

April 2, 2026

El Paso County
Department of Public Works
Stormwater Section
Attn.: Mikayla Hartford
2880 International Circle
Colorado Springs, CO 80910

RE: Woodmen View RV & Boat Storage Pond As-Built Memo
8035 Vollmer Place, El Paso County

Ms. Hartford,

The Woodmen View RV & Boat Storage pond facility was designed and constructed under County file #PPR03040. The Final Drainage Report and approved design plans were prepared by Calibre Engineering, Inc. in 2010. Baseline Engineering has been requested by the owner of Woodmen View RV & Boat Storage to prepare the PCM Certification Letter including a MHFD-Detention spreadsheet for the pond facility to demonstrate compliance with the approved Final Drainage Report and Design Plans.

A comparison of the designed parameters per the Final Drainage Report by Calibre dated July 2010 (Calibre Report) and the As-Built parameters as surveyed in May of 2025 and calculated by Baseline can be found in the table below:

	Designed Parameter	As-Built Parameter
<i>100-year volume+ 1/2 WQCV</i>	1.52 ac-ft at stage 5.05'	1.52 ac-ft at stage 5.12'
<i>10-year volume + WQCV</i>	1.15 ac-ft at stage 4.47'	1.15 ac-ft at stage 4.50'
<i>WQCV volume</i>	0.30 ac-ft at stage 2.74'	0.30 ac-ft at stage 2.65'
<i>100-year release rate</i>	16.9 cfs through outlet, 12.5 cfs bypass through spillway*, 29.4 cfs total	13.7 cfs through outlet, 12.5 cfs bypass through outlet/spillway, 26.2 cfs total
<i>10-year release rate</i>	16.22 cfs	8.3 cfs

Volume Comparison

The Calibre Report used the rational stored rate method to determine the volumes required in UD Detention v2.03. To evaluate the as-built pond's sufficiency the table above lists the stages at which the as-built pond stores the WQCV, 10-year and 100-year volumes designed in the Calibre Report, not the volumes

calculated as required in the modern MHFD v4-06. The Calibre Report is more conservative on storage volumes.

Release Rate

Release rates in the Calibre Report were determined using the Pond UD detention v2.03 Inlet control spreadsheets. As-built release rates as presented in the table above were calculated using MHFD Detention v4-06. The as-built 10- and 100-year release rates are lower than the designed release rates. The Calibre Report had specified that 12.5 cfs of flow would bypass the pond in the 100-year storm event and pass through the spillway. It is understood that as calculated using MHFD Detention v4-06, this bypass flow will be partially or fully passed by the outlet structure in the 100-yr event, and the amount of runoff going over the spillway will be less than 12.5 cfs.

WQCV

The WQCV that was evaluated for the as-built pond is the WQCV that was designed for in the Calibre report. The WQCV in the MHFD spreadsheet was overridden with the 0.300 ac-ft calculated in the Calibre Report.

Conclusions

The pond in its as-built condition provides the designed volumes at approximately at the same stages as designed in the Calibre Report. The release rate of the 10- and 100-year storm events are less than the designed release rates as presented in the Calibre Report due to the updated methodology from the v2.03 UD Detention spreadsheet that was used for the initial design and the MHFD Detention v4-06 spreadsheet that was utilized for the as-built analysis. Notably, the 100-year maximum volume stored as calculated using MHFD v4-06 is 0.813 acre-ft at stage 3.88', well below the estimated volume of 1.22 acre feet needed for the 100-year in the Final Drainage Report by Calibre. The reduced release rates drains 97% of the 5-year storm volume in less than 72 hours and 99% of the 100 year storm volume in less than 120 hours.

The site and adjacent properties (as affected by work performed under the County permit) are stable with respect to settlement and subsidence, sloughing of cut and fill slopes, revegetation or other ground cover, and that the improvements (public improvements, common development improvements, site grading and paving) meet or exceed the minimum design requirements. The PCM(s) provide the required storage volume and meet the required release rates, stage areas, elevations, and outlet dimensions, as documented by the attached revised MHFD-Detention spreadsheet that shows the as-built conditions.

If you have any questions or concerns, you may reach me at mark.sundstrom@baselinecorp.com or 719-531-6200.

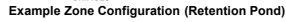
Sincerely,



Mark Sundstrom, PE
Baseline Engineering
Mark.Sundstrom@baselinecorp.com
Office: 719-531-6200 Cell: 303-525-7397

MHFD-Detention, Version 4.06 (July 2022)

Basin ID:

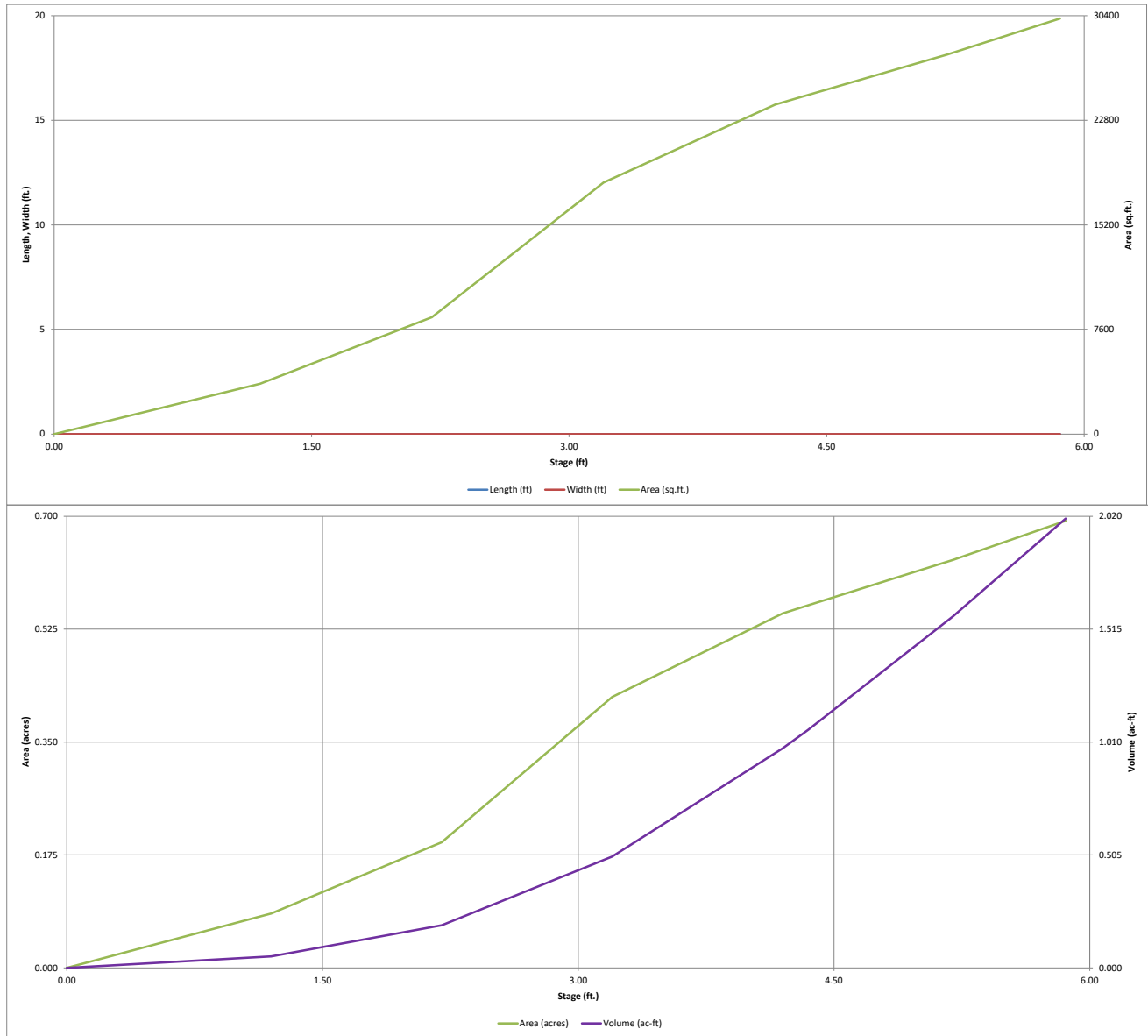


Optional User Overrides	
0.300	acre-feet
	acre-feet
0.92	inches
1.20	inches
1.46	inches
1.85	inches
2.17	inches
2.51	inches
3.42	inches

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

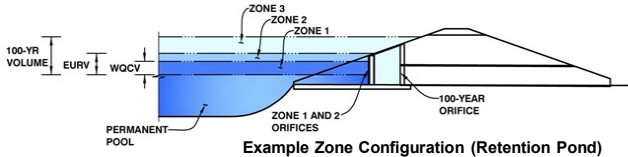


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Woodmen View Storage Pond As-Built

Basin ID:



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.65	0.300	Orifice Plate
Zone 2 (100-year)	4.72	0.976	Weir&Pipe (Rect.)
Zone 3			Not Utilized
Total (all zones)		1.276	

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

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

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = 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)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 2.67 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.33	0.66	0.99	1.32	1.65	1.98	
Orifice Area (sq. inches)	0.69	0.69	0.69	0.69	0.69	0.69	0.69	

	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)

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

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = Not Selected Not Selected ft²
Vertical Orifice Centroid = Not Selected Not Selected feet

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

Overflow Weir Front Edge Height, H_o = Zone 2 Weir Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 5.67 N/A feet
Overflow Weir Grate Slope = 0.00 N/A H:V
Horiz. Length of Weir Sides = 2.91 N/A feet
Overflow Grate Type = Close Mesh Grate N/A
Debris Clogging % = 0% N/A %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = Zone 2 Weir Not Selected feet
Overflow Weir Slope Length = 2.91 N/A feet
Grate Open Area / 100-yr Orifice Area = 9.06 N/A
Overflow Grate Open Area w/o Debris = 13.05 N/A ft²
Overflow Grate Open Area w/ Debris = 13.05 N/A ft²

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

Depth to Invert of Outlet Pipe = Zone 2 Rectangular Not Selected ft (distance)
Rectangular Orifice Width = 27.00 N/A inches
Rectangular Orifice Height = 7.68 N/A inches

A rectangular orifice was used to approximate the outlet orifice area and centroid height of the two 18" outlet pipes with restrictor plates.

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Outlet Orifice Area = Zone 2 Rectangular Not Selected ft²
Outlet Orifice Centroid = 1.44 N/A feet
Half-Central Angle of Restrictor Plate on Pipe = 0.32 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 4.32 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 22.63 feet
Spillway End Slopes = 4.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = 0.55 feet
Stage at Top of Freeboard = 5.87 feet
Basin Area at Top of Freeboard = 0.69 acres
Basin Volume at Top of Freeboard = 2.01 acre-ft

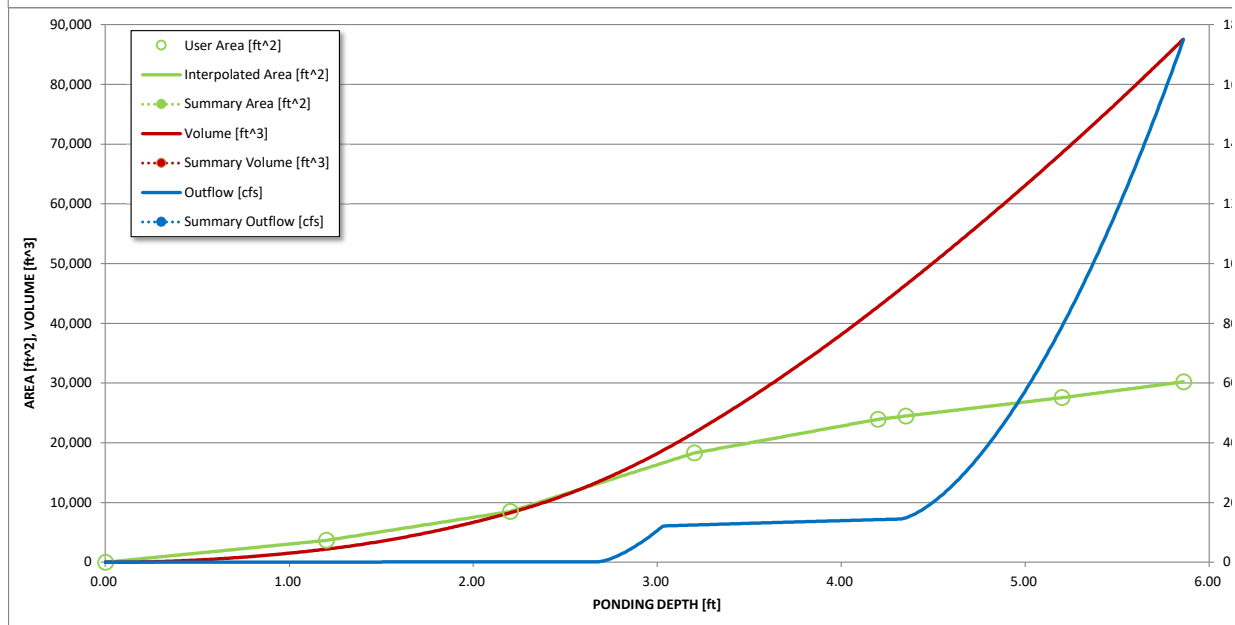
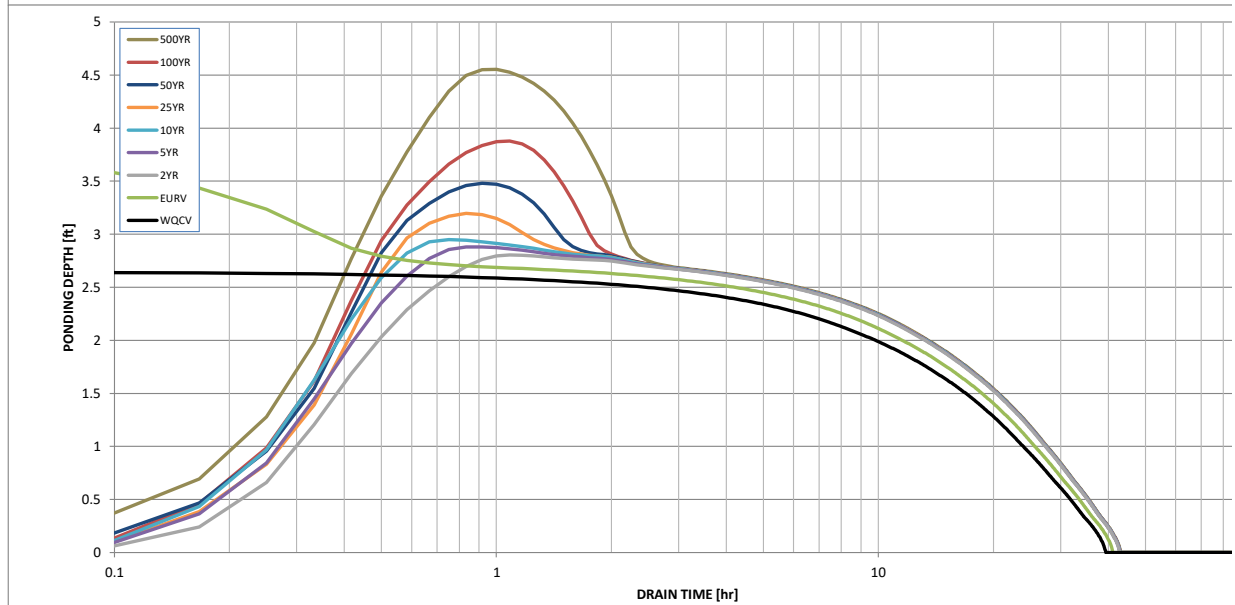
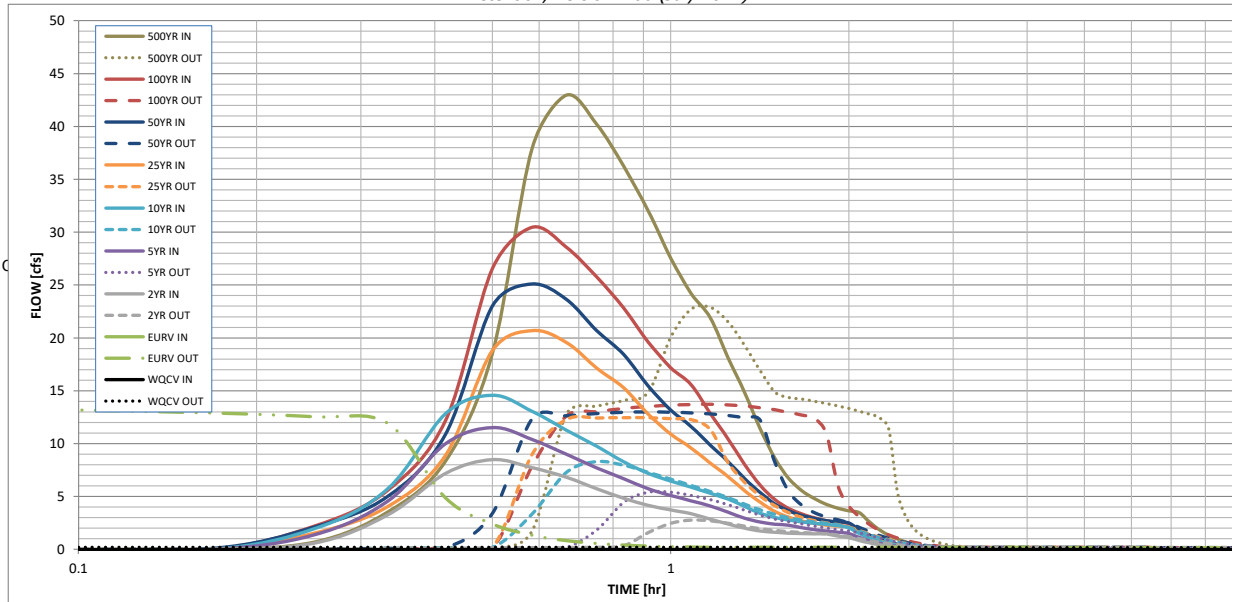
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	0.92	1.20	1.46	1.85	2.17	2.51	3.42
One-Hour Rainfall Depth (in)	N/A	N/A	0.92	1.20	1.46	1.85	2.17	2.51	3.42
CUHP Runoff Volume (acre-ft)	0.300	0.830	0.537	0.739	0.945	1.297	1.569	1.879	2.674
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.537	0.739	0.945	1.297	1.569	1.879	2.674
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.1	0.6	2.0	5.9	8.2	11.2	17.8
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.06	0.20	0.59	0.82	1.12	1.78
Peak Inflow Q (cfs)	N/A	N/A	8.5	11.5	14.6	20.7	25.1	30.5	43.0
Peak Outflow Q (cfs)	0.2	13.6	2.8	5.4	8.3	12.5	13.0	13.7	22.9
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	8.4	4.1	2.1	1.6	1.2	1.3
Structure Controlling Flow	Plate	Outlet Plate 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps)	N/A	1.04	0.20	0.4	0.6	0.9	1.0	1.0	1.1
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)	32	29	32	31	29	27	25	24	21
Time to Drain 99% of Inflow Volume (hours)	36	34	37	36	35	34	33	32	30
Maximum Ponding Depth (ft)	2.65	3.92	2.81	2.88	2.95	3.20	3.48	3.88	4.56
Area at Maximum Ponding Depth (acres)	0.30	0.51	0.33	0.35	0.36	0.42	0.46	0.51	0.58
Maximum Volume Stored (acre-ft)	0.300	0.833	0.347	0.374	0.399	0.493	0.620	0.813	1.179

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



S-A-V-D Chart Axis Override

	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



WOODMAN VIEW STORAGE FINAL DRAINAGE REPORT

**JULY 2004
REVISED FEBRUARY 2010
REVISED MAY 2010
REVISED JULY 2010**

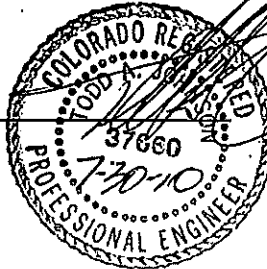
For:

**Woodmen View Storage
2720 Meridian Road
Peyton, CO 80831**

DESIGN ENGINEER'S STATEMENT

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

Todd A. Johnson, Professional Engineer
State of Colorado No. 37660



Date: _____

DEVELOPER'S STATEMENT

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

Name, Title:

Alan Brann / Owner

Date: 8-24-10

Business Name:

Woodmen View Storage

Address:

8725 Vollmer Rd

Colorado Springs 80908

EL PASO COUNTY

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

Max Z. Rothchildt PE

Date: 9-2-10

André Brackin

County Engineer / ECM Administrator

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REVISIONS

¹ Amended the outlet design to include a formal outlet structure with a water quality plate as requested by the County.

Date: January 2010
Amended By: JLT
Checked By: TAJ
Company: Calibre Engineering, Inc.

² Revised text regarding historical and developed flows released from the site. Added hydraulic and riprap calculations to the Appendix.

Date: May 2010
Amended By: KLH
Checked By: TAJ
Company: Calibre Engineering, Inc.

WOODMAN VIEW STORAGE
FINAL DRAINAGE REPORT
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1.0 GENERAL LOCATION AND DESCRIPTION

1.1 Location

The project is located as follows:

- Within the southwest quarter of Section 33, Township 12 South, Range 65 West of the 6th Principal Meridian
- South and east of Vollmer Road
- South of Vollmer Place
- West of Sand Creek
- Within El Paso County

1.2 Description of Property

The following are characteristics of the site:

- It contains approximately 10 acres.
- It drains south at existing slopes ranging from 2-20%.
- It is covered with native grasses, gravel, and existing out buildings.
- It contains soils belonging to Hydrologic Group A, Blakeland Complex (9); and in Hydrologic Soil Group B, Pring Coarse Sandy Loam (71).
- Sand Creek flows from north to south east of the property.
- An unnamed tributary channel to Sand Creek approaches the site from the south.
- There are no existing irrigation facilities on site.

2.0 DRAINAGE BASINS AND SUB-BASINS

2.1 Major Basin Description

- The site is not within a FEMA regulated floodplain.
- The proposed site falls within the study area of the report titled *Sand Creek Drainage Basin Planning Study* by Kiowa Engineering Corporation., dated January 1993, Rev. March 1996.
- Sand Creek flows from north to south east of the site.
- Sand Creek flows to the south to its confluence with Fountain Creek.
- There are no existing irrigation facilities that will be influenced by the local drainage.

WOODMAN VIEW STORAGE
FINAL DRAINAGE REPORT
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2.2 Sub-Basin Description

- Historically, the runoff sheet-flows across the site to the south where it enters one of two draws to Sand Creek.
- A large upstream basin sheet-flows across the site.
- The offsite basin will continue to sheet-flow through the site in the developed conditions and is routed through the onsite detention pond.
- A swale is provided along the west property line to convey the discharge from the existing culvert under Vollmer Place.

3.0 DRAINAGE DESIGN CRITERIA

3.1 Development Criteria Reference and Constraints

- Previous studies for the proposed site or the surrounding areas are not available.
- The *Sand Creek Drainage Basin Planning Study* does not affect the proposed site.
- This study is in compliance with the following Standards except where stated herein:
 - *City of Colorado Springs and El Paso County Drainage Criteria Manual Volume 1 & 2*
- The simplicity and proposed use of the site do not create any drainage constraints.
- The proposed detention pond and outlet works must be constructed within the proposed site.

3.2 Hydrological Criteria

- Design rainfall is from the City/County's Criteria.
- The rational method was used to calculate peak runoff rates for the development.
- The 10-year storm was used as the minor event.
- The 100-year storm was used as the major event.
- Detention storage requirements were calculated using the Rational Stored Rate Method.

WOODMAN VIEW STORAGE
FINAL DRAINAGE REPORT
PAGE 3 of 5

- The Water Quality Capture Volume was calculated using the City/County's criteria.
- The combined runoff from the detention pond and developed undetained basins will be less than or equal to the total historic runoff rate from the site.

4.0 DRAINAGE FACILITY DESIGN

4.1 General Concepts

The following are concepts and typical drainage patterns of the proposed drainage system:

- Runoff generated in both the minor and major storm events will sheet-flow overland to the onsite detention pond.
- A swale is graded along the west property line to convey runoff from the north side of Vollmer Place and to keep onsite runoff from leaving the site.
- The proposed development is divided into seven basins (A, B, C, D, E, F, and G).
- Basins A-D are offsite basins. The offsite basins will continue to flow through the site and will be routed through the onsite detention pond.
- Basins E-G are made up entirely of the proposed development.
- Basin E will sheet-flow to the onsite detention pond.
- Basins F and G will be released from the site undetained.

Offsite runoff will be handled in the following ways:

- Offsite flows entering the site are conveyed through the site and proposed detention pond.

The following tables, charts, and figures are presented in the appendix of this report:

- Vicinity Map and Soils Map
- ¹FIRM Map
- Runoff computation sheets
- Detention Pond calculations
- Water Quality Capture Volume calculations
- ¹Pond Outfall Sizing spreadsheet
- ¹Restrictor Plate Sizing
- ¹Weir Design Spreadsheet
- ²Culvert Calculations

WOODMAN VIEW STORAGE
FINAL DRAINAGE REPORT
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- ²Riprap Sizing Calculations
- Tables and charts from *City of Colorado Springs and El Paso County Drainage Criteria Manual*

4.2 Specific Details

- It is anticipated the site will be developed in two phases.
- The detention facility must be constructed with the first phase.
- ²The flows released from the detention pond (16.1 cfs and 29.4 cfs) during the 10-year and 100-year events respectively, are equal to the historic flow rates at Design Point H5 (16.7 cfs and 30.3 cfs) less the developed flows released from the site undetained at Design Point 7 (0.6 cfs and 0.9 cfs).
- The detention volume was calculated using the City/County's Criteria.
- The WQCV was calculated using the City/County's Criteria.
- ¹ The outlet structure for the detention pond consists of a Modified Type D inlet. The rim of the inlet is set at the water quality water surface elevation and will collect the 10-year flow.
- ¹ The 100-year flow will outfall over a weir directly to one of the draws that drain to Sand Creek.
- An 18" HDPE culvert is provided at DP3 to convey the 100-year flow, 12.5cfs, from the onsite swale along the west property line to the onsite detention pond.
- Maintenance access to the detention pond will be provided via proposed drive aisles within the development and a gentle slope to the bottom of the pond per the City/Counties criteria.
- It is the responsibility of the property owner to maintain all drainage facilities.
- There are no immediate adverse impacts on downstream properties. The flows released from the site are equal to the historic flow rates through the site.

WOODMAN VIEW STORAGE
FINAL DRAINAGE REPORT
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5.0 REFERENCES

1. *Drainage Criteria Manual*, City of Colorado Springs and El Paso County., October 1987, Revised November 1991.
2. *Drainage Criteria Manual Volume 2*, City of Colorado Springs and El Paso County., November 1, 2002, Adopted 2005.
3. *Sand Creek Drainage Basin Planning Study*, Kiowa Engineering Corporation, January 1993, Revised March 1996.
4. *Soil Survey of El Paso County Area, Colorado*, USDA – Soil Conservation Service.
5. *Urban Storm Drainage Criteria Manual*, Urban Drainage Flood Control District, June 2001.

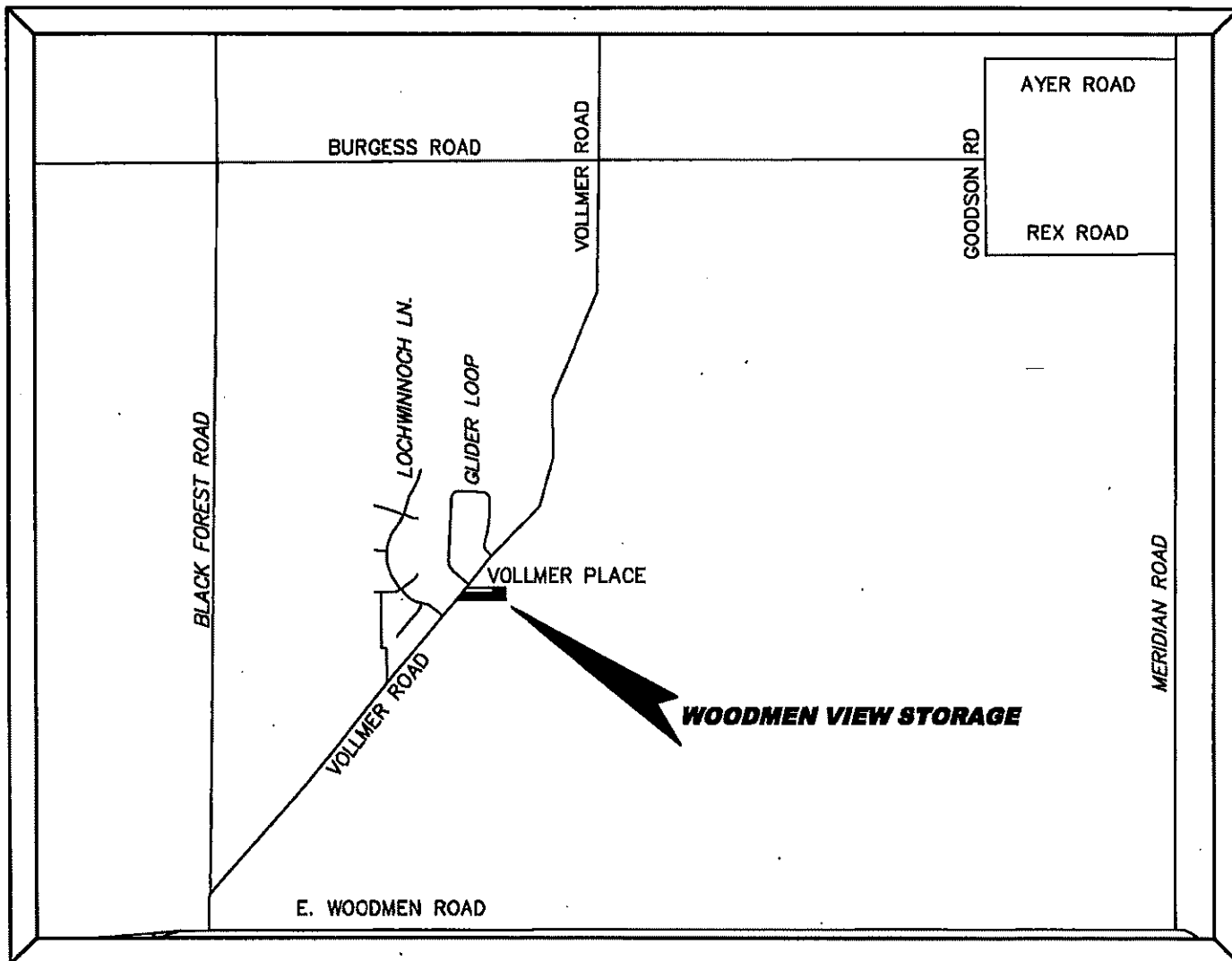
APPENDIX

PLOTTED BY: jaylor XREFS: BASE

PATH: P:\VW RV\1\CIVIL\CADD\

VICINITY.dwg

DRAWING NAME: VICINITY.dwg



Calibre

Calibre Engineering, Inc.
6201 Southpark Lane, Unit 200
Littleton, CO 80120 (303) 730-0434
www.calibre-engineering.com
Construction Management Civil Engineering Surveying

WOODMAN VIEW STORAGE EXHIBIT VICINITY MAP

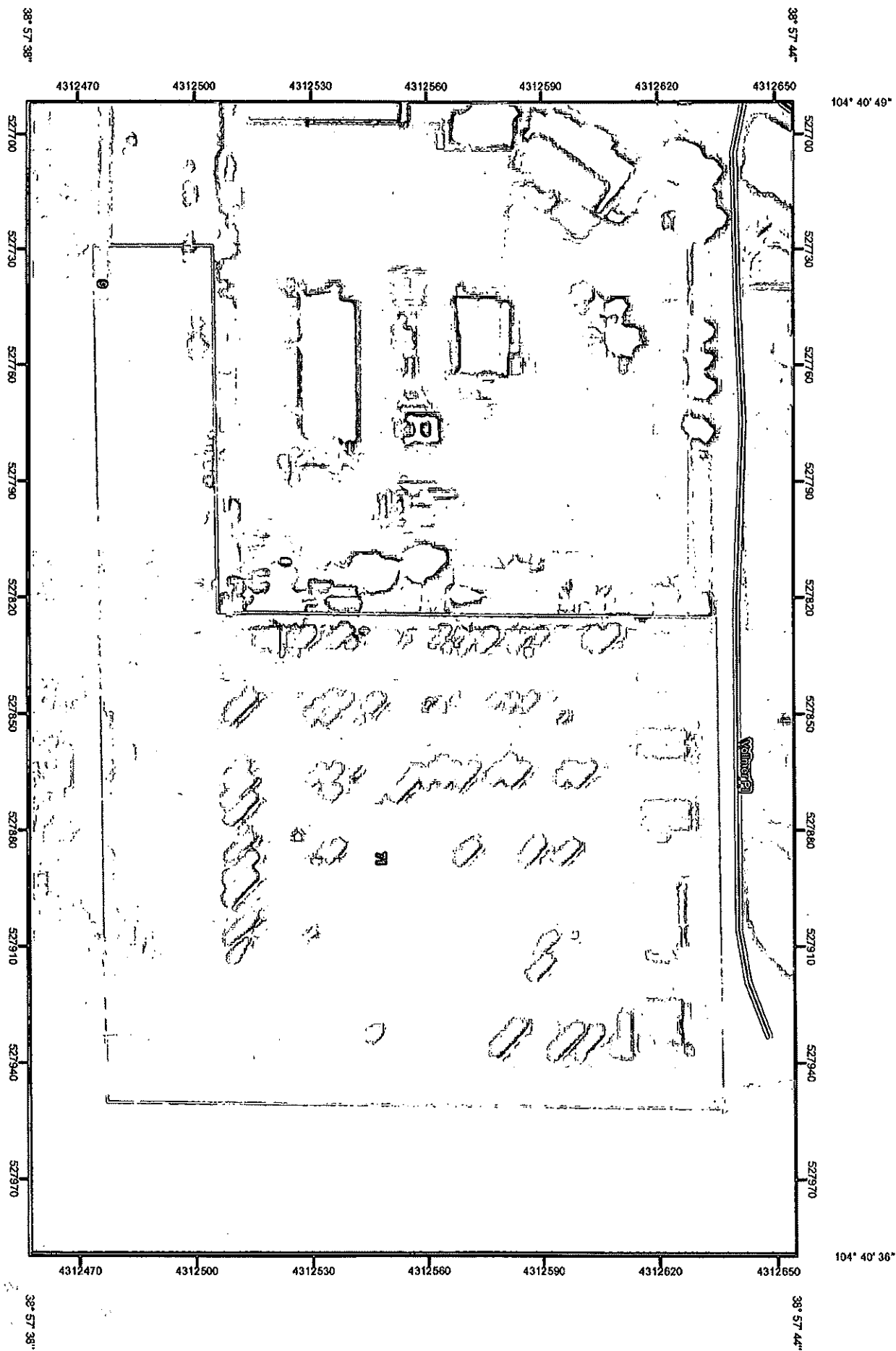
SHEET

X1

SCALE: NTS

DATE:

FEBRUARY 2010



Map Scale 1:1,420 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

	Area of Interest (AOI)		Very Stony Spot
	Soil Map Units		Wet Spot
	Special Point Features		Other
	Blowout		Special Line Features
	Borrow Pit		Gully
	Clay Spot		Short Steep Slope
	Closed Depression		Other
	Gravel Pit		Political Features
	Gravelly Spot		Cities
	Landfill		Water Features
	Lava Flow		Oceans
	Marsh or Swamp		Streams and Canals
	Mine or Quarry		Transportation
	Miscellaneous Water		Rails
	Perennial Water		Interstate Highways
	Rock Outcrop		US Routes
	Saline Spot		Major Roads
	Sandy Spot		Local Roads
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		
	Spoil Area		
	Stony Spot		

MAP INFORMATION

Map Scale: 1:1,420 if printed on A size (8.5" x 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000. Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 13N NAD83

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 7, May 4, 2009

Date(s) aerial images were photographed: 7/30/2005

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

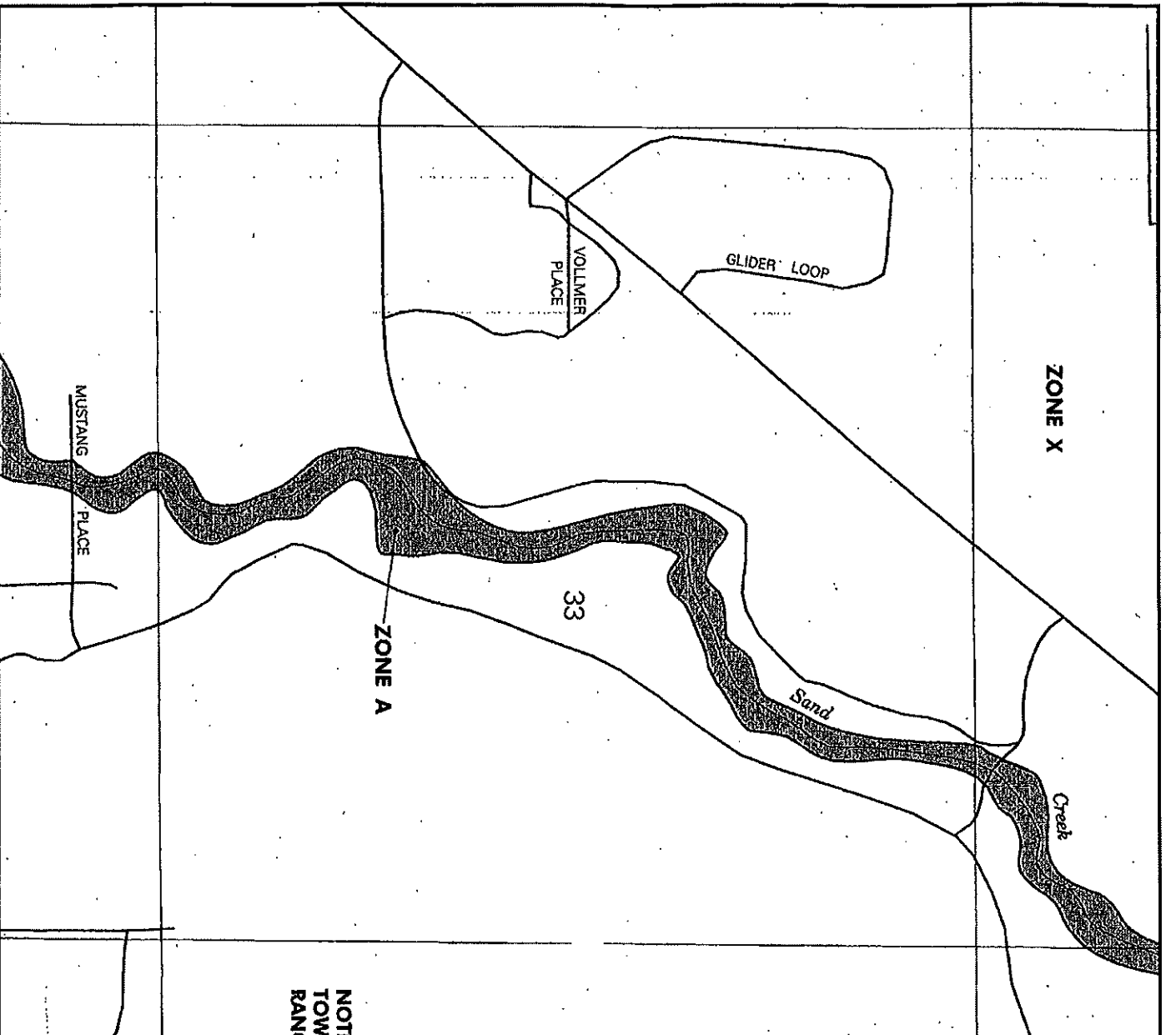
Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	0.1	1.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	5.6	98.9%
Totals for Area of Interest		5.7	100.0%



ZONE X

APPROXIMATE SCALE IN FEET
1000 0 1000



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

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

PANEL 535 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:
COMMUNITY

EL PASO COUNTY
UNINCORPORATED AREAS

NUMBER PANEL SURF

50000 0000 0



Federal Emergency Management Agency

MAP NUMBER
08041C0535 F

EFFECTIVE DATE
MARCH 17, 1997

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.fema.gov



COMPOSITE 'C' FACTORS

LOCATION: WOODMAN VIEW RV

FINAL REPORT

RWL

DATE: 5/10/2010

BASIN DESIGNATION	AREAS (ACRES)					SF 1/2 A			INDUST-LIGHT			UNDEV			STREETS-GRAVEL			STREETS-PAVED			COMPOSITE C FACTOR			
	SF 1/2 A	INDUST- LIGHT	UNDEV	STREETS GRAVEL	STREETS PAVED	TOTAL	%I	10 YR	100 YR	%I	10 YR	100 YR	%I	10 YR	100 YR	%I	10 YR	100 YR	%I	10 YR	100 YR	%I	10 YR	100 YR
HISTORIC																								
H-1	0.58	1.22	0.00	0.00	0.00	1.80	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	62.28	0.59	0.69
H-2	0.00	0.00	0.00	0.45	0.00	0.45	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.80	0.85
H-3	0.00	0.61	0.00	0.00	0.00	0.61	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.70	0.80
H-4	0.00	1.80	0.00	0.00	0.00	1.80	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.70	0.80
H-5	0.00	0.20	6.26	0.00	0.00	6.46	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	4.41	0.17	0.22
H-6	1.00	4.22	0.00	0.00	0.41	5.63	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	71.69	0.59	0.75
H-7	0.00	0.00	3.54	0.00	0.00	3.54	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	2.00	0.15	0.20
DEVELOPED																								
A	0.58	1.22	0.00	0.00	0.00	1.80	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	62.28	0.59	0.69
B	0.00	0.00	0.00	0.45	0.00	0.45	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.80	0.85
C	0.00	0.61	0.00	0.23	0.00	0.84	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.73	0.81
D	1.00	6.02	0.00	0.00	0.41	7.43	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	73.70	0.61	0.76
E	0.00	0.20	0.85	8.12	0.00	9.17	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	72.77	0.74	0.79
F	0.00	0.00	0.00	0.48	0.00	0.48	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.80	0.85
G	0.00	0.00	0.00	0.12	0.00	0.12	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	80.00	0.80	0.85
POND	1.58	8.05	0.85	9.40	0.41	20.29	25	0.35	0.45	80	0.70	0.80	2	0.15	0.20	80	0.80	0.85	100	0.90	0.95	72.85	0.68	0.77



LOCATION: WOODMAN VIEW RV FINAL REPORT EL PASO COUNTY

Calc. by: RWL
Chkd by: TAJ
Date: 5/10/2010

DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF							REMARKS
	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./hr.)	Q (cfs)	Sum AREA	Sum Tc (min.)	I (in./hr.)	Sum CA	Total Q (cfs)	FLOW IN PIPE	FLOW IN STREET	
H1	H-1	1.80	0.59	12	1.06	4.30	4.5								
H2	H-2	0.45	0.80	5	0.36	6.00	2.2								
H3	H-3	0.61	0.70	10	0.43	4.60	2.0								
H4	H-4	1.80	0.70	9	1.26	4.80	6.0								
H5	H-5	6.46	0.17	14	1.08	4.00	4.3	11.12	14	4.00	4.18	16.7			Total Historic flow on east side, Basin H1-5
H6	H-6	5.63	0.59	14	3.30	4.00	13.2								
H7	H-7	3.54	0.15	12	0.53	4.30	2.3	9.17	14	4.00	3.84	15.3			Total Historic flow on west side, Basin H6,7
		20.29						10.00	14	4.00	1.61	6.4			Total onsite historic
								20.29	14	4.00	8.02	32.1			Total Historic flow through site
1	A	1.80	0.59	12	1.06	4.30	4.5								Piped across Vollmer Pt to Basin C
2	B	0.45	0.80	5	0.36	6.00	2.2								Sheet flows onto site
3	C	0.84	0.73	9	0.61	4.80	2.9	2.64	12	4.30	1.67	7.2			Flows in onsite swale to culvert, Total runoff Basins A, C
4	D	7.43	0.61	14	4.56	5.00	22.8								Sheet flows onto site
5	E	9.17	0.74	9	6.76	4.80	32.5	19.69	12	4.30	13.36	57.4			Onsite Basin, sheet flows across site; Total Runoff to detention pond
6	F	0.48	0.80	5	0.38	6.00	2.3								Onsite Basin released undetained
7	G	0.12	0.80	5	0.10	6.00	0.6	0.60	5	6.00	0.48	2.9			Onsite Basin released undetained, Total undetained release

1041



LOCATION:

WOODMAN VIEW RV

FINAL REPORT

EL PASO COUNTY

Calc. by: RWL

Chk'd by: TAJ

Date: 5/10/2010

DESIGN POINT	DIRECT RUNOFF						TOTAL RUNOFF						REMARKS			
	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	Sum AREA	Sum Tc (min.)	I (in./hr.)	Sum CA	Total Q (cfs)		FLOW IN PIPE	FLOW IN STREET	
H1	H-1	1.80	0.69	12	1.24	6.50	8.0								Total Historic flow on east side, Basin H1-5	
H2	H-2	0.45	0.85	5	0.38	9.00	3.4									
H3	H-3	0.61	0.80	10	0.49	7.00	3.4									
H4	H-4	1.80	0.80	9	1.44	7.20	10.4									
H5	H-5	6.46	0.22	14	1.41	6.10	8.6	11.12	14	6.10	4.96	30.3				
H6	H-6	5.63	0.75	14	4.22	6.10	25.7									Total Historic flow on west side, Basin H6,7
H7	H-7	3.54	0.20	12	0.71	6.50	4.6	9.17	14	6.10	4.92	30.0				
								10.00	14	6.10	2.12	12.9				
								20.29	14	6.10	9.88	60.3				Total Historic flow through site
1	A	1.80	0.69	12	1.24	6.50	8.0								Piped across Vollmer Pl to Basin C	
2	B	0.45	0.85	5	0.38	9.00	3.4									Sheet flows onto site
3	C	0.84	0.81	9	0.68	7.20	4.9	2.64	12	6.50	1.92	12.5				
4	D	7.43	0.76	14	5.66	7.60	43.0								Sheet flows onto site	
5	E	9.17	0.79	9	7.23	7.20	52.1	19.69	14	6.10	15.19	92.7				Onsite Basin, sheet flows across site; Total Runoff to detention pond
6	F	0.48	0.85	5	0.41	9.00	3.7								Onsite Basin released undetained	
7	G	0.12	0.85	5	0.10	9.00	0.9	0.60	5	9.00	0.51	4.6				Onsite Basin released undetained, Total undetained release

100 yr



DETENTION POND VOLUME (RATIONAL STORED RATE METHOD)

100-Year

$T_c =$ 5 min
 $CA =$ 15.19
 $Q_{REL} =$ 29.4 cfs

Storm Duration (min)	Intensity (in/hr)	Peak Q (cfs)	Storm Vol (ft ³)	Release Vol (ft ³)	Storage Vol (ft ³)	Storage Vol (ac-ft)
5	9.00	136.7	41013	8820	32193	0.74
15	5.80	88.1	79292	26460	52832	1.21
20	5.10	77.5	92963	35280	57683	1.32
25	4.55	69.1	103672	44100	59572	1.37
30	4.10	62.3	112102	52920	59182	1.36
35	3.70	56.2	118026	61740	56286	1.29
40	3.40	51.6	123950	70560	53390	1.23
45	3.20	48.6	131242	79380	51862	1.19
50	3.00	45.6	136710	88200	48510	1.11
55	2.80	42.5	140356	97020	43336	0.99

10-Year

$T_c =$ 5 min
 $CA =$ 13.4
 $Q_{REL} =$ 16.1 cfs

Storm Duration (min)	Intensity (in/hr)	Peak Q (cfs)	Storm Vol (ft ³)	Release Vol (ft ³)	Storage Vol (ft ³)	Storage Vol (ac-ft)
5	6.00	80.4	24120	4830	19290	0.44
15	3.90	52.3	47034	14490	32544	0.75
20	3.45	46.2	55476	19320	36156	0.83
25	3.05	40.9	61305	24150	37155	0.85
30	2.70	36.2	65124	28980	36144	0.83
35	2.45	32.8	68943	33810	35133	0.81
40	2.30	30.8	73968	38640	35328	0.81
45	2.15	28.8	77787	43470	34317	0.79
50	1.95	26.1	78390	48300	30090	0.69



DETENTION POND CALCULATIONS

Woodman View Storage
El Paso County, CO

DETENTION POND CRITERIA

Peak release rate for the developed 10-yr and 100-yr events shall not exceed the historic rate for the drainage area

Criteria References:

El Paso County/City of Colorado Springs Drainage Criteria Manual
Urban Drainage and Flood Control District Criteria Manual

DETENTION POND RELEASE RATE CALCULATION

10-yr Historic Runoff (cfs)

Design Point H5 = 16.7
Design Point H7 = 15.3

10-yr Developed Runoff (cfs)

Design Point 5 = 57.4
Design Point 6 = 2.3
Design Point 7 = 0.6

100-yr Historic Runoff (cfs)

Design Point H5 = 30.3
Design Point H7 = 30.0

100-yr Developed Runoff (cfs)

Design Point 5 = 92.7
Design Point 6 = 3.7
Design Point 7 = 0.9

Allowable Release Rate at DP 5 (cfs)

10-yr = 16.1 (DP H5 - DP 7)
100-yr = 29.4 (DP H5 - DP 7)

Allowable Release Rate at DP 6 (cfs)

10-yr = 15.3 (Developed < Historic therefore no detention
100-yr = 30.0 at this location)

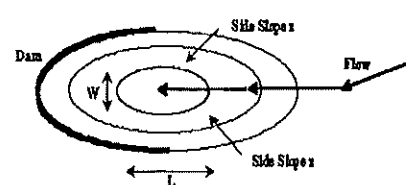
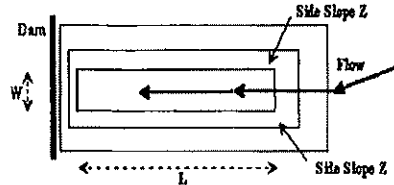
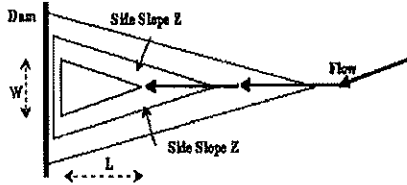
DETENTION POND VOLUME CALCULATION

Water Quality Capture Volume (WQCV) = 0.30	AC-FT	UDFCD WQCV Calculation	7045.74
10-yr Volume = 0.85	AC-FT	Rational Storage Rate Method	
10-yr Volume + WQCV = 1.15	AC-FT		7047.47
100-yr Volume = 1.37	AC-FT	Rational Storage Rate Method	
100-yr Volume + WQCV/2 = 1.52	AC-FT		7048.05

STAGE-STORAGE SIZING FOR POLYGONAL, ELLIPTICAL, OR IRREGULAR PONDS

Project: Woodman View Storage Final Drainage

Basin ID: _____



Design Information (Input):

Width of Pond Bottom, W = ft
 Length of Pond Bottom, L = ft
 Dam Side-slope (H:V), Z_d = ft/ft

Check Pond Shape

Right Triangle		OR...
Isosceles Triangle		OR...
Rectangle		OR...
Circle / Ellipse		OR...
Irregular	☒	(Use Override values in cells G32:G52)

Stage-Storage Relationship:

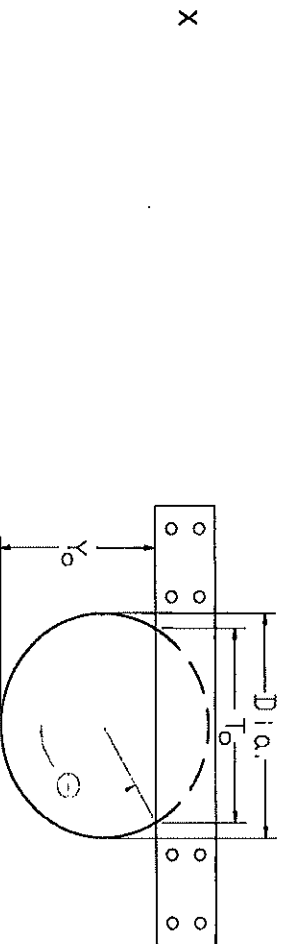
	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':			acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Stage ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Pond Width at Stage ft (output)	Pond Length at Stage ft (output)	Surface Area at Stage ft ² (output)	Surface Area at Stage ft ² User Override	Volume Below Stage ft ³ (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	7043.00					0		0.000	0.000	
	7043.20		0.00	0.00		85	8	0.002	0.000	
	7043.40		0.00	0.00		541	71	0.012	0.002	
	7043.60		0.00	0.00		1,206	246	0.028	0.006	
	7043.80		0.00	0.00		1,802	547	0.041	0.013	
	7044.00		0.00	0.00		2,468	974	0.057	0.022	
	7044.20		0.00	0.00		3,221	1,542	0.074	0.035	
	7044.40		0.00	0.00		4,074	2,272	0.094	0.052	
	7044.60		0.00	0.00		5,029	3,182	0.115	0.073	
	7044.80		0.00	0.00		6,067	4,292	0.139	0.099	
	7045.00		0.00	0.00		7,256	5,624	0.167	0.129	
	7045.20		0.00	0.00		8,604	7,210	0.198	0.166	
	7045.40		0.00	0.00		10,126	9,083	0.232	0.209	
	7045.60		0.00	0.00		11,774	11,273	0.270	0.250	
WQCV	7045.80		0.00	0.00		13,756	13,826	0.316	0.317	0.30 REQUIRED
	7046.00		0.00	0.00		16,086	16,810	0.369	0.386	
	7046.20		0.00	0.00		18,669	20,266	0.429	0.466	
	7046.40		0.00	0.00		21,153	24,268	0.486	0.557	
	7046.60		0.00	0.00		22,506	28,634	0.517	0.657	
	7046.80		0.00	0.00		23,692	33,254	0.544	0.763	
	7047.00		0.00	0.00		24,730	38,096	0.568	0.875	
	7047.20		0.00	0.00		25,577	43,127	0.587	0.990	
	7047.40		0.00	0.00		26,259	48,310	0.603	1.109	
10-YR WSEL	7047.60		0.00	0.00		26,971	53,633	0.619	1.231	1.15 REQUIRED
	7047.80		0.00	0.00		27,873	59,118	0.640	1.357	
	7048.00		0.00	0.00		28,982	64,803	0.665	1.488	
100-YR WSEL	7048.20		0.00	0.00		30,276	70,729	0.695	1.624	1.52 REQUIRED
	7048.40		0.00	0.00		31,774	76,934	0.729	1.766	

RESTRICTOR PLATE SIZING FOR CIRCULAR VERTICAL ORIFICES

Project: Woodman View Storage Final Drainage

Basin ID: _____



Sizing the Restrictor Plate for Circular Vertical Orifices or Pipes (Input)

Water Surface Elevation at Design Depth
Pipe/Vertical Orifice Entrance Invert Elevation
Required Peak Flow through Orifice at Design Depth
Pipe/Vertical Orifice Diameter (inches)
Orifice Coefficient

#1 Vertical Orifice	#2 Vertical Orifice
Elev: WS = 7.047.74	
Elev: Invert = 7.042.67	
Q = 8.05	
Dia = 18.0	
C _o = 0.65	

Full-flow Capacity (Calculated)

Full-flow area
Half Central Angle in Radians
Full-flow capacity

Af = 1.77	sq ft
Theta = 3.14	rad
Qf = 19.2	cfs
Percent of Design Flow = 238%	

Calculation of Orifice Flow Condition

Half Central Angle (0<Theta<3.1416)
Flow area
Top width of Orifice (inches)
Height from Invert of Orifice to Bottom of Plate (feet)
Elevation of Bottom of Plate
Resultant Peak Flow Through Orifice at Design Depth

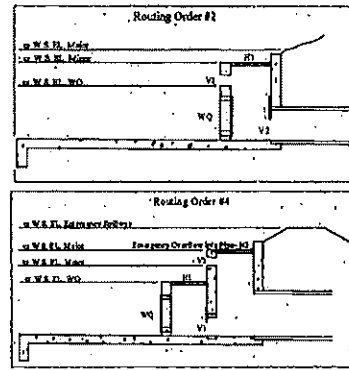
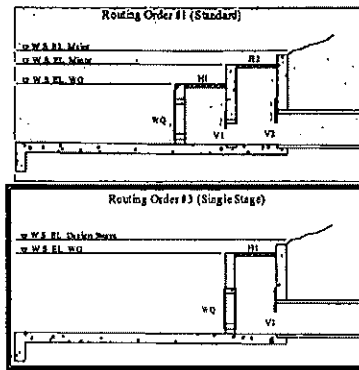
Theta = 1.42	rad
A _o = 0.71	sq ft
T _o = 17.78	inches
Y _o = 0.63	feet
Elev Plate Bottom Edge = 7.043.30	feet
Q _o = 8.1	cfs

Width of Equivalent Rectangular Vertical Orifice
Centroid Elevation of Equivalent Rectangular Vertical Orifice

Equivalent Width = 1.13	feet
Equiv. Centroid El. = 7.042.99	feet

STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Woodman View Storage Final Drainage
Basin ID:



Current Routing Order is #3

Design Information (Input):

Circular Opening: Diameter in Inches
OR
Rectangular Opening: Width in Feet
Length (Height for Vertical)
Percentage of Open Area After Trash Rack Reduction
Orifice Coefficient
Weir Coefficient
Orifice Elevation (Bottom for Vertical)

	#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Dia. =					inches
W =	2.92		1.55		ft.
L or H =	5.67		0.93		ft.
% open =	38		100		%
C _d =	0.65		0.65		
C _w =	2.55				
E _o =	7045.74		7,042.67		ft.

Calculation of Collection Capacity:

Net Opening Area (after Trash Rack Reduction)
OPTIONAL: User-Override Net Opening Area
Perimeter as Weir Length
OPTIONAL: User-Override Weir Length

A _n =	8.21		1.44		sq. ft.
A _o =					sq. ft.
L _w =	13.53				ft.
L _o =					ft.
Top Elevation of Vertical Orifice Opening, Top =			7043.60		ft.
Center Elevation of Vertical Orifice Opening, Cen =			7043.14		ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	Horizontal Orifices				Vertical Orifices		Total Collection Capacity cfs (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
			#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)		
	7043.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00	
	7043.20	0.01	0.00	0.00	0.00	0.00	2.20	0.00	0.01	
	7043.40	0.02	0.00	0.00	0.00	0.00	3.56	0.00	0.02	
	7043.60	0.03	0.00	0.00	0.00	0.00	5.12	0.00	0.03	
	7043.80	0.04	0.00	0.00	0.00	0.00	6.13	0.00	0.04	
	7044.00	0.05	0.00	0.00	0.00	0.00	8.99	0.00	0.05	
	7044.20	0.07	0.00	0.00	0.00	0.00	7.76	0.00	0.07	
	7044.40	0.09	0.00	0.00	0.00	0.00	8.45	0.00	0.09	
	7044.60	0.11	0.00	0.00	0.00	0.00	9.09	0.00	0.11	
	7044.80	0.13	0.00	0.00	0.00	0.00	9.69	0.00	0.13	
	7045.00	0.14	0.00	0.00	0.00	0.00	10.26	0.00	0.14	
	7045.20	0.17	0.00	0.00	0.00	0.00	10.79	0.00	0.17	
	7045.40	0.19	0.00	0.00	0.00	0.00	11.30	0.00	0.19	
	7045.60	0.24	0.00	0.00	0.00	0.00	11.70	0.00	0.24	
WQCV	7045.80	0.23	0.61	7.93	0.00	0.00	12.28	0.00	0.74	.30 REQUIRED
	7046.00	0.24	4.57	18.51	0.00	0.00	12.71	0.00	4.81	
	7046.20	0.25	10.78	21.97	0.00	0.00	13.15	0.00	11.01	
	7046.40	0.27	18.50	28.31	0.00	0.00	13.67	0.00	13.67	
	7046.60	0.28	27.52	30.03	0.00	0.00	13.98	0.00	13.98	
	7046.80	0.29	37.65	33.34	0.00	0.00	14.38	0.00	14.38	
	7047.00	0.30	48.80	38.35	0.00	0.00	14.77	0.00	14.77	
	7047.20	0.31	60.86	39.13	0.00	0.00	15.14	0.00	15.14	
	7047.40	0.33	73.79	41.73	0.00	0.00	15.51	0.00	15.51	
	7047.60	0.34	87.52	44.17	0.00	0.00	15.87	0.00	15.87	
10-YR WSEL	7047.80	0.35	102.01	46.48	0.00	0.00	16.22	0.00	16.22	1.15 REQUIRED
	7048.00	0.35	117.22	48.69	0.00	0.00	16.67	0.00	16.67	
100-YR	7048.20	0.36	133.12	50.80	0.00	0.00	16.90	0.00	16.90	1.52 REQUIRED
	7048.40	0.37	149.68	52.82	0.00	0.00	17.24	0.00	17.24	

STORM DRAINAGE SYSTEM DESIGN

WEIR DESIGN SPREADSHEET

PROJECT: Woodman View Storage
CITY/COUNTY: Colorado Springs/El Paso

DATE: 7-May-10
DESIGNER: JLT
REVIEWER: TAJ

100 Year Weir must pass: 12.5 cfs Q = 100 year flow (29.4) - 100 year inlet capacity (16.9*)
Emergency Weir must pass: 93.0 cfs Q = 100 year flow

Bottom of weir elevation = 7047.74 100-yr Available head = 0.31 feet
100 Year water elev. = 7048.05 Emergency Overflow Available head = 1.26 feet
Top of pond = 7049.00 Weir Coefficient = 3.1

Length of Rectangular Weir 22.8 FEET
Side Slope 1 25% Angle 1 75.96 DEGREES
Side Slope 2 25% Angle 2 75.96 DEGREES
Total Angle For V-notch Weir 151.93

WSE	head (ft.)	Freeboard (ft.)	Rect weir (cfs)	v-notch (cfs)	total Q (cfs)	
7048.05	0.3	0.9	12.2	0.3	12.5	-----Q(100) Flow
7049.00	1.3	0.0	100.0	9.8	109.8	-----Q(Emergency) Flow

*Total Collection Capacity at 100-yr WSEL (see inlet control spreadsheet)

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc.

Tuesday, Apr 20 2010

Culvert from DP 3 - 100 yr Runoff

Invert Elev Dn (ft) = 7044.00
Pipe Length (ft) = 160.00
Slope (%) = 4.38
Invert Elev Up (ft) = 7051.01
Rise (in) = 18.0
Shape = Cir
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.012
Inlet Edge = Projecting
Coeff. K,M,c,Y,k = 0.0045, 2, 0.0317, 0.69, 0.5

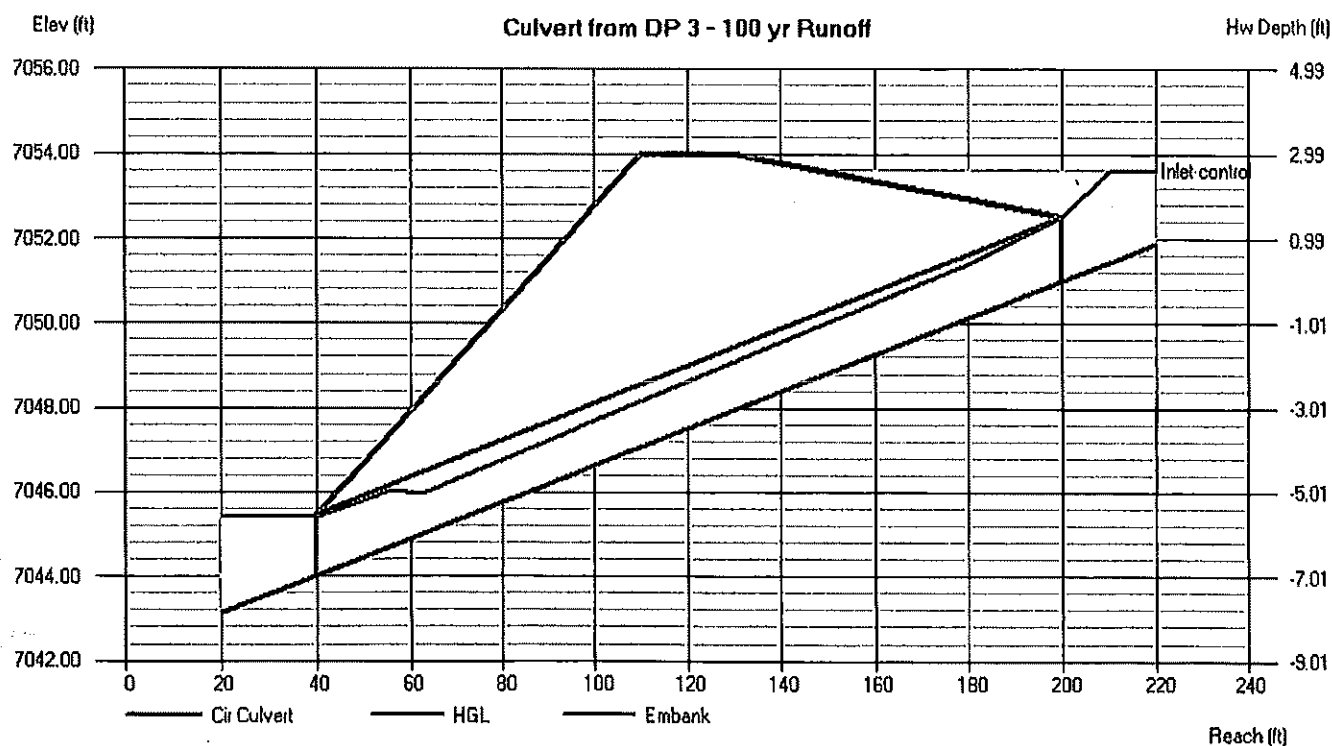
Embankment
Top Elevation (ft) = 7054.00
Top Width (ft) = 20.00
Crest Width (ft) = 20.00

Calculations

Qmin (cfs) = 12.00
Qmax (cfs) = 12.50
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 12.50
Qpipe (cfs) = 12.50
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 7.23
Veloc Up (ft/s) = 7.51
HGL Dn (ft) = 7045.42
HGL Up (ft) = 7052.35
Hw Elev (ft) = 7053.60
Hw/D (ft) = 1.73
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc.

Monday, May 10 2010

Culverts from DP 5 - 100 yr Runoff

Invert Elev Dn (ft) = 7042.50
Pipe Length (ft) = 53.67
Slope (%) = 0.32
Invert Elev Up (ft) = 7042.67
Rise (in) = 18.0
Shape = Cir
Span (in) = 18.0
No. Barrels = 2
n-Value = 0.012
Inlet Edge = Projecting
Coeff. K,M,c,Y,k = 0.0045, 2, 0.0317, 0.69, 0.5

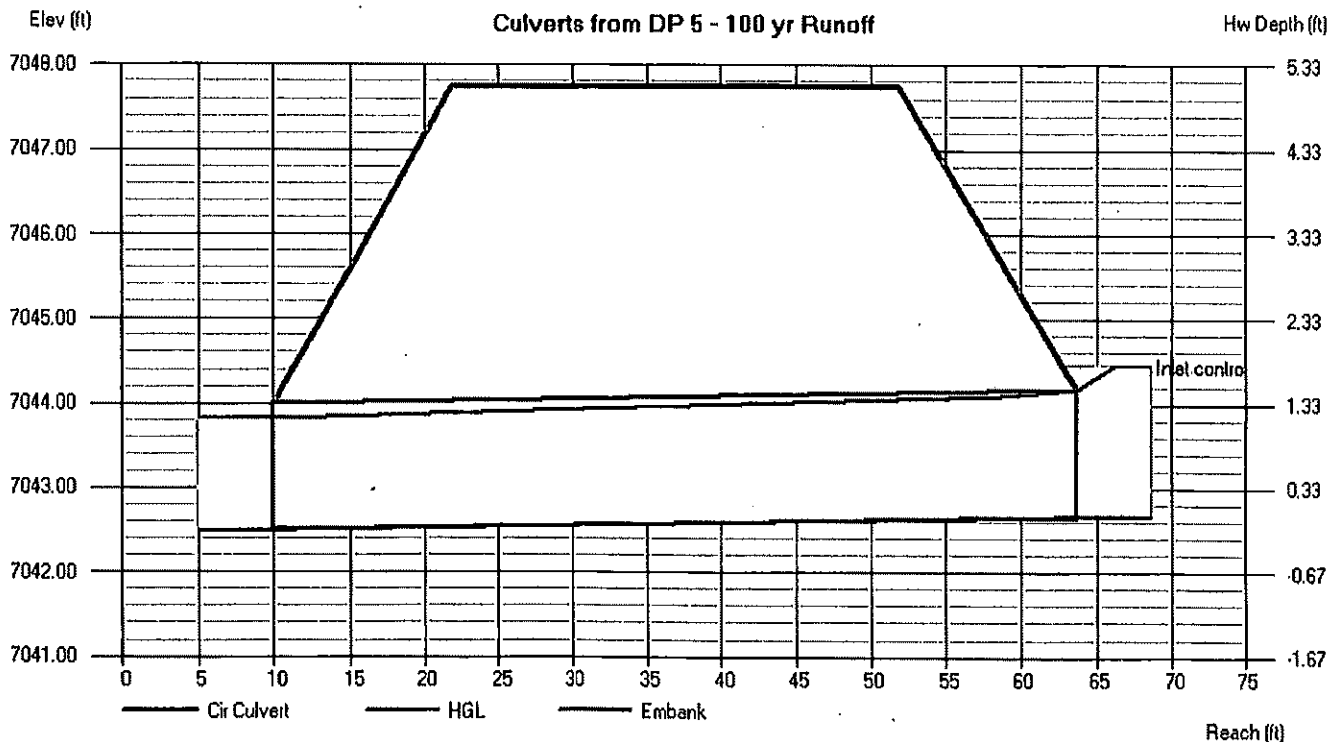
Embankment
Top Elevation (ft) = 7047.74
Top Width (ft) = 30.00
Crest Width (ft) = 20.00

Calculations

Qmin (cfs) = 16.80
Qmax (cfs) = 17.00
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 16.90
Qpipe (cfs) = 16.90
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.15
Veloc Up (ft/s) = 4.82
HGL Dn (ft) = 7043.81
HGL Up (ft) = 7044.13
Hw Elev (ft) = 7044.45
Hw/D (ft) = 1.18
Flow Regime = Inlet Control



RIPRAP SIZING

18" HDPE into Pond



DESIGN PARAMETERS

Pipe Diameter (D)=	18 in	HDPE	Normal Depth (D _n)=	1.50 ft
Discharge (Q _d)=	12.5	cfs	Tailwater Depth (Y _t)=	2.70 ft
Pipe Velocity (v)=	7.2	fps	Slope (S)=	4.38%

Froude Number (Fr)= 1.04 supercritical

RIP RAP SIZING

If Froude Number is greater than 1 (supercritical flow) then use:

$$D_a = 1/2 * (D + Y_n)$$

D_a = 1.50 Substitute D_a for D in Figure MD-21

If Froude Number is less than 1 (subcritical flow) then use:

$$D = 1.50$$

Use D_a = 1.50 Use w/ fig. MD-21

Use D = 1.50 for all other calculations

Other parameters

$$Q/D^{1.5} = 6.80$$

$$Y_t/D = 1.00$$

-From Figure MD-21 (Urban Drainage Design Criteria Manual)

Use Type	L	RipRap	-OR-	18 Inch Min. Dia. Uniform
d50 =	9	inches		Grouted Boulders

REQUIRED LENGTH

$$L = (1/(2 \tan q))(A_t/Y_t - W)$$

$$Q/D^{2.5} = 4.54$$

$$Y_t/D = 0.40$$

-From Figure MD-23 (Urban Drainage Design Criteria Manual)

expansion factor $1/(2 \tan q) = 3$

$$Q = 12.5 \text{ cfs}$$

$$V = 2.50 \text{ fps (assumed maximum for erosive velocities)}$$

$$A_t = 5.00 \text{ sq ft}$$

-DETERMINE LENGTHS

-Check length adjustment factor (D/4 for each whole number $Q/D^{2.5} > 6$)

Adjustment Factor >>> 0 No Length Adjustment Required

If $Q/D^{2.5} \leq 6$

Min. 4.5 FT

Calc. 2.0 FT

Max 15.0 FT

If $Q/D^{2.5} > 6$

Adj. L n/a

Rip Rap Length 4.5 ft

Required Rip Rap Width = 4(D) 6.0 ft

Required Rip Rap Depth = 2(d₅₀) 1.5 ft

Orifice Plate Perforation Sizing

Circular Perforation Sizing

Chart may be applied to orifice plate or vertical pipe outlet.

Hole Dia (in) *	Hole Dia (in)	Min. S _c (in)	Area per Row (sq in)		
			n=1	n=2	n=3
1/4	0.250	1	0.05	0.10	0.15
5/16	0.313	2	0.08	0.15	0.23
3/8	0.375	2	0.11	0.22	0.33
7/16	0.438	2	0.15	0.30	0.45
1/2	0.500	2	0.20	0.39	0.59
9/16	0.563	3	0.25	0.50	0.75
5/8	0.625	3	0.31	0.61	0.92
11/16	0.688	3	0.37	0.74	1.11
3/4	0.750	3	0.44	0.88	1.33
13/16	0.813	3	0.52	1.04	1.56
7/8	0.875	3	0.60	1.20	1.80
15/16	0.938	3	0.69	1.38	2.07
1	1.000	4	0.79	1.57	2.36
1 1/16	1.063	4	0.89	1.77	2.66
1 1/8	1.125	4	0.99	1.99	2.98
1 3/16	1.188	4	1.11	2.22	3.32
1 1/4	1.250	4	1.23	2.45	3.68
1 5/16	1.313	4	1.35	2.71	4.06
1 3/8	1.375	4	1.48	2.97	4.45
1 7/16	1.438	4	1.62	3.25	4.87
1 1/2	1.500	4	1.77	3.53	5.30
1 9/16	1.563	4	1.92	3.83	5.75
1 5/8	1.625	4	2.07	4.15	6.22
1 11/16	1.688	4	2.24	4.47	6.71
1 3/4	1.750	4	2.41	4.81	7.22
1 13/16	1.813	4	2.58	5.16	7.74
1 7/8	1.875	4	2.76	5.52	8.28
1 15/16	1.938	4	2.95	5.90	8.84
2	2.000	4	3.14	6.28	9.42
n = Number of columns of perforations					
Minimum steel plate thickness			1/4 "	5/16 "	3/8 "

* Designer may interpolate to the nearest 32nd inch to better match the required area, if desired.

Rectangular Perforation Sizing

Only one column of rectangular perforations allowed.

Rectangular Height = 2 inches

$$\text{Rectangular Width (inches)} = \frac{\text{Required Area per Row (sq in)}}{2"}$$

Rectangular Hole Width	Min. Steel Thickness
5"	1/4 "
6"	1/4 "
7"	5/32 "
8"	5/16 "
9"	11/32 "
10"	3/8 "
>10"	1/2 "

Urban Drainage and
Flood Control District

Drainage Criteria Manual (V.3)
File: V3-Outlet Details.dwg

Figure 5
WQCV Outlet Orifice
Perforation Sizing

Figure 5—WQCV Outlets Orifice Perforation Sizing.

