90	7.83
	1:58:13	0.52	1.62	1.29	1.78	2.47	3.55	4.29	5.27	6.98
	2:03:22	0.48	1.49	1.18	1.64	2.27	3.25	3.93	4.83	6.39
	2:08:30	0.35	1.09	0.87	1.21	1.67	2.41	2.93	3.61	4.82
	2:13:38	0.26	0.80	0.64	0.88	1.22	1.75	2.12	2.61	3.48
	2:18:47	0.19	0.59	0.47	0.65	0.90	1.29	1.57	1.93	2.58
	2:23:55	0.14	0.43	0.35	0.48	0.67	0.96	1.17	1.44	1.92
	2:29:04	0.10	0.31	0.25	0.35	0.48	0.70	0.85	1.05	1.41
	2:34:12	0.07	0.22	0.18	0.25	0.35	0.50	0.61	0.76	1.02
	2:39:20	0.05	0.16	0.13	0.18	0.25	0.36	0.44	0.55	0.74
	2:44:29	0.03	0.11	0.09	0.12	0.17	0.25	0.31	0.39	0.52
	2:49:37	0.02	0.07	0.05	0.08	0.11	0.16	0.20	0.25	0.34
	2:54:46	0.01	0.04	0.03	0.04	0.06	0.09	0.11	0.14	0.20
	2:59:54	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.09
	3:05:02	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03
	3:10:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:41:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:28:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:39:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:44:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:49:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:04:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:10:05	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).

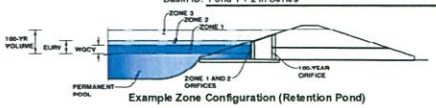
JUDGE ORR RD RV PARK																												
INFLOW HYDROGRAPH																												
TIME		WQCV			EURV			2 YR			5 YR			10 YR			25 YR			50 YR			100 YR			500 YR		TIME
	OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		
	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	POND 1	POND 2	POND 1+2	
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0:00:00
0:05:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0:05:08
0:15:25	0.13	0.00	0.13	0.13	0.00	0.13	0.13	0.00	0.13	0.13	0.00	0.13	0.14	0.00	0.14	0.14	0.00	0.14	0.14	0.00	0.14	0.14	0.00	0.14	0.16	0.00	0.16	0:15:25
0:20:34	0.14	0.37	0.51	0.18	1.07	1.25	0.14	0.87	1.01	0.18	1.17	1.35	0.19	1.59	1.78	0.21	2.22	2.43	0.22	2.63	2.85	0.23	3.15	3.38	0.24	3.98	4.22	0:20:34
0:25:42	0.18	0.99	1.17	0.23	2.92	3.15	0.21	2.35	2.56	0.23	3.20	3.43	0.24	4.35	4.59	0.26	6.11	6.37	0.27	7.29	7.56	0.28	8.80	9.08	0.38	11.30	11.68	0:25:42
0:30:50	0.27	2.54	2.81	0.32	7.49	7.81	0.30	6.03	6.33	0.28	8.22	8.50	0.33	11.16	11.49	0.39	15.69	16.08	0.43	18.72	19.15	0.46	22.58	23.04	0.53	29.02	29.55	0:30:50
0:35:59	0.29	6.99	7.28	0.34	20.56	20.90	0.32	16.57	16.89	0.32	22.56	22.88	0.40	30.62	31.02	0.47	43.03	43.50	0.51	51.34	51.85	0.56	61.90	62.46	11.99	79.47	91.46	0:35:59
0:41:07	0.30	8.27	8.57	0.41	24.72	25.13	0.33	19.85	20.18	0.34	27.16	27.50	0.46	37.09	37.55	0.53	52.52	53.05	0.58	63.07	63.65	7.29	76.79	84.08	55.96	100.34	156.30	0:41:07
0:46:16	0.31	7.89	8.20	0.45	23.65	24.10	0.35	18.97	19.32	0.41	25.99	26.40	0.50	35.53	36.03	0.57	50.40	50.97	7.40	60.64	68.04	30.79	74.05	104.84	68.17	97.31	165.48	0:46:16
0:51:24	0.32	7.18	7.50	0.47	21.53	22.00	0.39	17.27	17.66	0.44	23.66	24.10	0.53	32.34	32.87	3.12	45.87	48.99	22.80	55.20	78.00	50.09	67.52	117.61	98.14	88.93	187.07	0:51:24
0:56:32	0.32	6.40	6.72	0.50	19.31	19.81	0.42	15.48	15.90	0.47	21.23	21.70	0.55	29.06	29.61	12.13	41.28	53.41	34.90	49.74	84.64	56.52	60.84	117.36	110.65	80.18	190.83	0:56:32
1:01:41	0.33	5.52	5.85	0.51	16.75	17.26	0.43	13.41	13.84	0.49	18.43	18.92	0.57	25.29	25.86	20.34	36.04	56.38	42.21	43.48	85.69	57.06	53.27	110.33	109.87	70.35	180.22	1:01:41
1:06:49	0.33	4.81	5.14	0.53	14.56	15.09	0.45	11.66	12.11	0.51	16.01	16.52	0.59	22.00	22.59	25.79	31.42	57.21	45.24	37.95	83.19	57.30	46.54	103.84	102.60	61.53	164.13	1:06:49
1:11:58	0.34	4.36	4.70	0.54	13.20	13.74	0.46	10.58	11.04	0.53	14.52	15.05	1.25	19.93	21.18	28.21	28.41	56.62	44.75	34.27	79.02	57.22	41.96	99.18	92.02	55.36	147.38	1:11:58
1:17:06	0.34	3.59	3.93	0.55	10.98	11.53	0.47	8.78	9.25	0.54	12.09	12.63	3.32	16.63	19.95	28.26	23.76	52.02	41.97	28.71	70.68	56.83	35.23	92.06	80.62	46.64	127.26	1:17:06
1:22:14	0.34	2.92	3.26	0.56	9.04	9.60	0.47	7.21	7.68	0.55	9.96	10.51	5.05	13.73	18.78	26.66	19.66	46.32	37.85	23.78	61.63	56.17	29.21	85.38	69.82	38.73	108.55	1:22:14
1:27:23	0.34	2.24	2.58	0.56	7.06	7.62	0.48	5.61	6.09	0.56	7.79	8.35	6.09	10.78	16.87	24.14	15.52	39.66	33.15	18.82	51.97	48.09	23.20	71.29	60.99	30.88	91.87	1:27:23
1:32:31	0.34	1.66	2.00	0.57	5.35	5.92	0.48	4.23	4.71	0.56	5.91	6.47	6.50	8.24	14.74	21.24	11.94	33.18	28.44	14.53	42.97	39.63	17.95	57.58	57.47	23.99	81.46	1:32:31
1:37:40	0.34	1.21	1.55	0.57	3.91	4.48	0.48	3.08	3.56	0.56	4.33	4.89	6.52	6.08	12.60	18.45	8.88	27.33	24.18	10.84	35.02	32.66	13.44	46.10	56.42	18.05	74.47	1:37:40
1:42:48	0.34	0.94	1.28	0.57	2.98	3.55	0.48	2.36	2.84	0.57	3.30	3.87	6.33	4.60	10.93	16.01	6.68	22.69	20.62	8.13	28.75	27.16	10.06	37.22	47.92	13.44	61.36	1:42:48
1:47:56	0.34	0.77	1.11	0.57	2.44	3.01	0.48	1.93	2.41	0.57	2.69	3.26	6.03	3.74	9.77	13.95	5.39	19.34	17.71	6.55	24.26	22.88	8.07	30.95	38.21	10.74	48.95	1:47:56
1:53:05	0.34	0.66	1.00	0.57	2.06	2.63	0.49	1.63	2.12	0.57	2.27	2.84	5.71	3.15	8.86	12.24	4.55	16.79	15.36	5.51	20.87	19.53	6.79	26.32	31.26	9.02	40.28	1:53:05
1:58:13	0.34	0.58	0.92	0.58	1.80	2.38	0.49	1.43	1.92	0.57	1.99	2.56	5.37	2.75	8.12	10.82	3.96	14.78	13.46	4.29	17.75	16.90	5.90	22.80	26.17	7.83	34.00	1:58:13
2:03:22	0.34	0.52	0.86	0.58	1.62	2.20	0.49	1.29	1.78	0.57	1.78	2.35	5.00	2.47	7.47	9.57	3.55	13.12	10.25	3.93	14.18	14.67	5.27	19.94	22.14	6.98	29.12	2:03:22
2:08:30	0.34	0.48	0.82	0.58	1.49	2.07	0.49	1.18	1.67	0.58	1.64	2.22	4.57	2.27	6.84	8.37	3.25	11.62	8.85	2.93	11.78	12.63	4.83	17.46	18.64	6.39	25.03	2:08:30
2:13:38	0.34	0.35	0.69	0.58	1.09	1.67	0.49	0.87	1.36	0.58	1.21	1.79	4.13	1.67	5.80	7.28	2.41	9.69	7.62	2.12	9.74	10.80	3.61	14.41	15.63	4.82	20.45	2:13:38
2:18:47	0.34	0.26	0.60	0.58	0.80	1.38	0.49	0.64	1.13	0.58	0.88	1.46	3.70	1.22	4.92	6.32	1.75	8.07	6.56	1.57	8.13	9.22	2.61	11.83	13.11	3.48	16.59	2:18:47
2:23:55	0.34	0.19	0.53	0.58	0.59	1.17	0.49	0.47	0.96	0.58	0.65	1.23	3.31	0.90	4.21	5.48	1.29	6.77	5.65	1.17	6.82	7.88	1.93	9.81	11.01	2.58	13.59	2:23:55
2:29:04	0.34	0.14	0.48	0.58	0.43	1.01	0.49	0.35	0.84	0.58	0.48	1.06	2.95	0.67	3.62	4.76	0.96	5.72	4.88	0.85	5.73	6.74	1.44	8.18	9.28	1.92	11.20	2:29:04
2:34:12	0.34	0.10	0.44	0.58	0.31	0.89	0.49	0.25	0.74	0.58	0.35	0.93	2.63	0.48	3.11	4.14	0.50	4.64	4.23	0.61	4.84	5.77	1.05	6.82	7.84	1.41	9.25	2:34:12
2:39:20	0.34	0.07	0.41	0.58	0.22	0.80	0.49	0.18	0.67	0.58	0.25	0.83	2.35	0.35	2.70	3.61	0.36	3.97	3.67	0.44	4.11	4.96	0.76	5.72	6.65	1.02	7.67	2:39:20
2:44:29	0.34	0.05	0.39	0.58	0.16	0.74	0.49	0.13	0.62	0.58	0.18	0.76	2.10	0.25	2.35	3.16	0.25	3.41	3.20	0.31	3.51	4.28	0.55	4.83	5.65	0.74	6.39	2:44:29
0:02:49	0.34	0.03	0.37	0.58	0.11	0.69	0.49	0.09	0.58	0.58	0.12	0.70	1.88	0.17	2.05	2.77	0.16	2.93	2.80	0.20	3.00	3.70	0.39	4.09	4.83	0.52	5.35	0:02:49
2:54:46	0.34	0.02	0.36	0.58	0.07	0.65	0.49	0.05	0.54	0.58	0.08	0.66	1.69	0.11	1.80	2.44	0.09	2.53	2.45	0.11	2.56	3.21	0.14	3.35	4.13	0.34	4.47	2:54:46
2:59:54	0.34	0.01	0.35	0.58	0.04	0.62	0.49	0.03	0.52	0.57	0.04	0.61	1.52	0.06	1.58	2.15	0.04	2.19	2.16	0.05	2.21	2.80	0.07	2.87	3.55	0.20	3.75	2:59:54
3:05:02	0.34	0.00	0.34	0.58	0.01	0.59	0.49	0.01	0.50	0.57	0.02	0.59	1.38	0.03	1.41	1.91	0.01	1.92	1.92	0.01	1.93	2.45	0.02	2.47	3.07	0.09	3.16	3:05:02
3:10:11	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.57	0.00	0.57	1.25	0.01	1.26	1.71	0.00	1.71	1.17	0.00	1.17	2.16	0.00	2.16	2.67	0.03	2.70	3:10:11
3:15:19	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	1.14	0.00	1.14	1.53	0.00	1.53	1.54	0.00	1.54	1.91	0.00	1.91	2.34	0.00	2.34	3:15:19
3:20:28	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	1.05	0.00	1.05	1.39	0.00	1.39	1.39	0.00	1.39	1.71	0.00	1.71	2.07	0.00	2.07	3:20:28
3:25:36	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.97	0.00	0.97	1.26	0.00	1.26	1.26	0.00	1.26	1.53	0.00	1.53	1.84	0.00	1.84	3:25:36
3:30:44	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.90	0.00	0.90	1.15	0.00	1.15	1.15	0.00	1.15	1.39	0.00	1.39	1.64	0.00	1.64	3:30:44
3:35:53	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.84	0.00	0.84	1.06	0.00	1.06	1.06	0.00	1.06	1.26	0.00	1.26	1.48	0.00	1.48	3:35:53
3:41:01	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.74	0.00	0.74	0.98	0.00	0.98	0.98	0.00	0.98	1.15	0.00	1.15	1.34	0.00	1.34	3:41:01
3:46:10	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.71	0.00	0.71	0.90	0.00	0.90	0.91	0.00	0.91	1.06	0.00	1.06	1.22	0.00	1.22	3:46:10
3:51:18	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.67	0.00	0.67	0.85	0.00	0.85	0.85	0.00	0.85	0.98	0.00	0.98	1.12	0.00	1.12	3:51:18
3:56:26	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.65	0.00	0.65	0.79	0.00	0.79	0.79	0.00	0.79	0.90	0.00	0.90	1.03	0.00	1.03	3:56:26
4:01:35	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.63	0.00	0.63	0.75	0.00	0.75	0.75	0.00	0.75	0.85	0.00	0.85	0.95	0.00	0.95	4:01:35
4:06:43	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.61	0.00	0.61	0.71	0.00	0.71	0.71	0.00	0.71	0.79	0.00	0.79	0.88	0.00	0.88	4:06:43
4:11:52	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.59	0.00	0.59	0.67	0.00	0.67	0.67	0.00	0.67	0.75	0.00	0.75	0.83	0.00	0.83	4:11:52
4:17:00	0.34	0.00	0.34	0.57	0.00	0.57	0.48	0.00	0.48	0.57	0.00	0.57	0.59	0.00	0.59	0.65	0.00	0.65	0.65	0.00	0.65	0.71	0.00	0.71	0.77	0.00	0.77	4:17:00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd RV Park

Basin ID: Pond 1 + 2 in Series



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	30.35	acres
Watershed Length =	1,600	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	46.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	0.501	acre-feet
Excess Urban Runoff Volume (EURV) =	1.514	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.213	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.665	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.283	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.250	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.915	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.786	acre-feet
500-yr Runoff Volume (P1 = 3.01 in.) =	6.293	acre-feet
Approximate 2-yr Detention Volume =	1.135	acre-feet
Approximate 5-yr Detention Volume =	1.564	acre-feet
Approximate 10-yr Detention Volume =	2.093	acre-feet
Approximate 25-yr Detention Volume =	2.303	acre-feet
Approximate 50-yr Detention Volume =	2.411	acre-feet
Approximate 100-yr Detention Volume =	2.711	acre-feet

Optional User Override 1-hr Precipitation	
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.01	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.501	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.013	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.197	acre-feet
Total Detention Basin Volume =	2.711	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{Total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
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

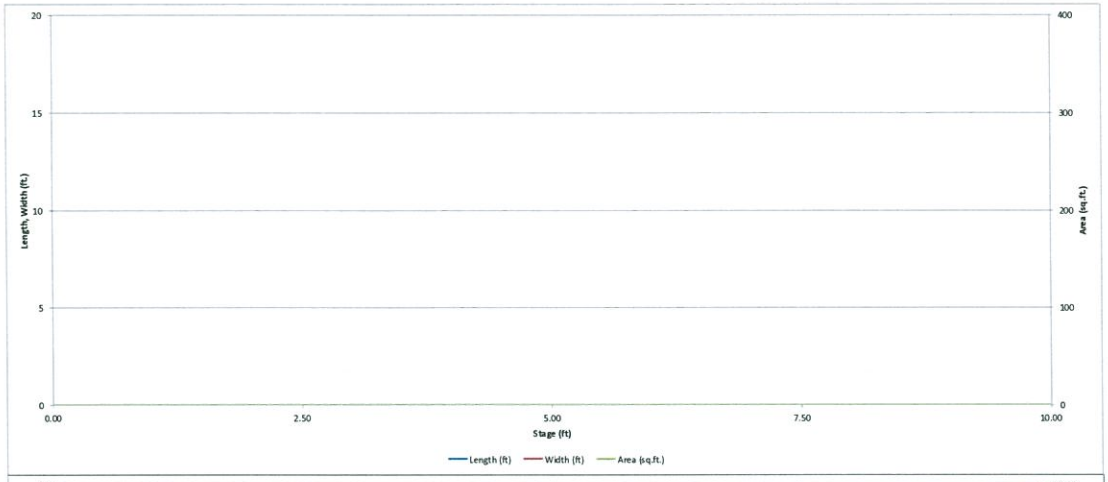
Depth Increment = 0.1 ft

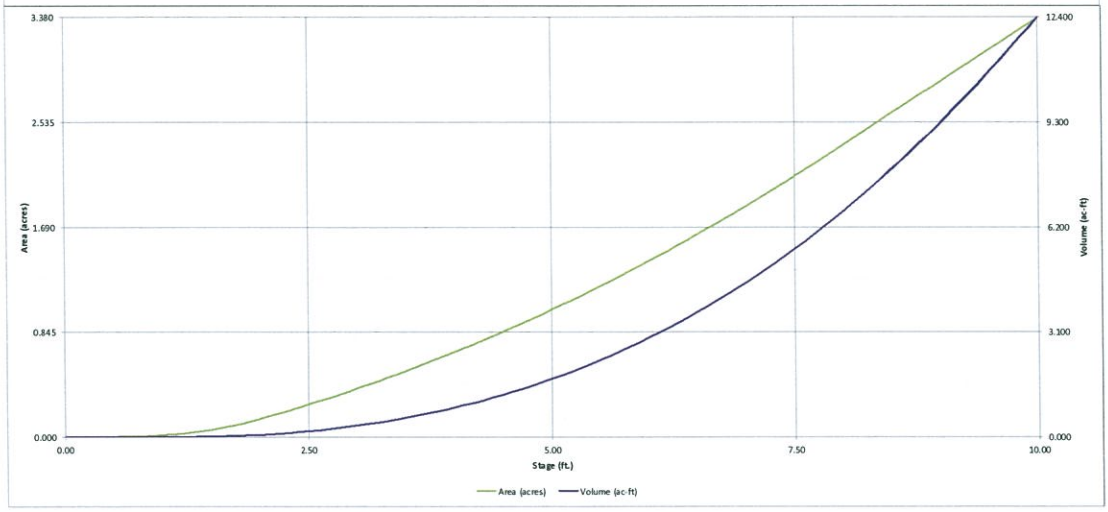
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
ISV	--	0.33	--	--	--	30	0.001	10	0.000
Floor	--	0.40	--	--	--	46	0.001	12	0.000
	--	0.50	--	--	--	89	0.002	18	0.000
	--	0.60	--	--	--	158	0.004	30	0.001
	--	0.70	--	--	--	254	0.006	50	0.001
	--	0.80	--	--	--	376	0.009	80	0.002
	--	0.90	--	--	--	525	0.012	124	0.003
	--	1.00	--	--	--	698	0.016	183	0.004
	--	1.10	--	--	--	921	0.021	262	0.006
	--	1.20	--	--	--	1,220	0.028	366	0.008
	--	1.30	--	--	--	1,596	0.037	503	0.012
	--	1.40	--	--	--	2,048	0.047	681	0.016
	--	1.50	--	--	--	2,577	0.059	907	0.021
	--	1.60	--	--	--	3,182	0.073	1,189	0.027
	--	1.70	--	--	--	3,864	0.089	1,534	0.035
	--	1.80	--	--	--	4,622	0.106	1,951	0.045
	--	1.90	--	--	--	5,457	0.125	2,447	0.056
	--	2.00	--	--	--	6,368	0.146	3,029	0.070
	--	2.10	--	--	--	7,328	0.168	3,777	0.087
	--	2.20	--	--	--	8,311	0.191	4,559	0.105
	--	2.30	--	--	--	9,314	0.214	5,440	0.125
	--	2.40	--	--	--	10,340	0.237	6,423	0.147
	--	2.50	--	--	--	11,387	0.261	7,509	0.172
	--	2.60	--	--	--	12,456	0.286	8,701	0.200
	--	2.70	--	--	--	13,546	0.311	10,001	0.230
	--	2.80	--	--	--	14,659	0.337	11,412	0.262
	--	2.90	--	--	--	15,793	0.363	12,934	0.297
	--	3.00	--	--	--	16,948	0.389	14,571	0.335
	--	3.10	--	--	--	18,126	0.416	16,325	0.375
	--	3.20	--	--	--	19,325	0.444	18,198	0.418
	--	3.30	--	--	--	20,545	0.472	20,191	0.464
Zone 1(WQCV)	--	3.40	--	--	--	21,788	0.500	22,308	0.512
	--	3.50	--	--	--	23,052	0.529	24,550	0.564
	--	3.60	--	--	--	24,338	0.559	26,919	0.618
	--	3.70	--	--	--	25,645	0.589	29,418	0.675
	--	3.80	--	--	--	26,975	0.619	32,049	0.736
	--	3.90	--	--	--	28,326	0.650	34,814	0.799
	--	4.00	--	--	--	29,698	0.682	37,716	0.866
	--	4.10	--	--	--	31,093	0.714	40,755	0.936
	--	4.20	--	--	--	32,509	0.746	43,935	1.009
	--	4.30	--	--	--	33,946	0.779	47,258	1.085
	--	4.40	--	--	--	35,406	0.813	50,725	1.164
	--	4.50	--	--	--	36,887	0.847	54,340	1.247
	--	4.60	--	--	--	38,390	0.881	58,104	1.334
	--	4.70	--	--	--	39,914	0.916	62,019	1.424
Zone 2(EURV)	--	4.80	--	--	--	41,461	0.952	66,088	1.517
	--	4.90	--	--	--	43,029	0.988	70,312	1.614
	--	5.00	--	--	--	44,618	1.024	74,695	1.715
	--	5.10	--	--	--	46,230	1.061	79,237	1.819
	--	5.20	--	--	--	47,863	1.099	83,942	1.927
	--	5.30	--	--	--	49,517	1.137	88,811	2.039
	--	5.40	--	--	--	51,194	1.175	93,846	2.154
	--	5.50	--	--	--	52,892	1.214	99,051	2.274
	--	5.60	--	--	--	54,612	1.254	104,426	2.397
	--	5.70	--	--	--	56,353	1.294	109,974	2.525
	--	5.80	--	--	--	58,117	1.334	115,698	2.656
Zone 3 (100-year)	--	5.90	--	--	--	59,902	1.375	121,598	2.792
	--	6.00	--	--	--	61,708	1.417	127,679	2.931
	--	6.10	--	--	--	63,537	1.459	133,941	3.075
	--	6.20	--	--	--	65,387	1.501	140,387	3.223
	--	6.30	--	--	--	67,258	1.544	147,020	3.375
	--	6.40	--	--	--	69,152	1.588	153,840	3.532
	--	6.50	--	--	--	71,067	1.631	160,851	3.693
	--	6.60	--	--	--	73,004	1.676	168,055	3.858
	--	6.70	--	--	--	74,962	1.721	175,453	4.028
	--	6.80	--	--	--	76,943	1.766	183,048	4.202
	--	6.90	--	--	--	78,945	1.812	190,843	4.381
	--	7.00	--	--	--	80,968	1.859	198,838	4.565
	--	7.10	--	--	--	83,014	1.906	207,037	4.753
	--	7.20	--	--	--	85,081	1.953	215,442	4.946
	--	7.30	--	--	--	87,169	2.001	224,055	5.144
	--	7.40	--	--	--	89,280	2.050	232,877	5.346
	--	7.50	--	--	--	91,412	2.099	241,912	5.554
	--	7.60	--	--	--	93,566	2.148	251,160	5.766
	--	7.70	--	--	--	95,741	2.198	260,626	5.983
	--	7.80	--	--	--	97,939	2.248	270,310	6.205
	--	7.90	--	--	--	100,158	2.299	280,215	6.433
	--	8.00	--	--	--	102,378	2.350	290,341	6.665
	--	8.10	--	--	--	104,598	2.401	300,690	6.903
	--	8.20	--	--	--	106,818	2.452	311,261	7.146
	--	8.30	--	--	--	109,038	2.503	322,054	7.393
	--	8.40	--	--	--	111,258	2.554	333,068	7.646
	--	8.50	--	--	--	113,478	2.605	344,305	7.904
	--	8.60	--	--	--	115,698	2.656	355,764	8.167
	--	8.70	--	--	--	117,918	2.707	367,445	8.435
	--	8.80	--	--	--	120,138	2.758	379,347	8.709
	--	8.90	--	--	--	122,358	2.809	391,472	8.987
	--	9.00	--	--	--	124,578	2.860	403,819	9.270
	--	9.10	--	--	--	126,798	2.911	416,388	9.559
	--	9.20	--	--	--	129,018	2.962	429,178	9.853
	--	9.30	--	--	--	131,238	3.013	442,191	10.151
	--	9.40	--	--	--	133,458	3.064	455,426	10.455
	--	9.50	--	--	--	135,678	3.115	468,883	10.764
	--	9.60	--	--	--	137,898	3.166	482,562	11.078
	--	9.70	--	--	--	140,118	3.217	496,462	11.397
	--	9.80	--	--	--	142,338	3.268	510,585	11.721
	--	9.90	--	--	--	144,558	3.319	524,930	12.051
	--	10.00	--	--	--	146,778	3.370	539,497	12.385

Revise the Pond 2 stage-storage based on the constructed pond shape shown on the GEC plan and not the computer generated values. Input the values in the "optional overrid stage/area".

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





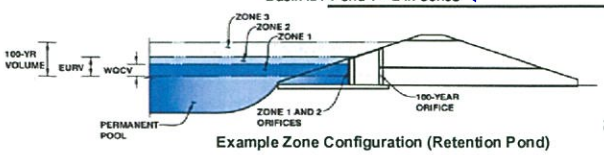
Update title. Staff assumes this is Pond 2 design (w/ Pond 1 & 2 in a series).

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd RV Park

Basin ID: Pond 1 + 2 in Series



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.38	0.501	Orifice Plate
Zone 2 (EURV)	4.80	1.013	Orifice Plate
Zone 3 (100-year)	5.85	1.197	Weir&Pipe (Restrict)
		2.711	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.64	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	22.60	inches
Orifice Plate: Orifice Area per Row =	2.41	sq. inches (diameter = 1-3/4 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.674E-02	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.88	3.76					
Orifice Area (sq. inches)	2.41	2.41	2.41					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.00	N/A	feet
Over Flow Weir Slope Length =	6.32	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.92	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	17.71	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.85	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.56	N/A	ft^2
Outlet Orifice Centroid =	0.74	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.60	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.92	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.95	feet
Stage at Top of Freeboard =	10.87	feet
Basin Area at Top of Freeboard =	3.37	acres

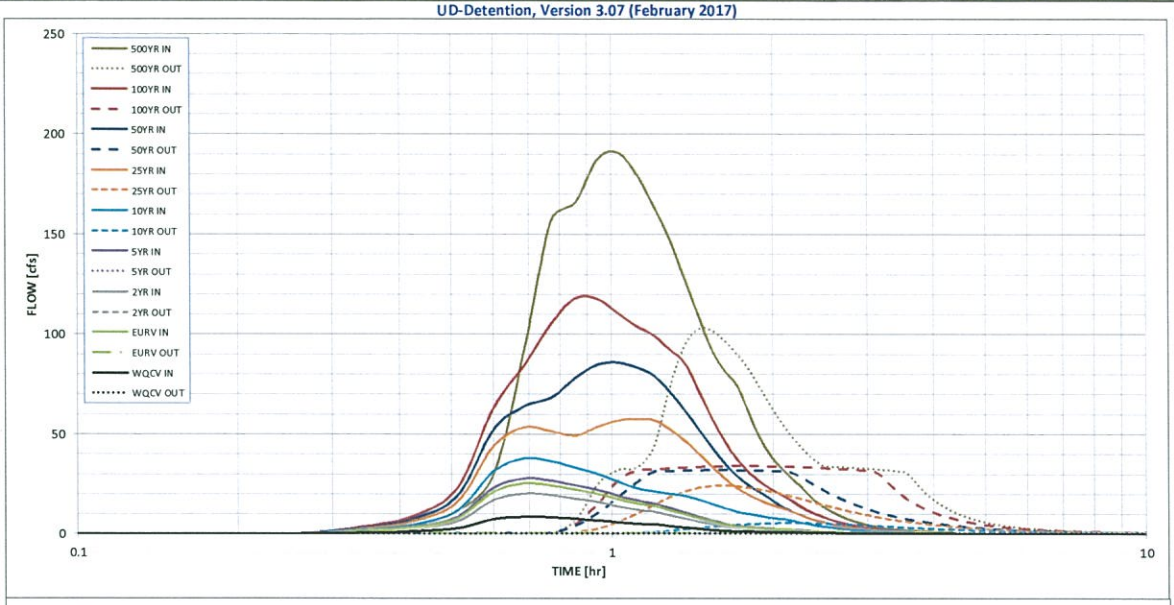
Routed Hydrograph Results

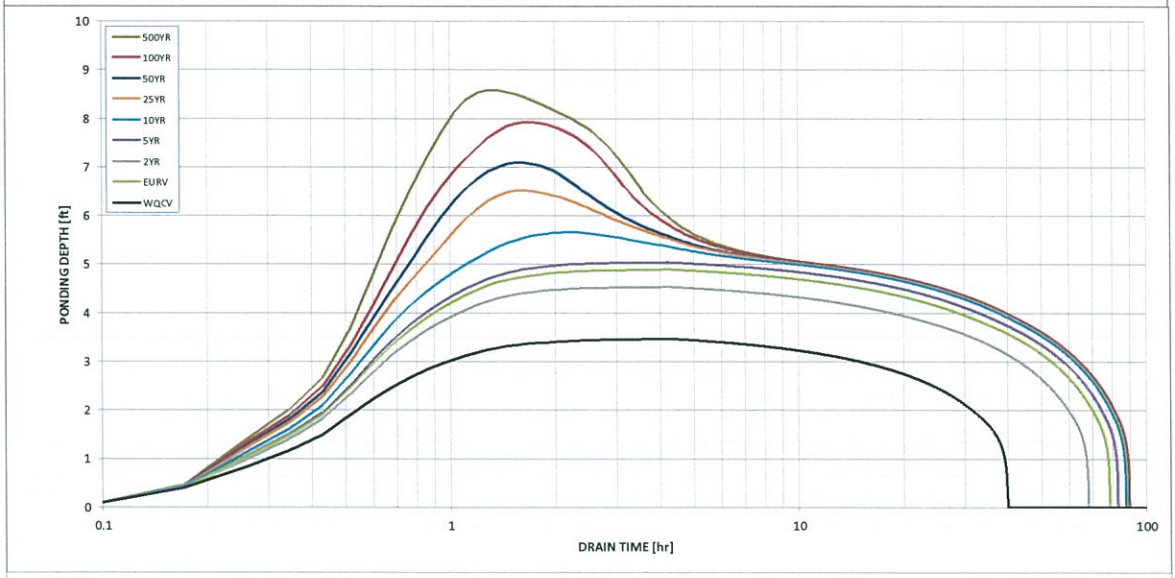
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.01
Calculated Runoff Volume (acre-ft) =	0.501	1.514	1.213	1.665	2.283	3.250	3.915	4.786	6.293
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.624	1.724	1.389	1.876	3.076	5.722	7.576	10.152	15.384
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.91	1.23	1.74
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.6	6.1	20.0	27.7	37.3	52.8
Peak Inflow Q (cfs) =	8.6	25.1	20.2	27.5	37.6	57.2	85.7	117.6	190.8
Peak Outflow Q (cfs) =	0.3	0.4	0.4	0.5	5.4	23.9	31.8	33.7	102.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.9	1.2	1.1	0.9	1.9
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	1.3	1.8	1.9	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	72	63	76	77	73	69	66	58
Time to Drain 99% of Inflow Volume (hours) =	39	76	66	80	83	81	79	78	75
Maximum Ponding Depth (ft) =	3.47	4.89	4.54	5.03	5.65	6.51	7.08	7.91	8.58
Area at Maximum Ponding Depth (acres) =	0.52	0.98	0.86	1.04	1.27	1.63	1.90	2.30	2.65
Maximum Volume Stored (acre-ft) =	0.543	1.594	1.273	1.746	2.460	3.693	4.715	6.456	8.114

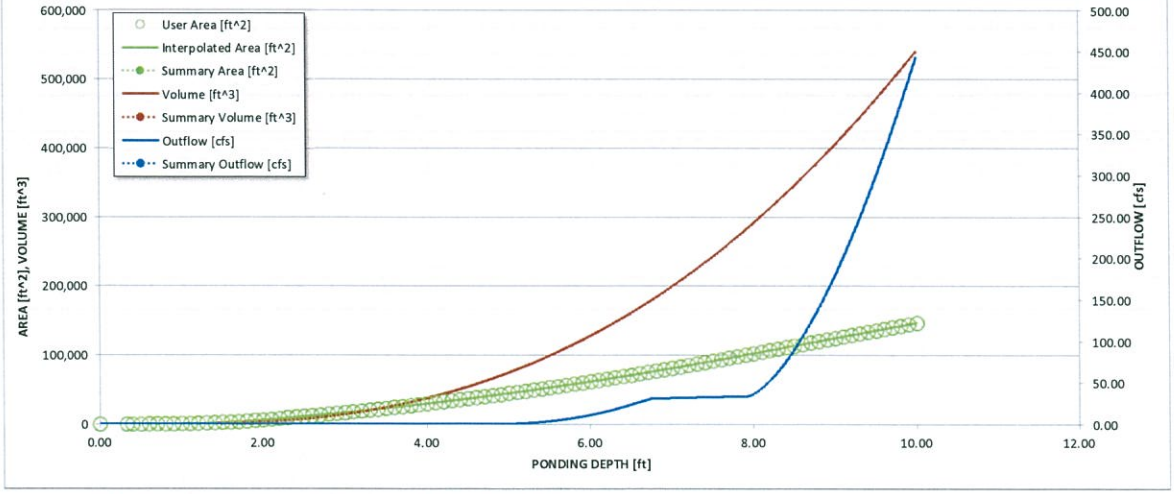
Revise. Drain time is not in compliance with senate bill 15-212 (must be less than or equal to 72 hours.

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.

User-Defined	SOURCE	USER	USER	USER	USER	USER	USER	USER	USER	USER
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]
5.14 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:25	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.16
0.993	0:20:34	0.51	1.25	1.01	1.35	1.78	2.43	2.85	3.38	4.22
	0:25:42	1.17	3.15	2.56	3.43	4.59	6.37	7.56	9.08	11.68
	0:30:50	2.81	7.81	6.33	8.50	11.49	16.08	19.15	23.04	29.55
	0:35:59	7.28	20.90	16.89	22.88	31.02	43.50	51.85	62.46	91.46
	0:41:07	8.57	25.13	20.18	27.50	37.55	53.05	63.65	84.08	156.30
	0:46:16	8.20	24.10	19.32	26.40	36.03	50.97	68.04	104.84	165.48
	0:51:24	7.50	22.00	17.66	24.10	32.87	48.99	78.00	117.61	187.07
	0:56:32	6.72	19.81	15.90	21.70	29.61	53.41	84.64	117.36	190.83
	1:01:41	5.85	17.26	13.84	18.92	25.86	56.38	85.69	110.33	180.22
	1:06:49	5.14	15.09	12.11	16.52	22.59	57.21	83.19	103.84	164.13
	1:11:58	4.70	13.74	11.04	15.05	21.18	56.62	79.02	99.18	147.38
	1:17:06	3.93	11.53	9.25	12.63	19.95	52.02	70.68	92.06	127.26
	1:22:14	3.26	9.60	7.68	10.51	18.78	46.32	61.63	85.38	108.55
	1:27:23	2.58	7.62	6.09	8.35	16.87	39.66	51.97	71.29	91.87
	1:32:31	2.00	5.92	4.71	6.47	14.74	33.18	42.97	57.58	81.46
	1:37:40	1.55	4.48	3.56	4.89	12.60	27.33	35.02	46.10	74.47
	1:42:48	1.28	3.55	2.84	3.87	10.93	22.69	28.75	37.22	61.36
	1:47:56	1.11	3.01	2.41	3.26	9.77	19.34	24.26	30.95	48.95
	1:53:05	1.00	2.63	2.12	2.84	8.86	16.79	20.87	26.32	40.28
	1:58:13	0.89	2.38	1.92	2.56	8.12	14.78	17.75	22.80	34.00
	2:03:22	0.92	2.20	1.78	2.35	7.47	13.12	14.18	19.94	29.12
	2:08:30	0.86	2.07	1.67	2.22	6.84	11.62	11.78	17.46	25.03
	2:13:38	0.82	1.67	1.36	1.79	5.80	9.69	9.74	14.41	20.45
	2:18:47	0.69	1.38	1.13	1.46	4.92	8.07	8.13	11.83	16.59
	2:23:55	0.60	1.17	0.96	1.23	4.21	6.77	6.82	9.81	13.59
	2:29:04	0.53	1.01	0.84	1.06	3.62	5.72	5.73	8.18	11.20
	2:34:12	0.48	0.89	0.74	0.93	3.11	4.64	4.84	6.82	9.25
	2:39:20	0.44	0.80	0.67	0.83	2.70	3.97	4.11	5.72	7.67
	2:44:29	0.41	0.74	0.62	0.76	2.35	3.41	3.51	4.83	6.39
	2:49:37	0.39	0.69	0.58	0.70	2.05	2.93	3.00	4.09	5.35
	2:54:46	0.37	0.65	0.54	0.66	1.80	2.53	2.56	3.35	4.47
	2:59:54	0.36	0.62	0.52	0.61	1.58	2.19	2.21	2.87	3.75
	3:05:02	0.35	0.59	0.50	0.59	1.41	1.92	1.93	2.47	3.16
	3:10:11	0.34	0.58	0.49	0.57	1.26	1.71	1.17	2.16	2.70
	3:15:19	0.34	0.57	0.48	0.57	1.14	1.53	1.54	1.91	2.34
	3:20:28	0.34	0.57	0.48	0.57	1.05	1.39	1.39	1.71	2.07
	3:25:36	0.34	0.57	0.48	0.57	0.97	1.26	1.26	1.53	1.84
	3:30:44	0.34	0.57	0.48	0.57	0.90	1.15	1.15	1.39	1.64
	3:35:53	0.34	0.57	0.48	0.57	0.84	1.06	1.06	1.26	1.48
	3:41:01	0.34	0.57	0.48	0.57	0.74	0.98	0.98	1.15	1.34
	3:46:10	0.34	0.57	0.48	0.57	0.71	0.90	0.91	1.06	1.22
	3:51:18	0.34	0.57	0.48	0.57	0.67	0.85	0.85	0.98	1.12
	3:56:26	0.34	0.57	0.48	0.57	0.65	0.79	0.79	0.90	1.03
	4:01:35	0.34	0.57	0.48	0.57	0.63	0.75	0.75	0.85	0.95
	4:06:43	0.34	0.57	0.48	0.57	0.61	0.71	0.71	0.79	0.88
	4:11:52	0.34	0.57	0.48	0.57	0.59	0.67	0.67	0.75	0.83
	4:17:00	0.34	0.57	0.48	0.57	0.59	0.65	0.65	0.71	0.77
	4:22:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:28:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:39:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:44:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:49:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:04:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:10:05	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

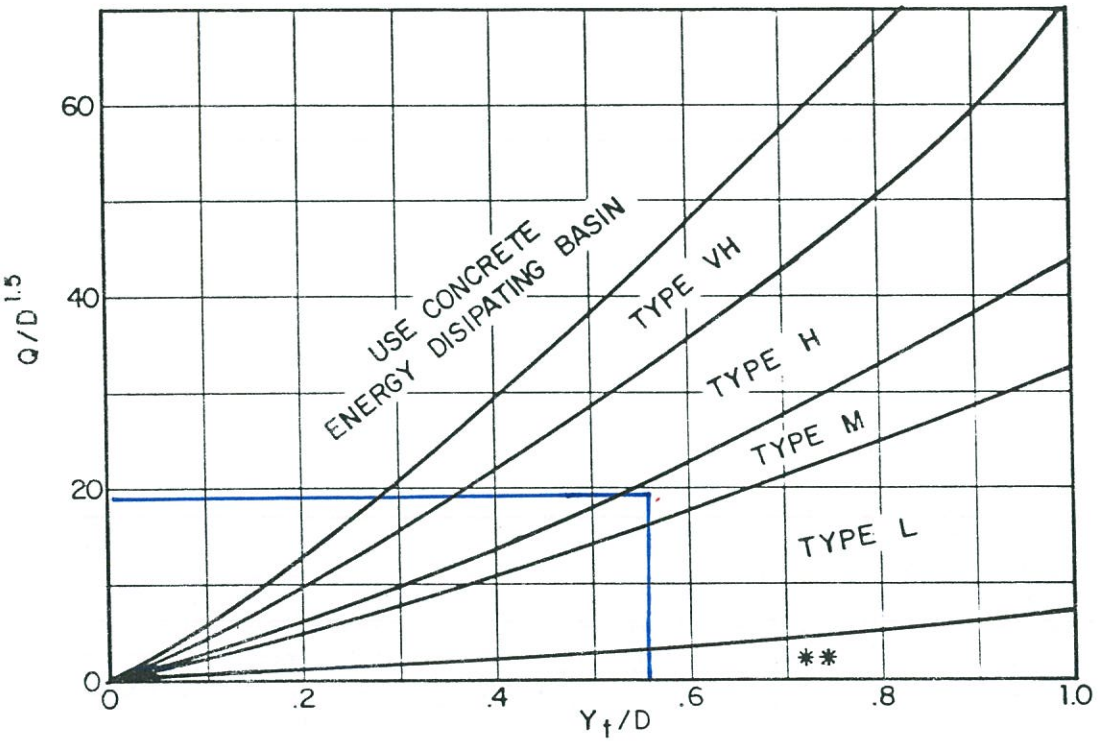
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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).



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

FOR POND 2 OUTLET PIPE

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

PROJECT: Judge Orr Rd DP Pond
CULVERT AT DP1

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MNS / 5/21/15

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

SEE ADD'L SHTS.

☒ METHOD: RATIONAL

☐ DRAINAGE AREA: 44.22 ☐ STREAM SLOPE

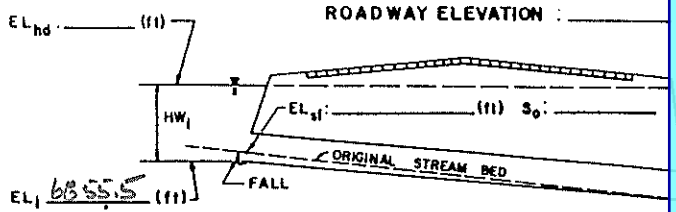
☐ CHANNEL SHAPE: TRAP

☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
100	54.3	

ROADWAY ELEVATION: _____ (ft)



$S = S_o - FALL / L_a$

$S =$ _____

$L_a =$ _____

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	INLET CONTROL HW_i	OUTLET CONTROL TW (5)	OUTLET CONTROL d_c	OUTLET CONTROL (d_c+D)/2	OUTLET CONTROL h_o (6)	OUTLET CONTROL h_e	OUTLET CONTROL H (7)	OUTLET CONTROL EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET
HDPE 30" w/FES	54.3	54.3	2.5	6.25								6175	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[(1 + k_e)(29 n^2 L) / R^{1.33} \right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

e. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

Update. Drainage map notes 57.3 cfs

Per DCM Table 6-5, Hw/D must be less than 1.5

Provide the analysis for overtopping on a Major Storm. Must meet the criteria per Table 6-1 & Table 6-4: Where cross pans are allowed, the depth of flow shall not exceed 12 inches at the flowline.

REFERENCE: Federal Highway Administration, Hydraulic Design of Highway Culverts; Hydraulic Design Series No. 5 1985

9-72

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Drainage Criteria Manual

Date
OCT. 1987

Figure
9-44

PROJECT: JUDGE ORR RD RV PARK
WEST CULVERT

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MAB / 5/21/15

REVIEWER / DATE: _____ / _____

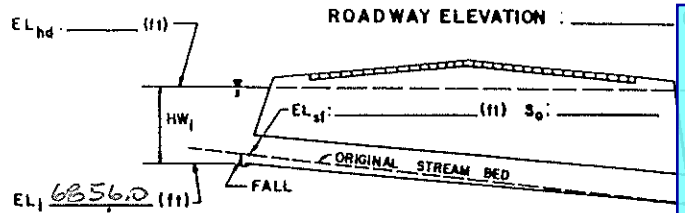
HYDROLOGICAL DATA

SEE ADD'L RMTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 31.39 ☐ STREAM SLOPE: 1.8%
- ☐ CHANNEL SHAPE: TRAP.
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	16.3	0.9



$S = S_o - FALL / L_a$

S = 0.01

L_a = 60

Provide the analysis for overtopping on a Major Storm (per drainage map Q=59.6cfs). Must meet the criteria per Table 6-1 & Table 6-4: Depth of flow shall not exceed 6 inches at the edge of the road shoulder. Similar comment for the east culvert.

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET
RCEP - 38"X24"W/FES	16.3	16.3	0.81	1.62		56.0	0.9	1.36	1.68	1.68	0.2	0.4	57.48	57.48	6.

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

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Date
OCT. 1987

Figure
9-44

REFERENCE: Federal Highway Administration, Hydraulic Design of Highway Culverts; Hydraulic Design Series No. 5 1985

9-72

PROJECT: Judge Orr Rd RV Park
EAST CULVERT

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MRB / 5/25/18

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

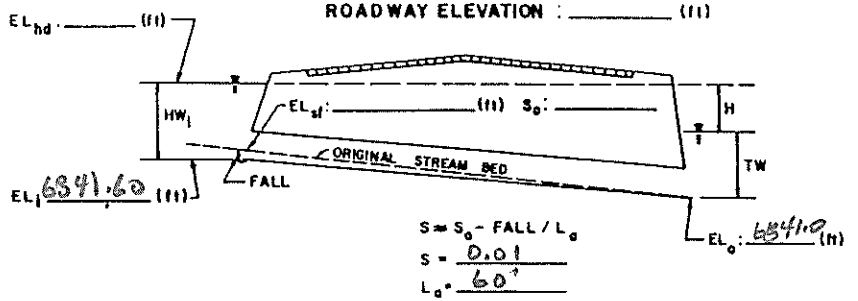
SEE ADD'L SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 33.89 ☐ STREAM SLOPE: 1.8%
- ☐ CHANNEL SHAPE: TRAP
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	16.3	0.9

ROADWAY ELEVATION: _____ (ft)



S = S_o - FALL / L_a

S = 0.01

L_a = 60'

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
RCBP - 58"X24" w/FES	16.3	16.3	0.81	1.62		52.0	0.9	1.36	1.68	1.68	0.2	0.04	43.08	43.22	6.0	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

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Drainage Criteria Manual

Date
OCT. 1987

Figure
9-44

REFERENCE: Federal Highway Administration, Hydraulic Design of Highway Culverts; Hydraulic Design Series No. 5 1985

APPENDIX C

DESIGN CHARTS

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

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.01	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Figure 6-25. Estimate of Average Concentrated Shallow Flow

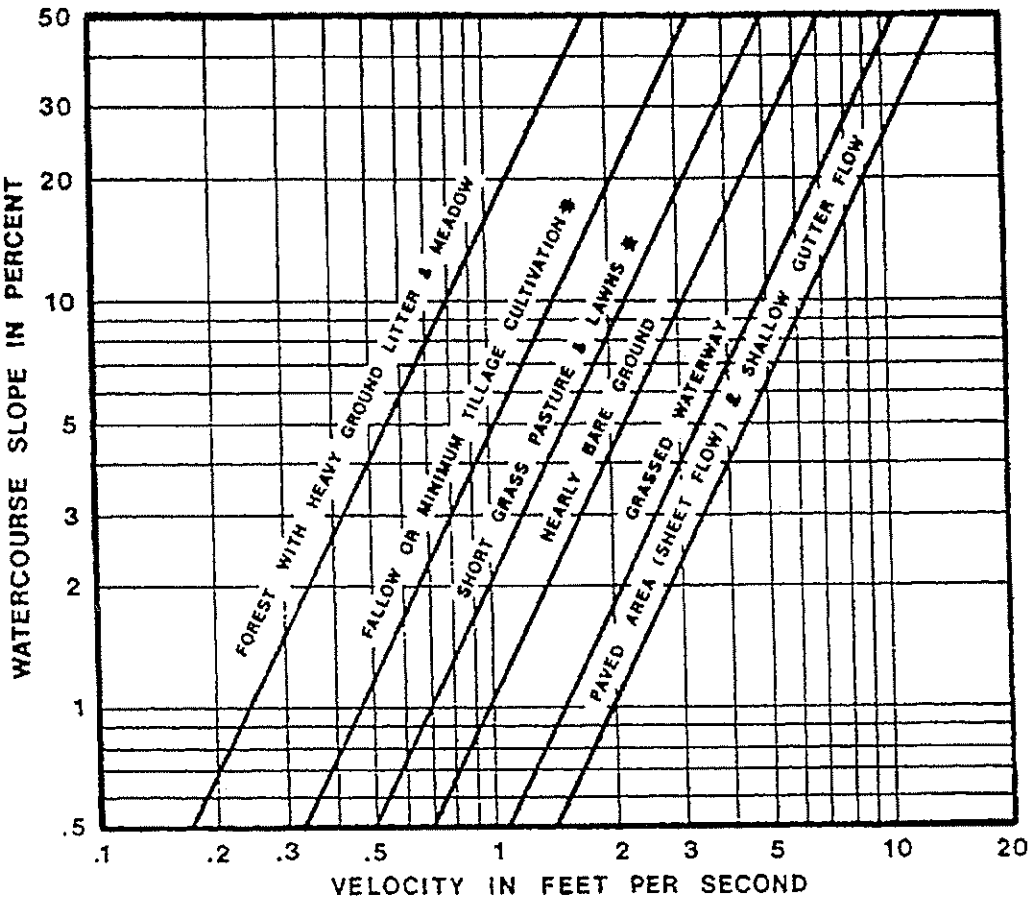
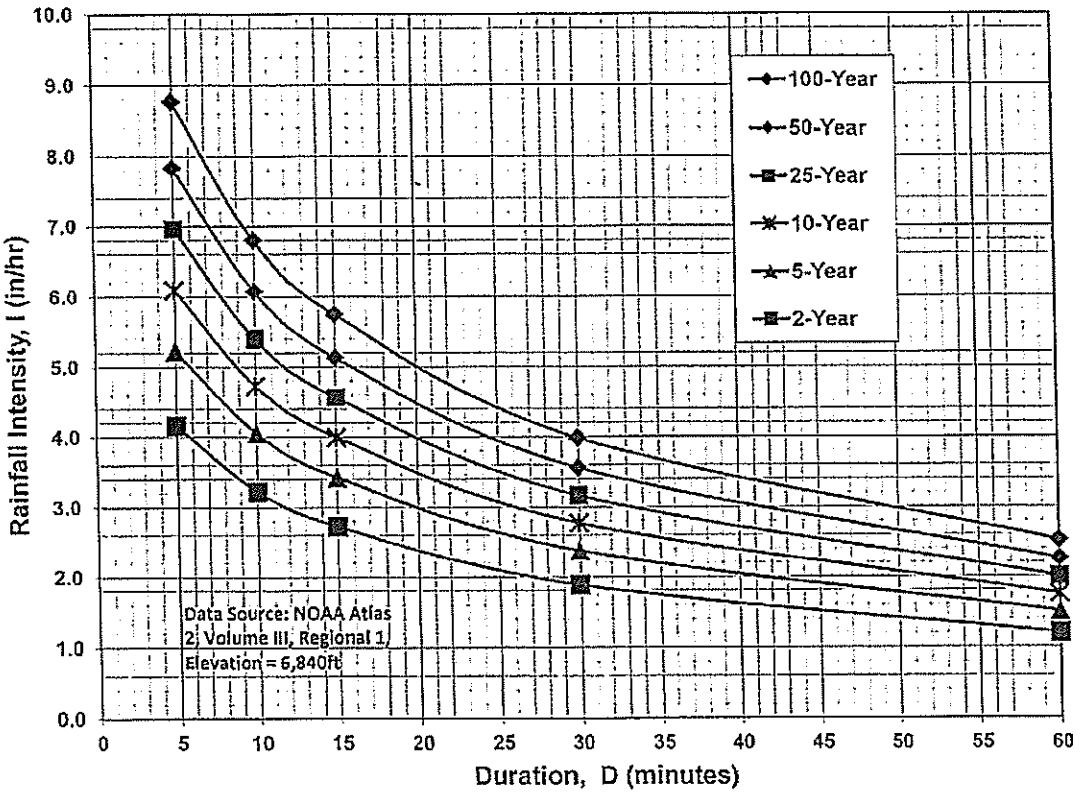


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

$I_{50} = -2.25 \ln(D) + 11.375$

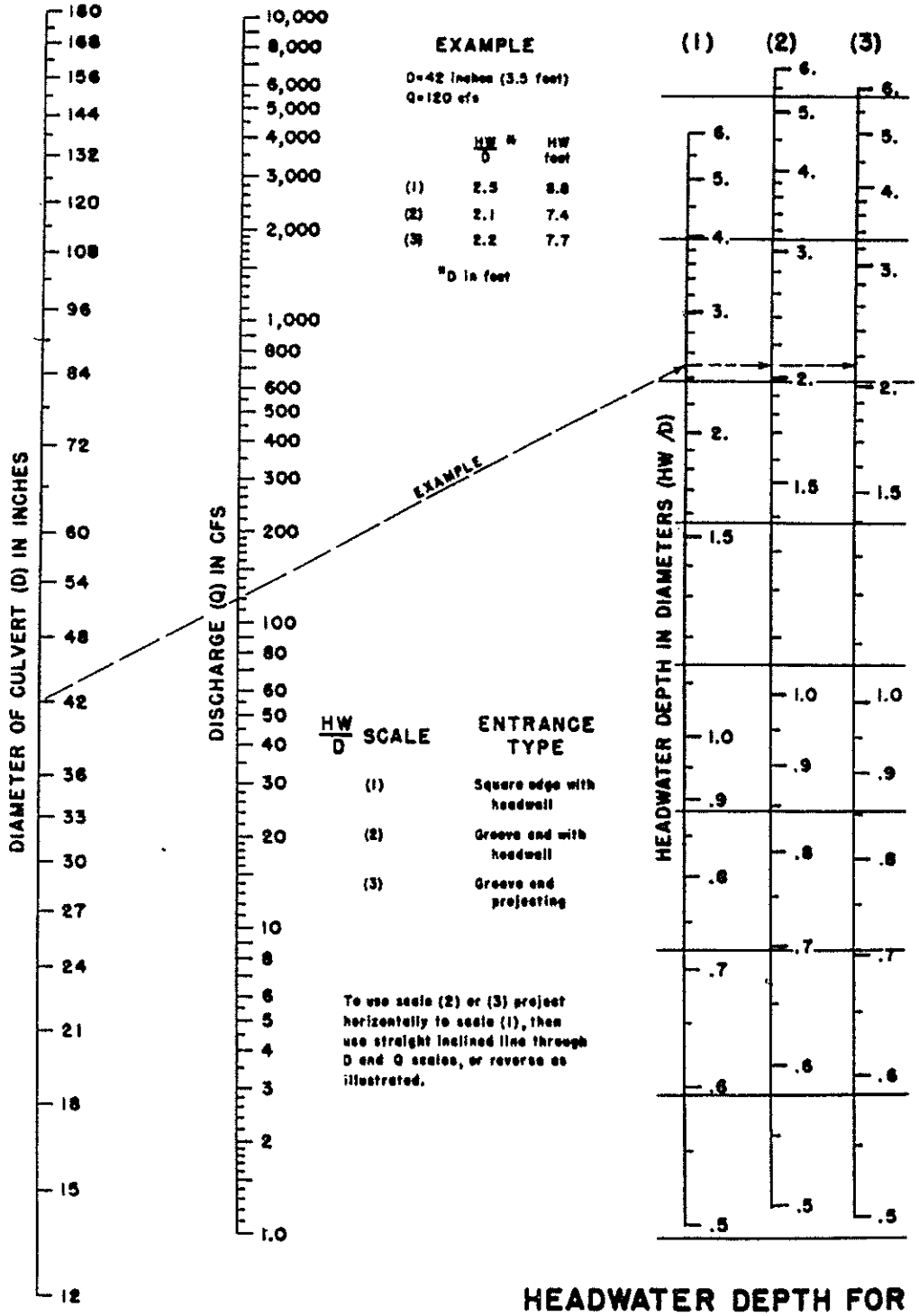
$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

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

$I_{2} = -1.19 \ln(D) + 6.035$

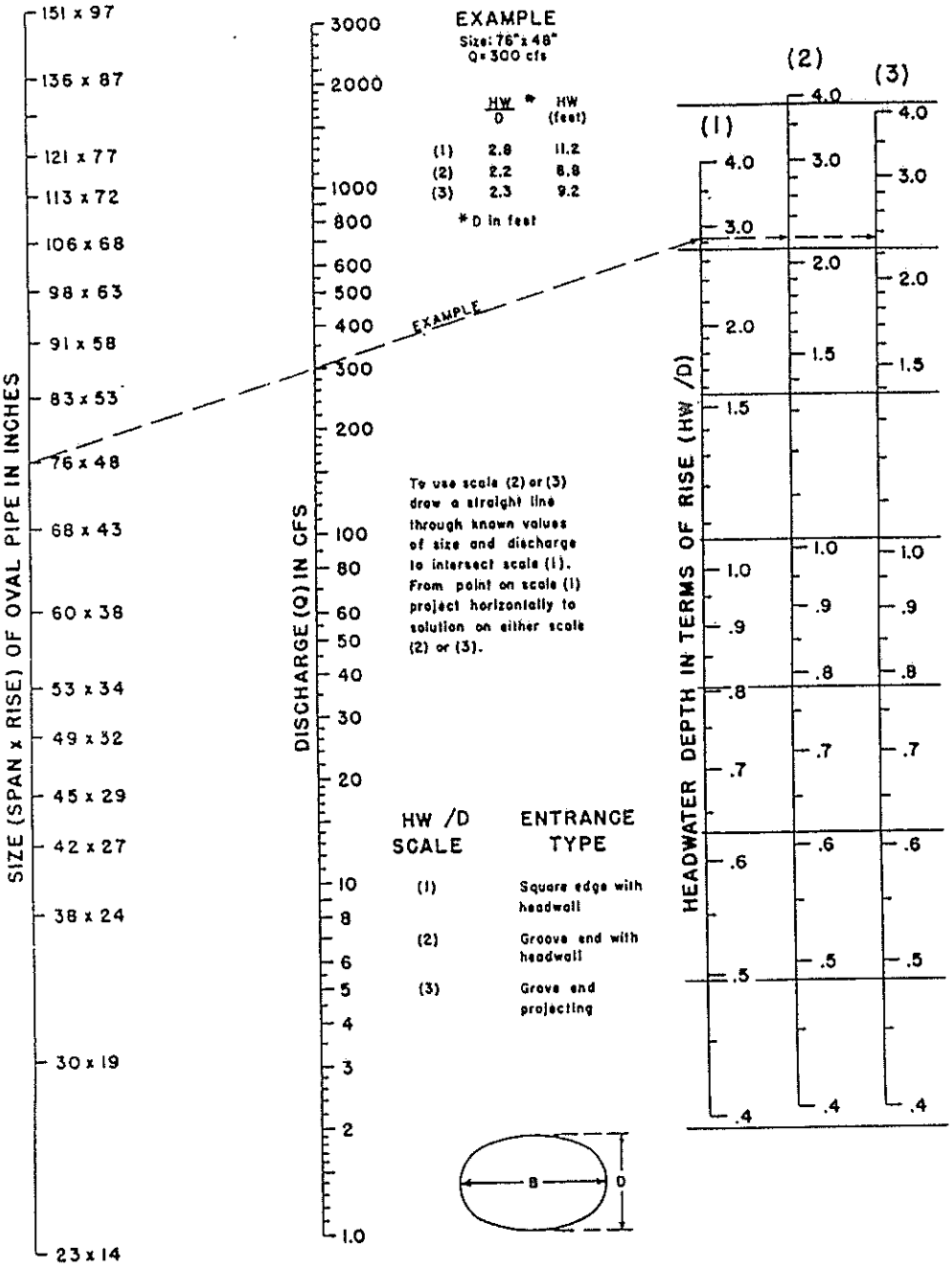
Note: Values calculated by equations may not precisely duplicate values read from figure.



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL



HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

LEGEND

- A1A / XX — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT: XX | XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

MATCHLINE

N

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

FOR CONTINUATION OF BASIN SEE OFF-SITE MAP FOR O-1 IN APPENDIX B

TABLE 1 – EXISTING CONDITIONS		
Sub-Basin	**Q5CFS**	**Q100 CFS**
OS1	1.7	12.9
OS2	3.6	27.1
OS3	17.8	62
OS4	4	30.4
OS5	1.3	3.3
A1	2.2	16.5
A2	3.1	24
A3	1.1	5.3
B	0.2	1.6
DP1 (OS1 + OS2)	4.8	36.7
DP2 (DP1 + A2)	6.6	50.1
DP3 (OS3 + OS4)	20.1	86.7
DP4 (OS5 + A3)	2	7.6
DP5 (DP3 + DP4)	18.9	80.7
DP6 (DP2 + DP4 + A1)	27.1	143.3

1.7 / 12.9 OS1 7.81

1. DP4 should be (DP3 + A3). DP3 flows go through Basin A3. Update the narrative and calculations accordingly.

2. Then DP5 is (DP4 + OS5).

3. DP6 is DP2 + DP5 + A1.

Unresolved 08/08/2018

Will be updated based on the meeting with the design engineer on 8/8/18.

B 0.87 / 0.2 1.6

FLOODPLAIN WETLAND BOUNDARY

A1 11.75 / 2.2 16.5

EXIST 24" CMP

17.8 / 62.0 OS3 27.21

3.6 / 27.1 OS2 22.10

1 4.8 / 36.7

A2 17.47 / 3.1 24

Unresolved 08/08/2018

Extend the drainage map to show the location of DP6.

4.0 / 30.4 OS4 25.14

Adjust the DP3 symbol to show that it continues within the ditch of basin OS5 and update the narrative accordingly.

Per the meeting with the design engineer ofn 8/8/18, DP4 will be removed and DP5 will be located at the diitch and narrative and associated calculation will be updated to clearly show that DP3, OS5 and A3 combines at the existing ditch.

3 20.1 / 86.7

A3 2.80 / 1.1 5.3

1.3 / 3.3 OS5 0.82

2 6.6 / 50.1

4 2.0 / 7.6

5 18.9 / 80.7

6 27.1 / 143.3

MATCHLINE

NO TOPOGRAPHY AVAILABLE BEYOND THIS AREA (SEE OFFSITE DRAINAGE MAP FOR CONTINUATION)

PCD PROJECT NO. PPR-16-040

M:\LAND_PROJECTS\2016\16301--Judge Orr Road RV Park\DWG\16301--Existing Conditions.dwg Jim Wed, 07/25/18 - 12:28 PM

DESIGNED BY MAB
PROJECT ENGINEER MAB
PROJECT MANAGER MAB
SCALE HORZ. 1" = 100'
VERT. N/A
DATE: 7/25/18
JOB NO. 16/301
CAD FILE NO. 16/301-Existing Conditions
DRAWN BY HJS

PREPARED BY:
ADPCIVIL ENGINEERING FOR THE FUTURE
3520 Austin Bluffs Parkway
Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341

NO.	DATE	REVISION	BY

JUDGE ORR ROAD RV PARK & STORAGE

COLORADO SPRINGS, COLORADO

DRAINAGE - EXIST OVERALL CONDITIONS

SHEET 1 of 3

LEGEND

- A1A / XX — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT: XX | XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

MATCHLINE

MATCHLINE

N

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)

1 inch = 100 ft.

FOR CONTINUATION OF BASIN SEE OFF-SITE MAP FOR O-1 IN APPENDIX B

TABLE 2 – PHASE I DEVELOPED CONDITIONS

Sub-Basin	Q5CFS	Q100 CFS
OS1	1.7	12.9
OS2	7.2	54.9
OS3	17.8	62
OS4	0.8	5.9
OS5	1	2.6
A1	17.2	36.5
A2	6.5	17.6
A3	13.7	37.2
A4	0.4	2.9
B	0.3	2.3
DP1 (OS1+OS2)	8.5	65
DPD1 (Detained DP1)	0.1	57.3
DP2 (DPD1 + A2)	5.1	69.1
DP3 (A1 + A3)	25.4	61.9
DP4 (DP2 + DP3)	20.2	103.3
DPD2 (Detained DP2)	0.5	40.6
DP5 (OS3+OS4)	16.3	59.6
DP6 (A3+OS5)	1	4.6
DP7 (DP4+DP5)	16.3	60.1
DP8 (DPD2+DP6)	16.6	91.1

DP2 + A1

1.7 / 12.9 OS1 7.81

B 1.22 — 0.3 / 2.3

A1 8.3 — 17.2 / 36.5

8.2 / 17.5

NEW PROPERTY LINE

POND 1 (FUTURE)

1 — 8.5 / 65

D1 — 0.1 / 57.3

A2 6.85 — 6.5 / 17.6

2 — 5.1 / 69.1

A3 15.2 — 13.7 / 37.2

POND 2

3 — 25.4 / 61.9

4 — 2.2 / 103.3

2 — 31.5 / 78.7

D2 — 0.5 / 40.6

8 — 16.6 / 91.1

5 — 16.3 / 59.6

A4 1.80 — 0.4 / 2.9

6 — 1.0 / 4.6

7 — 16.3 / 60.1

OS5 0.70 — 1.0 / 2.6

17.8 / 62.0 OS3 27.21

0.8 / 5.9 OS4 4.18

7.2 / 54.9

EXIST 24" CMP

FUTURE ROAD

FUTURE ROAD

STATE HWY 24 FRONTAGE ROAD PER CDOT HWY 24 PE STUDY

CDOT-Approved Access/Egress from PUD Site to Future Hwy. 24 Frontage Road

The design engineer noted on the 8/8/18 meeting that the intent was to pipe OS3 through basin OS2 and discharge to the Judge Orr ditch and not flow within the revised OS2 basin boundary shown on the proposed drainage map.

Update the narrative and drainage map accordingly.

Unresolved 08/08/2018

Unresolved 08/08/2018

Provide analysis and narrative regarding emergency spillway when Pond 1 is constructed. Based on current design, it appears that the emergency spillway path will be diverted south and into the existing ditch along Judge Orr road. What impact will this have.

Unresolved 08/08/2018

1. Extend the drainage map to show the location of DP8.

Adjust the location

There is already a DP 2.

Adjust to be insde the pond

Unresolved 08/08/2018

Analysis needs to extend to the swale. Looking at the contours the section highlighted in yellow does not appear to by hydraulically adequate and may need additional improvements.

Adjust per the meeting on 8/8/18. (remove DP 6 and adjust the locations of the symbol

NO TOPOGRAPHY AVAILABLE BEYOND THIS AREA (SEE OFFSITE DRAINAGE MAP FOR CONTINUATION)

PCD PROJECT NO. PPR-16-040

M:\LAND_PROJECTS\2016\160301–Judge Orr Road RV Park\DWG\160301–Developed Conditions.dwg, Jim, Wed, 07/25/18, 12:26 PM

DESIGNED BY MAB | PROJECT ENGINEER MAB | PROJECT MANAGER MAS | SCALE HORZ. 1" = 100' VERT. N/A

DATE: 7/25/18 | JOB NO. 160301 | CAD FILE NO. 160301-Developed Conditions | DRAWN BY HAS

PREPARED BY:

ADPCIVIL ENGINEERING FOR THE FUTURE

3520 Austin Bluffs Parkway
Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341

NO.	DATE	REVISION	BY

JUDGE ORR ROAD RV PARK & STORAGE

COLORADO SPRINGS, COLORADO

DRAINAGE - DEV OVERALL CONDITIONS

SHEET 2 of 3

LEGEND

- A1A / XX — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT — XX / XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

NO TOPOGRAPHY AVAILABLE BEYOND THIS AREA (SEE OFFSITE DRAINAGE MAP FOR CONTINUATION)

SWALE 'A'

SWALE 'B'

SWALE 'C'

SWALE 'D'

SWALE 'E'

ROAD SECTION 'F'

GRAPHIC SCALE

(IN FEET)
1 inch = 60 ft.

NOTE:
DETENTION POND AREA TO BEUTILIZED AS A SEDIMENTATION BASIN UNTIL EARTH MOVING IS COMPLETED AND THE GROUND STABLIZED AT WHICH TIME IT WILL BE CLEANED OUT AND THE DETENTION POND STRUCTURES ADDED.

PCD PROJECT NO. PPR-16-040

DESIGNED BY: MAB
PROJECT ENGINEER: MAB
PROJECT MANAGER: MAB
SCALE: HORZ. 1" = 60' VERT. N/A
DATE: 7/25/18
JOB NO. 160301
CAD FILE NO. 160301-Dev Cond
DRAWN BY HLS

PREPARED BY:
ADPCIVIL ENGINEERING FOR THE FUTURE
3520 Austin Bluffs Parkway
Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341

NO.	DATE	REVISION	BY

JUDGE ORR ROAD RV PARK & STORAGE

COLORADO SPRINGS, COLORADO

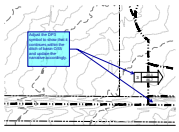
DRAINAGE - DEVELOPED CONDITIONS

SHEET 3 of 3

M:\LAND_PROJECTS\2016\160301--Judge Orr Road RV Park\DWG\160301--Developed Conditions.dwg Jim Wed, 07/25/18 12:24 PM

Markup Summary

dsdlaforce (49)



Subject: Callout
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:35:39 PM
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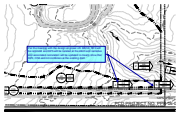
Adjust the DP3 symbol to show that it continues within the ditch of basin OS5 and update the narrative accordingly.



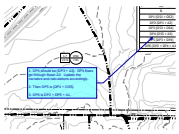
Subject: Callout
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:39:18 PM
Color:

Per the meeting with the design engineer ofn 8/8/18, DP4 will be removed and DP5 will be located at the diitch and narrative and associated calculation will be updated to clearly show that DP3, OS5 and A3 combines at the existing ditch.

Subject: Callout
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:41:18 PM
Color:

Extend the drainage map to show the location of DP6.

Subject: Unresolved
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:41:48 PM
Color:



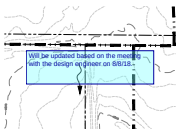
Subject: Callout
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:43:55 PM
Color:

1. DP4 should be (DP3 + A3). DP3 flows go through Basin A3. Update the narrative and calculations accordingly.

2. Then DP5 is (DP4 + OS5).

3. DP6 is DP2 + DP5 + A1.

Subject: Unresolved
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:44:08 PM
Color:



Subject: Text Box
Page Label: 52
Author: dsdlaforce
Date: 8/8/2018 3:45:02 PM
Color:

Will be updated based on the meeting with the design engineer on 8/8/18.

Subject: Cloud+
Page Label: 6
Author: dsdlaforce
Date: 8/8/2018 3:46:41 PM
Color:

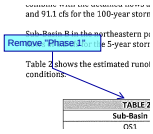
Update the narrative based on the meeting on 8/8/18

Subject: Callout
Page Label: 7
Author: dsdlaforce
Date: 8/8/2018 4:02:43 PM
Color:

Update the narrative and discuss in detail the plans to construct the north-south road to County standard to include the intended phasing plan.

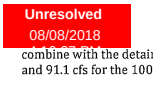
Since the intent is to construct to county standard section for future dedication, clearly describe the intent of the runoff conveyance with regards to the future road. Also, provide the drainage analysis for the roadway (street capacity, etc.).

Finally, submit street construction plans for the road and roundabout being constructed.



Subject: Callout
Page Label: 8
Author: dsdlaforce
Date: 8/8/2018 4:16:12 PM
Color:

Remove "Phase 1"



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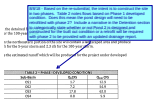
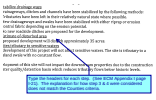
Author: dsdlaforce
Date: 8/8/2018 4:16:33 PM
Color:



Subject: Callout
Page Label: 8
Author: dsdlaforce
Date: 8/8/2018 4:16:42 PM
Color:

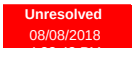
8/8/18 - Based on the re-submittal, the intent is to construct the site in two phases. Table 2 notes flows based on Phase 1 developed condition. Does this mean the pond design will need to be retrofitted with phase 2? Include a narrative in the Detention section to categorically state whether or not Pond 2 is designed and constructed for the built out condition or a retrofit will be required with phase 2 to be provided with an updated drainage report.

Subject: Unresolved
Page Label: 9
Author: dsdlaforce
Date: 8/8/2018 4:20:29 PM
Color:



Subject: Callout
Page Label: 10
Author: dsdlaforce
Date: 8/8/2018 4:23:41 PM
Color:

Type the headers for each step. (See ECM Appendix I page I-21). The explanation for how step 3 & 4 were considered does not match the Counties criteria.



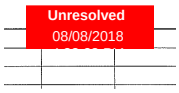
Subject: Unresolved
Page Label: 10
Author: dsdlaforce
Date: 8/8/2018 4:24:19 PM
Color:

Subject: Text Box
Page Label: 10
Author: dsdlaforce
Date: 8/8/2018 4:25:17 PM
Color:

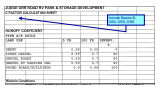
8/8/18
Step 3: Provide Water Quality Capture Volume (WQCV)
Step 4: Consider Need for Industrial and Commercial BMPs

Subject: Callout
Page Label: 9
Author: dsdlaforce
Date: 8/8/2018 4:30:49 PM
Color:

State what the percent impervious is based on the proposed site development plan. This number is likely to be used in calculating the fee instead of the typical values listed in ECM Appendix L Table 3-1 which is 95% for commercial.



Subject: Unresolved
Page Label: 19
Author: dsdlaforce
Date: 8/8/2018 4:33:28 PM
Color:



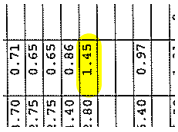
Subject: Callout
Page Label: 19
Author: dsdlaforce
Date: 8/8/2018 4:34:09 PM
Color:

Include Basins B, OS4, OS5, OS6

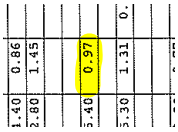
Subject: Callout
Page Label: 6
Author: dsdlaforce
Date: 8/8/2018 4:39:20 PM
Color:

1. The flow rate does not match the drainage map. Verify the values for all the other basins.

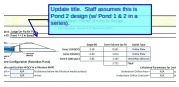
Provide additional detail on the narrative regarding Basin B. The proposed condition has increased the area and flow draining into the existing channel and untreated developed flow is now draining onto the existing channel.



Subject: Highlight
Page Label: 22
Author: dsdlaforce
Date: 8/8/2018 5:07:10 PM
Color:



Subject: Highlight
Page Label: 22
Author: dsdlaforce
Date: 8/8/2018 5:07:12 PM
Color:

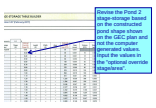


Subject: Callout
Page Label: 38
Author: dsdlaforce
Date: 8/8/2018 5:14:20 PM
Color:

Update title. Staff assumes this is Pond 2 design (w/ Pond 1 & 2 in a series).

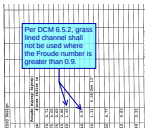
Subject: Callout
Page Label: 38
Author: dsdlaforce
Date: 8/8/2018 5:15:55 PM
Color:

Revise. Drain time is not in compliance with senate bill 15-212 (must be less than or equal to 72 hours.



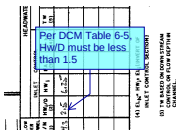
Subject: Callout
Page Label: 36
Author: dsdlaforce
Date: 8/8/2018 5:23:43 PM
Color:

Revise the Pond 2 stage-storage based on the constructed pond shape shown on the GEC plan and not the computer generated values. Input the values in the "optional override stage/area".



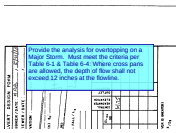
Subject: Callout
Page Label: 22
Author: dsdlaforce
Date: 8/8/2018 5:35:50 PM
Color:

Per DCM 6.5.2, grass lined channel shall not be used where the Froude number is greater than 0.9.



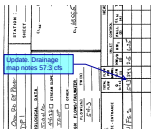
Subject: Callout
Page Label: 43
Author: dsdlaforce
Date: 8/8/2018 5:37:25 PM
Color:

Per DCM Table 6-5, Hw/D must be less than 1.5



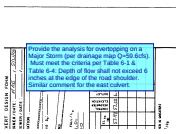
Subject: Text Box
Page Label: 43
Author: dsdlaforce
Date: 8/8/2018 5:44:05 PM
Color:

Provide the analysis for overtopping on a Major Storm. Must meet the criteria per Table 6-1 & Table 6-4: Where cross pans are allowed, the depth of flow shall not exceed 12 inches at the flowline.



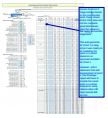
Subject: Callout
Page Label: 43
Author: dsdlaforce
Date: 8/8/2018 5:44:44 PM
Color:

Update. Drainage map notes 57.3 cfs



Subject: Text Box
Page Label: 44
Author: dsdlaforce
Date: 8/8/2018 5:47:40 PM
Color:

Provide the analysis for overtopping on a Major Storm (per drainage map Q=59.6cfs). Must meet the criteria per Table 6-1 & Table 6-4: Depth of flow shall not exceed 6 inches at the edge of the road shoulder.
Similar comment for the east culvert.

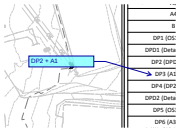


Subject: Callout
Page Label: 29
Author: dsdlaforce
Date: 8/8/2018 6:13:13 PM
Color:

Revise the Pond 2 stage-storage based on the constructed pond shape shown on the GEC plan and not the computer generated values. Input the values in the "optional override stage/area".

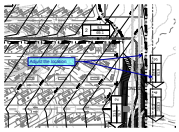
The auto-generate for Pond 1 is okay since it was mainly to for modeling the pond in a series based on an assumed condition for Pond 1.

However, add a statement that with development of pond 1, that drainage report will have to provide the same pond in a series analysis to verify release rates still meet Senate Bill 15-212.



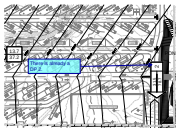
Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:15:34 PM
Color:

DP2 + A1



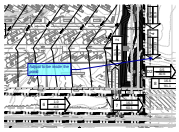
Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:16:00 PM
Color:

Adjust the location



Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:16:34 PM
Color:

There is already a DP 2.



Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:16:54 PM
Color:

Adjust to be insde the pond

Subject: Cloud+
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:18:00 PM
Color:

Adjust per the meeting on 8/8/18. (remove DP 6 and adjust the locations of the symbol

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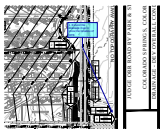


Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:18:13 PM
Color:

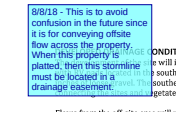
1. Extend the drainage map to show the location of DP8.

Subject: Unresolved
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:18:22 PM
Color:

Subject: Callout
Page Label: 7
Author: dsdlaforce
Date: 8/8/2018 6:20:03 PM
Color:

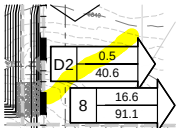
State in the narrative who own/maintain this stormline.

Subject: Unresolved
Page Label: 7
Author: dsdlaforce
Date: 8/8/2018 6:20:12 PM
Color:

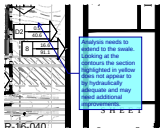


Subject: Text Box
Page Label: 7
Author: dsdlaforce
Date: 8/8/2018 6:22:13 PM
Color:

8/8/18 - This is to avoid confusion in the future since it is for conveying offsite flow across the property.
When this property is platted, then this stormline must be located in a drainage easement.

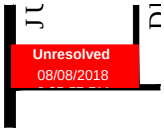


Subject: Highlight
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:24:06 PM
Color:

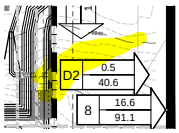


Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:25:47 PM
Color:

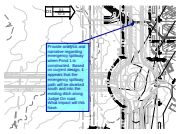
Analysis needs to extend to the swale. Looking at the contours the section highlighted in yellow does not appear to by hydraulically adequate and may need additional improvements.



Subject: Unresolved
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:26:00 PM
Color:



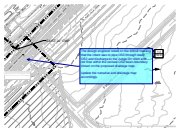
Subject: Highlight
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:26:30 PM
Color:



Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:29:14 PM
Color:

Provide analysis and narrative regarding emergency spillway when Pond 1 is constructed. Based on current design, it appears that the emergency spillway path will be diverted south and into the existing ditch along Judge Orr road. What impact will this have.

Subject: Unresolved
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:29:41 PM
Color:



Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:35:27 PM
Color:

The design engineer noted on the 8/8/18 meeting that the intent was to pipe OS3 through basin OS2 and discharge to the Judge Orr ditch and not flow within the revised OS2 basin boundary shown on the proposed drainage map.

Update the narrative and drainage map accordingly.

Subject: Unresolved
Page Label: 53
Author: dsdlaforce
Date: 8/8/2018 6:35:29 PM
Color: