WELL NO. 22
FINAL DRAINAGE REPORT

AT

1755 COUNTY LINE ROAD

NW ¼ SECTION 2, TOWNSHIP 11 SOUTH, RANGE 67 WEST OF THE 6TH P.M.

COUNTY OF EL PASO, COLORADO

FOR

WOODMOOR WATER AND SANITATION DISTRICT NO. 1

1845 WOODMOOR DRIVE

MONUMENT, CO 80132

JVA, Inc.
Consulting Engineers
1319 Spruce Street
Boulder, CO 80302
(303) 444-1951

JVA Inc. Project No. 1051.9e

July 7, 2023

PCD FILE NO. PPR2317

JVA, Incorporated
1319 Spruce Street
Boulder, CO 80302
303.444.1951
info@jvajva.com

www.jvajva.com

July 7, 2023

Glenn Reese
Stormwater Engineer
El Paso County Department of Public Works
Colorado Springs, CO 80910

RE: Final Drainage Memo
WWSD Well No. 22
JVA No. 1051.9e
PCD File No. 2317

Dear Glenn,

The following *Final Drainage Report* has been prepared for the above referenced project. The stormwater memo and grading & erosion control plans have been produced in accordance with "The City of Colorado Springs/El Paso County Drainage Criteria Manual" recommendations.

It is our understanding that the information provided herein meets all requirements of the County of El Paso.

Please contact us if you have any questions regarding this submission.

Sincerely,
JVA, Inc.

COLORADO LICENSED
KENNETH JAMES CLIFFORD
41654
07/08/2023
PROFESSIONAL ENGINEER

Kenneth J. Clifford, P.E.
Senior Project Manager, Associate

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 applicable 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.

COLORADO LICENSED
KENNETH JAMES CLIFFORD
41654
07/08/2023
PROFESSIONAL ENGINEER

Kenneth J. Clifford, P.E. # 41654 — Date

Owner/Developer's Statement:

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

Jessie Shaffer, District Manager — 7-19-23 Date
Woodmoor Water Sanitation District No. 1
1845 Woodmoor Dr, Monument, CO 80132

El Paso County:

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

_____ — Date

County Engineer / ECM Administrator

Conditions:

TABLE OF CONTENTS

FINAL DRAINAGE REPORT WELL NO. 22

GENERAL LOCATION AND DESCRIPTION

LOCATION

Woodmoor Water and Sanitation District No. 1 (WWSD) proposes to build a new groundwater well on their property at 1755 County Line Road in Monument, Colorado. The groundwater well will be constructed adjacent to WWSD's Crystal Creek Lift Station with access from County Line Road.

The facility is located in the Northwest ¼ Section 2 of Township 11 North, Range 67 West of the 6th Principal Meridian in Unincorporated El Paso County, State of Colorado. The project site is located southwest of the intersection of County Line Road and Doewood Drive just east of Interstate 25. A vicinity map is included in Appendix A.

The site currently drains in a westerly direction to Crystal Creek. The property is bound by County Line Road to the north, Crystal Creek to the west, and open space to the south and east.

DESCRIPTION OF PROPERTY

The WWSD property is currently 0.8 acres and was partially developed for the Crystal Creek Lift Station. The site was partially developed for lift station's needs with an existing drive and a gravel access road. The remnant of the property is undisturbed open space with various trees, shrubs and native grasses. In general, the majority of the site has slopes in the 4% to 8% range with some steeper areas approaching 4:1 slopes near the Creek or Roadside ditch along the south side of County Line Road. The study area for this report includes the area of the property that will be under development and two upstream offsite basins that characterize sheet flows that cross the property. The study area is 5.15 acres and has a calculated imperviousness of 23.7%. A Historic Drainage Map depicting the limits of study and summary of historic runoff is enclosed at the end of the report.

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) mapping of the area indicates that the soils are predominately Peyton-Pring complex, 8 to 15 percent slopes. These soils within the site area are classified as hydrological soil group B. Soils in this group have a moderate infiltration rate when thoroughly wet and therefore have moderate runoff potential. A Soils Map is provided in Appendix A.

There are no irrigation facilities on site. There are multiple utilities serving the lift station site.

DESCRIPTION OF PROJECT

The design of the Well 22 site has been split into three phases. The first phase, completed in the Summer of 2022, focused on drilling the well and completing any necessary site improvements to accommodate the drill rig. During this phase, JVA identified the placement of a future, additional well on the project site to aid WWSD in their planning efforts to meet future demand. The second and current phase presented in this report focuses on the development of Well 22, including its equipping, housing and site infrastructure. The third and final phase will be the design of a transmission main to convey water from Well 22 to WWSD's Central Water Treatment Plant (CWTP).

The requested erosion and stormwater quality control permit is only for the well house and its associated site development. The future well and transmission main, as well as any associated site developments, will be permitted separately at a later date.

The study area for the project is 5.16 acres and proposes a calculated imperviousness of 26.2%. A Developed Drainage Map depicting the limits of study and summary of proposed runoff is enclosed at the end of the report.

DRAINAGE BASINS

MAJOR DRAINAGE BASIN DESCRIPTION

The property will drain to Crystal Creek which is then conveyed to Monument Creek. This is part of the Fountain Creek Watershed which drains to the Arkansas River.

The Property is located within Zone X as defined by the Federal Emergency Management Agency (FEMA). Zone X is defined as: *Area of Minimal Flood Hazard.* The site is located within FEMA Flood Insurance Rate Map (FIRM) number 08041C0065G, revised December 7, 2018.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm drainage facilities for the project are designed to comply with the "The City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

HYDROLOGIC METHOD

Design storm recurrence intervals for this project are consistent with The City of Colorado Springs/El Paso County Drainage Criteria Manual.

The Rational Method (Q=CIA) was used to determine the storm runoff (Q) from the site, with composite runoff coefficients (C) and contributing areas (A) given for design points in sub-basins. Intensities (I) were determined using NOAA Time-Intensity-Frequency Tables for the site located in Unincorporated El Paso County, Colorado and a calculated Time of Concentration (t_c). Runoff coefficients were calculated based on Table 6-3 of the UDFCD Runoff chapter. Post-development Time of Concentration calculations for each sub-basin, corresponding rainfall intensities, and composite runoff coefficients for each sub-basin are provided in Appendix B.

The runoff calculations were based on NOAA Point Precipitation Frequency Estimates Tables set in the location of the site in unincorporated El Paso County and are listed in Table 1 below.

Return Period	One Hour Depth (in).
5-year	1.20
100-year	2.52

The CDR223 filing plans show the well at the approximate location of the well called out as "future well" on the current PPR2317 GEC Plans. Please add some text to the drainage report clarifying that the location of the well drilled with CDR223 was shifted during construction (if true, it appears that way). The County is available for a meeting/call/email to clarify this if it would be helpful.

Please note: This comment is a preference so that in the future it is clear for County tracking where Well 22 was built and why the CDR223 and PPR2317 Well 22 locations appear different on their respective plansets.

The proposed development will not significantly alter historic drainage patterns and will not be disturbing more than an acre (.78 acres) for the new addition. Because of these considerations, there will not be any detention or water quality facilities proposed.

DRAINAGE FACILITY DESIGN

GENERAL SUMMARY

An erosion and stormwater quality control permit for the Phase 1 drilling work (El Paso County Project Number CDR223) was issued in May 2022. The Phase 1 drilling for this project consisted of minor grading to create a generally level pad site for the drill rig to set up. The grading for the pad site resulted in the creation of two temporary diversion swales to route storm runoff around the drill rig pad site. Rock Check dams were located near the downstream ends of the two temporary drainage swales to act as "level spreaders" to provide energy dissipation of the swales and return the storm runoff to follow the historic overland flow. The swales were sized to route the stormwater runoff around the site temporarily during the Phase 1 operations. The Phase 1 drilling did not add any additional impervious areas to the site.

The Phase 2 improvements consist of the construction of the well house, an electrical transformer enclosure, wet and dry utilities, an asphalt access drive off of County Line Road, a gravel parking area, a retaining wall, and site grading.

The boundary and drainage pattern for the proposed basin will remain relatively unchanged from the historic patterns. Offsite flows that are not within the WWSD property will continue to flow in historic patterns to the property and continue to be conveyed towards Crystal Creek. There will be one developed swale to intercept runoff along the east side of the site before it flows northwest to the public roadside swale in County Line Road and ultimately to Crystal Creek. The eastern swale will be dissipated through a rock check dam and stabilized in a low trapezoidal channel to promote sheet flow onsite prior to shedding to the existing roadside swale in County Line Road.

Any improvements associated with the future well and transmission main will be completed under a separate future permit.

SPECIFIC DETAILS

The current development will result in a slight increase in impervious area and, consequently, runoff to Crystal Creek. 5,714 square feet (0.13 acre) of asphalt will be added to the site for the access drive to the well house. 1,441 square feet (0.03 acre) of gravel will be added for parking at the well house. The roof area of the well house will be 445 square feet (0.01 acre).

Analysis of the existing 18-inch RCP culvert at the driveway indicated that it has about 12.44 cubic feet per second (CFS) capacity. The culvert proved to be adequately sized for the minor storm event in both historic and proposed conditions. The majority of the peak runoff the driveway during the 100-yr storm event is expected to be conveyed in the culvert: 12.44 cfs is expected to

be conveyed in the culvert and approximately 1.14 cfs is expected to bypass the culvert as surface flow in County Line Road.

All disturbed areas will be returned to native seeding to match the historic conditions. Because the project is directly adjacent to Crystal Creek, the current development will not result in any increase in runoff to the neighboring or downstream parcels. Temporary erosion control BMP's will be installed during construction to minimize erosion potential.

According to the National Wetlands inventory, a freshwater emergent wetland habitat (classification PEM1C) exists to the east of the lift station property. While no wetlands exist within either of the WWSD-owned properties in the project area, all work and earth disturbance shall be done in a manner that minimizes pollution of the adjacent wetlands. Storm drainage design will consider the presence of the adjacent wetlands and limit impacts that can result from flow volumes, flow rates, and water quality entering the wetland habitat. Temporary BMPs will be installed to protect the wetlands during construction.

CONCLUSION

The proposed WWSD Well 22 project has been designed in accordance with The City of Colorado Springs/El Paso County Drainage Criteria Manual. The area of disturbance will be less than one acre with 0.78 acres being disturbed. The increased imperviousness of the study area from 23.7% to 26.2% is expected to increase the peak runoff from 13.1 cfs to 14.0 cfs during the 100-yr storm event. Similarly, the peak runoff is expected to increase from 2.1 cfs to 2.4 cfs during the 5-year storm event. The minor increases in peak flows due to development of Well 22 are not expected to affect any adjacent or downstream properties negatively or adversely. Historic drainage patterns to convey offsite flow through the property will be maintained.

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, October 1991.
2. "Urban Storm Drainage Criteria Manual," Urban Drainage and Flood Control District, updated March 2017.
3. Web Soil Survey, Natural Resources Conservation Service, United State Department of Agriculture, Online at http://websoilsurvey.nrcs.usda.gov, accessed April 20, 2022.

APPENDIX A – VICINITY MAP

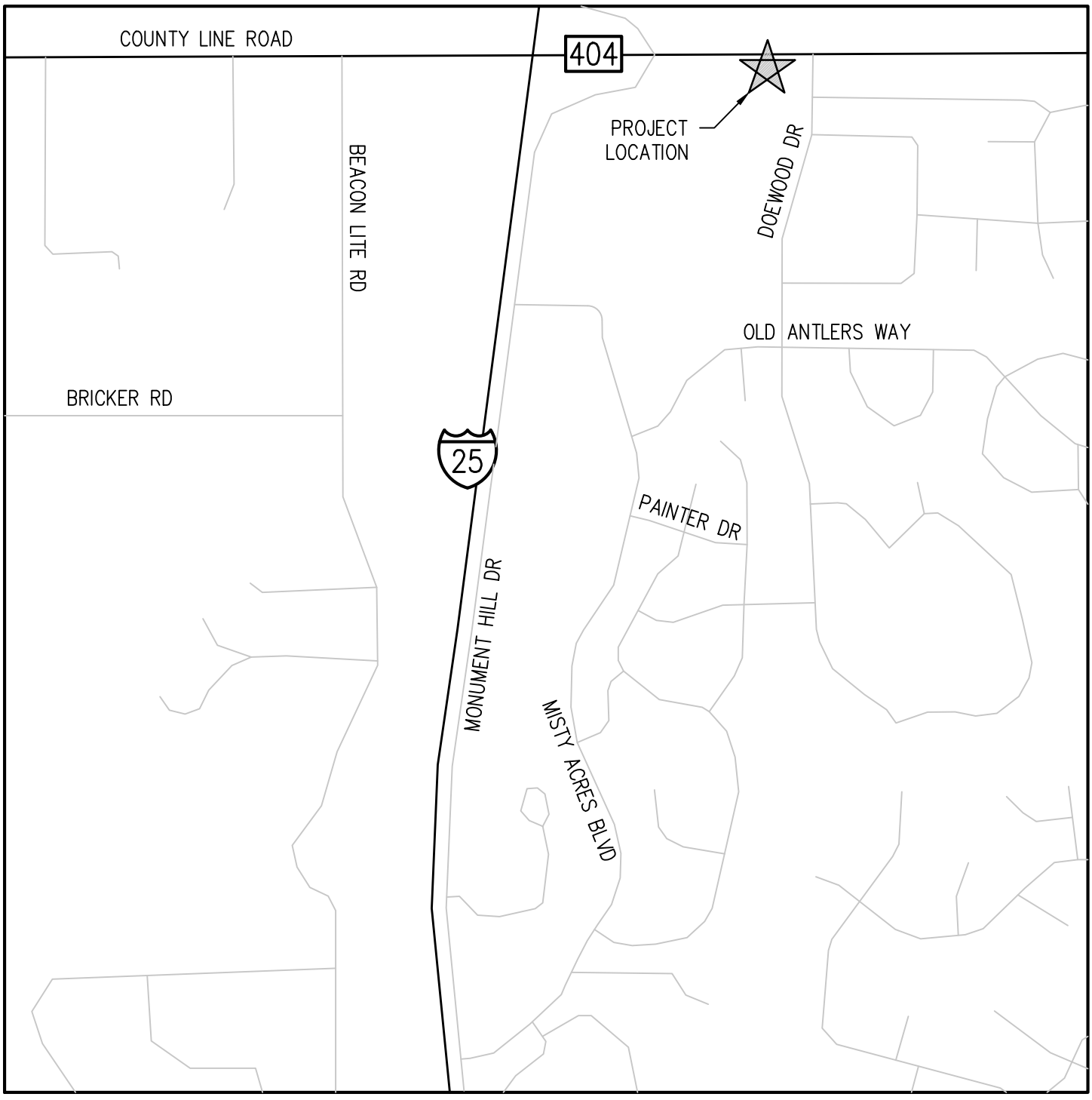

FIGURE 1 - VICINITY MAP

WWSD WELL NO. 22

FEBRUARY 2022

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APPENDIX B – CALCULATIONS

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: (303) 444 1951

Job Name: Woodmoor Well 22
Job Number: 1051.9e
Date: 7/7/23
By: MHT

Woodmoor Well 22

Historic Runoff Coefficient & Time of Concentration Calculations

Location: El Paso County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

Basin Design Data

	I (%) =	100%	90%	90%	40%	25%	25%	2%	2%			I (%)	Runoff Coeff's				Initial Overland Time (t_i)			Travel Time (t_t) x 60) t_t=Length/(Velocity						t_c Comp
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art.\ turf}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	K	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$
H1	1	0	0	0	0	0	0	17,928	0	17,928	0.41	2.0%	0.01	0.01	0.07	0.44	63	1.4%	14.2	188	1.5%	Nearly bare ground	10	1.2	2.6	16.7
H2	2	680	0	0	562	0	0	11,364	0	12,606	0.29	9.0%	0.05	0.06	0.13	0.47	58	0.3%	21.6	25	40.0%	Paved areas & shallow paved swales	20	12.6	0.0	21.7
OH1	3	0	1,803	3,161	2,167	0	0	28,663	0	35,795	0.82	16.5%	0.10	0.12	0.19	0.50	40	18.0%	4.3	300	6.2%	Short Pasture and lawns	7	1.7	2.9	7.2
OH2	4	30,101	5,000	4,072	13,791	0	0	105,307	0	158,270	3.63	29.0%	0.20	0.22	0.29	0.56	300	4.0%	17.5	540	3.5%	Paved areas & shallow paved swales	20	3.7	2.4	19.9
										0	0.00											Paved areas & shallow paved swales	20			
TOTAL SITE		30,781	6,802	7,233	16,520	0	0	163,262	0	224,599	5.16	23.7%	0.16	0.18	0.25	0.54										

I = (28.5 P1) / ((10 + TC) 0.786)

			Runoff Coeff's				Rainfall Intensities (in/hr)				Area		Flow Rates (cfs)			
Basin Name	Design Point	Time of Conc (tc)	C2	C5	C10	C100	2	5	10	100	A_{Total} (sf)	A_{Total} (ac)	Q2	Q5	Q10	Q100
H1	1	16.7	0.01	0.01	0.07	0.44	1.94	2.57	3.15	5.41	17,928	0.41	0.01	0.01	0.09	0.97
H2	2	21.7	0.05	0.06	0.13	0.47	1.70	2.24	2.75	4.73	12,606	0.29	0.02	0.04	0.10	0.64
OH1	3	7.2	0.10	0.12	0.19	0.50	2.74	3.62	4.45	7.65	35,795	0.82	0.23	0.36	0.70	3.16
OH2	4	19.9	0.20	0.22	0.29	0.56	1.78	2.35	2.88	4.95	158,270	3.63	1.27	1.91	3.05	10.11
0	0										0	0.00				
										TOTAL SITE	224,599	5.16	1.37	2.08	3.53	13.10

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Job Name: Woodmoor Well 22
Job Number: 1051.9e
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Woodmoor Well 22

Composite Runoff Coefficient Calculations

Location: El Paso County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

CA 100yr = 0.78i + 0.11
CB 100yr = 0.47i + 0.426
CC/D 100yr = 0.41i + 0.484)

Basin Design Data

	I (%) =	100%	90%	90%	40%	25%	25%	2%	2%			I (%)	Runoff Coeff's			
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art.\ turf}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
A1	1	0	0	0	0	0	0	1,573	0	1,573	0.04	2.0%	0.01	0.01	0.07	0.44
A2	2	1,570	7	445	85	0	0	6,311	0	8,416	0.19	25.4%	0.17	0.19	0.26	0.55
A3	3	2,155	0	0	1,356	0	0	10,301	0	13,811	0.32	21.0%	0.14	0.16	0.23	0.52
A4	4	1,983	0	0	0	0	0	245	0	2,228	0.05	89.2%	0.74	0.76	0.78	0.85
A5	5	0	0	0	0	0	0	4,506	0	4,506	0.10	2.0%	0.01	0.01	0.07	0.44
OS1	6	0	1,803	3,161	2,167	0	0	28,663	0	35,795	0.82	16.5%	0.10	0.12	0.19	0.50
OS2	7	30,101	5,000	4,072	13,791	0	0	105,307	0	158,270	3.63	29.0%	0.20	0.22	0.29	0.56
TOTAL SITE		35,808	6,809	7,678	17,399	0	0	156,905	0	224,599	5.16	26.2%	0.18	0.20	0.27	0.55

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Woodmoor Well 22

Time of Concentration Calculations

Location: El Paso County
Minor Design Storm: 5
Major Design Storm: 100
Soil Type: B

Sub-Basin Data				Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp
Basin Name	Design Point	A_{Total} (ac)	C5	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$
A1	1	0.04	0.01	44	4.0%	8.3	0	1.5%	Short Pasture and lawns	7	0.9	0.0	8.3
A2	2	0.19	0.19	18	15.0%	2.9	180	1.5%	Grassed waterway	15	1.8	1.6	4.5
A3	3	0.32	0.16	135	2.0%	15.9	95	6.0%	Paved areas & shallow paved swales	20	4.9	0.3	16.3
A4	4	0.05	0.76	30	8.0%	1.7	28	4.0%	Paved areas & shallow paved swales	20	4.0	0.1	1.8
A5	5	0.10	0.01	27	21.0%	3.8	30	7.7%	Short Pasture and lawns	7	1.9	0.3	4.0
OS1	6	0.82	0.12	40	18.0%	4.3	300	6.2%	Short Pasture and lawns	7	1.7	2.9	7.2
OS2	7	3.63	0.22	300	4.0%	17.5	540	3.5%	Paved areas & shallow paved swales	20	3.7	2.4	19.9

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Woodmoor Well 22

Developed Storm Runoff Calculations

Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.51**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
OS1	6	0.82	0.50	7.20	0.41	7.64	3.16	7.20	0.41	7.65	3.16														
A2	2	0.19	0.55	5.00	0.11	8.51	0.90	5.00	0.11	8.51	0.90														
	Flow at check dam							7.20	0.52	7.65	3.97														
A3	3	0.32	0.52	16.30	0.17	5.47	0.91	16.30	0.17	5.48	0.91														
	Flow at trapezoidal channel							16.30	0.69	5.48	3.75														
A1	1	0.04	0.44	8.30	0.02	7.28	0.11	8.30	0.02	7.28	0.11														
OS2	7	3.63	0.56	19.90	2.04	4.95	10.11	19.90	2.04	4.95	10.11														
	Flow at existing culvert							19.90	2.74	4.95	13.58	Culvert	13.58	0.00	0.00	18 in	RCP	1.5%	13.6	13.8	63.9	7.3	0.15	20.05	
A4	4	0.05	0.85	5.00	0.04	8.51	0.37	5.00	0.04	8.51	0.37														
A5	5	0.10	0.44	5.00	0.05	8.51	0.38	5.00	0.05	8.51	0.38														
	Total peak flow							19.90	2.67	4.95	13.20														

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Job Name: Woodmoor Well 22
Job Number: 1051.9e
Date: 7/7/23
By: MHT

Woodmoor Well 22

Developed Storm Runoff Calculations

Design Storm : **5 Year**

Point Hour Rainfall (P_1) : **1.19**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
OS1	6	0.82	0.12	7.20	0.10	3.62	0.36	7.20	0.10	3.62	0.36														
A2	2	0.19	0.19	5.00	0.04	4.03	0.15	5.00	0.04	4.04	0.15														
	Flow at check dam							7.20	0.14	3.62	0.50														
A3	3	0.32	0.16	16.30	0.05	2.59	0.13	16.30	0.05	2.60	0.13														
	Flow at trapezoidal channel							16.30	0.19	2.60	0.49														
A1	1	0.04	0.01	8.30	0.00	3.45	0.00	8.30	0.00	3.45	0.00														
OS2	7	3.63	0.22	19.90	0.81	2.34	1.90	19.90	0.81	2.35	1.91														
	Flow at existing culvert							19.90	1.00	2.35	2.35	Culvert	2.35	0.00	0.00	18 in	RCP	1.5%	2.3	13.8	63.9	5.5	0.19	20.09	
A4	4	0.05	0.76	5.00	0.04	4.03	0.16	5.00	0.04	4.04	0.16														
A5	5	0.10	0.01	5.00	0.00	4.03	0.01	5.00	0.00	4.04	0.01														
	Total peak flow							19.90	0.99	2.35	2.32														

Clarify the naming of the channel. Is this for existing conditions, initial grading, etc.

Worksheet for Triangular Channel - 1 (OS1&A2)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.015 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	3.97 cfs

Results	
Normal Depth	7.0 in
Flow Area	1.0 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	3.3 in
Top Width	3.51 ft
Critical Depth	7.7 in
Critical Slope	0.009 ft/ft
Velocity	3.87 ft/s
Velocity Head	0.23 ft
Specific Energy	0.82 ft
Froude Number	1.262
Flow Type	Supercritical

Channel velocity seems high for unlined conditions. Please specify seeding or sod lining requirements per DCM Vol 1 Section 3 Chapter 9.2 Table 10-3 and Table 10-4.

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

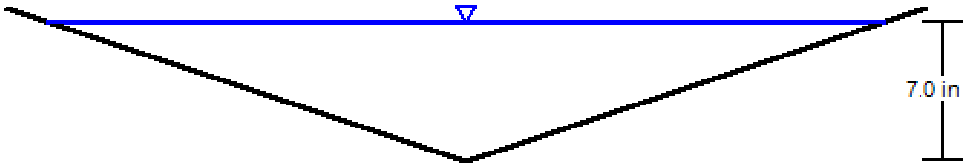
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.0 in
Critical Depth	7.7 in
Channel Slope	0.015 ft/ft
Critical Slope	0.009 ft/ft

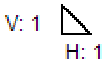
Per DCM Vol 1 Section 3 Chapter 10.7 Supercritical Flow the froude number for an open channel should be designed to be less than 0.9. Please explain in the report what measures are being taken to prevent unstable flows of the channel or revise channel design to meet criteria.

Cross Section for Triangular Channel - 1 (OS1&A2)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.015 ft/ft
Normal Depth	7.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	3.97 cfs





Worksheet for Trapezoidal Channel - 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.016 ft/ft
Left Side Slope	18.000 H:V
Right Side Slope	6.000 H:V
Bottom Width	20.00 ft
Discharge	3.97 cfs

Results	
Normal Depth	1.2 in
Flow Area	2.1 ft²
Wetted Perimeter	22.4 ft
Hydraulic Radius	1.1 in
Top Width	22.34 ft
Critical Depth	1.3 in
Critical Slope	0.013 ft/ft
Velocity	1.92 ft/s
Velocity Head	0.06 ft
Specific Energy	0.15 ft
Froude Number	1.114
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

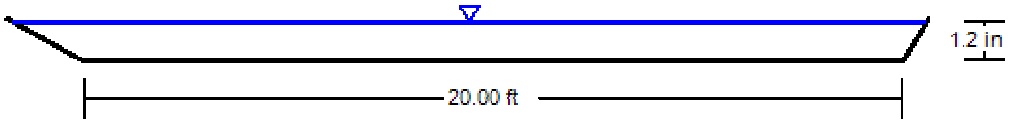
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.2 in
Critical Depth	1.3 in
Channel Slope	0.016 ft/ft
Critical Slope	0.013 ft/ft

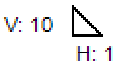
Per DCM Vol 1 Section 3 Chapter 10.7 Supercritical Flow the froude number for an open channel should be designed to be less than 0.9. Please explain in the report what measures are being taken to prevent unstable flows of the channel or revise channel design to meet criteria.

Cross Section for Trapezoidal Channel - 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.016 ft/ft
Normal Depth	1.2 in
Left Side Slope	18.000 H:V
Right Side Slope	6.000 H:V
Bottom Width	20.00 ft
Discharge	3.97 cfs





Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 7 2023

Existing Driveway Culvert - 100 year

Invert Elev Dn (ft)	=	7259.53
Pipe Length (ft)	=	63.93
Slope (%)	=	1.50
Invert Elev Up (ft)	=	7260.49
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	7263.40
Top Width (ft)	=	24.00
Crest Width (ft)	=	18.00

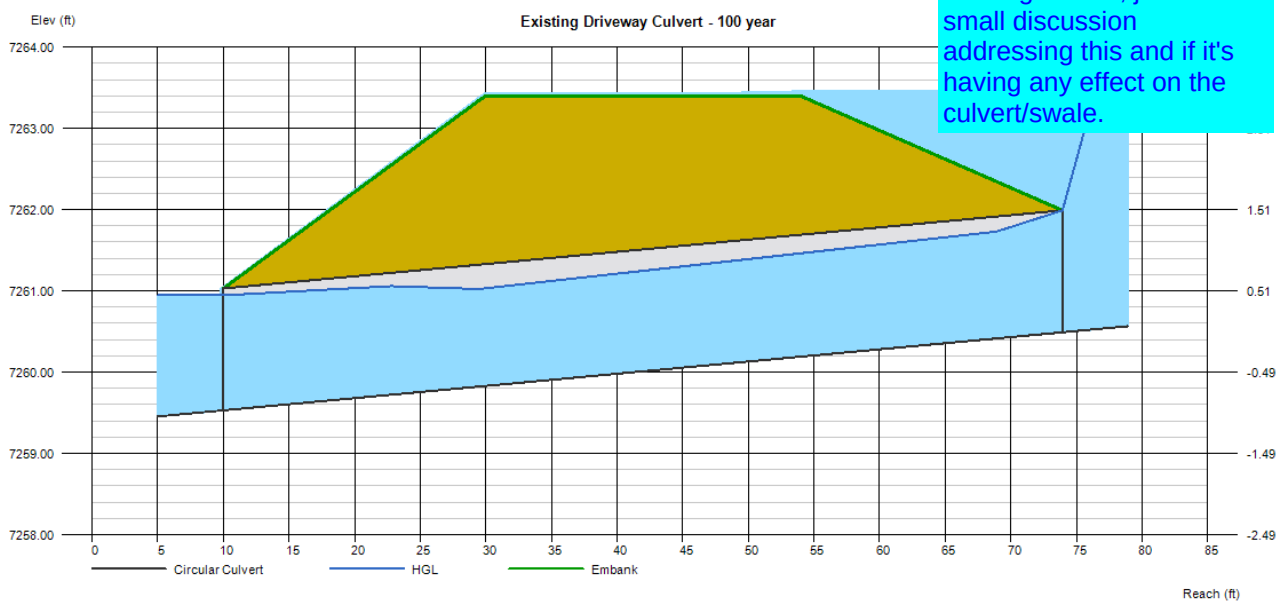
Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	13.58
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	13.00
Qpipe (cfs)	=	12.44
Qovertop (cfs)	=	0.56
Veloc Dn (ft/s)	=	7.20
Veloc Up (ft/s)	=	7.51
HGL Dn (ft)	=	7260.95
HGL Up (ft)	=	7261.82
Hw Elev (ft)	=	7263.46
Hw/D (ft)	=	1.98
Flow Regime	=	Inlet Control

Per table 6-5 in the DCM HW/D should be greater than 1.5. As this is an existing culvert, just add a small discussion addressing this and if it's having any effect on the culvert/swale.



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 7 2023

Existing Driveway Culvert - 5 year

Invert Elev Dn (ft)	=	7259.53
Pipe Length (ft)	=	63.93
Slope (%)	=	1.50
Invert Elev Up (ft)	=	7260.49
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

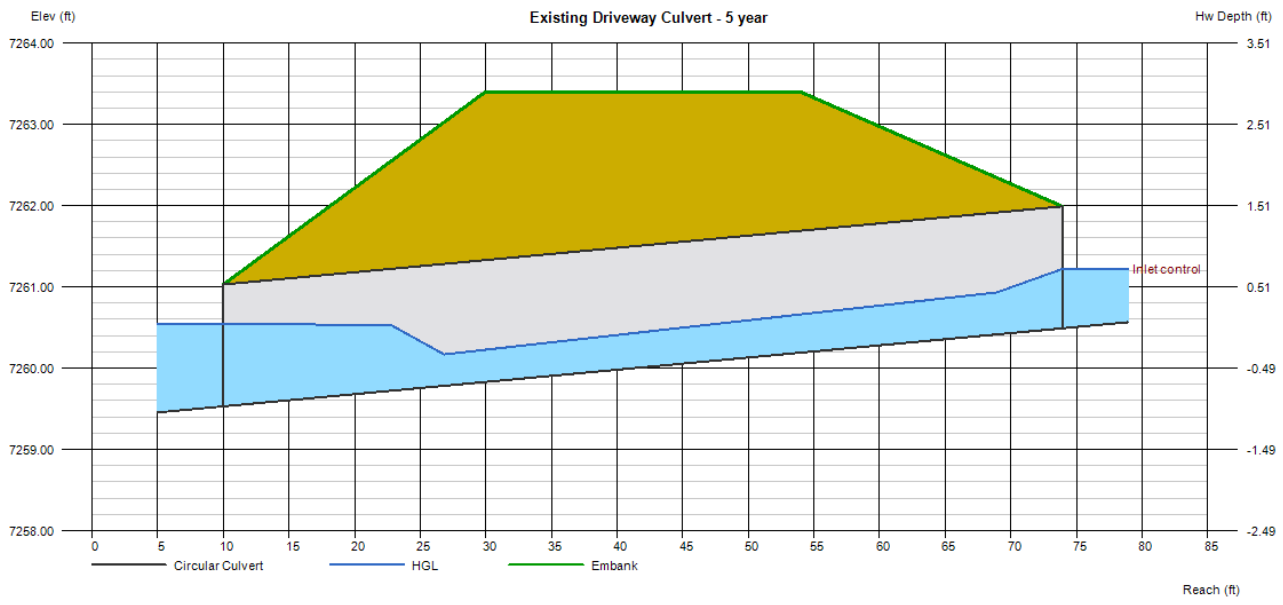
Top Elevation (ft)	=	7263.40
Top Width (ft)	=	24.00
Crest Width (ft)	=	18.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2.23
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2.00
Qpipe (cfs)	=	2.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.57
Veloc Up (ft/s)	=	3.56
HGL Dn (ft)	=	7260.55
HGL Up (ft)	=	7261.02
Hw Elev (ft)	=	7261.22
Hw/D (ft)	=	0.49
Flow Regime	=	Inlet Control



APPENDIX C – PCSM APPLICABILITY EVALUATION FORM

Post Construction Stormwater Management Applicability Evaluation Form

This form is to be used by the Engineer of Record to evaluate applicable construction activities to determine if the activities are eligible for an exclusion to permanent stormwater quality management requirements. Additionally Part III of the form is used to identify and document which allowable control measure design standard is used for the structure.

Part I. Project Information	
1. Project Name: Woodmoor Water & Sanitation District No. 1 Well No. 22	
2. El Paso County Project #: PPR2317	**3. ESQCP #:**
4. Project Location: Monument, CO	**Project Location in MS4 Permit Area (Y or N):** N
5. Project Description: WWSD proposes to build Water Well # 22 well house and transformer enclosure, complete final grading and erosion control stabilization elements and pave access drive to well house.	
If project is located within the El Paso County MS4 Permit Area, please provide copy of this completed form to the Stormwater Quality Coordinator for reporting purposes; and save completed form with project file.	

Part II. Exclusion Evaluation: Determine if Post-Construction Stormwater Management exclusion criteria are met. Note: Questions A thru K directly correlate to the MS4 permit Part I.E.4.a.i (A) thru (K). If Yes, to any of the following questions, then mark Not Applicable in Part III, Question 2.

Questions	Yes	No	Not Applicable	Notes:
A. Is this project a "Pavement Management Site" as defined in Permit Part I E.4.a.i.(A)?		x		This exclusion applies to "roadways" only. Areas used primarily for parking or access to parking are not included.
B. Is the project "Excluded Roadway Development"?				
• Does the site add less than 1 acre of paved area per mile?		x		
• Does the site add 8.25 feet or less of paved width at any location to the existing roadway?		x		
C. Does the project increase the width of the existing roadway by less than 2 times the existing width?		x		For redevelopment of existing roadways, only the area of the existing roadway is excluded from post-construction requirements when the site does not increase the width by two times or more. ***This exclusion only excludes the original roadway area it does NOT apply to entire project.***
D. Is the project considered an aboveground and Underground Utilities activity?		x		Activity can NOT permanently alter the terrain, ground cover or drainage patterns from those present prior to the activity
E. Is the project considered a "Large Lot Single-Family Site"?		x		Must be a single-residential lot or agricultural zoned land, $\geq$ 2.5 acres per dwelling and total lot impervious area < 10 percent.

Questions (cont'd)	Yes	No	Not Applicable	Notes
F. Do Non-Residential or Non-Commercial Infiltration Conditions exist? Post-development surface conditions do not result in concentrated stormwater flow or surface water discharge during an 80th percentile stormwater runoff event.			x	Exclusion does not apply to residential or commercial sites for buildings. A site specific study is required and must show: rainfall and soil conditions; allowable slopes; surface conditions; and ratios of imperviousness area to pervious area.
G. Is the project land disturbance to Undeveloped Land where undeveloped land remains undeveloped following the activity?		x		Project must be on land with no human made structures such as buildings or pavement.
H. Is the project a Stream Stabilization Site?		x		Standalone stream stabilization projects are excluded.
I. Is the project a bike or pedestrian trail?		x		Bike lanes for roadways are not included in this exclusion, but may qualify if part of larger roadway activity is excluded in A, B or C above.
J. Is the project Oil and Gas Exploration?		x		Activities and facilities associated with oil and gas exploration are excluded.
K. Is the project in a County Growth Area?				Note, El Paso County does not apply this exclusion. All Applicable Construction Activity in El Paso County must comply the Post-Construction Stormwater Management criteria.

Part III. Post Construction (Permanent) Stormwater Control Determination		
Questions	**Yes**	**No**
1. Is project an Applicable Construction Activity?		x
2. Do any of the Exclusions (A-K in Part II) apply?		x
If the project is an Applicable Construction Activity and no Exclusions apply then Post-Construction (Permanent) Stormwater Management is required. Complete the applicable sections of Part IV below and then coordinate signatures for form and place in project file. If the project is not an Applicable Construction Activity, or Exclusion(s) apply then Post-Construction (Permanent) Stormwater Management is NOT required. Coordinate signatures for form and place in project file.		

Part IV: Onsite PWQ Requirements, Documentation and Considerations	Yes	No
1. Check which Design Standard(s) the project will utilize. Standards align with Control Measure Requirements identified in permit Part I.E.4.a.iv.		
A. Water Quality Capture Volume (WQCV) Standard		
B. Pollutant Removal/80% Total Suspended Solids Removal (TSS)		
C. Runoff Reduction Standard		
D. Applicable Development Site Draining to a Regional WQCV Control Measure		
E. Applicable Development Site Draining to a Regional WQCV Facility		
F. Constrained Redevelopment Sites Standard		
G. Previous Permit Term Standard		
2. Will any of the project permanent stormwater control measure(s) be maintained by another MS4? If Yes, you must obtain a structure specific maintenance agreement with the other MS4 prior to advertisement.		
3. Will any of the project permanent stormwater control measures be maintained by a private entity or quasi-governmental agency (e.g. HOA or Special District, respectively)? If Yes, a Private Detention Basin/Stormwater Quality Best Management Practice Maintenance Agreement and Easement must be recorded with the El Paso County Clerk and Recorder.		

Part V Notes (attach an additional sheet if you need more space)

Project design is complete to include the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required. The engineering, drainage considerations and information used to complete these documents is complete, true, and accurate to the best of my belief and knowledge.

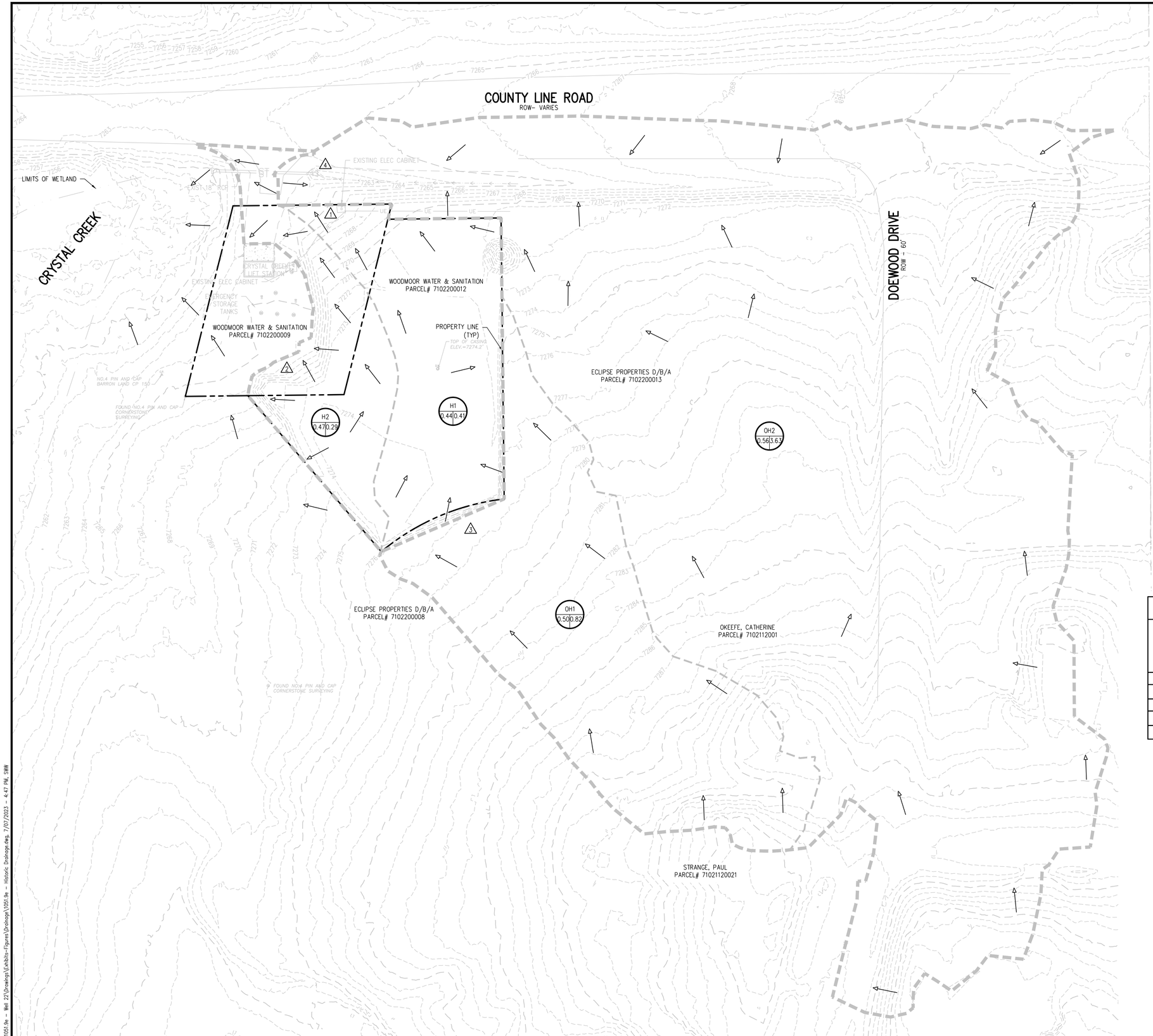
COLORADO LICENSED
KENNETH JAMES CLIFFORD
41654
07/24/2023
PROFESSIONAL ENGINEER

Signature and Stamp of Engineer of Record — Date

Post-Construction Stormwater Management Applicability Form has been reviewed and the project design, construction plans, drainage report, specifications, and maintenance and access agreements as required, have been reviewed for compliance with the Post Construction Stormwater Management process and MS4 Permit requirements.

Signature of El Paso County Project Engineer — Date

APPENDIX D – DRAINAGE MAPS



SUMMARY PROPOSED RUNOFF

BASIN	DESIGN POINT	AREA (AC)	RUNOFF COEFF. (5-YR)	RUNOFF COEFF. (100-YR)	DIRECT 5 YR RUNOFF (CFS)	DIRECT 100 YR PEAK (CFS)
H1	1	0.41	0.01	0.44	0.01	0.97
H2	2	0.29	0.06	0.47	0.04	0.64
OH1	3	0.82	0.12	0.50	0.36	3.16
OH3	4	3.63	0.22	0.56	1.91	10.11
TOTAL		5.16	0.18	0.54	2.08	13.10

DRAINAGE MAP LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- +03.3 EXISTING SPOT ELEVATION
- +03.54 PROPOSED SPOT ELEVATION
- HISTORIC DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- HISTORIC DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DIRECTION OF FLOW (HISTORIC)
- DIRECTION OF FLOW (DEVELOPED)
- OVERFLOW PATH
- BASIN DESIGN POINT
- DRAINAGE BASIN IDENTIFICATION BUBBLE

A (DESIGNATION) / .50 (100-YR RUNOFF COEFFICIENT) / 1.0 (AREA ACRES)

CONSULTING ENGINEERS
JVA, Inc. 1319 Spruce Street
Boulder, CO 80302 303.444.1951
www.jvajva.com
Boulder • Fort Collins • Winter Park
Glenwood Springs • Denver

NO.	DATE	DESD	DWN	REVISION DESCRIPTION

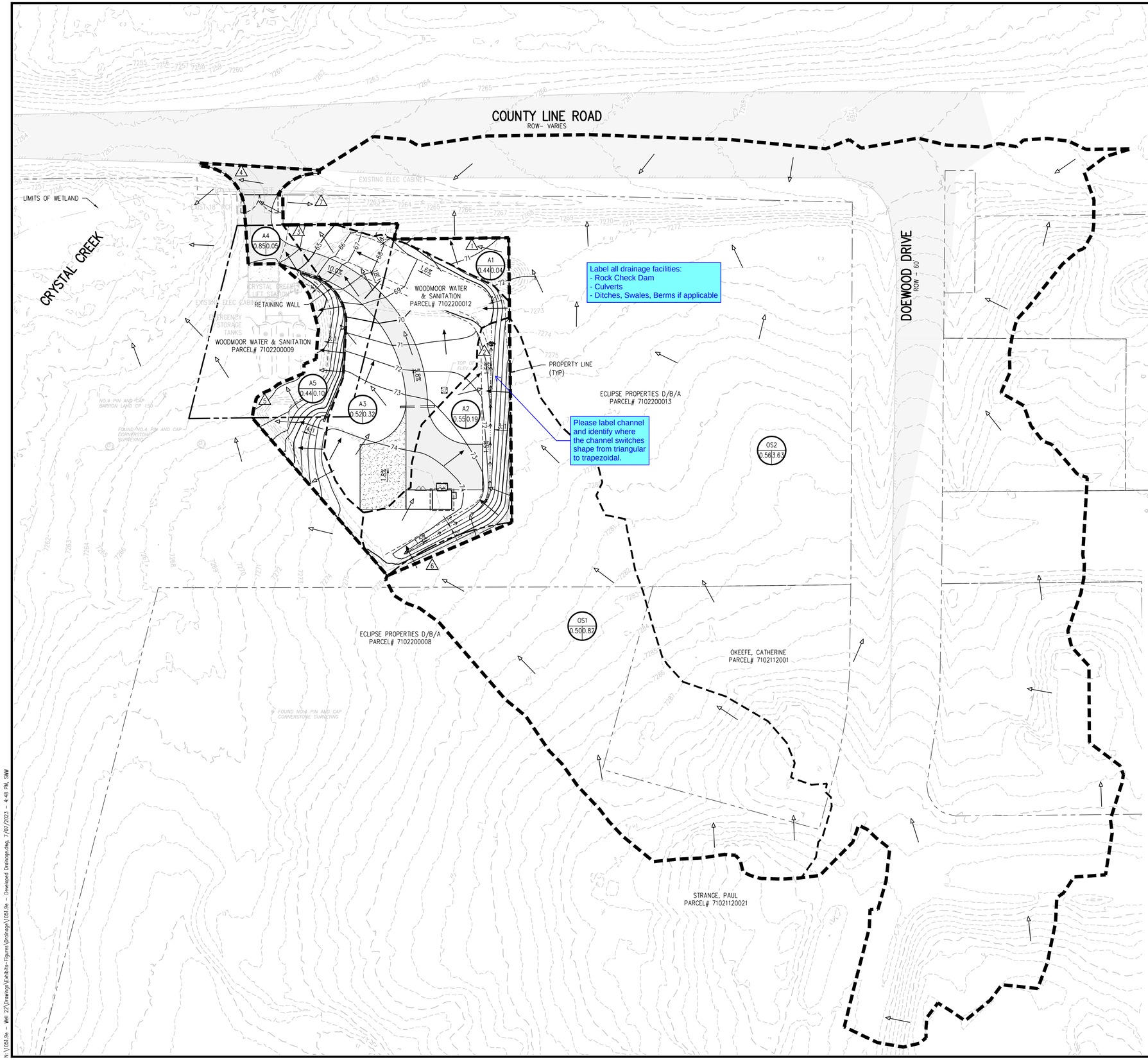
DESIGNED BY:	JGJ/KJC
DRAWN BY:	JGJ/MHT
CHECKED BY:	KJC
JOB #:	1051.9e
DATE:	MARCH 2023

WOODMOOR WSD NO. 1
WELL NO. 22
EL PASO COUNTY, COLORADO

HISTORIC DRAINAGE MAP

SHEET NO.
DPE

N:\1051.9e - Well 22\Drawings\Exhibits-Figures\Drainage\1051.9e - Historic Drainage.dwg, 7/07/2023 - 4:47 PM, SWI



SUMMARY PROPOSED RUNOFF

BASIN	DESIGN POINT	AREA (AC)	RUNOFF COEFF. (5–YR)	RUNOFF COEFF. (100–YR)	DIRECT 5 YR RUNOFF (CFS)	DIRECT 100 YR PEAK (CFS)
A1	1	0.04	0.01	0.44	0.00	0.11
A2	2	0.19	0.19	0.55	0.15	0.90
A3	3	0.32	0.16	0.52	0.13	0.91
A4	4	0.05	0.76	0.85	0.16	0.37
A5	5	0.10	0.01	0.44	0.01	0.38
OS1	6	0.82	0.12	0.50	0.36	3.16
OS2	7	3.63	0.22	0.56	1.91	10.11
TOTAL		5.16	0.20	0.55	2.44	14.02

DRAINAGE MAP LEGEND

- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION
- HISTORIC DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- HISTORIC DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (MAJOR BASIN)
- DEVELOPED DRAINAGE BASIN BOUNDARY (SUB BASIN)
- DIRECTION OF FLOW (HISTORIC)
- DIRECTION OF FLOW (DEVELOPED)
- OVERFLOW PATH
- BASIN DESIGN POINT
- DRAINAGE BASIN IDENTIFICATION BUBBLE

A = DEVELOPED BASIN DESIGNATION
.50 = 100–YR RUNOFF COEFFICIENT
1.0 = AREA ACRES

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DESIGNED BY:	JGJ/KJC
DRAWN BY:	JGJ/MHT
CHECKED BY:	KJC
JOB #:	1051.9e
DATE:	MAY 2023

WOODMOOR WSD NO. 1
WELL NO. 22
EL PASO COUNTY, COLORADO

DEVELOPED DRAINAGE MAP

SHEET NO.
DPP