Please refer to comments provided with PPR 1827

FINAL DRAINAGE REPORT
FOR
YODER ELECTRIC SUBSTATION
EL PASO COUNTY, COLORADO

FEBRUARY 2016

Prepared For:
MOUNTAIN VIEW ELECTRIC ASSOCIATION
David Waldner
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Prepared By:

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Job No. 1802.00

FINAL DRAINAGE REPORT
FOR
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CERTIFICATION STATEMENT:

Engineers Statement

This 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.

_____

Quentin Armijo, P.E. 37170 Seal

Developers Statements

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

Mountain View Electric Association
Business Name

By:_____
Title:_____
Address:_____
_____

El Paso County Approval:

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

_____ _____

Jennifer Irvine, Date
County Engineer / ECM Administrator

Conditions:

FINAL DRAINAGE REPORT
FOR
YODER ELECTRIC SUBSTATION

PURPOSE

The purpose of this Final Drainage Report is to identify and analyze the proposed drainage patterns, determine proposed runoff quantities, size drainage structures for conveyance of developed runoff, and present solutions to drainage impacts on-site and off-site resulting from this development.

GENERAL DESCRIPTION

This Final Drainage Report (FDR) is an analysis of approximately 5.0 acres of undeveloped land located just east of the residential house at 1625 N. Yoder Road. This site is being developed by our client to include an electric substation. The development will also include improving the dirt access road to gravel. The site is located in the southwest quarter of Section 3, Township 14 South, Range 61West of the 6th Principal Meridian currently within El Paso County, Colorado. The site is bounded to the north, west, & south by a 5 acres single family lots, and to the east by undeveloped open space. The site is contained within the Upper Pond Creek Basin.

Soils for this project are delineated by the map in the appendix as Bresser sandy loam (11) 0 to 3 percent slopes and Truckton sandy loam (97), 3 to 9 percent slopes. Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area" and contains soils of Hydrologic Group B and A respectively.

FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C0875 F, dated March 17, 1997 (see appendix).

EXISTING DRAINAGE CONDITIONS

The site has not been previously developed and is currently part of a 40 acre single family parcel. The site consists mostly of natural vegetative grass and weeds, with some areas of bare ground. There is a natural ridge that runs north south through the site and splits it. The site has been broken down into two existing design points 1 & 2, two existing onsite basins EXA & EXB and two existing offsite basins OS-1 & OS-2 in order to show the historic drainage flows. Below is a description of them. See appendix for calculations.

Offsite Basin OS-1 (11.85 acres; Q_5=2.7 cfs and Q_{100}=17.4 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from north to south and drains onto Basin EXA.

Basin EXA (3.83 acres; Q_5=1.1 cfs and Q_{100}=7.4 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from north to south. The combined flow (Q_5=3.5 cfs and Q_{100}=23.0 cfs) of Basin OS-1 and EXA sheet flows south in an existing broad swale and then to a low point at the south boundary (Design Point 1) where it ponds and then overtops offsite.

Offsite Basin OS-2 (0.33 acres; Q_5=0.1 cfs and Q_{100}=0.7 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from northwest to southeast and partially drains onto Basin EXB.

Basin EXB (1.17 acres; Q_5=0.4 cfs and Q_{100}=2.7 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from northwest to southeast. The combined flow (Q_5=0.5 cfs and Q_{100}=3.4 cfs) of Basin OS-2 and EXB sheet flows southeast into an existing offsite natural channel (Design Point 2).

PROPOSED DRAINAGE CONDITIONS

Runoff in the developed conditions will closely flow the historic drainage patterns with the exception of adding an Extended Detention Basin to capture and treat the runoff form the developed substation yard. For analysis the site has been broken down into three design points 1, 2, & 1A, four onsite basins A, A1 & A2, and the same two existing offsite basins OS-1 & OS-2. Below is a description of the runoff in the developed conditions and how it will be safely routed and treated. See appendix for calculations.

Offsite Basin OS-1 (11.85 acres; Q_5=2.7 cfs and Q_{100}=17.4 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from north to south and drains onto Basin A1.

Basin A1 (1.70 acres; Q_5=0.5 cfs and Q_{100}=3.4 cfs) consist of undeveloped open space prairie that will be inside the site boundary but will not have any improvements other than placing a 2' high berm on the north side of the yard to direct runoff to a broad swale, so the offsite flow can be routed around the substation yard. Drainage in this basin sheet flows to the broad swale (Design Point 1A). The combined flow (Q_5=3.1 cfs and Q_{100}=19.9 cfs) of Basin OS-1 and A1 is directed south in the broad swale and then to a low point at the south boundary (Design Point 1).

Basin A (1.38 acres; Q_5=1.2 cfs and Q_{100}=3.8 cfs) will consist of the proposed substation yard and is comprised of loose gravel. Drainage in this basin sheet flows south to the proposed Extended Detention Basin (EDB). At the 0.221 acre EDB the inflow point consists of concrete rundown into concrete lined forebay, with a 1' high wall. A 2" slit in the wall routes the minor flow to 2' concrete trickle channels then the runoff is routed to the 2.5' deep micropool which has a 0.004 ac-ft Initial Surcharge Volume. The 1.38 acres tributary to EDB are 40.74% impervious. Based upon this we need a WQCV of 0.021 ac-ft, an ERUV volume of 0.004 ac-ft and 100-year volume of 0.045 ac-ft for a total volume needed of 0.105 ac-ft. An outlet structure will release the flows. The Micropool bottom elevation is 6203.00, the top is at 6205.50 while the ISV elevation is at 6205.83. The WQCV orifice starts at 6205.50 with 3-5/8-inch diameter holes spaced 3.16" inches

apart. The 2'x2' outlet structure grate is set at 6206.29, which corresponds to the EURV elevation. The 100-year elevation tops out at 6206.66. No restrictor plate is needed for the 12" outlet pipe, which releases Q_5=0.0 cfs and Q_{100}=0.8 cfs. Pipe Run 1 a 12" storm drain routes the discharge to the south boundary where the historic drainage flowed (Design Point 1). A 10' long emergency spillway set at 6207.16 will safely pass the 100' developed storm in case of failure in the outlet structure.

Basin A2 (0.75 acres; Q_5=0.4 cfs and Q_{100}=1.8 cfs) will consist undeveloped land with some gravel drive in the area just south of the proposed EDB. Drainage in this basin sheet flows south to Design Point 1. The combined flow of Basins OS-1, A, A1, & A2 at Design Point 1 is Q_5=3.3 cfs and Q_{100}=21.9 cfs

As in the historic condition Offsite Basin OS-2 (0.33 acres; Q_5=0.1 cfs and Q_{100}=0.7 cfs) consist of undeveloped open space prairie. Drainage in this basin sheet flows from northwest to southeast and partially drains onto Basin EXB.

Basin B (1.17 acres; Q_5=0.4 cfs and Q_{100}=2.7 cfs) consist of undeveloped open space prairie inside the property, but is not being improved. Drainage in this basin sheet flows from northwest to southeast. The combined flow (Q_5=0.5 cfs and Q_{100}=3.4 cfs) of Basin OS-2 and EXB sheet flows southeast into an existing offsite natural channel (Design Point 2).

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County Storm Drainage Design Criteria Manual - Volumes 1 & 2, latest editions. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals. The Urban Drainage Criteria Manual was used to calculate the detention and water quality volume.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County Storm Drainage Design Criteria Manual – Volumes 1 & 2, latest editions. The pertinent data sheets are included in the appendix of this report.

EROSION CONTROL

An erosion control plan is included with this drainage report. Vehicle Tracking Control (VTC) will be placed at any entrance to the site. A Concrete Washout (CW) will be placed on site, as well as a Materials Staging Area (SSA) and a Dirt Stockpile (SP) location. Silt Fence (SF) will be placed around the SP and Sediment Control Logs (SCL) are to be placed at the southern border of the site to keep runoff in place.

MAINTENANCE

The Extended Detention Basins and the storm drain systems are private and therefore must be maintained by the owner. These should be cleaned and checked after any significant precipitation event and at least once every three months. The proposed erosion control measures will be repaired and maintained by the property owner or owner's representative as required.

CONSTRUCTION COST OPINION

Public Non Reimbursable

NOT APPLICABLE

Private Non Reimbursable

1. 12" HDPE	95 LF	$ 35	$ 3,325
2. EDB	1 EA	$ 10,000	$ 10,000
3. Concrete channel	65 LF	$ 25	$ 1,625
4. 2'x2' Dual Outlet	1 EA	$ 2,500	$ 2,500
		Total	**$ 17,450**

DRAINAGE FEES

The existing site is in the Upper Pond Creek Basin. It appears this is an unstudied basin and therefore no basin fees are due at the time of final plat.

SUMMARY

Development of this site will not adversely affect the surrounding development. Proposed flows, as detailed in this report, will follow the drainage patterns outlined in this report showing how runoff will be safely routed downstream. The Extended Detention Basins will control developed flow to historic levels and provide water quality for this site. These water features will need to be periodically maintained by the owner in order to maintain their effectiveness in cleaning the discharge form the site.

PREPARED BY:
TERRA NOVA ENGINEERING, INC.

Quentin Armijo, P.E.
Senior Project Manager
Jobs/1802.00/drainage/180200 - FDR.doc

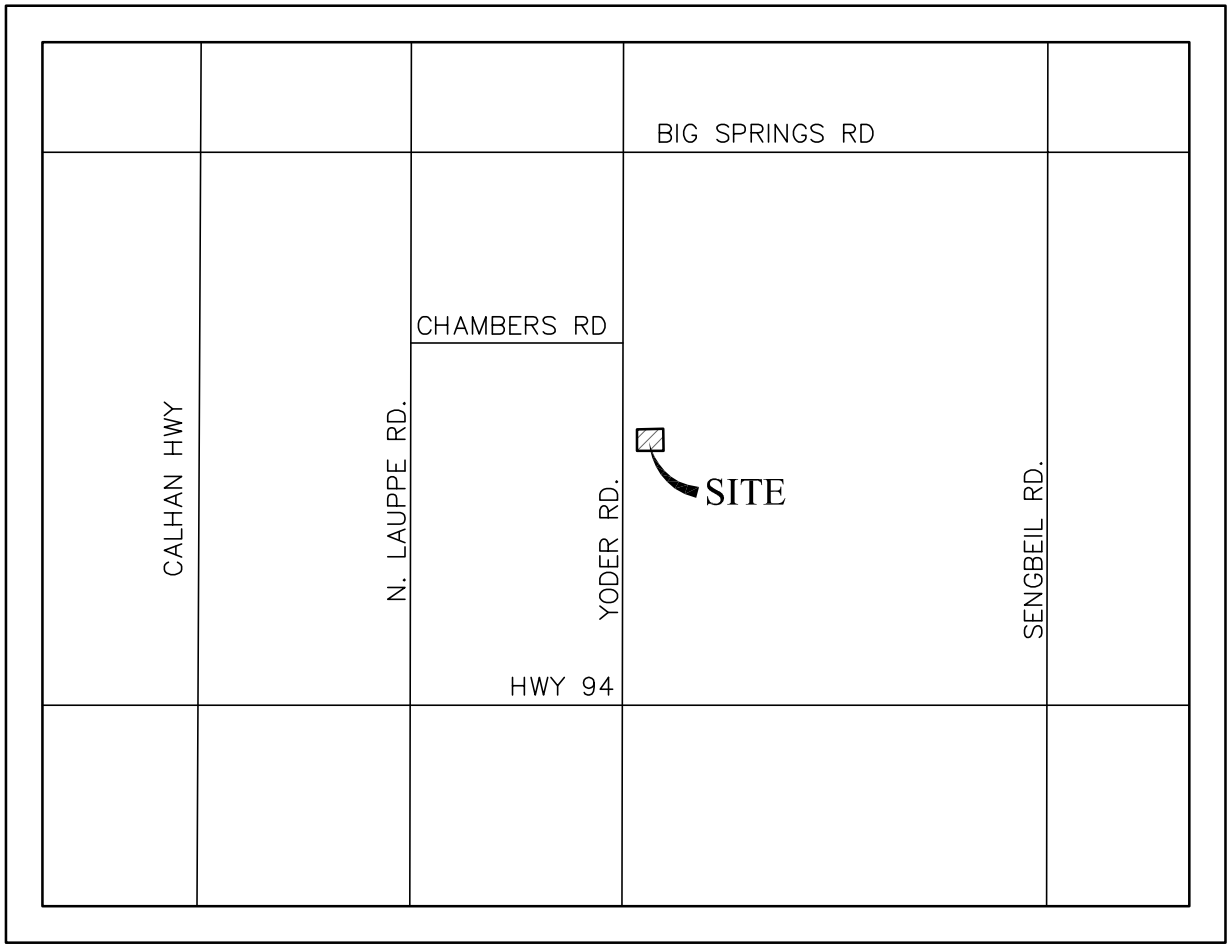
REFERENCE

"El Paso County Drainage Criteria Manual-Volumes 1 & 2, latest edition"

SCS Soils Map for El Paso County

Federal Emergency Management Agency (FEMA) flood maps

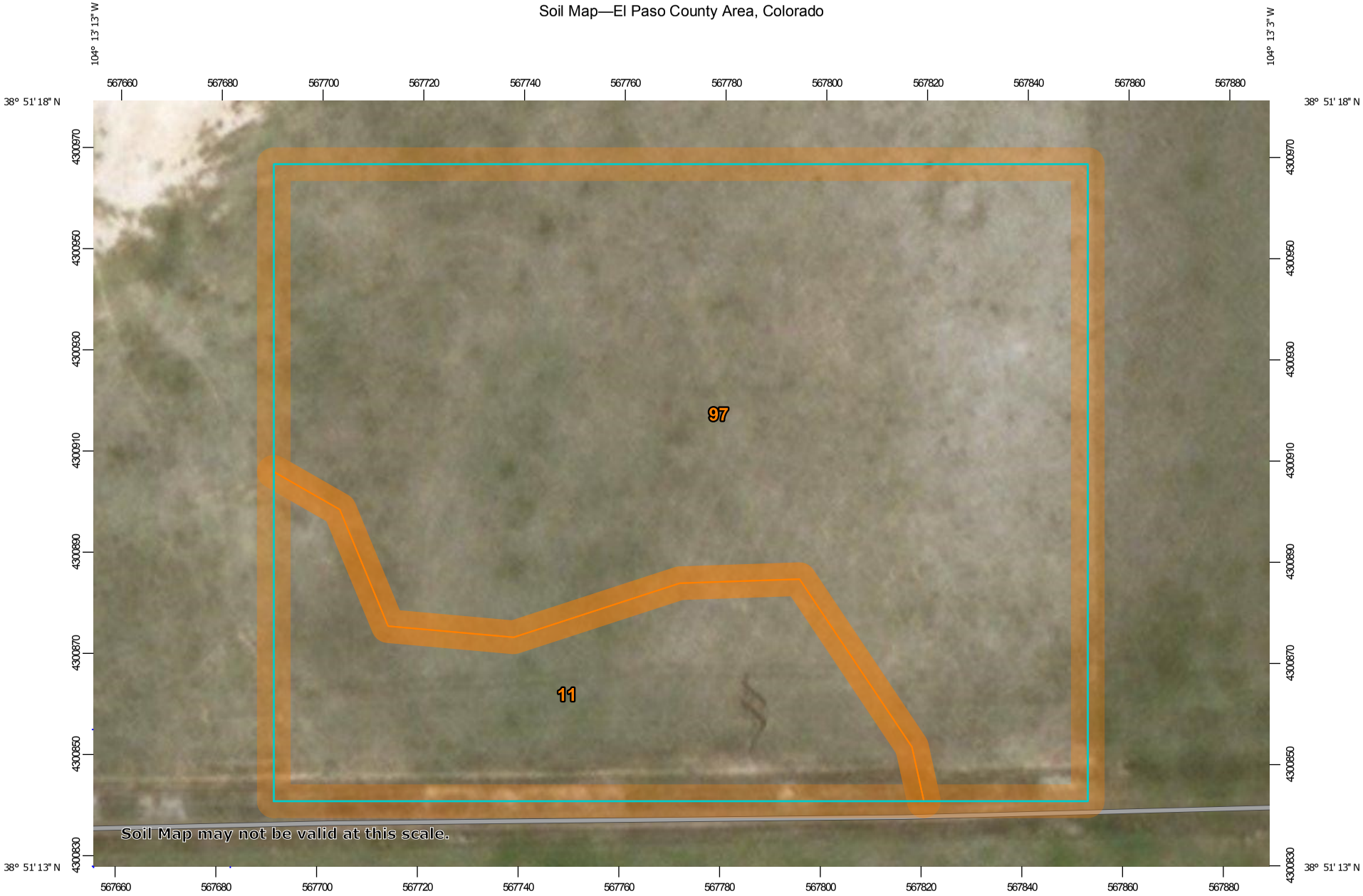
VICINITY MAP



VICINITY MAP

N.T.S.

S.C.S. SOILS MAP



Map Scale: 1:1,070 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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 15, Oct 10, 2017

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

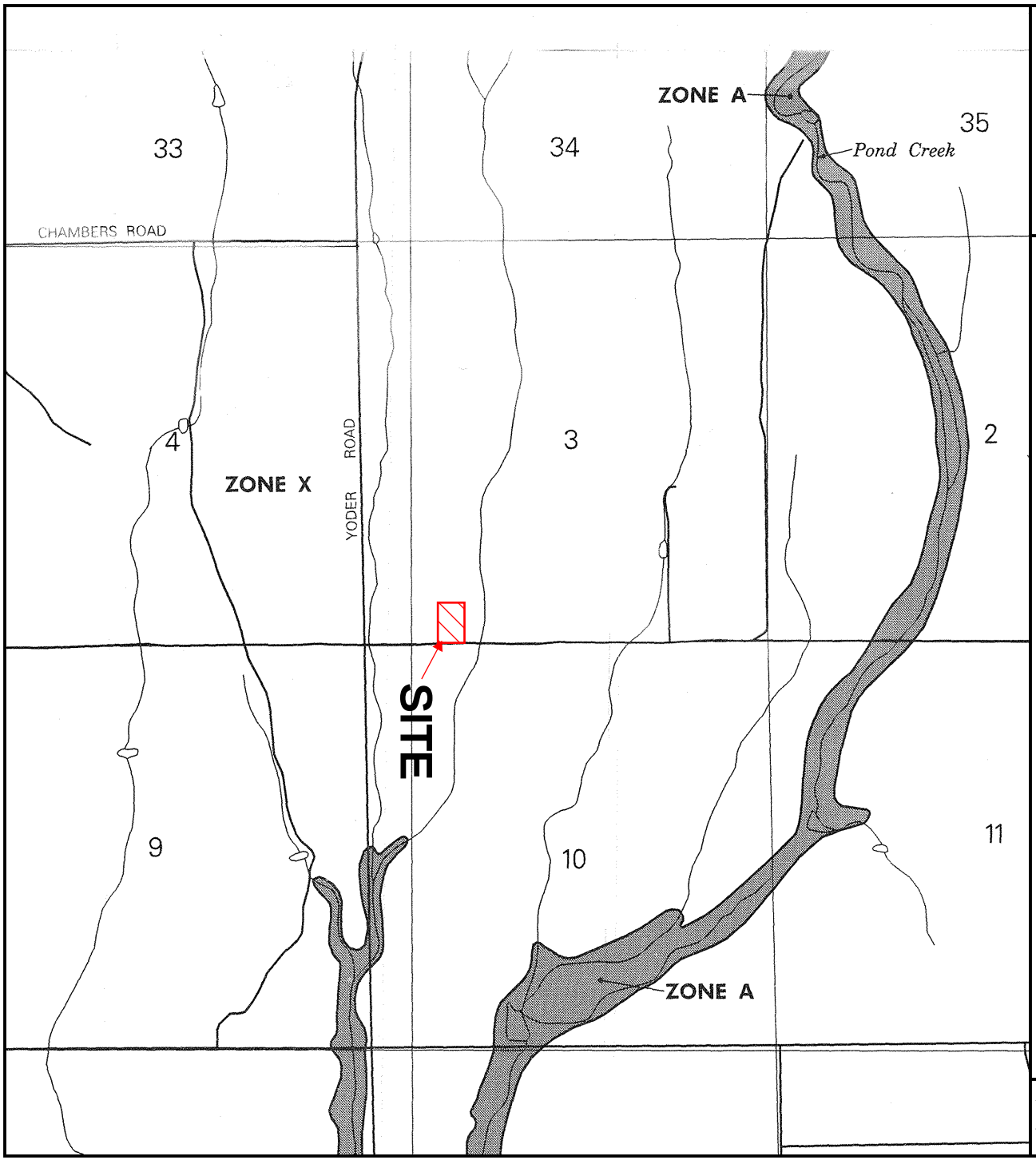
Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11	Bresser sandy loam, cool, 0 to 3 percent slopes	1.2	24.5%
97	Truckton sandy loam, 3 to 9 percent slopes	3.8	75.5%
Totals for Area of Interest		**5.0**	**100.0%**

FEMA FIRM MAP



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 875 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0875	F

MAP NUMBER 08041C0875 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

MVEA YODER SUBSTAITON
(Area Runoff Coefficient Summary)

HISTORIC

		DEVELOPED			*UNDEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA**	**AREA**	**C_5**	**C_{100}**	**AREA**	**C_5**	**C_{100}**	**C_5**	**C_{100}**
	(Acres)	*(Acres)*			*(Acres)*				
OS-1	11.85	0.00	0.30	0.50	11.85	0.09	0.36	0.09	0.36
OS-2	0.33	0.00	0.30	0.50	0.33	0.09	0.36	0.09	0.36
EXA	3.83	0.00	0.30	0.50	3.83	0.09	0.36	0.09	0.36
EXB	1.17	0.00	0.30	0.50	1.17	0.09	0.36	0.09	0.36

QNA
Date: 2/16/2018
Checked by: _____

DEVELOPED

		DEVELOPED			*UNDEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA**	**AREA**	**C_5**	**C_{100}**	**AREA**	**C_5**	**C_{100}**	**C_5**	**C_{100}**
	(Acres)	*(Acres)*			*(Acres)*				
OS-1	11.85	0.00	0.30	0.50	11.85	0.09	0.36	0.09	0.36
OS-2	0.33	0.00	0.30	0.50	0.33	0.09	0.36	0.09	0.36
A	1.38	1.02	0.30	0.50	0.36	0.09	0.36	0.25	0.46
A1	1.70	0.06	0.30	0.50	1.65	0.09	0.36	0.10	0.36
A2	0.75	0.16	0.30	0.50	0.59	0.09	0.36	0.14	0.39
B	1.17	0.00	0.30	0.50	1.17	0.09	0.36	0.09	0.36

QNA
Date: 2/16/2018
Checked by: _____

MVEA YODER SUBSTATION
AREA DRAINAGE SUMMARY

HISTORIC

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	** For Calcs See Runoff Summary*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
OS-1	11.85	0.09	0.36	0.09	100	1.2	17.8	1565	2.8%	2.2	11.9	29.6	2.5	4.1	2.7	17.4
OS-2	0.33	0.09	0.36	0.09	100	5.0	11.1	205	1.7%	2.1	1.6	12.7	3.7	6.4	0.1	0.7
EXA	3.83	0.09	0.36	0.09	86	1.9	13.5	531	1.3%	2.0	4.4	17.9	3.2	5.4	1.1	7.4
EXB	1.17	0.09	0.36	0.09	100	5.0	11.1	170	2.4%	2.6	1.1	12.2	3.8	6.5	0.4	2.7

Calculated by: QNA
Date: 2/16/2018
Checked by:

DEVELOPED

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	** For Calcs See Runoff Summary*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
OS-1	11.85	0.09	0.36	0.09	100	1.2	17.8	1565	2.8%	2.2	11.9	29.6	2.5	4.1	2.7	17.4
OS-2	0.33	0.09	0.36	0.09	100	5.0	11.1	205	1.7%	2.0	1.7	12.8	3.7	6.3	0.1	0.7
A	1.38	0.25	0.46	0.30	100	1.3	13.7	125	1.0%	2.0	1.0	14.8	3.5	5.9	1.2	3.8
A1	1.70	0.10	0.36	0.09	100	5.0	11.1	550	0.9%	1.5	6.1	17.2	3.3	5.5	0.5	3.4
A2	0.75	0.14	0.39	0.09	89	2.0	13.6	68	1.5%	2.1	0.5	14.2	3.6	6.1	0.4	1.8
B	1.17	0.09	0.36	0.09	100	3.0	13.1	63	5.4%	3.7	0.3	13.4	3.6	6.2	0.4	2.6

Calculated by: QNA
Date: 2/16/2018
Checked by:

MVEA YODER SUBSTATION
SURFACE ROUTING SUMMARY

HISTORIC									
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*	
						I_5	*I_{100}*	*Q_5*	*Q_{100}*
1	OS-1 & EXA	15.69	1.41	5.65	29.6	2.5	4.1	3.5	23.0
2	OS-2, & EXB	1.49	0.13	0.54	12.7	3.7	6.4	0.5	3.4

DEVELOPED									
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*	
						I_5	*I_{100}*	*Q_5*	*Q_{100}*
1A	OS-1 & A1	13.55	1.23	4.89	29.6	2.5	4.1	3.1	19.9
1	OS-1, A1, & A2 EDB Release	15.69	1.34	5.38	29.6	2.5	4.1	3.3	21.9
2	OS-1, & B	1.49	0.13	0.54	12.8	3.7	6.3	0.5	3.4

Date: 2/16/2018

Checked by: _____

HYDRAULIC CALCULATIONS

Free Online Manning Pipe Flow Calculator

>> Nationalism not welcome here. <<

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

Check out our newest spreadsheet update: Download Spreadsheet (spreadsheet/Manning-Pipe-Flow.xlsx) Open Google Sheets version (spreadsheet/Manning-Pipe-Flow.php) View All Spreadsheets (http://www.hawsedc.com/engcalcs/SpreadsheetLibrary.php)
--CAUTION: If you have downloaded the spreadsheet prior to September 24, you may have received incorrect results!--

Pipe Run 1

12" Pond outlet

Set units: m mm ft in

Pipe diameter, d_0	12	in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	.013	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	.5	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	39	%

Results

Flow, Q	0.8104	cfs
Velocity, v	2.8575	ft/sec
Velocity head, h_v	0.1269	ft
Flow area	0.2836	ft^2
Wetted perimeter	1.3490	ft
Hydraulic radius	0.2102	ft
Top width, T	0.9755	ft
Froude number, F	0.93	
Shear stress (tractive force), tau	0.1218	psf

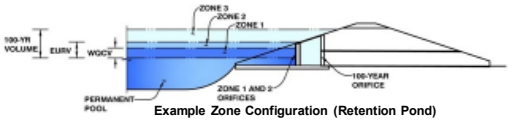
DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Gold Hill Mesa MDDP Amendment

Basin ID: Pond 1 100-year Detention for Future Development



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	1.38	acres	
Watershed Length =	300	ft	
Watershed Slope =	0.010	ft/ft	
Watershed Imperviousness =	40.74%	percent	
Percentage Hydrologic Soil Group A =	75.5%	percent	
Percentage Hydrologic Soil Group B =	24.5%	percent	
Percentage Hydrologic Soil Groups C/D =	0.0%	percent	
Desired WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	User Input		
Water Quality Capture Volume (WQCV) =	0.021	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.061	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.043	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.057	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.074	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.099	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.126	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.159	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3 in.) =	0.224	acre-feet	3.00 inches
Approximate 2-yr Detention Volume =	0.040	acre-feet	
Approximate 5-yr Detention Volume =	0.054	acre-feet	
Approximate 10-yr Detention Volume =	0.068	acre-feet	
Approximate 25-yr Detention Volume =	0.082	acre-feet	
Approximate 50-yr Detention Volume =	0.091	acre-feet	
Approximate 100-yr Detention Volume =	0.105	acre-feet	

Optional User Override 1-hr Precipitation

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.021	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.040	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.045	acre-feet
Total Detention Basin Volume =	0.105	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.25 ft

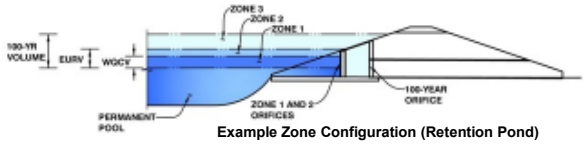
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	124	0.003		
	--	0.25	--	--	--	2,437	0.056	296	0.007
	--	0.50	--	--	--	4,750	0.109	1,171	0.027
	--	0.75	--	--	--	5,049	0.116	2,393	0.055
	--	1.00	--	--	--	5,348	0.123	3,690	0.085
	--	1.25	--	--	--	5,647	0.130	5,061	0.116
	--	1.50	--	--	--	5,946	0.137	6,507	0.149
	--	1.75	--	--	--	6,264	0.144	8,030	0.184
	--	2.00	--	--	--	6,582	0.151	9,633	0.221

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.44	0.021	Orifice Plate
Zone 2 (EURV)	0.79	0.040	Orifice Plate
Zone 3 (100-year)	1.16	0.045	Weir&Pipe (Restrict)
		0.105	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 =	0.79	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	3.16	inches
Orifice Plate: Orifice Area per Row =	0.30	sq. inches (diameter = 5/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.083E-03	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	0.30	0.60					
Orifice Area (sq. inches)	0.30	0.30	0.30					

	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 =	1.16	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.00	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 =	1.16	N/A	feet
Over Flow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.57	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	2.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	1.40	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 =	0.52	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.79	N/A	ft^2
Outlet Orifice Centroid =	0.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.66	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.15	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.19	feet
Stage at Top of Freeboard =	2.00	feet
Basin Area at Top of Freeboard =	0.15	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.021	0.061	0.043	0.057	0.074	0.099	0.126	0.159	0.224
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.020	0.060	0.042	0.057	0.073	0.099	0.125	0.159	0.224
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.06	0.18	0.37	0.65	1.19
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	0.5	0.9	1.6
Peak Inflow Q (cfs) =	0.4	1.0	0.7	1.0	1.2	1.7	2.1	2.6	3.7
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	1.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	0.3	0.1	0.4	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.3	0.6
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) =	43	72	62	70	78	88	91	89	84
Time to Drain 99% of Inflow Volume (hours) =	**45**	77	65	75	83	95	99	98	96
Maximum Ponding Depth (ft) =	0.41	0.76	0.61	0.73	0.87	1.07	1.21	1.29	1.39
Area at Maximum Ponding Depth (acres) =	0.09	0.12	0.11	0.12	0.12	0.12	0.13	0.13	0.13
Maximum Volume Stored (acre-ft) =	0.019	0.056	0.039	0.054	0.069	0.095	0.111	0.121	0.135

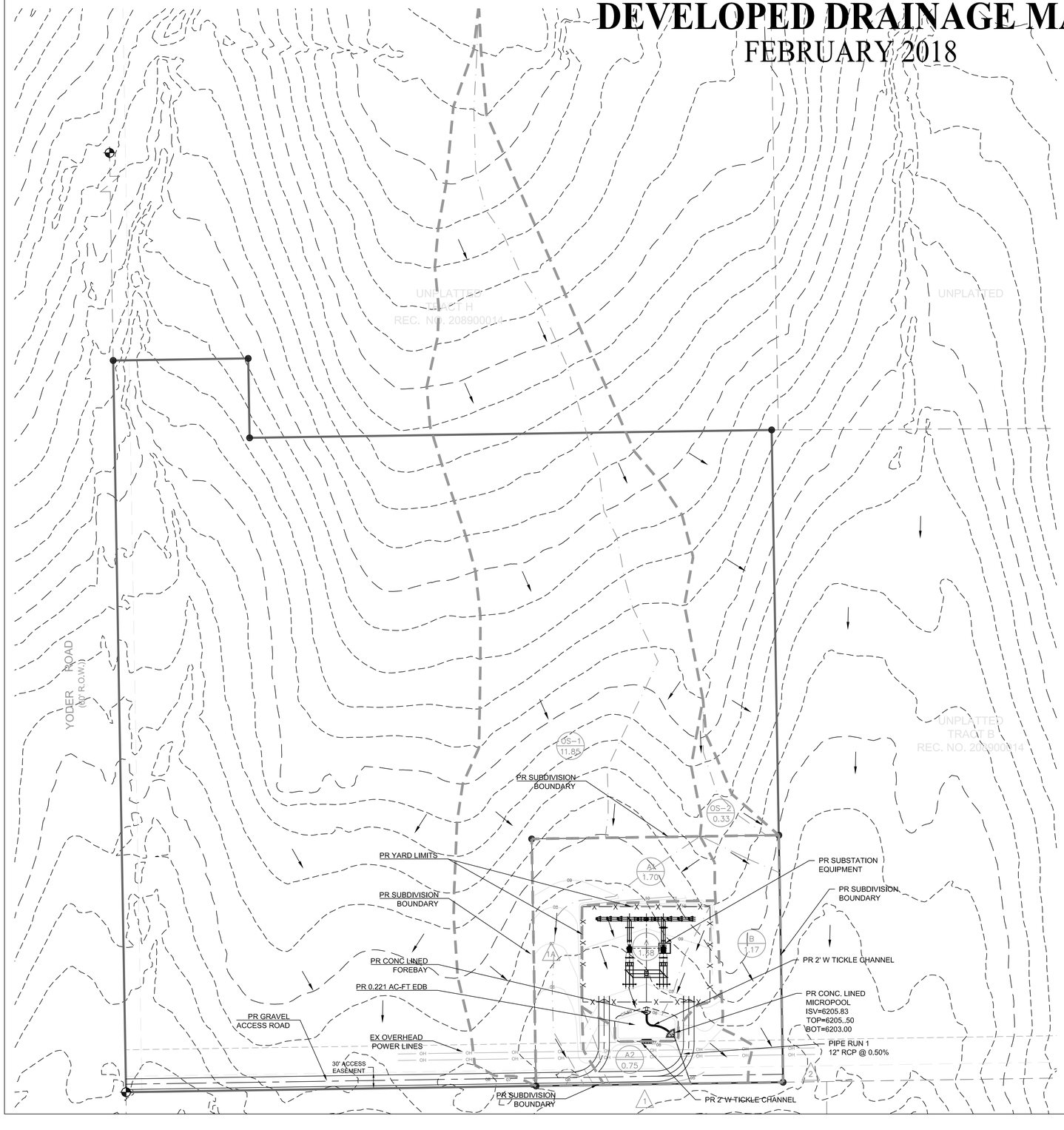
DRAINAGE MAPS

MVEA YODER SUBSTATION

EL PASO COUNTY, CO

DEVELOPED DRAINAGE MAP

FEBRUARY 2018



PIPE RUN SUMMARY

PIPE RUN	CONTRIBUTING DESIGN POINTS	AREA AC.	Q5 CFS	Q100 CFS	MIN. SLOPE	SIZE
1	POND RELEASE	1.38	0.0	0.8	0.50%	12"

DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS
1A	OS-A & A1	13.55	3.1	19.9
1	OS-A, A, A1, & A2	15.69	3.3	21.9
2	OS-1 & OS-B	1.49	0.5	3.4

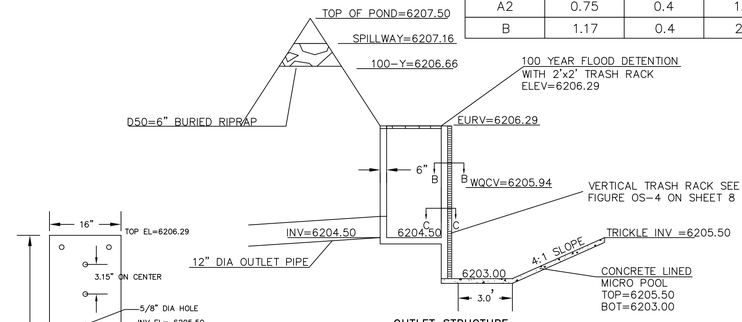
N

100' 0 100' 200'

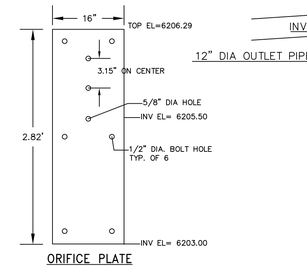
SCALE: 1"=100'

PROPOSED CONDITIONS

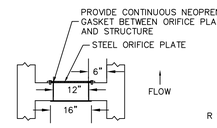
BASIN	ACRES	Q5 CFS	Q100 CFS
OS-1	11.85	2.7	17.4
OS-2	0.33	0.1	0.7
A	1.38	1.2	3.8
A1	1.70	0.5	3.4
A2	0.75	0.4	1.8
B	1.17	0.4	2.6



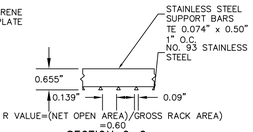
OUTLET STRUCTURE



ORIFICE PLATE
PERFORATED HOLE PATTERN

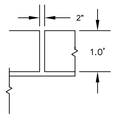


SECTION B-B

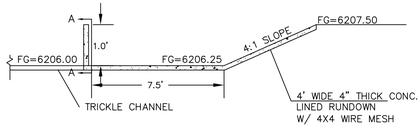


SECTION C-C

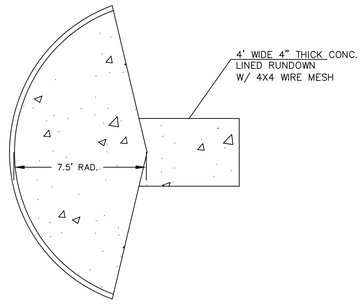
POND OUTLET OVERALL DETAIL



SECTION A-A

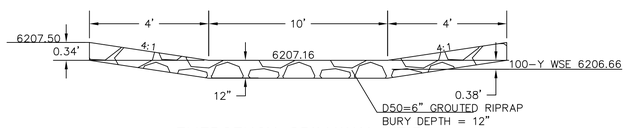


SIDE VIEW



PLAN VIEW

CONCRETE FORBAY



EMERGENCY SPILLWAY WEIR
SECTION 1-1

REVISIONS

NO.	DESCRIPTION	DATE

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PREPARED FOR:
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(719) 495-2283

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Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnesinc.com

MVEA YODER SUBSTATION

DEVELOPED DRAINAGE MAP

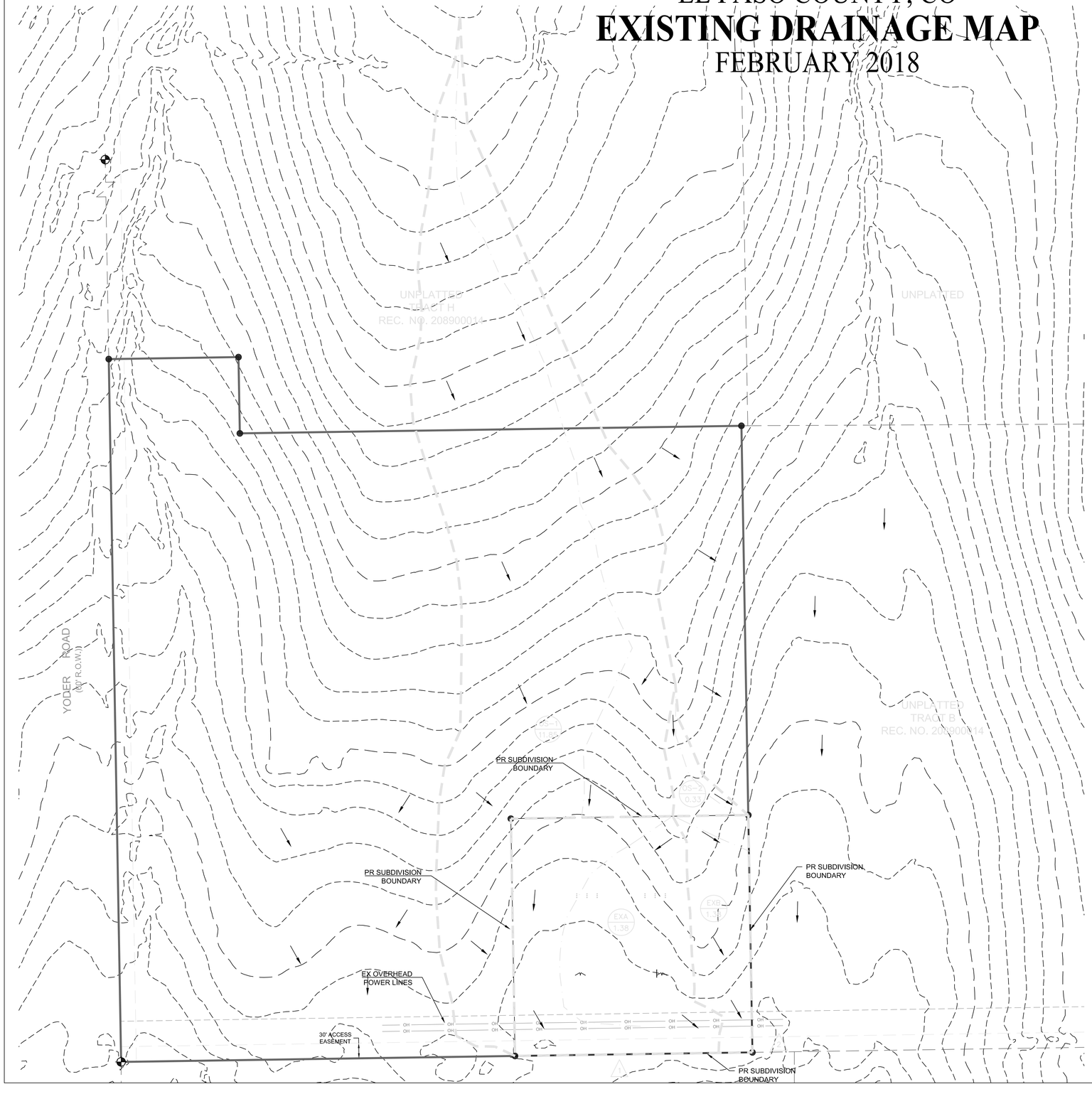
DESIGNED BY	QNA
DRAWN BY	QNA
CHECKED BY	
H-SCALE	1"=100'
V-SCALE	NA
JOB NO.	1802.00
DATE ISSUED	2/17/18
SHEET NO.	1 OF 1

MVEA YODER SUBSTATION

EL PASO COUNTY, CO

EXISTING DRAINAGE MAP

FEBRUARY 2018



DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS
1	OS-1 & EXA	15.69	3.5	23.0
2	OS-2 & EXB	1.49	0.5	3.4

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
OS-1	11.85	2.7	17.4
OS-2	0.33	0.1	0.7
A	1.38	1.2	3.8
A1	1.70	0.5	3.4
A2	0.75	0.4	1.8
B	1.17	0.4	2.6

LEGEND

- 10' EX CONTOUR — 6810
- 2' EX CONTOUR — 6802
- 10' PROP. CONTOUR — 6810
- 2' PROP. CONTOUR — 6802
- PROPOSED FLOW DIRECTION
- BASIN BOUNDARY
- TIME OF CONCENTRATION
- BASIN ID — A
- ACREAGE — 0.37
- DESIGN POINT — 3

N

100' 0 100' 200'

SCALE: 1"=100'

REVISIONS

NO.	DESCRIPTION	DATE

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MVEA YODER SUBSTATION

EXISTING DRAINAGE MAP

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Markup Summary

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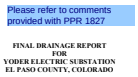

Subject: Engineer
Page Label: 1
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