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
May 18, 2018

PPR-16-040

PCD Project #16-040

ADP CIVIL
ENGINEERING FOR THE FUTURE

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 29.9 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.

Identify Full Spectrum Design for the detention facilities.

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 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 5.9 cfs and 44.7 cfs respectively. These flows combine with the flows from Sub-Basin OS1 at DP1 for total flows of 7.1 cfs for the 5-year storm and 54.3 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 2.7 cfs and 20.8 cfs respectively. These flows combine with the flows from DP1 at DP2 to produce total flows of 8.2 cfs for the 5-

Revise the routing summary per comments on the summary table of the existing drainage map

year storm and 62.8 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 2.2 cfs and 16.6 cfs respectively. These flows combine with the flows from OS3 at DP3 to produce flows of 18.3 cfs for the 5-year storm and 72.9 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 0.9 cfs and 4.4 cfs respectively. OS5 drains the area between the property line and the center line of Judge Orr Road. This area produces flows of 1.1 and 2.9 respectively, and combines with the flows from A3 at DP4 to produce total flows of 1.7 cfs for the 5-year storm and 6.4 cfs for the 100-year storm. These flows combine with the flows from DP3 at DP5 to produce total flows of 17.1 cfs for the 5-year storm and 67.90 cfs for the 100-year storm. 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 DP7 to produce total flows in the main channel of 26.9 cfs for the 5-year storm and 143.1 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.

Identify how OS5 is being conveyed. Is this a road side ditch along Judge Orr?

TABLE 1 – EXISTING CONDITIONS		
Sub-Basin	Q_5CFS	
OS1	1.7	12.9
OS2	5.9	44.7
OS3	17.8	62.0
OS4	2.2	16.6
OS5	1.1	2.9
A1	2.2	16.5
A2	2.7	20.8
A3	0.9	4.4
B	0.2	1.6
DP1 (OS1 + OS2)	7.1	54.3
DP2 (DP1 + A2)	8.2	62.6
DP3 (OS3 + OS4)	18.3	72.9
DP4 (OS5 + A3)	1.7	6.4
DP5 (DP3 + DP4)	17.1	67.9
DP6 (DP2 + DP4 + A1)	26.9	143.1

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. A conceptual 4.6 acre foot pond was calculated for the future neighborhood commercial site with an estimated outflow of 0.6 cfs for the 5-year storm and 57.4 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 7.2 cfs and 22.3 cfs for the five- and 100-year storms. This area drains to the southeast and is intercepted by a proposed 4 ft swale. The combined flows at DP2 will be 12.3 cfs for the 5-year storm and 65.2 cfs for the 100-year storm. These flows will be intercepted by a 36 inch HDPE and transported to the detention basin.

From discussions OS6 is constructed with the RV site plan.

Sub-basin OS6 drains an area between the west property line and the future development. It includes a future roadway and a landscape [illegible] flows of 8.4 cfs and 17.5 cfs respectively. It will flow into Sub-basin A2.

Sub-Basin A2 drains the southern part of the developed parcel. This area will be developed as an RV park with 120 RV gravel parking areas 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 18.9 cfs and 48.0 cfs respectively. These flows will combine with the flows from OS6 at DP2 to produce flows of 23.7 cfs for the 5-year storm and 57.8 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin A1 at DP4 to produce total flows into the detention basin of 23.0 cfs and 113.31 cfs respectively. The proposed 2.243 AF detention basin will release these flows through an outlet structure with a 30 inch HDPE pipe at a rate of 0.4 cfs for the 5-year storm and 77.5 cfs for the 100-year storm.

Sub-Basin A3 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 combine with the detained flows at DPD2 to produce total flows of 16.6 cfs for the 5-year storm and 131.2 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.

List all the assumptions made with regards to Pond 1 & Pond 2. Identify design guidance/limitations that may need to be accounted for during the design process of the western property.

Add a statement that the FDR for the adjacent property to the west will need to conduct the pond in a series analysis based on actual pond 1 design to verity that Pond 2 still meets criteria.

TABLE 2 – PHASE I DEVELOPED CONDITIONS		
Sub-Basin	Q_5CFS	Q_{100} CFS
OS1	1.7	12.9
OS2	7.3	55.6
OS3	17.8	62.0
OS4	0.8	5.9
OS5	1.0	2.6
OS6	8.4	17.5
A1	7.2	22.3
A2	18.9	48.0
A3	0.4	2.9
B	0.3	2.3
DP1 (OS1+OS2)	8.6	65.7
DPD1 (Detained DP1)	0.6	57.4
DP2 (OS6+A2)	23.7	57.8
DP3 (DP2+A1)	23.0	59.0
DP4 (DPD1+DP3)	23.0	113.3
DPD2 (Detained DP2)	0.4	77.5
DP5 (OS3+OS4)	16.3	59.6
DP6 (A3+OS5)	1.0	2.6
DP7 (DP5+DP6)	1.0	4.6
DP8 (DPD2+DP7)	16.6	131.2

Describe why this approach was done. i.e. Pond 1 and pond 2 are designed as ponds in a series.

The analysis submitted is based on the ultimate configuration, however timing wise Pond 2 is constructed now with no anticipated timeline for Pond 1. Provide an analysis to verify that Pond 2 design meets criteria in the interim condition (OS1 & OS2 tributary to the pond)

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 0.423 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 (SQ IN)
Detention Basin A	3.22	18,426	0,1.61,3.22	2.41,2.41,2.41

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. The outflow hydrograph from the commercial site (Pond 1) 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**
A	2.243	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 77.5 cfs will only produce a flow depth of 1.2 ft. and a velocity of 4.0 fps. Once the Judge Orr ditch flows combine with the detained flows, the 131.2 cfs, approximately 300 ft. east of the project, will produce a flow depth of 1.4 ft and a velocity of 4.85 fps.

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 2.9 ft. and a velocity of 6.9 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		
Storm Manhole	EA	2		

15% Contingen

Identify the on-site only percent impervious of the proposed development and state that drainage and bridge fees will be due with future subdivision based on "XX" % impervious.

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.

CONCLUSION

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

Step 1: Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.
Step 2: 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: The proposed development will disturb approximately 35 acres.
Step 4: The development of this project will not affect sensitive waters.

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.

The development of this site will have little impact on downstream properties once the water quality/detention basin is constructed.

"will have little impact" implies there is some impact. Identify what little impacts the development has and how it plans to mitigate said impacts.

Per ECM 3.2.8 "The proposed project or developed land use shall not change historical runoff values, cause downstream damage or adversely impact adjacent properties."

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

APPENDIX B

DESIGN CALCULATIONS

APPENDIX C

DESIGN CHARTS

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.

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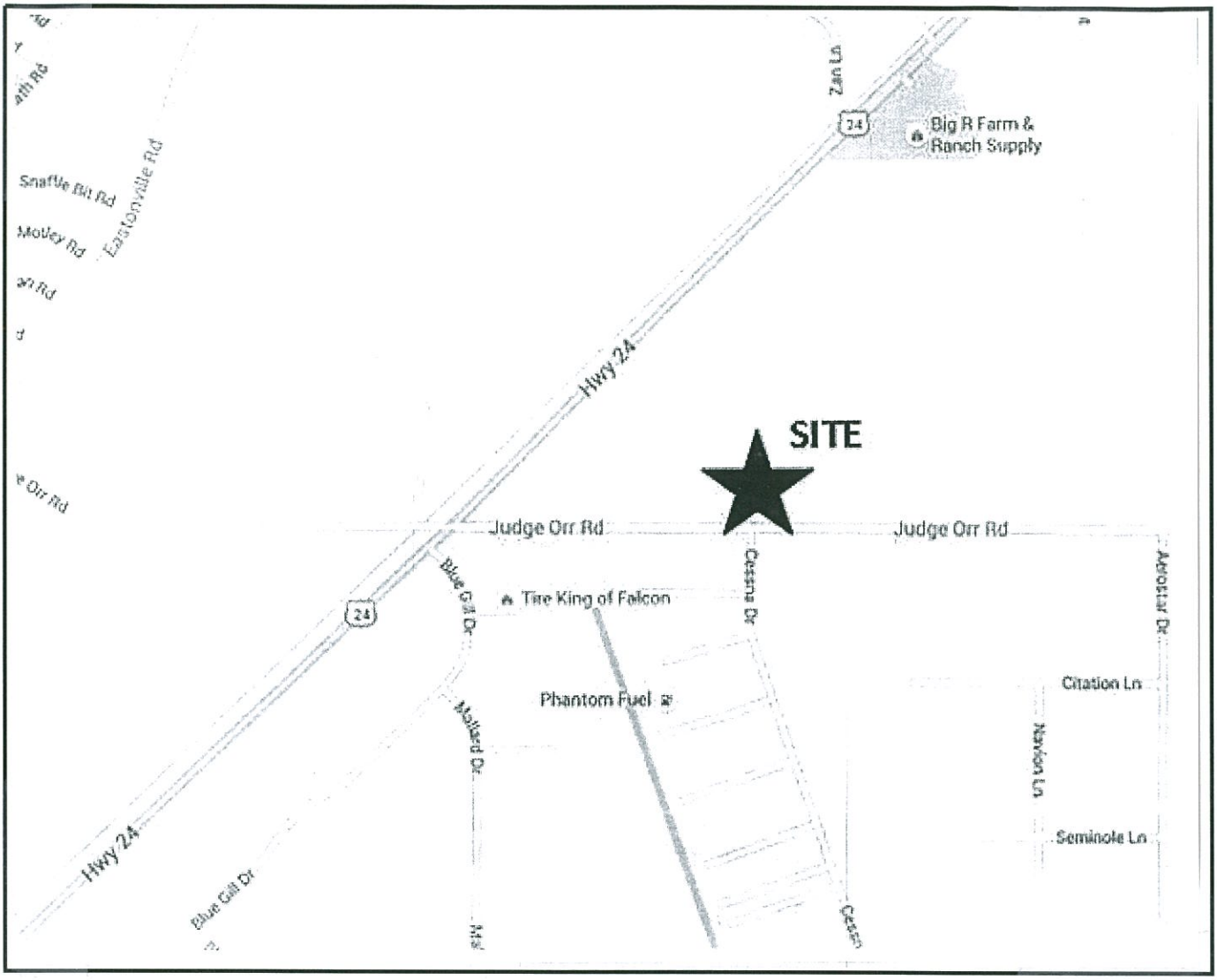
APPENDIX A

MAPS



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VICINITY MAP

N.T.S.

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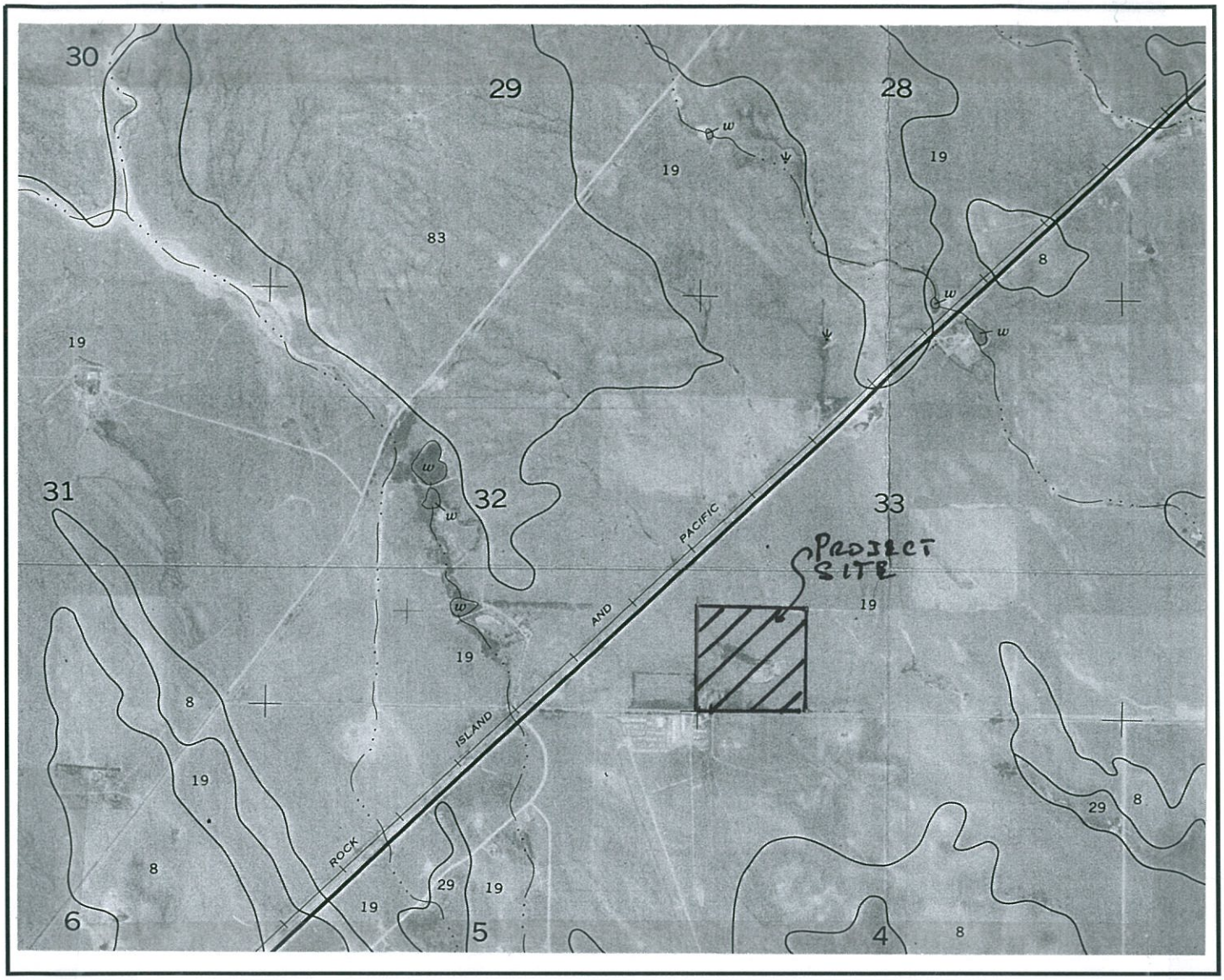

N

SOILS MAP

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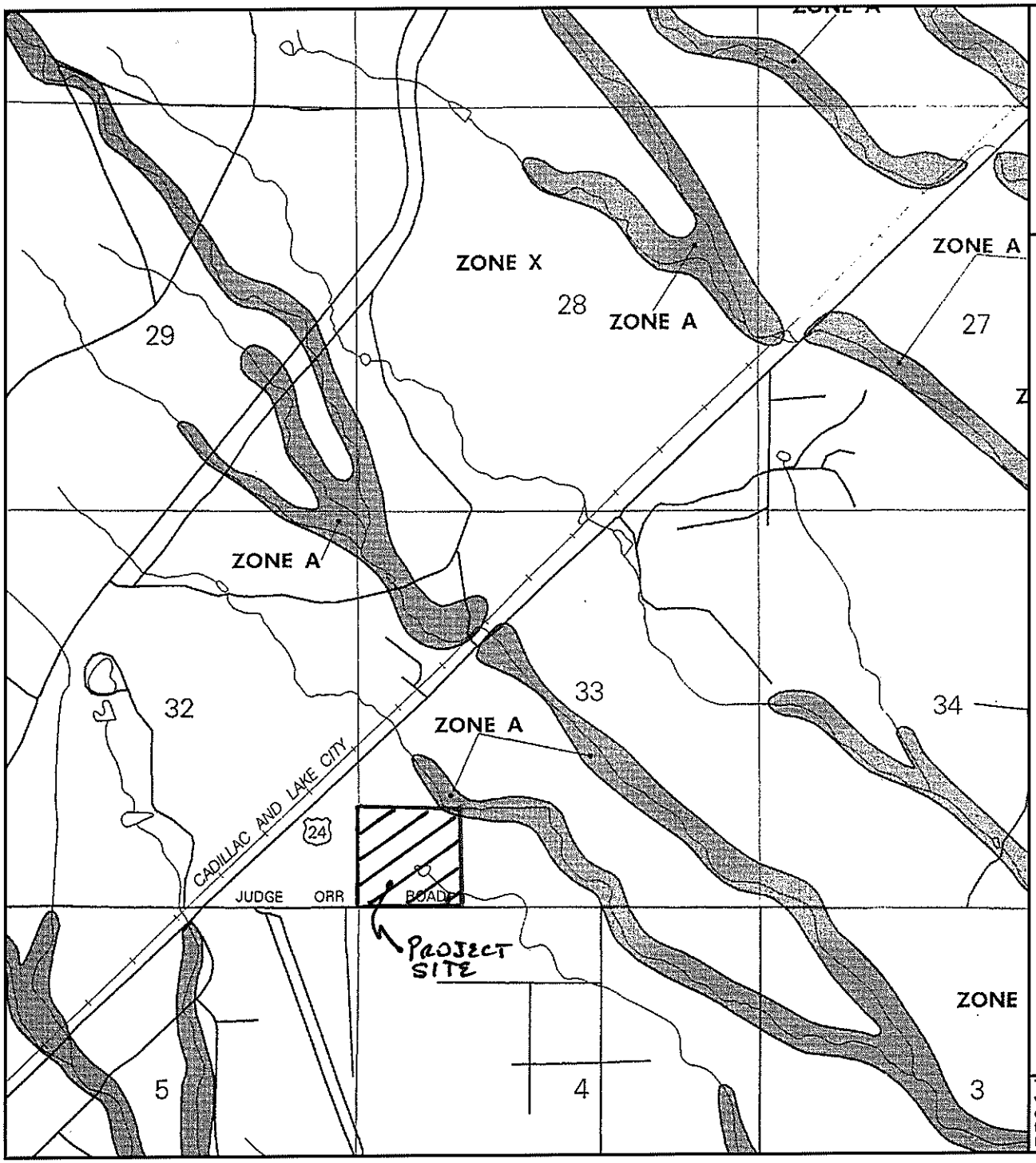


APPROXIMATE SCALE IN FEET

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

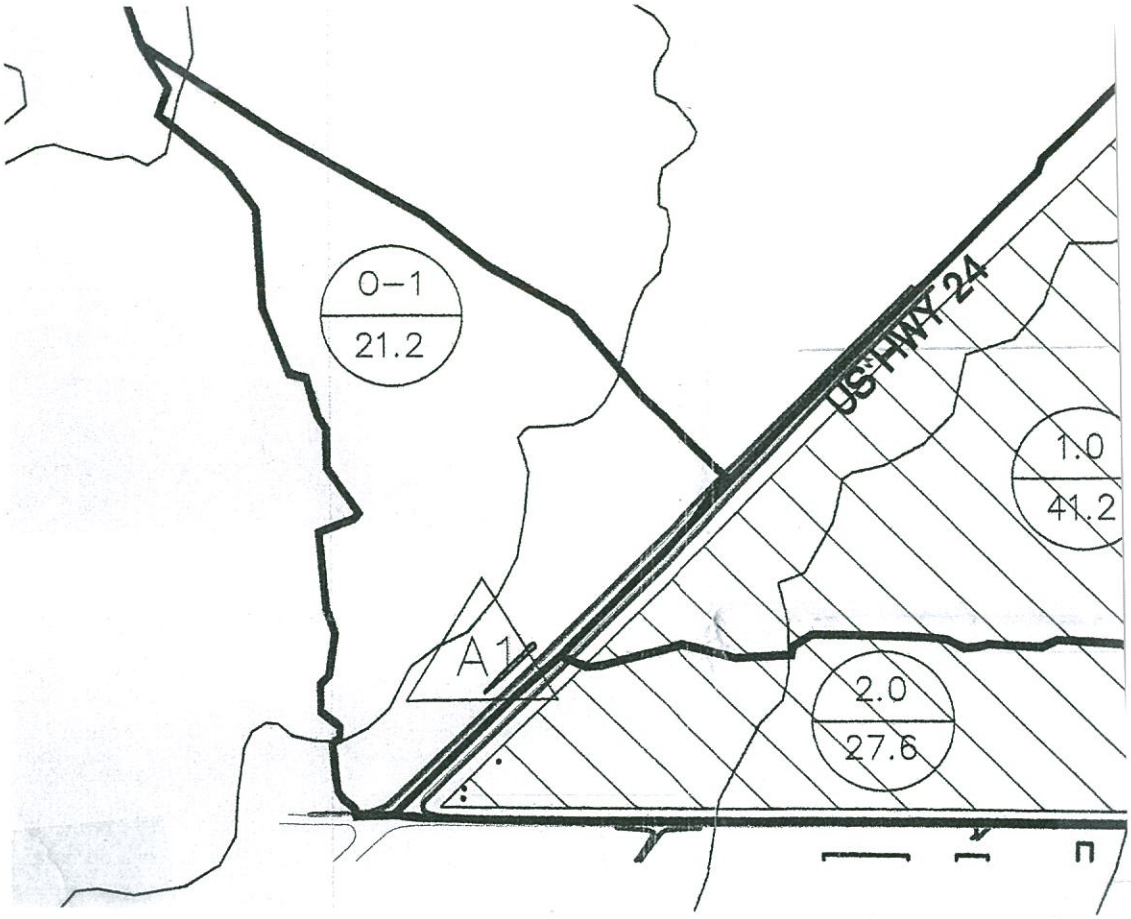
MAP NUMBER 08041C0575 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX B

DESIGN CALCULATIONS



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

N

OFFSITE DRAINAGE MAP

SCALE: 1" = 500'

Identify which report this subbasin O-1 is taken from.

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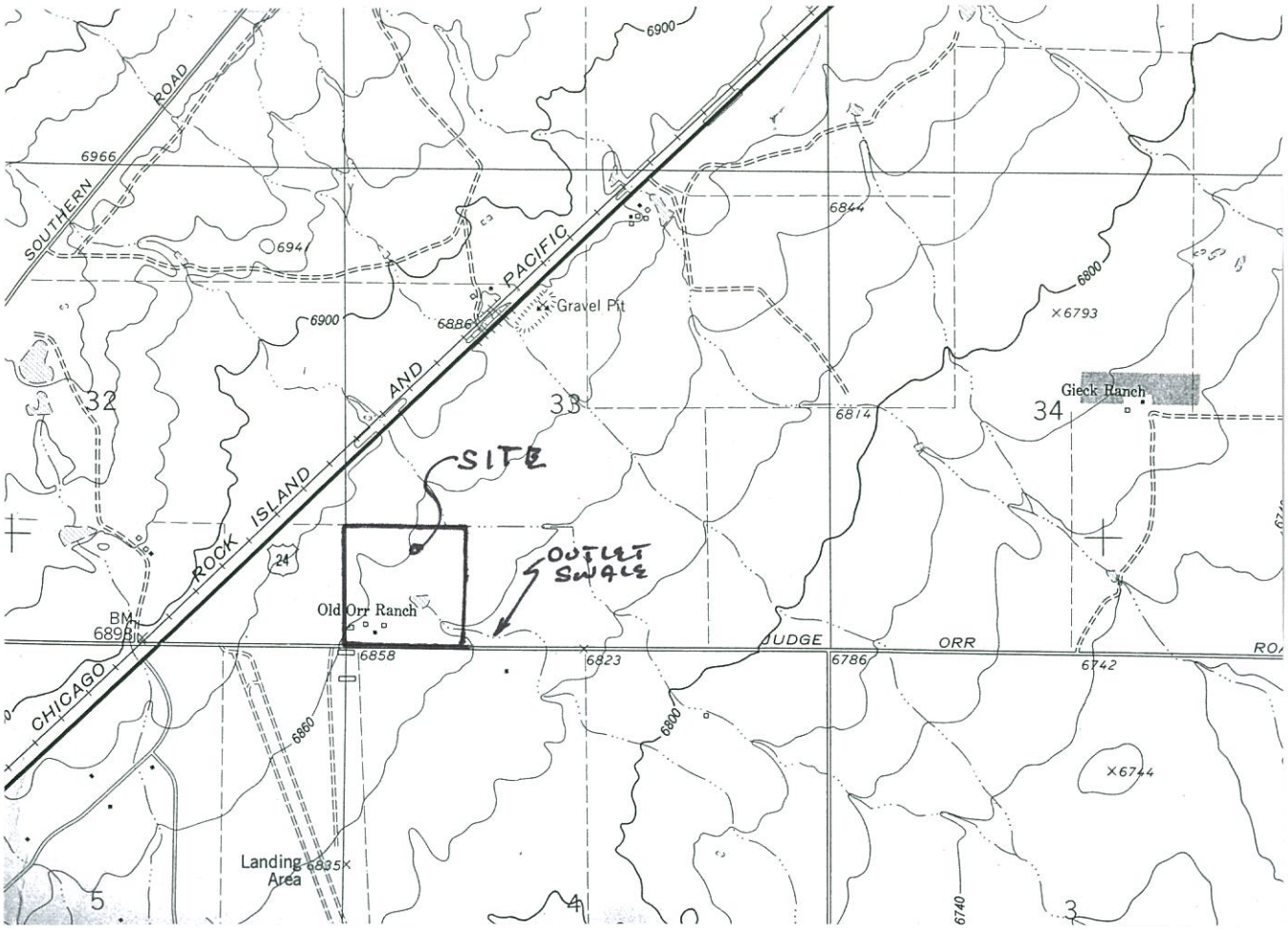

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OFFSITE DRAINAGE MAP

SCALE; 1'=2000'

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JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT

C FACTOR CALCULATION SHEET

RUNOFF COEFICIENT

TYPE A/B SOILS

LAND USE	5 YR	100 YR
UNDEV	0.08	0.35
LOOSE GRAVEL	0.3	0.5
GRAVEL ROADS	0.59	0.7
GRAVEL RV PARKING PAD	0.59	0.7
PAVED ROADS/BUILDINGS	0.9	0.96

Revise to 0.59, 0.7, and 80%. Per Chapter 6 of the City DCM "Gravel parking areas, storage areas, and access drives proposed on site Improvement Plans shall be analyzed based on an imperviousness of 80%"

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					0.09	0.36

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	**0.29**	**0.49**
A2	18.65	9.95	0.00	4.80	3.90	**0.38**	**0.57**
OS1	1.08	1.08	0.00	0.00	0.00	**0.08**	**0.35**
OS2	1.77	1.77	0.00	0.00	0.00	**0.08**	**0.35**
Total A	29.80	13.25	7.85	4.80	3.90	0.32	0.49
A3	1.80	1.72	0.00	0.00	0.08	**0.08**	**0.38**
% Impervious		0%	40%	80%	100%		
Imp x A		0	3.14	3.84	3.9		
Total I x A	10.88						
Total Imp	10.88/29.8 = 36.5%						

Include Basins B, A3, OS4, OS5, OS6

Pond 1+ Pond 2							
% Impervious							
Pond 1 = 51.06 x 56.9% = 29.05							
Pond 2 = 29.8 x 36.5% = 10.88							
Pond 1 + Pond 2 = 39.93							
Total Imp	39.93/80.86 = 49.4%						

Show the calculation for the watershed imperviousness

JUDGE ORR ROAD RV PARK & STORAGE DEVELOPMENT
PROJ. #160301
DRAINAGE CALCULATION SHEET
file:judge orr rv dr
05/21/18

							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	36.41	0.08	0.35	2.91	12.74	150	2.00	18.58	1400	1.20	1.20	19.44	38.03	2.01	3.51	5.85	44.67				OS2
DP1	44.22			3.54	15.48								38.03	2.01	3.51	7.10	54.25	1250	2.10	9.92	DP1
A2	15.16	0.08	0.35	1.21	5.31	250	3.20	20.55	1400	1.90	2.10	11.11	31.66	2.25	3.92	2.72	20.81				A2
DP2	59.38			4.75	20.78								47.95	1.73	3.02	8.22	62.81				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	13.73	0.08	0.35	1.10	4.81	250	2.00	23.99	1800	1.00	2.00	15.00	38.99	1.98	3.45	2.17	16.58				OS4
DP3	40.94			9.26	21.13								38.99	1.98	3.45	18.30	72.92	1050	2.25	7.78	DP3
A3	2.32	0.14	0.39	0.32	0.90	100	2.00	14.28	1050	1.23	2.25	7.78	22.06	2.76	4.83	0.90	4.37				A3
OS5	0.71	0.41	0.59	0.29	0.42	10	2.00	3.26	1050	1.23	2.25	7.78	11.03	3.88	6.78	1.13	2.86				OS5
DP4	3.03			0.61	1.33								22.06	2.76	4.83	1.70	6.40				DP4
DP5	43.97			9.88	22.46								47.95	1.73	3.02	17.09	67.88				DP5
DP6	115.10			15.57	47.35								47.95	1.73	3.02	26.94	143.12				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	43.25	0.08	0.35	3.46	15.14	150	2.00	18.58	1200	1.20	1.20	16.67	35.25	2.10	3.67	7.28	55.61	1300	4.50	4.81	OS2
DP1	51.06			4.08	17.87								35.25	2.10	3.67	8.59	65.66	1020	5.00	3.40	DP1
DPD1	51.06			0.03	15.64	*Adjusted C Factor for Detention Basin							35.25	2.10	3.67	0.06	57.40				DPD1
OS6	2.85	0.65	0.78	1.86	2.21	25	2.00	3.32	600	1.18	2.35	4.26	7.57	4.52	7.89	8.42	17.47				OS6
A2	18.65	0.40	0.58	7.46	10.82	100	2.00	10.41	1100	1.50	1.20	15.28	25.69	2.54	4.43	18.93	47.95				A2
DP2	21.50			9.32	13.03								25.69	2.54	4.43	23.66	57.76	1020	5.00	3.40	DP2
A1	8.30	0.27	0.48	2.24	3.98	100	2.00	12.35	1150	0.50	4.50	4.26	16.61	3.21	5.60	7.19	22.32				A1
DP3	29.80			11.56	17.02								38.65	1.99	3.47	22.97	59.04				DP3
DP4	80.86			11.59	32.66								38.65	1.99	3.47	23.03	113.31	150	5.00	0.50	DP4
DPD2	80.86			0.20	22.33	*Adjusted C Factor for Detention Basin							38.65	1.99	3.47	0.40	77.50				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

A3	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				A3
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	41.22								44.25	1.82	3.18	16.64	131.23				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
West Swale	7.1	54.3	1.00	4.00	0.035	3:1	3.00	1.25	4.90	0.91	
East Swale	3.0	10.0	1.00	0.00	0.035	3:1	1.50	1.10	2.75	0.65	
Judge Orr Rd Ditch	16.3	60.1	1.80	2.00	0.035	3:1	2.00	1.60	5.40	0.97	
Spillway	23.0	113.3	5.00	40.00	0.040	3:1	2.00	0.50	5.20	1.30	0.28
Swale At Prop Line	0.3	82.1	1.70	8.00	0.040	8:1	6.00	1.20	4.00	0.81	
Swale 300' East of PL	21.2	131.7	1.70	8.00	0.040	8:1	6.00	1.40	4.85	0.85	
Det Breach Flow	---	500.0	1.70	8.00	0.040	8:1	6.00	2.90	6.90	0.93	

Use standard riprap convention

STORM SEWER HYDRAULIC GRADELINE CALCULATION SHEET

Location	Pipe Size	Slope %	Q5	Q100	Pipe Cap	Critical d	Invert
DP2	36"	1.3	8.6	65.7	88.6	2.6	6855.5
DP2 @ GB	36"	4.0	8.6	65.7	155.5	2.6	6836.0
DP5	38"x24"	1.0	16.3	59.6	44	1.36	6856.0
DP7	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 = 113.3 cfs
QMAX=120.0 cfs

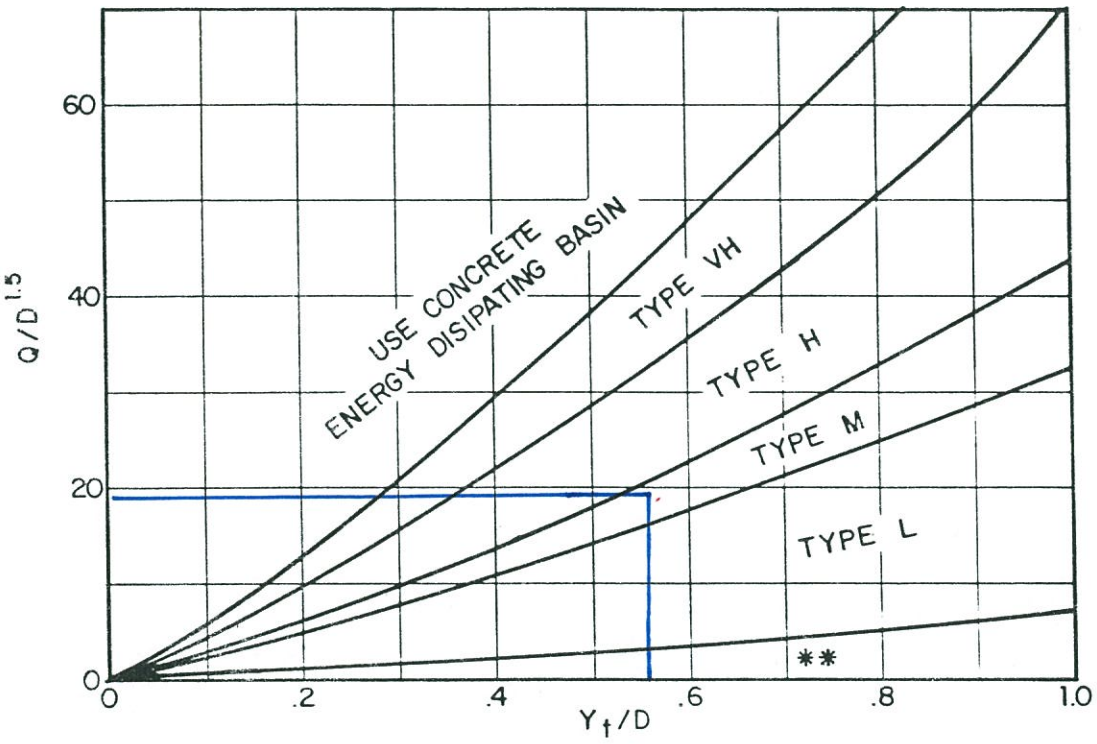
FOREBAY CALCULATIONS

2% OF WQV
0.02 X 0.423 = 0.0085 AF = 369 CF

FOREBAY NOTCH CALCULATIONS

0.02 OF 100YR FLOW
0.02 X 113.3 = 2.27 CFS
W =Q/(D^1.5XC)
W=2.27/(1X3.0)=0.76 FT

Where does this pertain to?



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

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

PROJECT: Judge Orr Rd Pk Pond
CULVERT AT DP1

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MNB / 5/21/16

REVIEWER / DATE: _____ / _____

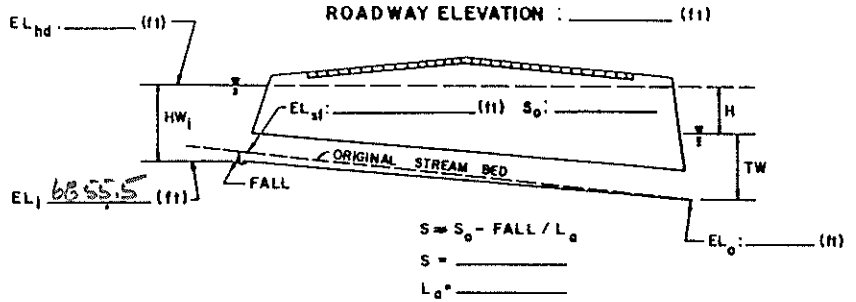
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☒ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 44.22 ☐ STREAM SLOPE: 1%
- ☐ CHANNEL SHAPE: TRAP
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

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



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HWi/D (2)	HWi	FALL (3)	ELhi (4)	OUTLET CONTROL TW (5)	dc	(dc+D)/2	ho (6)	he	H (7)	ELho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
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_i (INVERT OF INLET CONTROL SECTION)

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

(6) h_e = 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
c. 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: _____

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987

Figure
9-44

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

PROJECT: JUDGE ORR RD RV PARK

WEST CULVERT

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MAB / 5/21/18

REVIEWER / DATE: _____ / _____

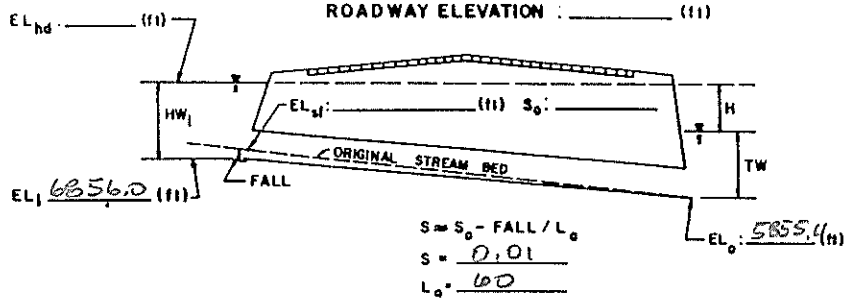
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☐ 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



$S \approx S_o - FALL / L_a$

$S = 0.01$

$L_a = 60$

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)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
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	57.62	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) $H = \left[1 + h_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(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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A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date: OCT. 1987

Figure: 9-44

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

PROJECT: Judge Orr Rd RV Park

EAST CULVERT

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: MRB / 5/21/13

REVIEWER / DATE: _____ / _____

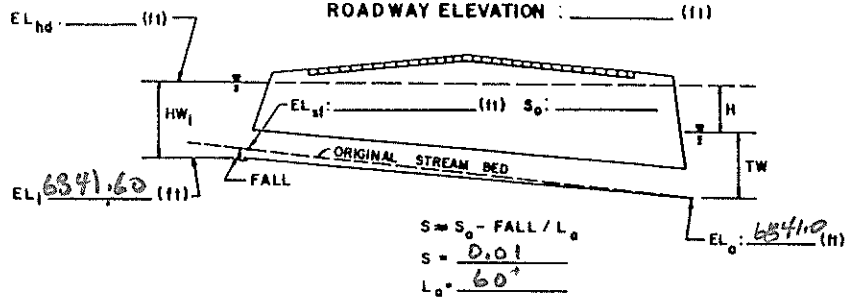
HYDROLOGICAL DATA

SEE ADD'L RMTS.

- ☐ 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



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)	dc	(dc+D)/2	ho (6)	ke	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
RCBP - 55"X24" W/FES	16.3	16.3	0.61	1.62		52.0	0.9	1.36	1.68	1.68	0.2	0.14	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:

e. APPROXIMATE
f. CULVERT FACE
he. 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: _____

HDR Infrastructure, Inc.
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Drainage Criteria Manual

Date
OCT. 1987

Figure
9-44

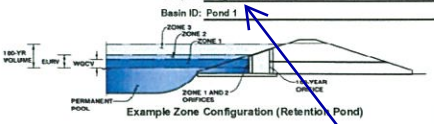
REFERENCE: Federal Highway Administration, Hydraulic Design of Highway Culverts; Hydraulic Design Series No. 5 1985

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd PUD

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

Provide a more descriptive Basin ID. Is Pond 1 the future commercial to the west? For clarity, you may want to also identify the tributary basins ie. (OS1, OS2) in the header.

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	51.06	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) =	0.962	acre-feet
Excess Urban Runoff Volume (EURV) =	2.777	acre-feet
2-yr Runoff Volume (P1 = 0.83 in.) =	1.824	acre-feet
5-yr Runoff Volume (P1 = 1.09 in.) =	2.764	acre-feet
10-yr Runoff Volume (P1 = 1.33 in.) =	3.636	acre-feet
25-yr Runoff Volume (P1 = 1.69 in.) =	5.338	acre-feet
50-yr Runoff Volume (P1 = 1.99 in.) =	6.636	acre-feet
100-yr Runoff Volume (P1 = 2.31 in.) =	8.228	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	11.967	acre-feet
Approximate 2-yr Detention Volume =	1.711	acre-feet
Approximate 5-yr Detention Volume =	2.604	acre-feet
Approximate 10-yr Detention Volume =	3.106	acre-feet
Approximate 25-yr Detention Volume =	3.709	acre-feet
Approximate 50-yr Detention Volume =	4.009	acre-feet
Approximate 100-yr Detention Volume =	4.635	acre-feet

Optional User Override 1-hr Precipitation

inches
inches
inches
inches
inches
inches

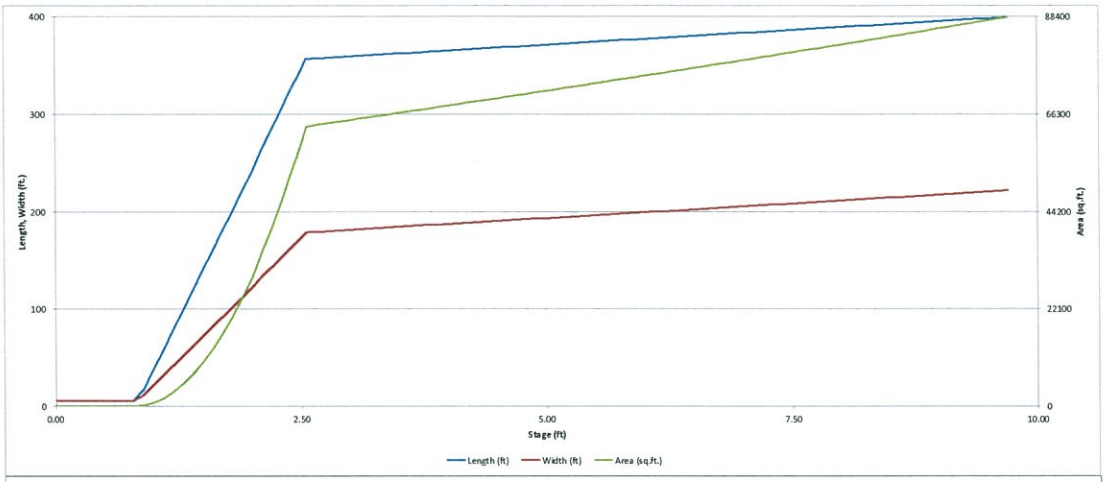
Stage-Storage Calculation

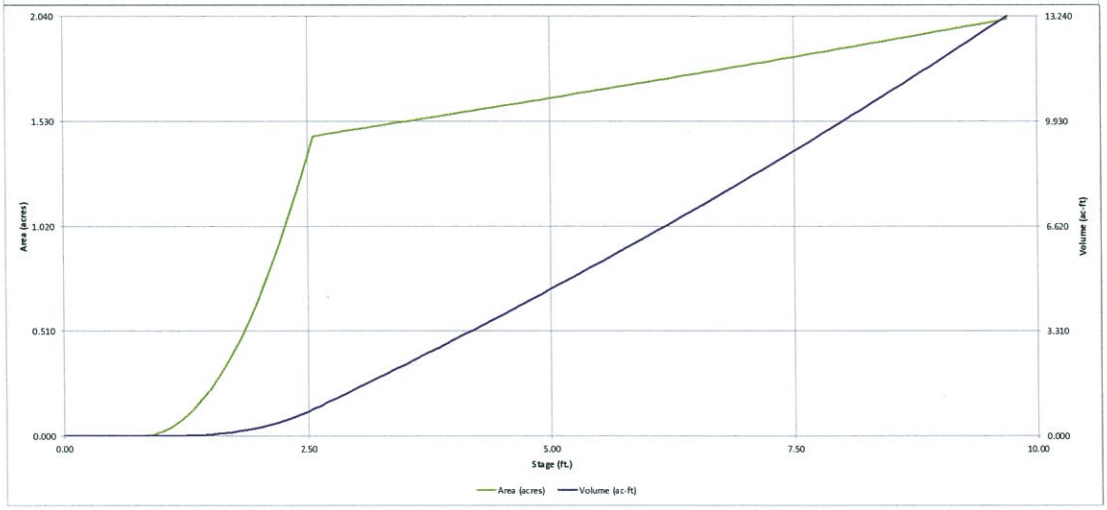
Zone 1 Volume (WQCV) =	0.962	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.815	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.858	acre-feet
Total Detention Basin Volume =	4.635	acre-feet
Initial Surcharge Volume (ISV) =	10	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (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}) =	1.73	ft
Length of Basin Floor (L_{FLOOR}) =	356.1	ft
Width of Basin Floor (W_{FLOOR}) =	178.2	ft
Area of Basin Floor (A_{FLOOR}) =	63,457	ft^2
Volume of Basin Floor (V_{FLOOR}) =	37,347	ft^3
Depth of Main Basin (H_{MAIN}) =	2.44	ft
Length of Main Basin (L_{MAIN}) =	370.7	ft
Width of Main Basin (W_{MAIN}) =	192.8	ft
Area of Main Basin (A_{MAIN}) =	71,493	ft^2
Volume of Main Basin (V_{MAIN}) =	164,529	ft^3
Calculated Total Basin Volume (V_{total}) =	4.635	acre-feet

	Depth (ft)	Override Depth (ft)	Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
	Top of Micropool	0.00	30	0.001		
	0.10	5.5	30	0.001	10	0.000
	0.20	5.5	30	0.001	12	0.000
	0.30	5.5	30	0.001	15	0.000
	0.40	5.5	30	0.001	18	0.000
	0.50	5.5	30	0.001	21	0.000
	0.60	5.5	30	0.001	24	0.001
	0.70	5.5	191	0.004	31	0.001
	0.80	21.2	791	0.018	76	0.002
	0.90	31.2	1,798	0.041	202	0.005
	1.00	41.2	3,210	0.074	449	0.010
	1.10	51.2	5,028	0.115	858	0.020
	1.20	61.2	7,253	0.167	1,469	0.034
	1.30	71.2	9,883	0.227	2,322	0.053
	1.40	81.2	12,920	0.297	3,459	0.079
	1.50	91.2	16,362	0.376	4,920	0.113
	1.60	101.2	20,211	0.464	6,745	0.155
	1.70	111.2	24,465	0.562	8,975	0.206
	1.80	121.2	29,126	0.669	11,651	0.267
	1.90	132.2	34,721	0.797	15,159	0.348
	2.00	142.2	40,234	0.924	18,903	0.434
	2.10	152.2	46,153	1.060	23,219	0.533
	2.20	162.2	52,478	1.205	28,147	0.646
	2.30	172.2	59,209	1.359	33,728	0.774
Floor	2.56	178.2	63,443	1.456	37,407	0.859
	2.60	178.4	63,585	1.460	39,948	0.917
Zone 1 (WQCV)	2.64	178.7	63,713	1.463	42,464	0.976
	2.70	179.0	63,906	1.467	46,322	1.063
	2.80	179.6	64,228	1.474	52,729	1.210
	2.90	180.2	64,551	1.482	59,168	1.358
	3.00	180.8	64,874	1.489	65,639	1.507
	3.10	181.4	65,198	1.497	72,143	1.656
	3.20	182.0	65,523	1.504	78,679	1.806
	3.30	182.6	65,849	1.512	85,247	1.957
	3.40	183.2	66,175	1.519	91,849	2.109
	3.50	183.8	66,502	1.527	98,482	2.261
	3.60	184.4	66,830	1.534	105,149	2.414
	3.70	185.0	67,158	1.542	111,848	2.568
	3.80	185.6	67,487	1.549	118,581	2.722
Zone 2 (EURV)	3.84	185.9	67,619	1.552	121,283	2.784
	3.90	186.2	67,817	1.557	125,346	2.878
	4.00	186.8	68,148	1.564	132,144	3.034
	4.10	187.4	68,479	1.572	138,975	3.190
	4.20	188.0	68,811	1.580	145,840	3.348
	4.30	188.6	69,144	1.587	152,738	3.506
	4.40	189.2	69,477	1.595	159,669	3.665
	4.50	189.8	69,811	1.603	166,633	3.825
	4.60	190.4	70,146	1.610	173,631	3.986
	4.70	191.0	70,482	1.618	180,662	4.147
	4.80	191.6	70,818	1.626	187,727	4.310
	4.90	192.2	71,155	1.634	194,826	4.473
Zone 3 (100-year)	5.00	192.8	71,493	1.641	201,958	4.636
	5.10	193.4	71,832	1.649	209,125	4.801
	5.20	194.0	72,171	1.657	216,325	4.966
	5.30	194.6	72,511	1.665	223,559	5.132
	5.40	195.2	72,851	1.672	230,827	5.299
	5.50	195.8	73,193	1.680	238,129	5.467
	5.60	196.4	73,535	1.688	245,466	5.635
	5.70	197.0	73,878	1.696	252,836	5.804
	5.80	197.6	74,221	1.704	260,241	5.974
	5.90	198.2	74,566	1.712	267,680	6.145
	6.00	198.8	74,911	1.720	275,154	6.317
	6.10	199.4	75,256	1.728	282,663	6.489
	6.20	200.0	75,603	1.736	290,206	6.662
	6.30	200.6	75,950	1.744	297,783	6.836
	6.40	201.2	76,298	1.752	305,396	7.011
	6.50	201.8	76,646	1.760	313,043	7.186
	6.60	202.4	76,996	1.768	320,725	7.363
	6.70	203.0	77,346	1.776	328,442	7.540
	6.80	203.6	77,696	1.784	336,194	7.718
	6.90	204.2	78,048	1.792	343,981	7.897
	7.00	204.8	78,400	1.800	351,804	8.076
	7.10	205.4	78,753	1.808	359,661	8.257
	7.20	206.0	79,107	1.816	367,554	8.438
	7.30	206.6	79,461	1.824	375,483	8.620
	7.40	207.2	79,816	1.832	383,446	8.803
	7.50	207.8	80,172	1.840	391,446	8.986
	7.60	208.4	80,528	1.849	399,481	9.171
	7.70	209.0	80,886	1.857	407,552	9.356
	7.80	209.6	81,243	1.865	415,658	9.542
	7.90	210.2	81,602	1.873	423,800	9.729
	8.00	210.8	81,962	1.882	431,978	9.917
	8.10	211.4	82,322	1.890	440,193	10.105
	8.20	212.0	82,682	1.898	448,443	10.295
	8.30	212.6	83,044	1.906	456,729	10.485
	8.40	213.2	83,406	1.915	465,052	10.676
	8.50	213.8	83,769	1.923	473,410	10.868
	8.60	214.4	84,133	1.931	481,805	11.061
	8.70	215.0	84,497	1.940	490,237	11.254
	8.80	215.6	84,863	1.948	498,705	11.449
	8.90	216.2	85,228	1.957	507,210	11.644
	9.00	216.8	85,595	1.965	515,751	11.840
	9.10	217.4	85,962	1.973	524,329	12.037
	9.20	218.0	86,330	1.982	532,943	12.235
	9.30	218.6	86,699	1.990	541,595	12.433
	9.40	219.2	87,069	1.999	550,283	12.633
	9.50	219.8	87,439	2.007	559,008	12.833
	9.60	220.4	87,810	2.016	567,771	13.034
	9.70	221.0	88,181	2.024	576,570	13.236

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



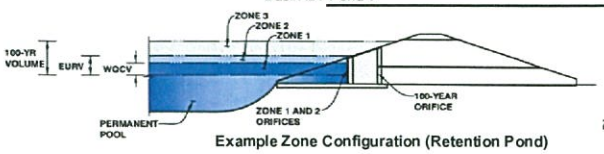


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd PUD

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.64	0.962	Orifice Plate
Zone 2 (EURV)	3.84	1.815	Orifice Plate
Zone 3 (100-year)	5.00	1.858	Weir&Pipe (Restrict)
		4.635	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

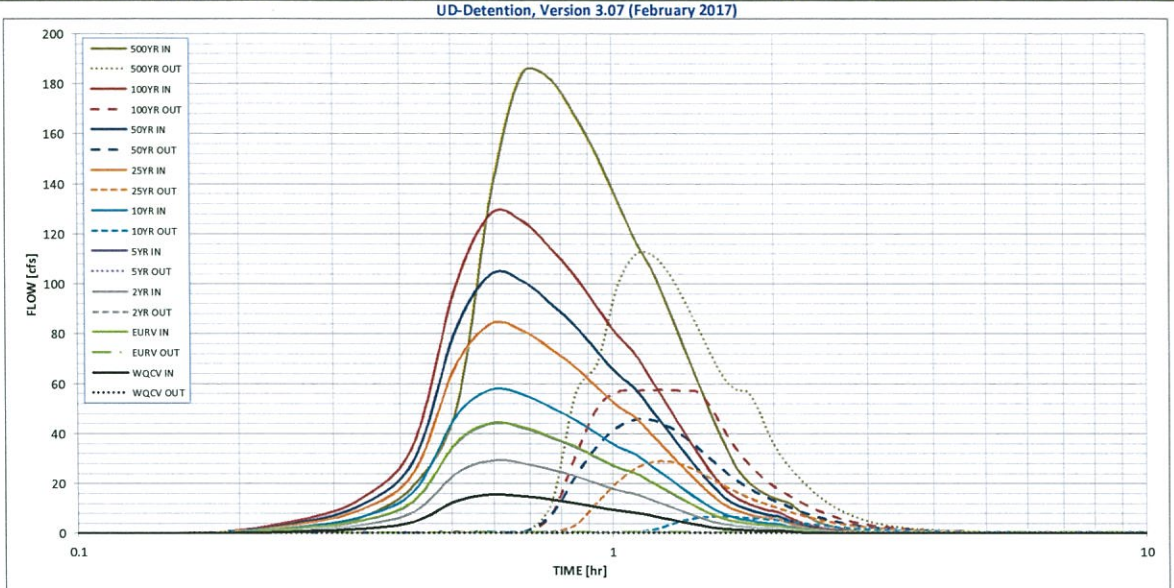
Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	7.00	feet
Basin Area at Top of Freeboard =	1.80	acres

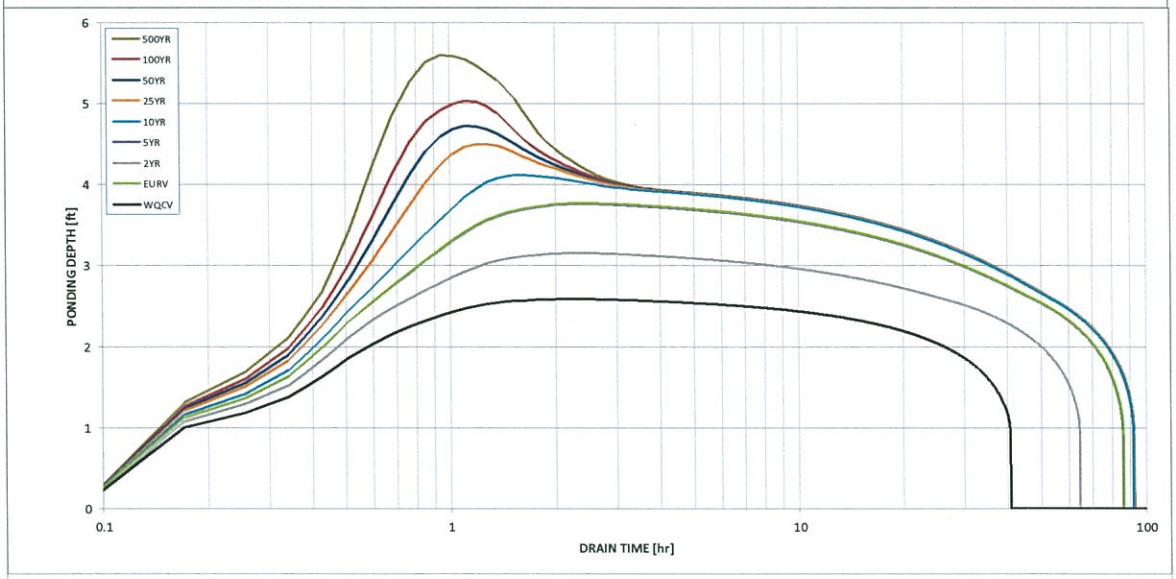
Routed Hydrograph Results

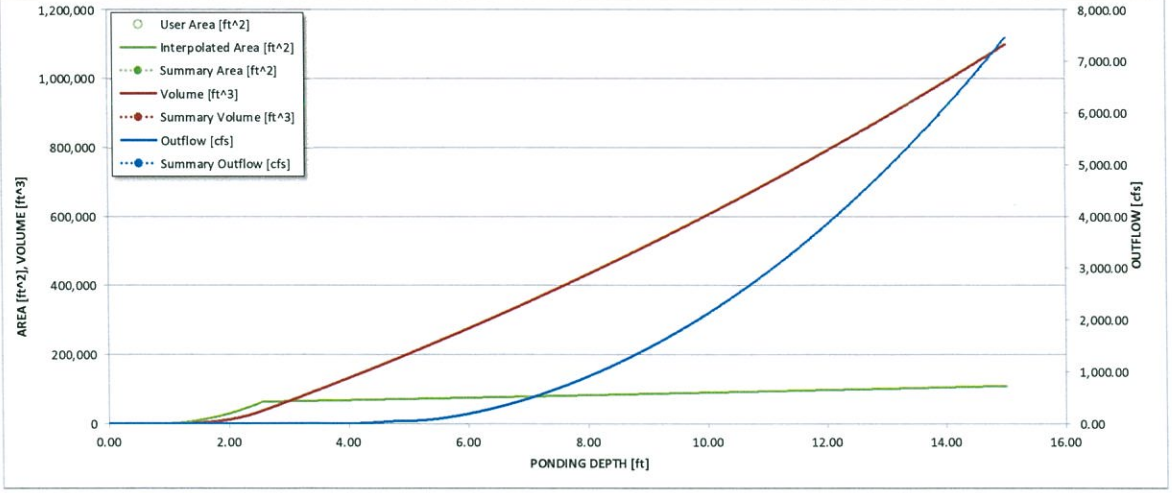
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.83	1.09	1.33	1.69	1.99	2.31	3.14
Calculated Runoff Volume (acre-ft) =	0.962	2.777	1.824	2.764	3.636	5.338	6.636	8.228	11.967
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.962	2.777	1.824	2.763	3.634	5.330	6.631	8.217	11.963
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.09	0.25	0.65	0.90	1.21	1.92
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	4.4	12.8	33.1	45.8	61.9	97.9
Peak Inflow Q (cfs) =	15.5	44.2	29.2	44.0	57.6	83.9	103.8	127.9	184.0
Peak Outflow Q (cfs) =	0.3	0.6	0.5	0.6	6.6	28.5	45.6	57.4	111.8
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	1.7	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) =	39	80	61	80	85	83	81	79	74
Time to Drain 99% of Inflow Volume (hours) =	40	84	63	83	89	88	87	87	85
Maximum Ponding Depth (ft) =	2.59	3.77	3.16	3.76	4.11	4.50	4.72	5.03	5.59
Area at Maximum Ponding Depth (acres) =	1.46	1.55	1.50	1.55	1.57	1.60	1.62	1.64	1.69
Maximum Volume Stored (acre-ft) =	0.888	2.676	1.731	2.660	3.206	3.809	4.180	4.669	5.618

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
	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]
5.12 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:22	0.68	1.88	1.26	1.87	2.42	3.40	4.09	4.87	6.51
0.976	0:20:29	1.84	5.16	3.44	5.14	6.68	9.55	11.65	14.11	19.55
	0:25:36	4.73	13.26	8.83	13.19	17.16	24.52	29.91	36.23	50.26
	0:30:43	13.01	36.37	24.23	36.19	47.06	67.20	81.90	99.11	137.20
	0:35:50	15.52	44.22	29.22	44.00	57.64	83.89	103.80	127.89	183.99
	0:40:58	14.83	42.40	27.97	42.19	55.37	81.07	100.80	124.93	182.07
	0:46:05	13.50	38.59	25.46	38.39	50.39	73.98	92.17	114.48	167.60
	0:51:12	12.08	34.70	22.85	34.53	45.38	66.67	83.11	103.27	151.30
	0:56:19	10.46	30.26	19.85	30.10	39.66	58.43	72.95	90.80	133.43
	1:01:26	9.10	26.35	17.24	26.22	34.60	51.07	63.81	79.47	116.89
	1:06:34	8.25	23.85	15.64	23.73	31.26	46.01	57.39	71.34	104.53
	1:11:41	6.83	19.92	13.03	19.82	26.17	38.67	48.38	60.35	89.02
	1:16:48	5.60	16.47	10.74	16.38	21.67	32.09	40.19	50.17	74.12
	1:21:55	4.34	12.97	8.41	12.91	17.13	25.52	32.07	40.18	59.71
	1:27:02	3.26	9.95	6.40	9.90	13.21	19.78	24.93	31.31	46.71
	1:32:10	2.35	7.37	4.70	7.33	9.84	14.84	18.77	23.65	35.47
	1:37:17	1.81	5.57	3.57	5.54	7.39	11.08	13.97	17.54	26.15
	1:42:24	1.49	4.50	2.91	4.48	5.96	8.88	11.15	13.95	20.67
	1:47:31	1.26	3.80	2.46	3.78	5.02	7.46	9.36	11.70	17.29
	1:52:38	1.11	3.31	2.15	3.29	4.37	6.48	8.12	10.13	14.93
	1:57:46	1.00	2.97	1.93	2.95	3.91	5.79	7.25	9.03	13.28
	2:02:53	0.92	2.72	1.77	2.71	3.58	5.30	6.62	8.25	12.11
	2:08:00	0.67	2.01	1.30	2.00	2.66	3.98	5.01	6.29	9.39
	2:13:07	0.49	1.46	0.95	1.46	1.93	2.87	3.61	4.53	6.76
	2:18:14	0.36	1.08	0.70	1.07	1.43	2.13	2.68	3.36	5.02
	2:23:22	0.27	0.80	0.52	0.80	1.06	1.58	1.99	2.50	3.72
	2:28:29	0.19	0.58	0.38	0.58	0.78	1.16	1.47	1.84	2.76
	2:33:36	0.14	0.42	0.27	0.42	0.56	0.84	1.06	1.33	2.00
	2:38:43	0.10	0.30	0.19	0.30	0.40	0.61	0.77	0.96	1.44
	2:43:50	0.07	0.21	0.13	0.21	0.28	0.43	0.54	0.68	1.03
	2:48:58	0.04	0.13	0.08	0.13	0.18	0.28	0.35	0.45	0.69
	2:54:05	0.02	0.07	0.04	0.07	0.10	0.16	0.21	0.27	0.41
	2:59:12	0.01	0.03	0.02	0.03	0.05	0.08	0.10	0.13	0.21
	3:04:19	0.00	0.01	0.00	0.01	0.01	0.02	0.03	0.04	0.07
	3:09:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:56:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:43:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:08:38	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'.

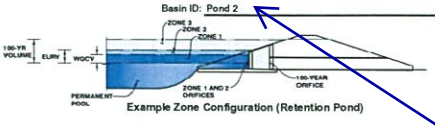
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Ve[illegible] (February 2017)

Project: Judge Orr Road RV Park and Storage

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Provide a more descriptive Basin ID. Is Pond 2 the RV on-site basin. For clarity, you may want to also identify the tributary basins ie. (A1, A2, OS6) in the header.

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	29.80	acres	Note: L / W Ratio < 1
Watershed Length =	1,100	ft	L / W Ratio = 0.9
Watershed Slope =	0.018	ft/ft	
Watershed Imperviousness =	36.50%	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) =	0.423	acre-feet	Optional User Override 1-hr Precipitation
Excess Urban Runoff Volume (EURV) =	1.134	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.886	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.242	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.803	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.801	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.467	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.340	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.01 in.) =	5.843	acre-feet	3.01 inches
Approximate 2-yr Detention Volume =	0.828	acre-feet	
Approximate 5-yr Detention Volume =	1.165	acre-feet	
Approximate 10-yr Detention Volume =	1.632	acre-feet	
Approximate 25-yr Detention Volume =	1.844	acre-feet	
Approximate 50-yr Detention Volume =	1.938	acre-feet	
Approximate 100-yr Detention Volume =	2.243	acre-feet	

Stage-Storage Calculation

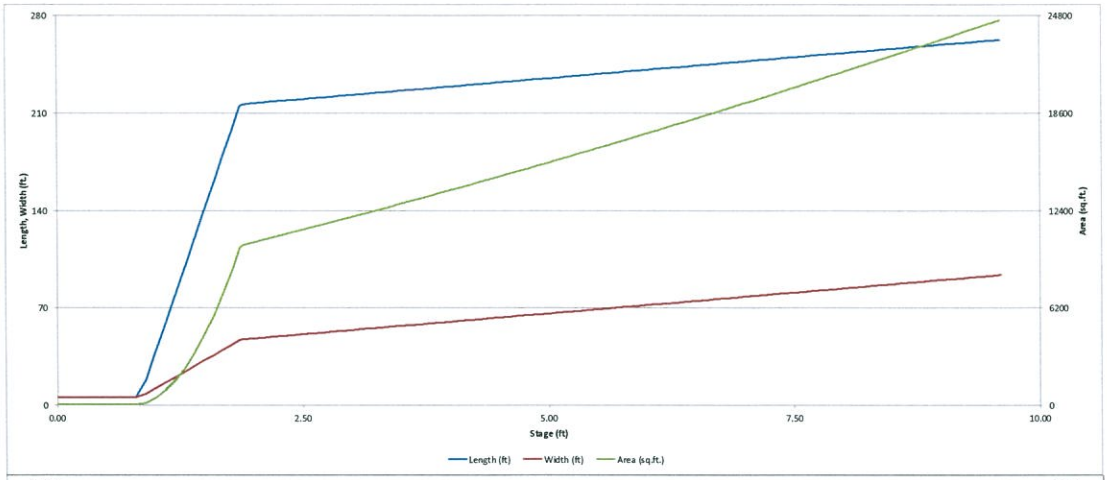
Zone 1 Volume (WQCV) =	0.423	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.711	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.109	acre-feet
Total Detention Basin Volume =	2.243	acre-feet
Initial Surcharge Volume (ISV) =	10	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (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}) =	1.04	ft
Length of Basin Floor (L_{FLOOR}) =	215.9	ft
Width of Basin Floor (W_{FLOOR}) =	47.0	ft
Area of Basin Floor (A_{FLOOR}) =	10,142	ft^2
Volume of Basin Floor (V_{FLOOR}) =	3,706	ft^3
Depth of Main Basin (H_{MAIN}) =	6.13	ft
Length of Main Basin (L_{MAIN}) =	252.7	ft
Width of Main Basin (W_{MAIN}) =	83.8	ft
Area of Main Basin (A_{MAIN}) =	21,171	ft^2
Volume of Main Basin (V_{MAIN}) =	93,978	ft^3
Calculated Total Basin Volume (V_{total}) =	2.243	acre-feet

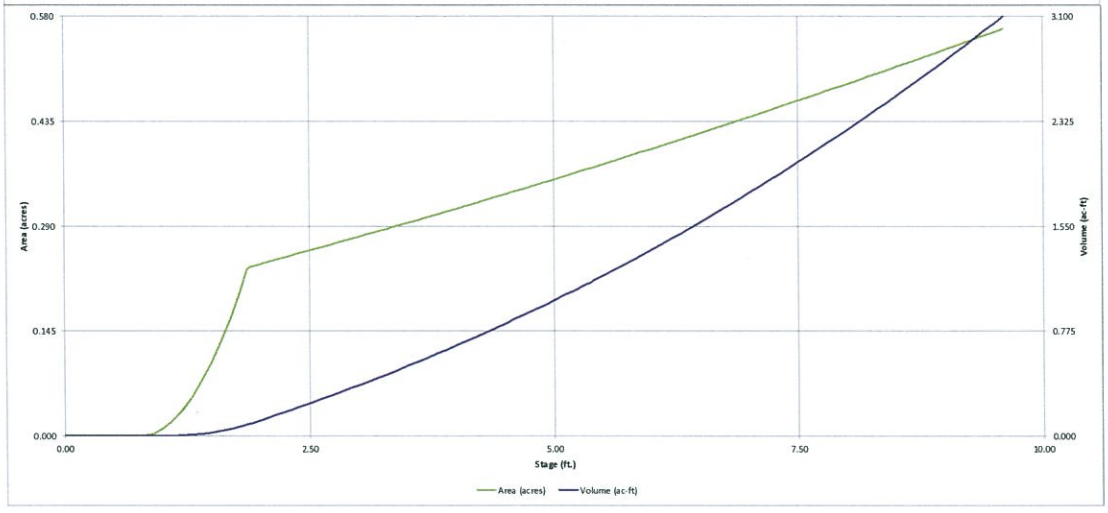
Depth Inc[illegible]

Stage - Storage Description	Stage (ft)	Override	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Mi[illegible]							0.001		
ISV							0.001	10	0.000
							0.001	12	0.000
							0.001	15	0.000
							0.001	18	0.000
							0.001	21	0.000
							0.001	24	0.001
							0.003	30	0.001
							0.010	58	0.001
							0.021	126	0.003
							0.036	249	0.006
	1.30		98.9	23.9	2,364		0.054	444	0.010
	1.40		119.2	27.9	3,326		0.076	727	0.017
	1.50		139.5	31.9	4,450		0.102	1,115	0.026
	1.60		159.8	35.9	5,737		0.132	1,623	0.037
	1.70		180.1	39.9	7,186		0.165	2,267	0.052
	1.80		200.4	43.9	8,798		0.202	3,065	0.070
Floor	1.87		214.6	46.7	10,023		0.230	3,724	0.085
	1.90		216.1	47.1	10,179		0.234	4,028	0.092
	2.00		216.7	47.7	10,337		0.237	5,054	0.116
	2.10		217.3	48.4	10,512		0.241	6,200	0.142
	2.20		217.9	49.0	10,672		0.245	7,259	0.167
	2.30		218.5	49.6	10,833		0.249	8,335	0.191
	2.40		219.1	50.2	10,994		0.252	9,426	0.216
	2.50		219.7	50.8	11,156		0.256	10,533	0.242
	2.60		220.3	51.4	11,318		0.260	11,657	0.268
	2.70		220.9	52.0	11,482		0.264	12,797	0.294
	2.80		221.5	52.6	11,646		0.267	13,954	0.320
	2.90		222.1	53.2	11,811		0.271	15,126	0.347
	3.00		222.7	53.8	11,976		0.275	16,316	0.375
	3.10		223.3	54.4	12,143		0.279	17,522	0.402
Zone 1 (WQCV)	3.18		223.8	54.8	12,276		0.282	18,498	0.425
	3.20		223.9	55.0	12,310		0.283	18,744	0.430
	3.30		224.5	55.6	12,477		0.286	19,984	0.459
	3.40		225.1	56.2	12,646		0.290	21,240	0.488
	3.50		225.7	56.8	12,815		0.294	22,513	0.517
	3.60		226.3	57.4	12,985		0.298	23,803	0.546
	3.70		226.9	58.0	13,155		0.302	25,110	0.576
	3.80		227.5	58.6	13,327		0.306	26,434	0.607
	3.90		228.1	59.2	13,499		0.310	27,775	0.638
	4.00		228.7	59.8	13,671		0.314	29,134	0.669
	4.10		229.3	60.4	13,845		0.318	30,509	0.700
	4.20		229.9	61.0	14,019		0.322	31,903	0.732
	4.30		230.5	61.6	14,194		0.326	33,313	0.765
	4.40		231.1	62.2	14,369		0.330	34,741	0.798
	4.50		231.7	62.8	14,546		0.334	36,187	0.831
	4.60		232.3	63.4	14,723		0.338	37,651	0.864
	4.70		232.9	64.0	14,901		0.342	39,132	0.898
	4.80		233.5	64.6	15,079		0.346	40,631	0.933
	4.90		234.1	65.2	15,258		0.350	42,148	0.968
	5.00		234.7	65.8	15,438		0.354	43,682	1.003
	5.10		235.3	66.4	15,619		0.359	45,235	1.038
	5.20		235.9	67.0	15,800		0.363	46,806	1.075
	5.30		236.5	67.6	15,982		0.367	48,395	1.111
Zone 2 (EURV)	5.37		237.0	68.0	16,110		0.370	49,519	1.137
	5.40		237.1	68.2	16,165		0.371	50,003	1.148
	5.50		237.7	68.8	16,349		0.375	51,628	1.185
	5.60		238.3	69.4	16,533		0.380	53,273	1.223
	5.70		238.9	70.0	16,718		0.384	54,935	1.261
	5.80		239.5	70.6	16,904		0.388	56,616	1.300
	5.90		240.1	71.2	17,090		0.392	58,316	1.339
	6.00		240.7	71.8	17,277		0.397	60,034	1.378
	6.10		241.3	72.4	17,465		0.401	61,771	1.418
	6.20		241.9	73.0	17,654		0.405	63,527	1.458
	6.30		242.5	73.6	17,843		0.410	65,302	1.499
	6.40		243.1	74.2	18,033		0.414	67,096	1.540
	6.50		243.7	74.8	18,224		0.418	68,909	1.582
	6.60		244.3	75.4	18,415		0.423	70,741	1.624
	6.70		244.9	76.0	18,608		0.427	72,592	1.666
	6.80		245.5	76.6	18,800		0.432	74,462	1.709
	6.90		246.1	77.2	18,994		0.436	76,352	1.753
	7.00		246.7	77.8	19,188		0.441	78,261	1.797
	7.10		247.3	78.4	19,383		0.445	80,190	1.841
	7.20		247.9	79.0	19,579		0.449	82,138	1.886
	7.30		248.5	79.6	19,776		0.454	84,106	1.931
	7.40		249.1	80.2	19,973		0.459	86,093	1.976
	7.50		249.7	80.8	20,171		0.463	88,100	2.023
	7.60		250.3	81.4	20,370		0.468	90,127	2.069
	7.70		250.9	82.0	20,569		0.472	92,174	2.116
	7.80		251.5	82.6	20,769		0.477	94,241	2.163
	7.90		252.1	83.2	20,970		0.481	96,328	2.211
Zone 3 (100-year)	7.97		252.6	83.6	21,111		0.485	97,801	2.245
	8.00		252.7	83.8	21,171		0.486	98,435	2.260
	8.10		253.3	84.4	21,374		0.491	100,562	2.309
	8.20		253.9	85.0	21,577		0.495	102,710	2.358
	8.30		254.5	85.6	21,780		0.500	104,878	2.408
	8.40		255.1	86.2	21,985		0.505	107,066	2.458
	8.50		255.7	86.8	22,190		0.509	109,275	2.509
	8.60		256.3	87.4	22,396		0.514	111,504	2.560
	8.70		256.9	88.0	22,602		0.519	113,754	2.611
	8.80		257.5	88.6	22,810		0.524	116,024	2.664
	8.90		258.1	89.2	23,018		0.528	118,316	2.716
	9.00		258.7	89.8	23,226		0.533	120,628	2.769
	9.10		259.3	90.4	23,436		0.538	122,961	2.823
	9.20		259.9	91.0	23,646		0.543	125,315	2.877
	9.30		260.5	91.6	23,857		0.548	127,690	2.931
	9.40		261.1	92.2	24,069		0.553	130,087	2.986
	9.50		261.7	92.8	24,281		0.557	132,504	3.042
	9.60		262.3	93.4	24,494		0.562	134,943	3.098

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



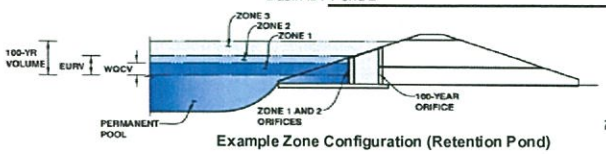


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Road RV Park and Storage

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.18	0.423	Orifice Plate
Zone 2 (EURV)	5.37	0.711	Orifice Plate
Zone 3 (100-year)	7.97	1.109	Weir&Pipe (Restrict)
		2.243	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

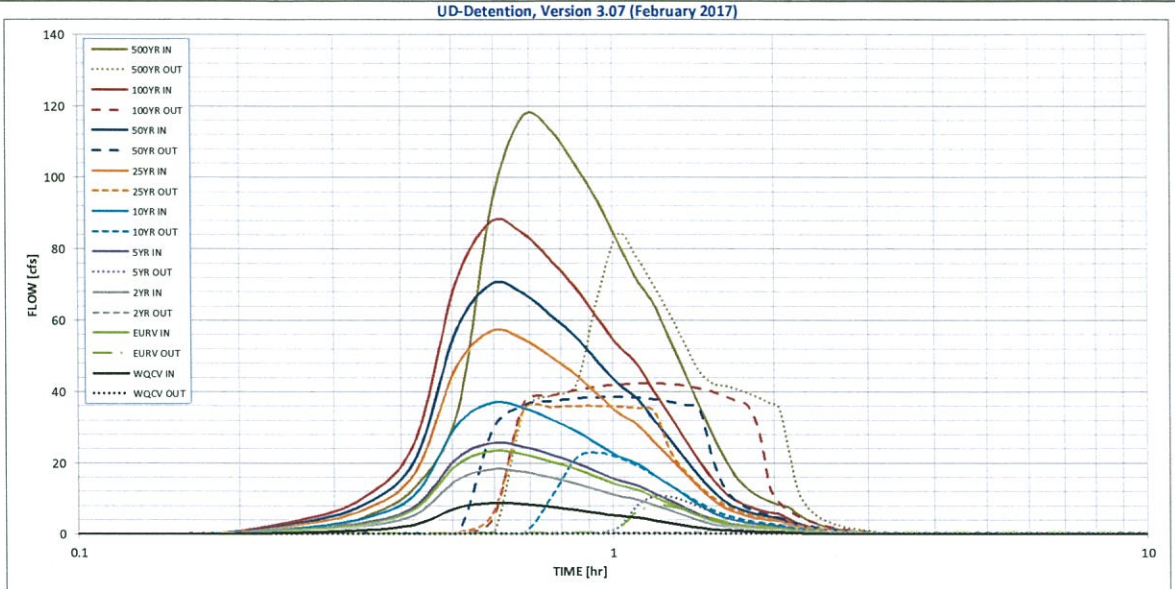
Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	11.30	feet
Basin Area at Top of Freeboard =	0.65	acres

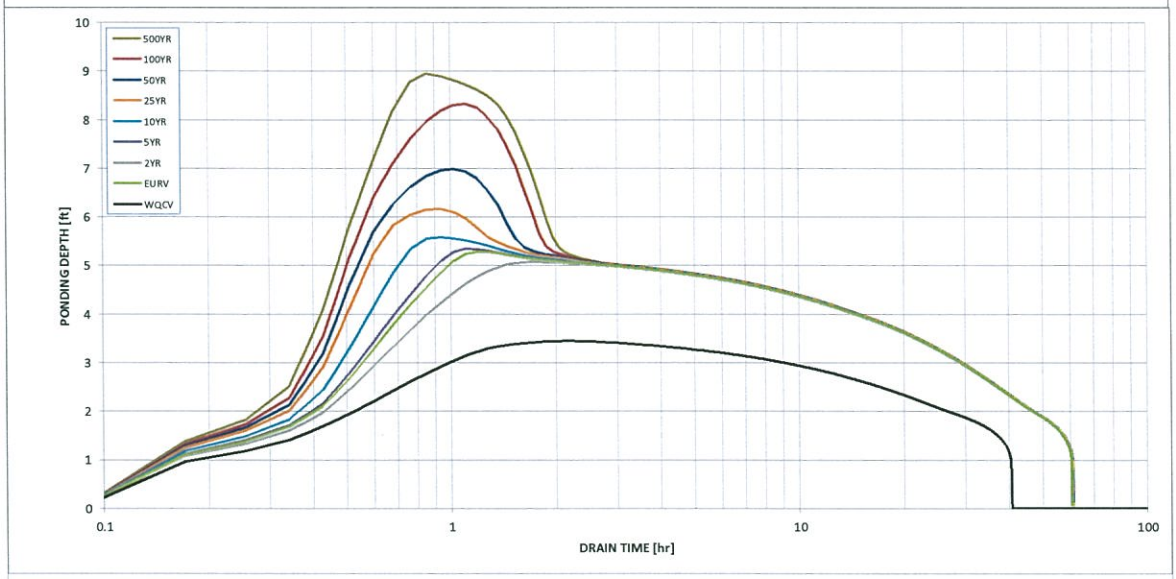
Routed Hydrograph Results

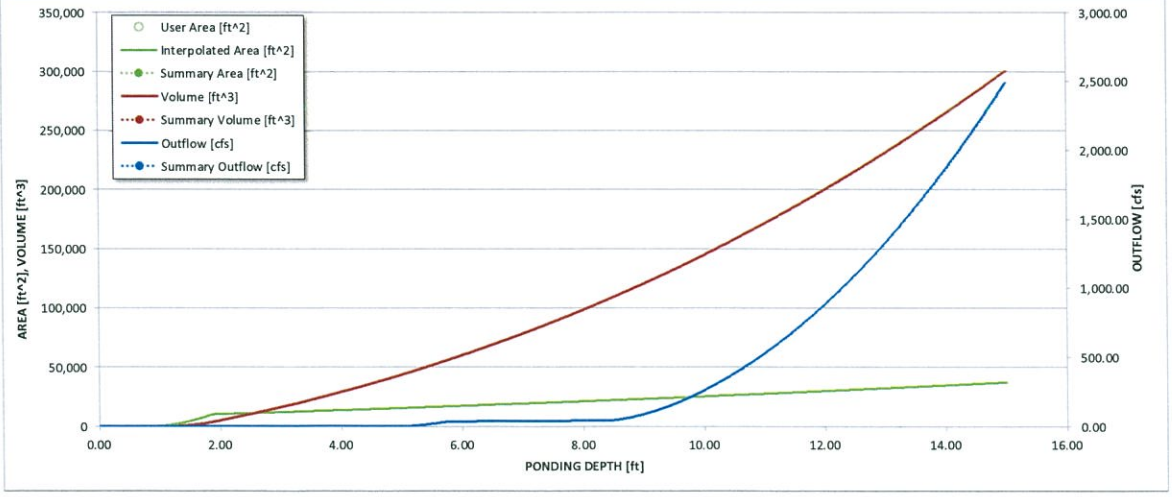
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.01
Calculated Runoff Volume (acre-ft) =	0.423	1.134	0.886	1.242	1.803	2.801	3.467	4.340	5.843
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.539	1.446	1.130	1.584	2.300	3.573	4.423	5.536	7.454
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.27	0.84	1.17	1.55	2.19
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.8	8.0	25.2	34.7	46.3	65.3
Peak Inflow Q (cfs) =	8.8	23.3	18.3	25.5	36.8	56.9	70.2	87.5	117.1
Peak Outflow Q (cfs) =	0.2	8.0	1.4	10.6	22.8	35.8	38.4	42.2	84.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	13.2	2.9	1.4	1.1	0.9	1.3
Structure Controlling Flow =	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.30	0.04	0.4	0.9	1.4	1.5	1.7	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	55	56	55	52	48	46	43	39
Time to Drain 99% of Inflow Volume (hours) =	40	59	59	59	58	56	55	54	52
Maximum Ponding Depth (ft) =	3.45	5.28	5.07	5.34	5.57	6.15	6.98	8.31	8.94
Area at Maximum Ponding Depth (acres) =	0.29	0.37	0.36	0.37	0.38	0.40	0.44	0.50	0.53
Maximum Volume Stored (acre-ft) =	0.499	1.100	1.028	1.122	1.212	1.438	1.788	2.413	2.737

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]
5.12 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:22	0.39	1.02	0.80	1.11	1.59	2.42	2.95	3.62	4.69
1.246	0:20:29	1.05	2.76	2.17	3.02	4.33	6.64	8.15	10.07	13.25
	0:25:36	2.71	7.09	5.57	7.75	11.13	17.05	20.93	25.86	34.03
	0:30:43	7.44	19.47	15.31	21.27	30.56	46.79	57.41	70.91	93.21
	0:35:50	8.79	23.30	18.26	25.49	36.85	56.89	70.21	87.52	117.06
	0:40:58	8.37	22.27	17.44	24.37	35.28	54.56	67.41	84.27	113.34
	0:46:05	7.62	20.27	15.88	22.19	32.11	49.65	61.34	76.77	103.51
	0:51:12	6.79	18.16	14.20	19.88	28.81	44.65	55.23	69.17	93.31
	0:56:19	5.85	15.73	12.29	17.23	25.03	38.94	48.25	60.52	81.83
	1:01:26	5.10	13.68	10.70	14.99	21.74	33.91	42.08	52.85	71.54
	1:06:34	4.62	12.41	9.69	13.59	19.72	30.69	38.03	47.69	64.41
	1:11:41	3.80	10.29	8.02	11.28	16.43	25.64	31.82	39.99	54.20
	1:16:48	3.09	8.45	6.57	9.27	13.54	21.19	26.34	33.14	45.00
	1:21:55	2.36	6.57	5.09	7.21	10.60	16.70	20.82	26.28	35.84
	1:27:02	1.75	4.94	3.81	5.44	8.06	12.81	16.03	20.31	27.81
	1:32:10	1.27	3.59	2.75	3.96	5.92	9.49	11.93	15.18	20.90
	1:37:17	0.99	2.76	2.12	3.03	4.50	7.17	8.97	11.38	15.58
	1:42:24	0.81	2.26	1.74	2.48	3.67	5.80	7.24	9.14	12.46
	1:47:31	0.69	1.91	1.48	2.10	3.10	4.89	6.10	7.69	10.47
	1:52:38	0.61	1.68	1.30	1.84	2.71	4.26	5.31	6.69	9.09
	1:57:46	0.55	1.51	1.17	1.65	2.43	3.82	4.75	5.98	8.12
	2:02:53	0.51	1.39	1.08	1.52	2.23	3.50	4.35	5.48	7.42
	2:08:00	0.37	1.02	0.79	1.12	1.64	2.59	3.23	4.09	5.59
	2:13:07	0.27	0.75	0.58	0.82	1.20	1.88	2.34	2.96	4.04
	2:18:14	0.20	0.55	0.42	0.60	0.88	1.39	1.73	2.19	2.99
	2:23:22	0.15	0.40	0.31	0.44	0.65	1.03	1.29	1.63	2.22
	2:28:29	0.10	0.29	0.23	0.32	0.47	0.75	0.94	1.19	1.63
	2:33:36	0.07	0.21	0.16	0.23	0.34	0.54	0.67	0.86	1.18
	2:38:43	0.05	0.15	0.11	0.16	0.24	0.39	0.49	0.62	0.85
	2:43:50	0.03	0.10	0.08	0.11	0.17	0.27	0.34	0.43	0.60
	2:48:58	0.02	0.06	0.05	0.07	0.10	0.17	0.22	0.28	0.39
	2:54:05	0.01	0.03	0.02	0.04	0.06	0.10	0.12	0.16	0.23
	2:59:12	0.00	0.01	0.01	0.01	0.02	0.04	0.06	0.07	0.11
	3:04:19	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03
	3:09:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:56:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:43:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:08:38	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).

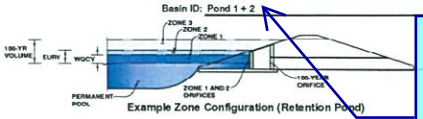
JUDGE ORR RD RV PARK																												
INFLOW HYDROGRAPH																												
TIME		WQCV			EURV			2 YR			5 YR			10 YR			25 YR			50 YR			100 YR			500 YR		TIME
	OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		OUTFLOW	INFLOW		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
0:05:07	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	0:05:07
0:10:14	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	0:10:14
0:15:22	0.14	0.39	0.53	0.18	1.02	1.20	0.14	0.80	0.94	0.18	1.11	1.29	0.19	1.59	1.78	0.21	2.42	2.63	0.22	2.95	3.17	0.23	3.62	3.85	0.24	4.69	4.93	0:15:22
0:20:29	0.18	1.05	1.23	0.23	2.76	2.99	0.21	2.17	2.38	0.28	3.02	3.30	0.25	4.33	4.58	0.26	6.64	6.90	0.27	8.15	8.42	0.28	10.07	10.35	0.30	13.25	13.55	0:20:29
0:25:36	0.23	2.71	2.94	0.28	7.09	7.37	0.26	5.57	5.83	0.32	7.75	8.07	0.29	11.13	11.42	0.31	17.05	17.36	0.32	20.93	21.25	0.33	25.86	26.19	0.28	34.03	34.31	0:25:36
0:30:43	0.27	7.44	7.71	0.32	19.47	19.79	0.30	15.31	15.61	0.34	21.27	21.61	0.33	30.56	30.89	0.39	46.79	47.18	0.43	57.41	57.84	0.46	70.91	71.37	0.53	93.21	93.74	0:30:43
0:35:50	0.29	8.79	9.08	0.34	23.30	23.64	0.32	18.26	18.58	0.41	25.49	25.90	0.40	36.85	37.25	0.47	56.89	57.36	0.51	70.21	70.72	0.56	87.52	88.08	11.96	117.06	129.02	0:35:50
0:40:58	0.30	8.37	8.67	0.41	22.27	22.68	0.33	17.44	17.77	0.45	24.37	24.82	0.46	35.28	35.74	0.53	54.56	55.09	0.58	67.41	67.99	7.22	84.27	91.49	55.96	113.34	169.30	0:40:58
0:46:05	0.31	7.62	7.93	0.45	20.27	20.72	0.35	15.88	16.23	0.47	22.19	22.66	0.50	32.11	32.61	0.57	49.65	50.22	7.41	61.34	68.75	30.68	76.77	107.45	68.40	103.51	171.91	0:46:05
0:51:12	0.32	6.79	7.11	0.47	18.16	18.63	0.40	14.20	14.60	0.50	19.88	20.38	0.53	28.81	29.34	3.18	44.65	47.83	22.82	55.23	78.05	50.11	69.17	119.28	98.87	93.31	192.18	0:51:12
0:56:19	0.33	5.85	6.18	0.50	15.73	16.23	0.42	12.29	12.71	0.51	17.23	17.74	0.55	25.03	25.58	12.22	38.94	51.16	35.01	48.25	83.26	56.54	60.52	117.06	111.83	81.83	193.66	0:56:19
1:01:26	0.33	5.10	5.43	0.51	13.68	14.19	0.45	10.70	11.15	0.53	14.99	15.52	0.57	21.74	22.31	20.46	33.91	54.37	42.44	42.08	84.52	57.00	52.85	109.85	111.26	71.54	182.80	1:01:26
1:06:34	0.33	4.62	4.95	0.53	12.41	12.94	0.46	9.69	10.15	0.54	13.59	14.13	1.29	19.72	21.01	25.97	30.69	56.66	45.58	38.03	83.61	57.36	47.69	105.05	104.03	64.41	168.44	1:06:34
1:11:41	0.34	3.80	4.14	0.54	10.29	10.83	0.47	8.02	8.49	0.55	11.28	11.83	3.36	16.43	19.79	28.45	25.64	54.09	45.19	31.82	77.01	57.30	39.99	97.29	93.38	54.20	147.58	1:11:41
1:16:48	0.34	3.09	3.43	0.55	8.45	9.00	0.47	6.57	7.04	0.56	9.27	9.83	5.10	13.54	18.64	28.55	21.19	49.74	42.47	26.34	68.81	56.94	33.14	90.08	81.83	45.00	126.83	1:16:48
1:21:55	0.34	2.36	2.70	0.56	6.57	7.13	0.48	5.09	5.57	0.56	7.21	7.77	6.15	10.60	16.75	26.98	16.70	43.68	38.36	20.82	59.18	56.30	26.28	82.58	70.83	35.84	106.67	1:21:55
1:27:02	0.34	1.75	2.09	0.56	4.94	5.50	0.48	3.81	4.29	0.56	5.44	6.00	6.57	8.06	14.63	24.47	12.81	37.28	33.66	16.03	49.69	49.60	20.31	69.91	61.71	27.81	89.52	1:27:02
1:32:10	0.34	1.27	1.61	0.57	3.59	4.16	0.48	2.75	3.23	0.57	3.96	4.53	6.59	5.92	12.51	21.58	9.49	31.07	28.92	11.93	40.85	40.83	15.18	56.01	57.56	20.90	78.46	1:32:10
1:37:17	0.34	0.99	1.33	0.57	2.76	3.33	0.48	2.12	2.60	0.57	3.03	3.60	6.40	4.50	10.90	18.77	7.17	25.94	24.63	8.97	33.60	33.62	11.38	45.00	56.54	15.58	72.12	1:37:17
1:42:24	0.34	0.81	1.15	0.57	2.26	2.83	0.48	1.74	2.22	0.57	2.48	3.05	6.11	3.67	9.78	16.30	5.80	22.10	21.02	7.24	28.26	27.95	9.14	37.09	49.38	12.46	61.84	1:42:24
1:47:31	0.34	0.69	1.03	0.57	1.91	2.48	0.48	1.48	1.96	0.57	2.10	2.67	5.78	3.10	8.88	14.22	4.89	19.11	18.07	6.10	24.17	23.53	7.69	31.22	39.37	10.47	49.84	1:47:31
1:52:38	0.34	0.61	0.95	0.57	1.68	2.25	0.49	1.30	1.79	0.57	1.84	2.41	5.45	2.71	8.16	12.49	4.26	16.75	15.68	5.31	20.99	20.07	6.69	26.76	32.19	9.09	41.28	1:52:38
1:57:46	0.34	0.55	0.89	0.58	1.51	2.09	0.49	1.17	1.66	0.58	1.65	2.23	5.08	2.43	7.51	11.05	3.82	14.87	13.75	4.75	18.50	17.36	5.98	23.34	26.93	8.12	35.05	1:57:46
2:02:53	0.34	0.51	0.85	0.58	1.39	1.97	0.49	1.08	1.57	0.58	1.52	2.10	4.65	2.23	6.88	9.78	3.50	13.28	12.07	4.35	16.42	15.07	5.48	20.55	22.77	7.42	30.19	2:02:53
2:08:00	0.35	0.37	0.72	0.58	1.02	1.60	0.49	0.79	1.28	0.58	1.12	1.70	4.20	1.64	5.84	8.56	2.59	11.15	10.48	3.23	13.71	12.97	4.09	17.06	19.17	5.59	24.76	2:08:00
2:13:07	0.35	0.27	0.62	0.58	0.75	1.33	0.49	0.58	1.07	0.58	0.82	1.40	3.77	1.20	4.97	7.45	1.88	9.33	9.05	2.34	11.39	11.09	2.96	14.05	16.08	4.04	20.12	2:13:07
2:18:14	0.35	0.20	0.55	0.58	0.55	1.13	0.49	0.42	0.91	0.58	0.60	1.18	3.37	0.88	4.25	6.47	1.39	7.86	7.80	1.73	9.53	9.47	2.19	11.66	13.49	2.99	16.48	2:18:14
2:23:22	0.35	0.15	0.50	0.58	0.40	0.98	0.49	0.31	0.80	0.58	0.44	1.02	3.01	0.65	3.66	5.62	1.03	6.65	6.73	1.29	8.02	8.10	1.63	9.73	11.34	2.22	13.56	2:23:22
2:28:29	0.35	0.10	0.45	0.58	0.29	0.87	0.49	0.23	0.72	0.58	0.32	0.90	2.69	0.47	3.16	4.88	0.75	5.63	5.80	0.94	6.74	6.93	1.19	8.12	9.55	1.63	11.18	2:28:29
2:33:36	0.35	0.07	0.42	0.58	0.21	0.79	0.49	0.16	0.65	0.58	0.23	0.81	2.40	0.34	2.74	4.25	0.54	4.79	5.01	0.67	5.68	5.94	0.86	6.80	8.08	1.18	9.26	2:33:36
2:38:43	0.34	0.05	0.39	0.58	0.15	0.73	0.49	0.11	0.60	0.58	0.16	0.74	2.15	0.24	2.39	3.71	0.39	4.10	4.35	0.49	4.84	5.11	0.62	5.73	6.85	0.85	7.70	2:38:43
2:43:50	0.34	0.03	0.37	0.58	0.10	0.68	0.49	0.08	0.57	0.58	0.11	0.69	1.92	0.17	2.09	3.25	0.27	3.52	3.78	0.34	4.12	4.41	0.43	4.84	5.83	0.60	6.43	2:43:50
2:48:58	0.34	0.02	0.36	0.58	0.06	0.64	0.49	0.05	0.54	0.58	0.07	0.65	1.73	0.10	1.83	2.85	0.17	3.02	3.29	0.22	3.51	3.82	0.28	4.10	4.98	0.39	5.37	2:48:58
2:54:05	0.34	0.01	0.35	0.58	0.03	0.61	0.49	0.02	0.51	0.58	0.04	0.62	1.56	0.06	1.62	2.51	0.10	2.61	2.88	0.12	3.00	3.31	0.16	3.47	4.27	0.23	4.50	2:54:05
2:59:12	0.34	0.00	0.34	0.58	0.01	0.59	0.49	0.01	0.50	0.58	0.01	0.59	1.41	0.02	1.43	2.22	0.04	2.26	2.53	0.06	2.59	2.89	0.07	2.96	3.67	0.11	3.78	2:59:12
3:04:19	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	1.28	0.00	1.28	1.97	0.01	1.98	2.23	0.01	2.24	2.53	0.02	2.55	3.17	0.03	3.20	3:04:19
3:09:26	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	1.17	0.00	1.17	1.76	0.00	1.76	1.98	0.00	1.98	2.23	0.00	2.23	2.76	0.00	2.76	3:09:26
3:14:34	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	1.08	0.00	1.08	1.58	0.00	1.58	1.76	0.00	1.76	1.98	0.00	1.98	2.42	0.00	2.42	3:14:34
3:19:41	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	1.00	0.00	1.00	1.43	0.00	1.43	1.59	0.00	1.59	1.76	0.00	1.76	2.14	0.00	2.14	3:19:41
3:24:48	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.92	0.00	0.92	1.30	0.00	1.30	1.43	0.00	1.43	1.59	0.00	1.59	1.90	0.00	1.90	3:24:48
3:29:55	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.86	0.00	0.86	1.19	0.00	1.19	1.30	0.00	1.30	1.43	0.00	1.43	1.70	0.00	1.70	3:29:55
3:35:02	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.81	0.00	0.81	1.09	0.00	1.09	1.19	0.00	1.19		0.00	0.00	1.53	0.00	1.53	3:35:02
3:40:10	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.76	0.00	0.76	1.01	0.00	1.01	1.09	0.00	1.09	1.30	0.00	1.30	1.39	0.00	1.39	3:40:10
3:45:17	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.72	0.00	0.72	0.93	0.00	0.93	1.01	0.00	1.01	1.19	0.00	1.19	1.26	0.00	1.26	3:45:17
3:50:24	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.69	0.00	0.69	0.87	0.00	0.87	0.93	0.00	0.93	1.09	0.00	1.09	1.16	0.00	1.16	3:50:24
3:55:31	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.65	0.00	0.65	0.81	0.00	0.81	0.87	0.00	0.87	0.93	0.00	0.93	1.06	0.00	1.06	3:55:31
4:00:38	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.64	0.00	0.64	0.76	0.00	0.76	0.82	0.00	0.82	0.87	0.00	0.87	0.98	0.00	0.98	4:00:38
4:05:46	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.62	0.00	0.62	0.73	0.00	0.73	0.77	0.00	0.77	0.82	0.00	0.82	0.91	0.00	0.91	4:05:46
4:10:53	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.60	0.00	0.60	0.69	0.00	0.69	0.73	0.00	0.73	0.77	0.00	0.77	0.85	0.00	0.85	4:10:53
4:16:00	0.34	0.00	0.34	0.58	0.00	0.58	0.49	0.00	0.49	0.58	0.00	0.58	0.59	0.00	0.59	0.66	0.00	0.66	0.69	0.00	0.69	0.73	0.00	0.73	0.80	0.00	0.80	4:16:00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd RV Park

Basin ID: Pond 1 + 2



Example Zone Configuration (Retention Pond)

Provide a more descriptive Basin ID. This is still Pond 2 but analyzed with Pond 1 in a series.

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	29.80	acres
Watershed Length =	1,100	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	36.50%	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) =	0.423	acre-feet
Excess Urban Runoff Volume (EURV) =	1.134	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.886	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.242	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.803	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.801	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.467	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.340	acre-feet
500-yr Runoff Volume (P1 = 3.01 in.) =	5.843	acre-feet
Approximate 2-yr Detention Volume =	0.828	acre-feet
Approximate 5-yr Detention Volume =	1.165	acre-feet
Approximate 10-yr Detention Volume =	1.632	acre-feet
Approximate 25-yr Detention Volume =	1.844	acre-feet
Approximate 50-yr Detention Volume =	1.938	acre-feet
Approximate 100-yr Detention Volume =	2.243	acre-feet

Note: L / W Ratio < 1.0. Use rectangular basin.
L / W Ratio = 0.9

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

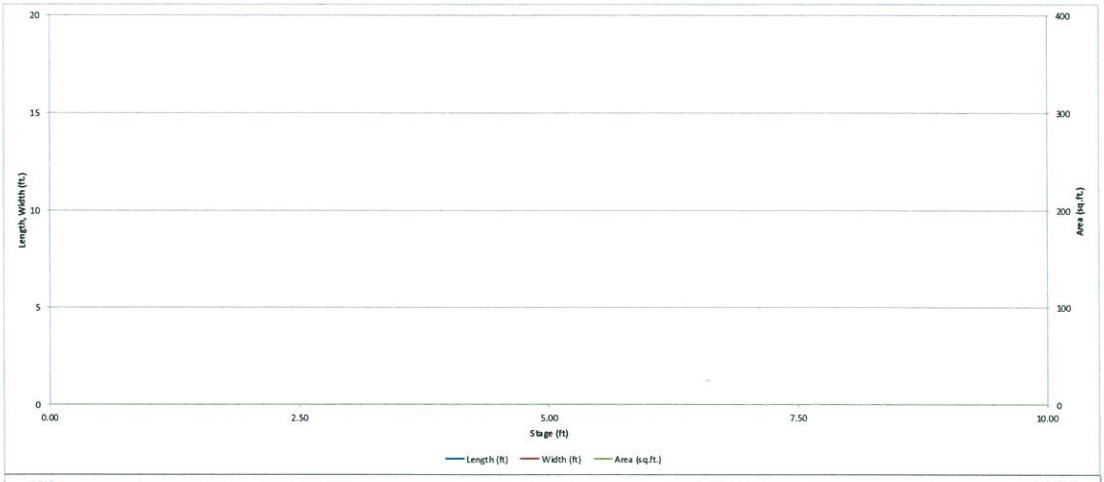
Stage-Storage Calculation

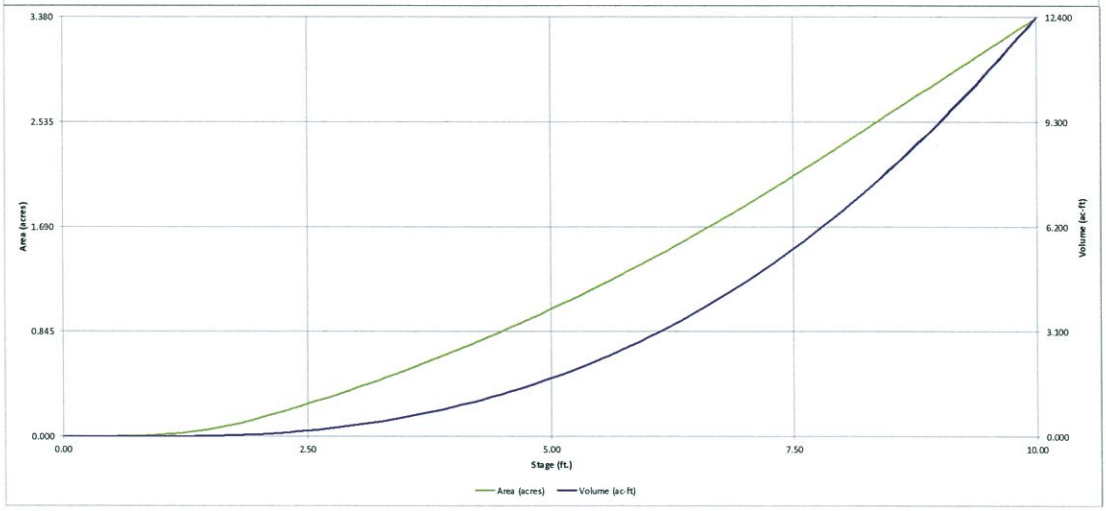
Zone 1 Volume (WQCV) =	0.423	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.711	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.109	acre-feet
Total Detention Basin Volume =	2.243	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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 (ft)	Optional User Override Depth (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acres)	Volume (ft^3)	Volume (ac-ft)
	--	0.00	--	--	--	30	0.001		
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	--	--	--	264	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
Zone 1(WQCV)	--	3.20	--	--	--	19,325	0.444	18,198	0.418
	--	3.30	--	--	--	20,545	0.472	20,191	0.464
	--	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
Zone 2(EURV)	--	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
	--	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
Zone 3 (100-year)	--	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
	--	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



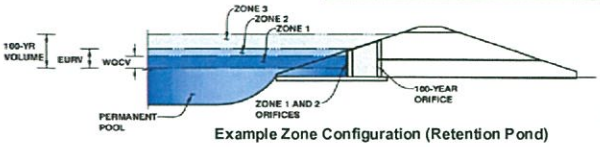


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Judge Orr Rd RV Park

Basin ID: Pond 1 + 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.22	0.423	Orifice Plate
Zone 2 (EURV)	4.37	0.711	Orifice Plate
Zone 3 (100-year)	5.48	1.109	Weir&Pipe (Restrict)
		2.243	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 =	5.00	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 =	6.19	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	22.14	N/A	ft^2
Overflow Grate Open Area w/ Debris =	11.07	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 =	20.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.57	N/A	ft^2
Outlet Orifice Centroid =	0.96	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.95	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	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 =	9.95	feet
Basin Area at Top of Freeboard =	3.34	acres

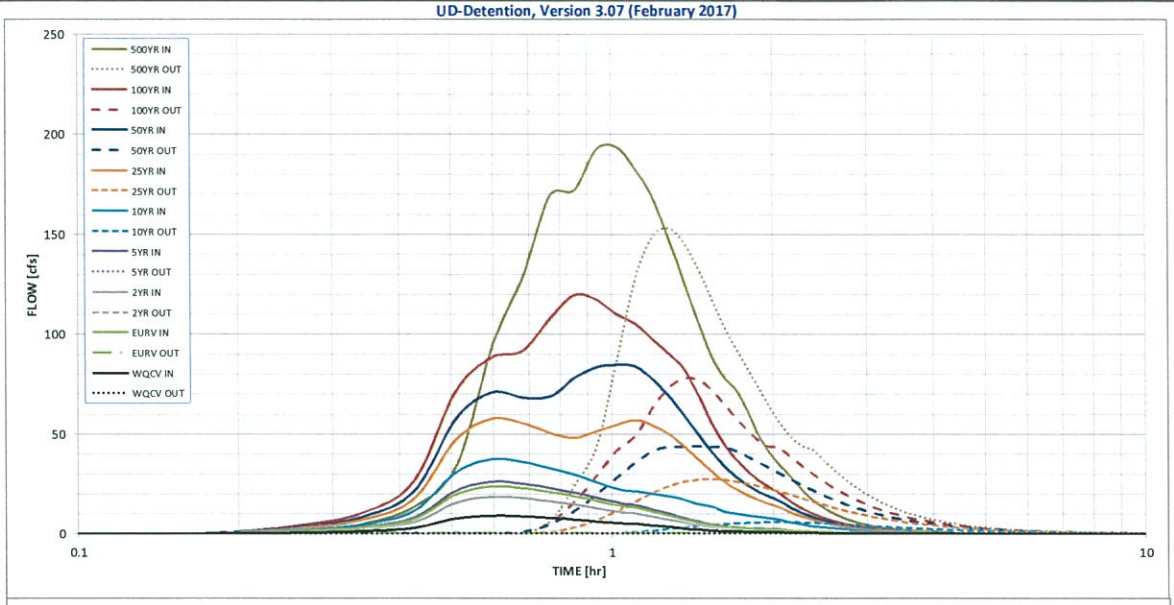
Routed Hydrograph Results

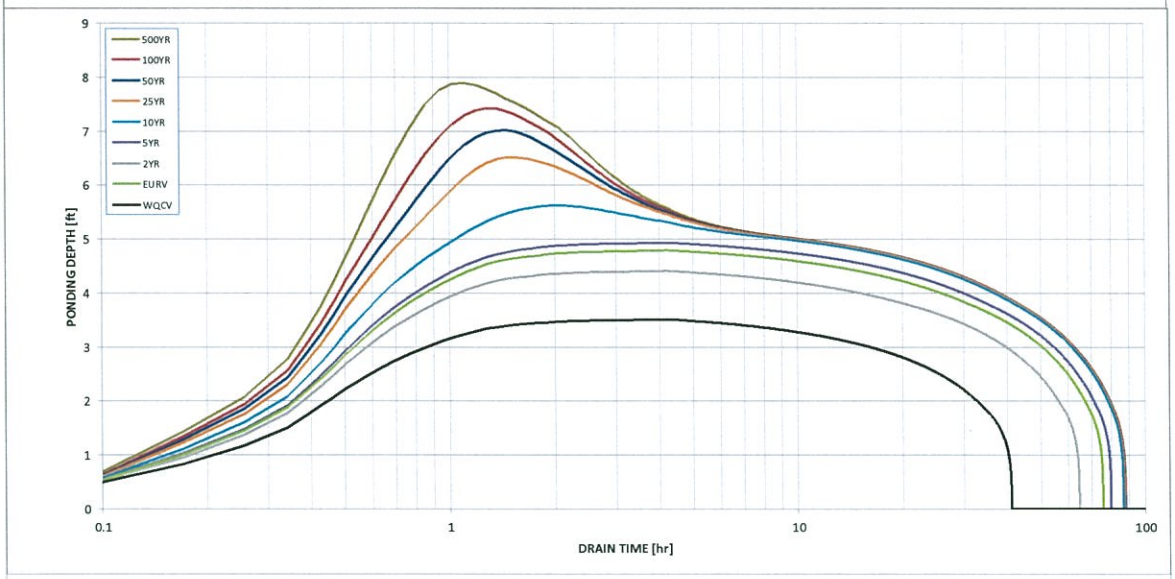
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.01
Calculated Runoff Volume (acre-ft) =	0.423	1.134	0.886	1.242	1.803	2.801	3.467	4.340	5.843
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.650	1.627	1.284	1.767	3.064	6.012	8.158	10.854	16.507
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.27	0.84	1.17	1.55	2.19
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.8	8.0	25.2	34.7	46.3	65.3
Peak Inflow Q (cfs) =	9.1	23.6	18.6	25.9	37.3	57.4	84.5	119.3	193.7
Peak Outflow Q (cfs) =	0.3	0.4	0.4	0.4	5.7	27.2	43.6	77.5	152.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	1.1	1.3	1.7	2.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.2	1.9	2.0	2.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	60	73	76	71	67	63	54
Time to Drain 99% of Inflow Volume (hours) =	40	73	63	77	82	80	78	76	73
Maximum Ponding Depth (ft) =	3.51	4.79	4.41	4.93	5.62	6.51	7.01	7.41	7.89
Area at Maximum Ponding Depth (acres) =	0.53	0.94	0.82	1.00	1.26	1.64	1.86	2.05	2.29
Maximum Volume Stored (acre-ft) =	0.569	1.498	1.173	1.634	2.410	3.709	4.583	5.367	6.410

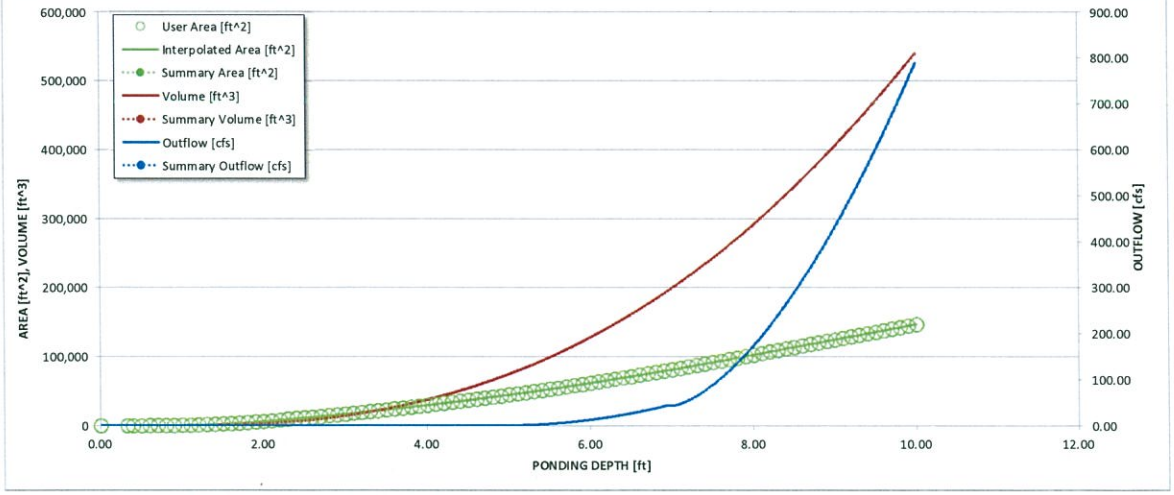
For the FSD this value is supposed to be 0.9 of the pre-developed. You need to explain in the narrative what the actual value is supposed to be and why there is a discrepancy.

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]
5.12 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:14	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.16
Constant	0:15:22	0.53	1.20	0.94	1.29	1.78	2.63	3.17	3.85	4.93
1.246	0:20:29	1.23	2.99	2.38	3.30	4.58	6.90	8.42	10.35	13.55
	0:25:36	2.94	7.37	5.83	8.07	11.42	17.36	21.35	26.19	34.31
	0:30:43	7.71	19.79	15.61	21.61	30.89	47.18	57.84	71.37	93.74
	0:35:50	9.08	23.64	18.58	25.90	37.25	57.36	70.72	88.08	129.02
	0:40:58	8.67	22.68	17.77	24.82	35.74	55.09	67.99	91.49	169.30
	0:46:05	7.93	20.72	16.23	22.66	32.61	50.22	68.75	107.45	171.91
	0:51:12	7.11	18.63	14.60	20.38	29.34	47.83	78.05	119.28	192.18
	0:56:19	6.18	16.23	12.71	17.74	25.58	51.16	83.26	117.06	193.66
	1:01:26	5.43	14.19	11.15	15.52	22.31	54.37	84.52	109.85	182.80
	1:06:34	4.95	12.94	10.15	14.13	21.01	56.66	83.61	105.05	168.44
	1:11:41	4.14	10.83	8.49	11.83	19.79	54.09	77.01	97.29	147.58
	1:16:48	3.43	9.00	7.04	9.83	18.64	49.74	68.81	90.08	126.83
	1:21:55	2.70	7.13	5.57	7.77	16.75	43.68	59.18	82.58	106.67
	1:27:02	2.08	5.50	4.29	6.00	14.63	37.28	49.69	69.91	89.52
	1:32:10	1.61	4.16	3.23	4.53	13.51	31.07	40.85	56.01	78.46
	1:37:17	1.33	3.33	2.60	3.60	10.90	25.94	33.60	45.00	72.12
	1:42:24	1.15	2.83	2.22	3.05	9.78	22.10	28.26	37.09	61.84
	1:47:31	1.03	2.48	1.96	2.67	8.88	19.11	24.17	31.22	49.84
	1:52:38	0.95	2.25	1.79	2.41	8.16	16.75	20.99	26.76	41.28
	1:57:46	0.89	2.09	1.66	2.23	7.51	14.87	18.50	23.34	35.05
	2:02:53	0.85	1.97	1.57	2.10	6.88	13.28	16.42	20.55	30.19
	2:08:00	0.72	1.60	1.28	1.70	5.84	11.15	13.71	17.06	24.76
	2:13:07	0.62	1.33	1.07	1.40	4.97	9.33	11.39	14.05	20.12
	2:18:14	0.55	1.13	0.91	1.18	4.25	7.86	9.53	11.66	16.48
	2:23:22	0.50	0.98	0.80	1.02	3.66	6.65	8.02	9.73	13.56
	2:28:29	0.45	0.87	0.72	0.90	3.16	5.63	6.74	8.12	11.18
	2:33:36	0.42	0.79	0.65	0.81	2.74	4.79	5.68	6.80	9.26
	2:38:43	0.39	0.73	0.60	0.74	2.39	4.10	4.84	5.73	7.70
	2:43:50	0.37	0.68	0.57	0.69	2.09	3.52	4.12	4.84	6.43
	2:48:58	0.36	0.64	0.54	0.65	1.83	3.02	3.51	4.10	5.37
	2:54:05	0.35	0.61	0.51	0.62	1.62	2.61	3.00	3.47	4.50
	2:59:12	0.34	0.59	0.50	0.59	1.43	2.26	2.59	2.96	3.78
	3:04:19	0.34	0.58	0.49	0.58	1.28	1.98	2.24	2.55	3.20
	3:09:26	0.34	0.58	0.49	0.58	1.17	1.76	1.98	2.23	2.76
	3:14:34	0.34	0.58	0.49	0.58	1.08	1.58	1.76	1.98	2.42
	3:19:41	0.34	0.58	0.49	0.58	1.00	1.43	1.59	1.76	2.14
	3:24:48	0.34	0.58	0.49	0.58	0.92	1.30	1.43	1.59	1.90
	3:29:55	0.34	0.58	0.49	0.58	0.86	1.19	1.30	1.43	1.70
	3:35:02	0.34	0.58	0.49	0.58	0.81	1.09	1.19	1.37	1.53
	3:40:10	0.34	0.58	0.49	0.58	0.76	1.01	1.09	1.30	1.39
	3:45:17	0.34	0.58	0.49	0.58	0.72	0.93	1.01	1.19	1.26
	3:50:24	0.34	0.58	0.49	0.58	0.69	0.87	0.93	1.09	1.16
	3:55:31	0.34	0.58	0.49	0.58	0.65	0.81	0.87	0.93	1.06
	4:00:38	0.34	0.58	0.49	0.58	0.64	0.76	0.82	0.87	0.98
	4:05:46	0.34	0.58	0.49	0.58	0.62	0.73	0.77	0.82	0.91
	4:10:53	0.34	0.58	0.49	0.58	0.60	0.69	0.73	0.77	0.85
	4:16:00	0.34	0.58	0.49	0.58	0.59	0.66	0.69	0.73	0.80
	4:21:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:56:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:43:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:08:38	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).

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	0.04	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

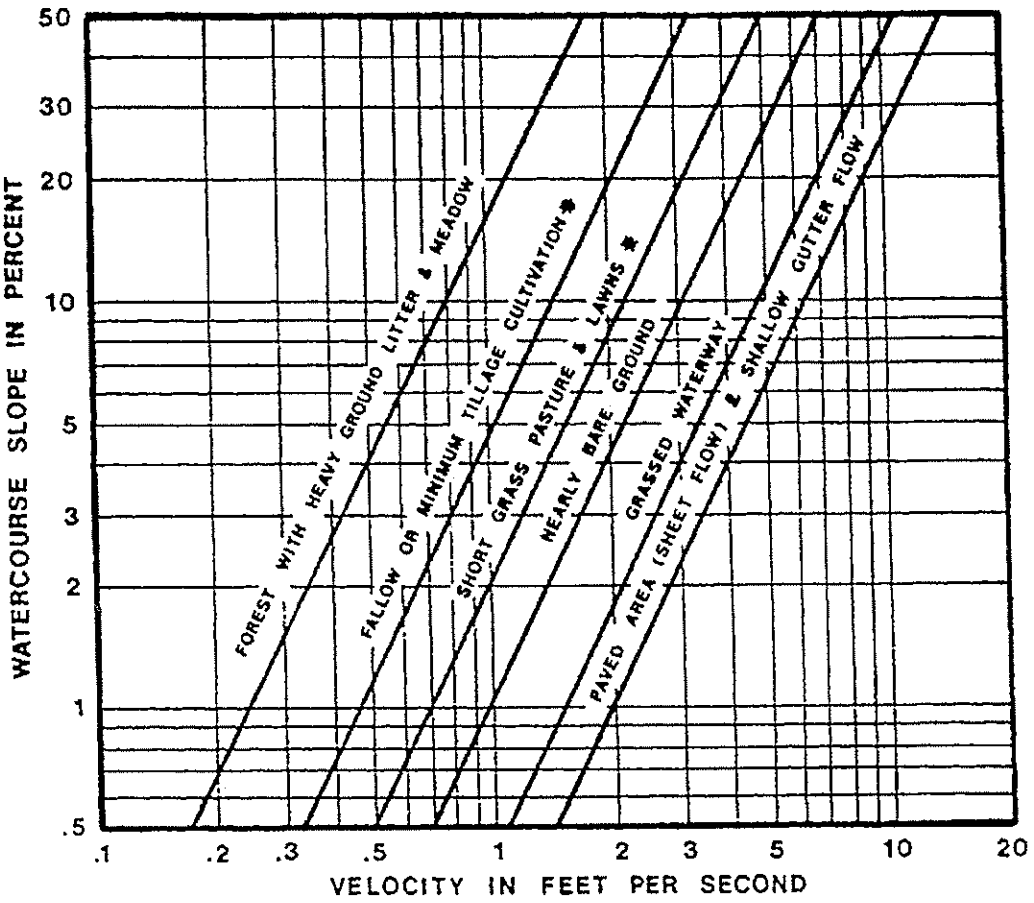
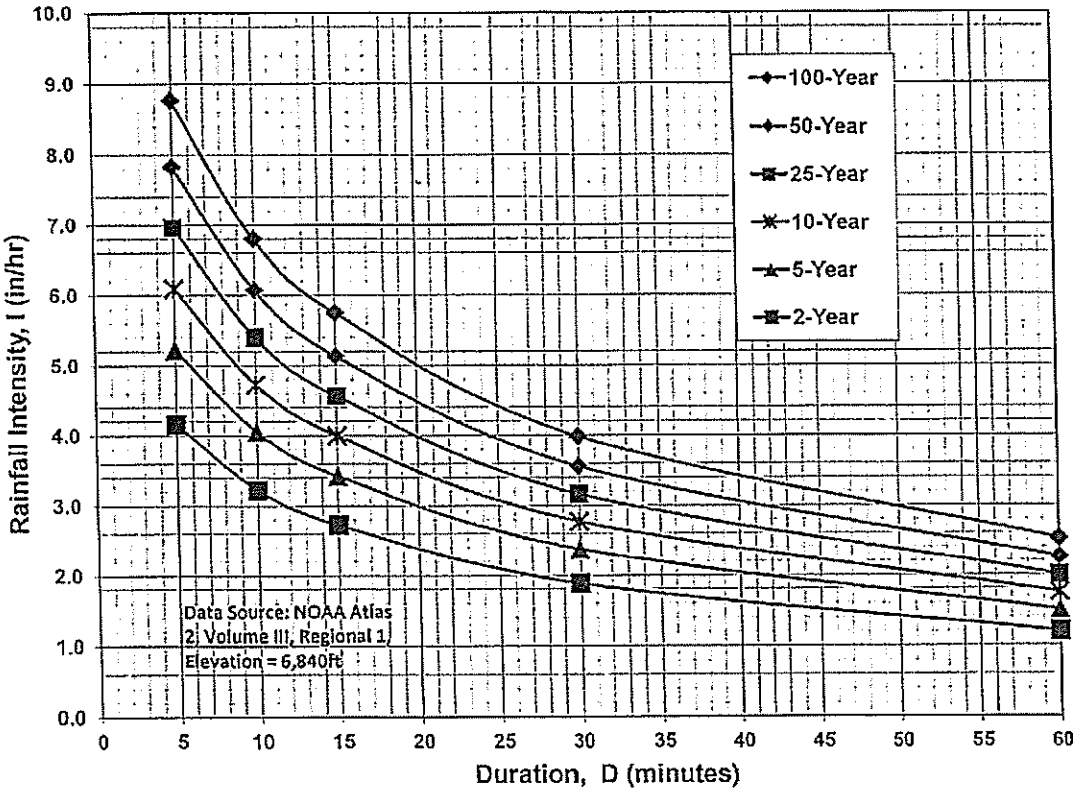


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

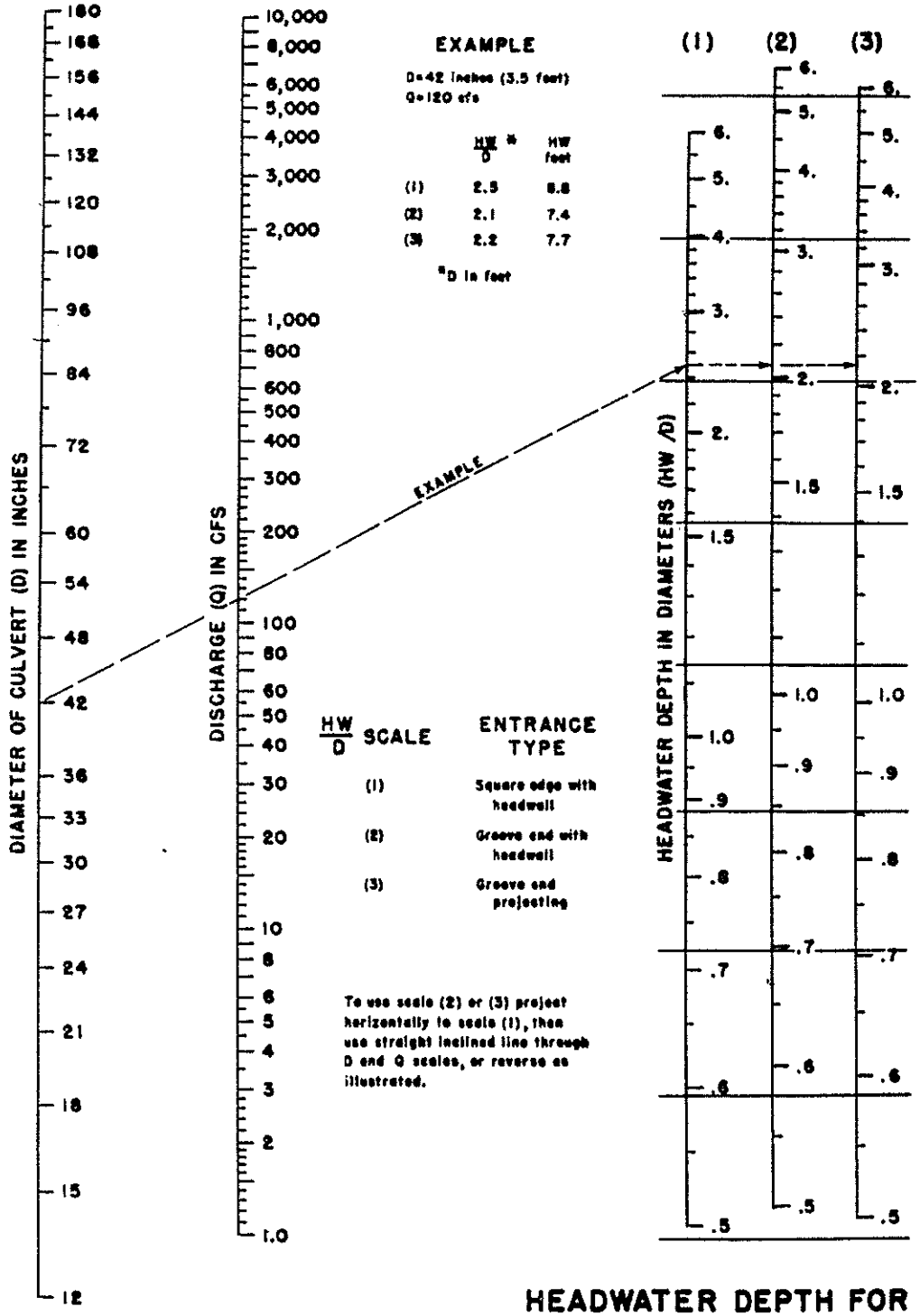
$I_{25} = -2.00 \ln(D) + 10.111$

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

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

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

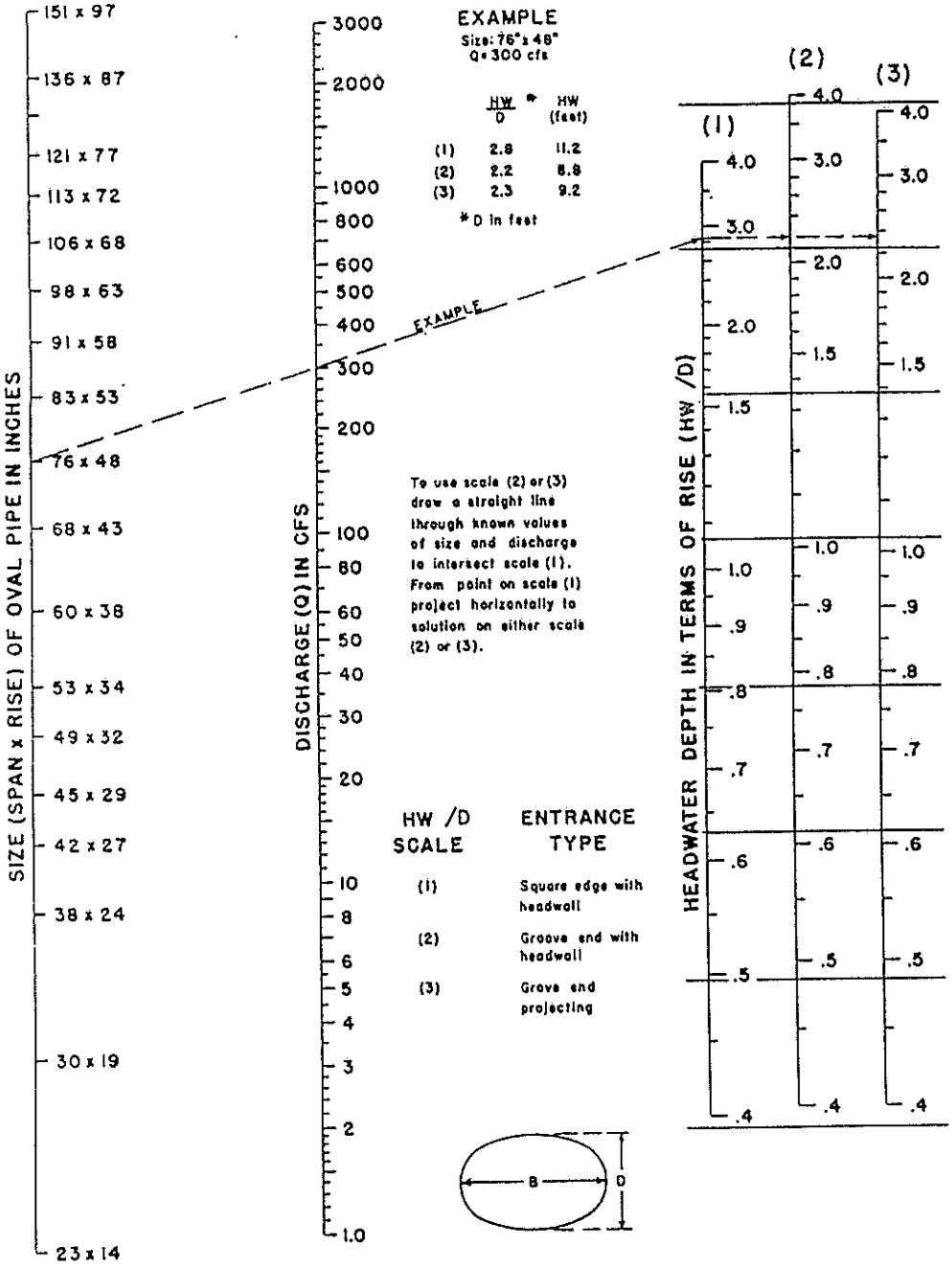
Note: Values calculated by equations may not precisely duplicate values read from figure.



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



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	**Q_5CFS**	**Q_{100} CFS**
OS1	1.7	12.9
OS2	5.9	44.7
OS3	17.8	62.0
OS4	2.2	16.6
OS5	1.1	2.9
A1	2.2	16.5
A2	2.7	20.8
A3	0.9	4.4
B	0.2	1.6
DP1 (OS1 + OS2)	7.1	54.3
DP2 (DP1 + A2)	8.2	62.6
DP3 (OS3 + OS4)	18.3	72.9
DP4 (OS5 + A3)	1.7	6.4
DP5 (DP3 + DP4)	17.1	67.9
DP6 (DP2 + DP4 + A1)	26.9	143.1

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.

Show the FEMA floodplain

Extend the drainage map to show the location of DP6.

Adjust the basin boundary. Per the contours this area is tributary to OS4

Adjust the boundary. Per the narrative (pg 3) the area between the centerline of Judge Orr and the property line is basin OS5

Why would a portion of the ditch be included within OS4 but then change to OS5? Update the basin boundaries accordingly.

Show the basin boundary of OS5

EXIST 24" CMP

1.7 / 12.9 OS1 / 7.81
17.8 / 62.0 OS3 / 27.21
5.9 / 44.7 OS2 / 36.41
2.2 / 16.8 OS4 / 13.73
1.3 / 4.4 OS5 / 0.71
A1 2.2 / 11.75 16.5
A2 2.7 / 15.16 20.8
A3 0.9 / 2.32 4.4
B 0.2 / 0.87 1.6
1 7.1 / 54.3
2 8.2 / 62.8
3 18.3 / 72.9
4 1.7 / 6.4
5 17.1 / 67.9
6 26.9 / 143.1

PCD PROJECT NO. 16-040

DESIGNED BY MAB
PROJECT ENGINEER MAB
PROJECT MANAGER MAB
SCALE HORZ. 1" = 100' VERT. N/A
DATE: 5/21/18
JOB NO. 160301
CAD FILE NO. 160301-Existing Conditions
DRAWN BY HJS

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NO.	DATE	REVISION	BY

JUDGE ORR ROAD RV PARK & STORAGE

COLORADO SPRINGS, COLORADO

DRAINAGE - EXIST OVERALL CONDITIONS

SHEET 1 of 3

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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

VICINITY MAP

MATCHLINE

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	**Q_5CFS**	**Q_{100} CFS**
OS1	1.7	12.9
OS2	7.3	55.6
OS3	17.8	62.0
OS4	0.8	5.9
OS5	1.0	2.6
OS6	8.4	17.5
A1	7.2	22.3
A2	18.9	48.0
A3	0.4	2.9
B	0.3	2.3
DP1 (OS1+OS2)	8.6	65.7
DPD1 (Detained DP1)	0.6	57.4
DP2 (OS6+A2)	23.7	57.8
DP3 (DP2+A1)	23.0	59.0
DP4 (DPD1+DP3)	23.0	113.3
DPD2 (Detained DP2)	0.4	77.5
DP5 (OS3+OS4)	16.3	59.6
DP6 (A3+OS5)	1.0	2.6
DP7 (DP5+DP6)	1.0	4.6
DP8 (DPD2+DP7)	16.6	131.2

Show the existing contours.

DP6 is (A3 + DP5)
DP7 is (OS5 + DP6)

1. Show/Label the 100yr flood plain.
2. Add the hatching on the Legend

Identify that these are future roads per (reference the project name and file number) or free these improvements to the adjacent property.

Show/label the property line.

Adjust the basin boundary. Area to the south is tributary to A1.

Is there a swale or C&G along the basin boundary line? Label and update the narrative or update the basin boundary line according to the drainage pattern.

Identify as future pond 1.

Show the anticipated emergency flow path and update the narrative.

Typo. Appears to be OS3.

Unclear how OS3 is being routed to DP5. If it's per the existing drainage map then adjust the basin boundary. Update the proposed drainage condition section of the narrative to discuss.

Include a summary regarding OS2 in the narrative. Summary should provide design guidance regarding this basin (OS2), OS3, and OS4.

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

2. Extend the analysis to the suitable outfall (i.e. to an existing hydraulically adequate man-made system.
Hydraulic analysis of the channel between the pond and the man-made system must be included in the report. Plus a hydraulic analysis of the man-made system to show that it is hydraulically adequate.

Identify as Pond 2

State in the narrative who own/maintain this stormline.

Appears to be a low point on the road. If DP5 flows are not conveyed by the roadside ditch, then a second culvert is required meeting County criteria for Hw/D and overtopping depth.
Similar comment applies to the second access location.

Provide hydraulic calculations for the inverted road to ensure sufficient capacity.

Adjust the boundary. Per the narrative (pg 3) the area between the centerline of Judge Orr and the property line is basin OS5

Provide the culvert calculation for both culverts.

Label the emergency spillway. Provide analysis that shows the stretch between the spillway and the natural channel is hydraulically adequate. If it isn't additional improvements may be required.
Same comment applies for the outlet structure outfall.

EXIST 24" CMP

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DRAINAGE - DEV OVERALL CONDITIONS

SHEET 2 of 3

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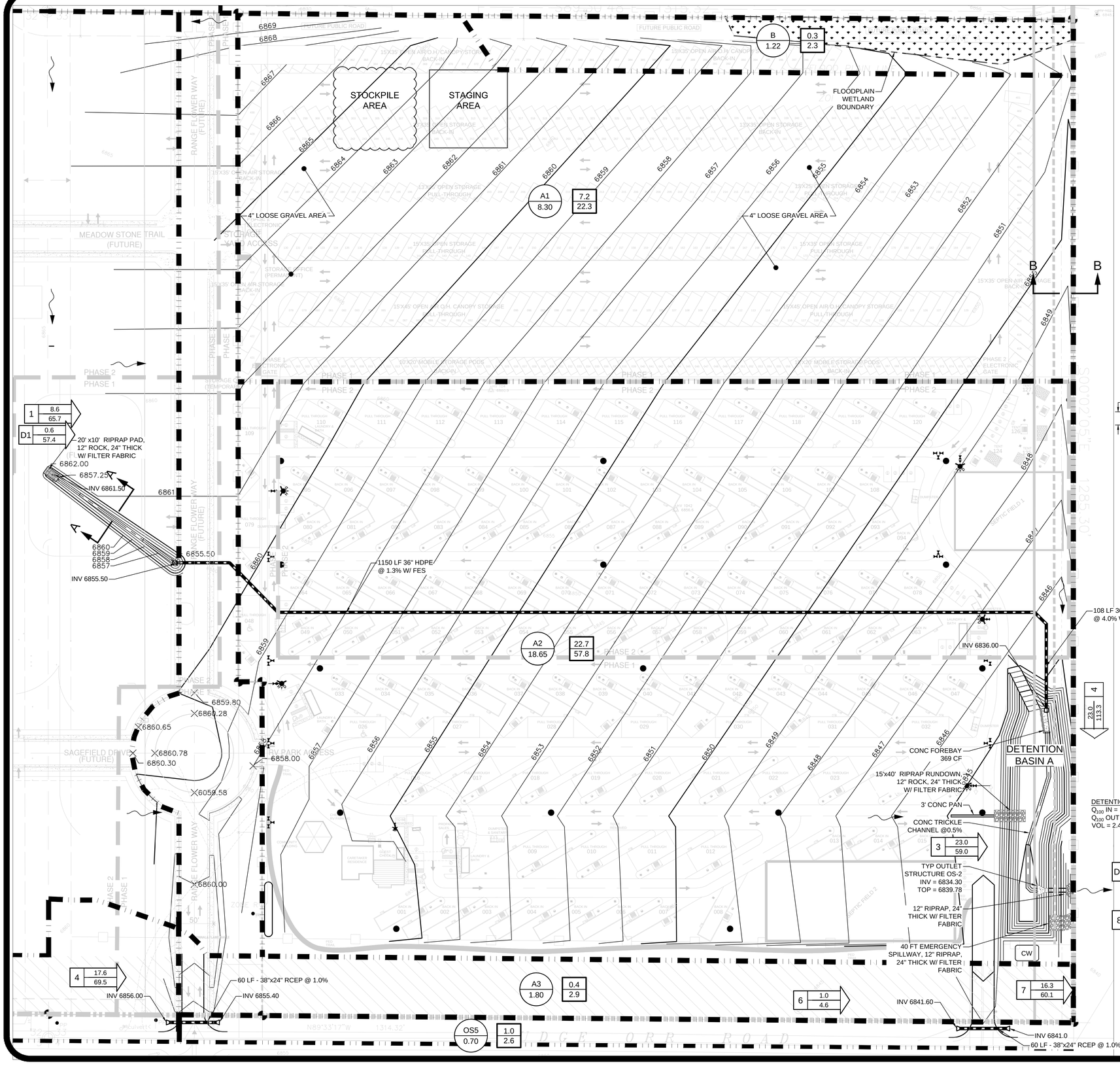

LEGEND

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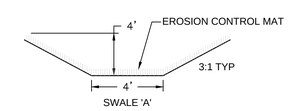

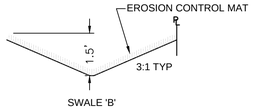

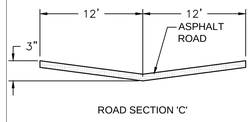

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COLORADO SPRINGS, COLORADO

DRAINAGE - DEVELOPED CONDITIONS

SHEET 3 of 3

PCD PROJECT NO. 16-040

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